The Impact of Macroeconomic Conditions, Economic Development and Government Industrial Policy on Capital Structure of Firms: Evidence from Taiwan

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Submitted in Fulfilment of the Requirements of the Degree of Doctor of Philosophy

July 2008
Abstract

The thesis examines the impact of macroeconomic conditions, economic development and government industrial policy on capital structure. These three macro-level factors have been neglected by most of the voluminous studies on capital structure that have emerged since Modigliani and Miller’s irrelevance propositions in 1958. Very few studies have examined the impact of macroeconomic conditions and economic development on capital structure. In the case of macroeconomic conditions, a few studies on capital structure have analysed this variable in the context of default risk or investor protections while, in regards to economic development, a handful of studies have found that the impact of economic development on capital structure varies amongst countries. No study on capital structure decisions has examined the impact of government industrial policy. Thus, the effect of these three important variables on capital structure is not yet clearly established in the literature. The thesis therefore addresses this knowledge gap.

The investigation of these three factors is conducted based on the Partial Adjustment Model, i.e. PAM, of Capital Structure that the thesis reformulates. The thesis considers two important situations that have not been addressed by previous studies based on PAM – when firms are under financial constraint of either over-leverage or under-leverage relative to their target capital structure. Unlike previous studies, the thesis investigates macroeconomic conditions, economic development and government industrial policy guided by the agency theory of capital structure and with consideration given to growth opportunities. The thesis research is undertaken in the context of Taiwan – a country that has recently joined the ranks of developed countries after successfully transforming itself from being a Third World country, and
with industries that are widely recognised worldwide. The period of study is from 1983 to 1995. This period has been chosen due to the limited availability of data for the electronics industry before 1980 and to control for the potential impact of intervening factors such as the Asian Financial Crisis in 1997, Taiwan’s implementation of a new tax policy in 1998 and both the bubble economy and the dot-com problem in the early 2000s. The sample used in the thesis includes the listed firms in the textile, plastics and electronics industries that were financially supported by the Taiwanese government’s industrial policy during the periods of the 1960s, the 1970s to the mid-1980s and the mid-1980s to the mid-1990s.

The first major finding in the thesis is that macroeconomic conditions have a cyclical positive effect on the debt ratio adjustment and the actual debt ratio for the listed firms with the financial constraint of under-leverage in the textile, plastics and electronics industries of Taiwan. However, any effect of macroeconomic conditions does not appear for firms with the financial constraint of over-leverage. This new evidence from Taiwan is consistent with the agency theory of capital structure.

The second major finding in the thesis is that economic development has a significant effect on the debt ratio adjustment and the actual debt ratio for the listed firms in the textile, plastics and electronics industries of Taiwan. However, this effect varies according to whether firms are over-leveraged or under-leveraged. Economic development has a significant positive effect on the actual debt ratios for firms with the financial constraint of under-leverage but not for those with the financial constraint of over-leverage. The finding provides further evidence on the diverse effects of economic development on capital structure decisions as found by previous studies.
The third major finding in the thesis is that government industrial policy has a significant positive effect on the debt ratio adjustment and the actual debt ratio for the listed firms that are under-leveraged in the three industries covered in the thesis research. However, government industrial policy does not significantly affect the debt ratio adjustment and the actual debt ratio of over-leveraged firms. This finding suggests that firms that are over-leveraged tend to gear down to reduce the default and bankruptcy risk even if government industrial policy provides them with cheap debt.

In conclusion, the thesis provides new perspectives on the impact of macroeconomic conditions, economic development and government industrial policy on capital structure decisions within the context of Taiwan. The impact of macroeconomic conditions, economic development and government industrial policy on the debt ratio adjustment and the actual debt ratio varies according to whether firms are over-leveraged or under-leveraged. The findings would be helpful for practitioners of corporate finance, for policy-makers in Taiwan, in developing or less-developed countries or in economies in transition and also for future researchers in capital structure.

The findings suggest that, in order to avoid over-investment or under-investment, firms with the financial constraint of over-leverage or under-leverage, should have a proper financial plan for future investment opportunities over the business cycles in the course of economic development in order to mitigate the agency problem that could arise from the short-run effect of macroeconomic conditions and the long-run effect of economic development. Firms can take advantage of the measures provided by government industrial policy to maximize the value of government intervention.
However, firms with the financial constraint of over-leverage should gear down their debt ratios to decrease the risk of bankruptcy and so avoid losing the benefits from government industrial policy.

On the other hand, policy-makers can impose some financial requirements on firms under the financial constraint of over-leverage in order to prevent the catastrophe of a financial system failure. In addition, proper design of government industrial policy can avoid imbalanced development and inefficient credit allocation among industries and the possible increased instability of the economy arising from government industrial policy. Finally, the findings of the thesis suggest that the agency problem between managers and shareholders seems to become less serious for firms with the financial constraint of over-leverage than for those with the financial constraint of under-leverage. Government industrial policy might increase the conflicts of interest between managers and shareholders and force firms to finance with more debt to mitigate the agency problem. Future research may provide evidence on the issue.
Statement of Originality

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

________________________________________
Hsien-Hung Yeh
# Table of Contents

Abstract i  
Statement of Originality v  
Table of Contents vi  
Acknowledgements xiii  
List of Tables xv  
List of Figures xxi  
List of Abbreviations xxii  

## Chapter 1: Introduction 1  
1.1 Research Background, Gaps, Questions and the Objectives of the Thesis 1  
1.1.1 Research Background 1  
1.1.2 Research Gaps 3  
1.1.3 Research Questions and the Objectives of the Thesis 6  
1.2 Overview of the Theoretical Framework and the Research Methodology 7  
1.2.1 Theoretical Framework 7  
1.2.2 Research Methodology 9  
1.3 Significance and Contributions of the Thesis 12  
1.4 Overview of the Major Findings of the Thesis 14  
1.4.1 Impact of Macroeconomic Conditions 15  
1.4.2 Impact of Economic Development 15  
1.4.3 Impact of Government Industrial Policy 16  
1.5 Structure of the Thesis 17
Chapter 2: Literature Review and Hypotheses Development

2.1 Introduction

2.2 Literature Review: The Determinants of Capital Structure Decisions

2.2.1 Firm Characteristics

2.2.2 Industry Type

2.2.3 Macroeconomic Conditions

2.2.4 Economic Development

2.2.5 Government Industrial Policy

2.3 Hypothesized Effects of Test Variables

2.3.1 Hypothesized Effect of Macroeconomic Conditions

2.3.2 Hypothesized Effect of Economic Development

2.3.3 Hypothesized Effect of Government Industrial Policy

2.3.4 Hypothesized Effects of Control Variables

2.5 Conclusion

Chapter 3: Taiwan as a Context for the Study of Capital Structure

3.1 Introduction

3.2 Taiwan as a Context for the Study

3.2.1 Political and Economic Status of Taiwan

3.2.2 Economic and Industrial Development of Taiwan

3.3 Macro-Level Factors and Capital Structure

3.3.1 Macroeconomic Conditions and Capital Structure Decisions

3.3.2 Economic Development and Capital Structure Decisions

3.3.3 Government Industrial Policy and Capital Structure Decisions

3.4 Firm Characteristics across Industries
3.5 Conclusion

Chapter 4: A Modified Partial Adjustment Model for Capital Structure

4.1 Introduction

4.2 Rationale for the Application of the Partial Adjustment Model

4.2.1 Capital Structure Adjustment

4.2.2 Spare Debt Capacity

4.2.3 Optimal or Target Capital Structure

4.3 The Partial (Stock) Adjustment Model

4.4 Capital Structure Adjustment in the Partial Adjustment Model

4.4.1 Positive Adjustment Gap and Capital Structure Adjustment

4.4.2 Negative Adjustment Gap and Capital Structure Adjustment

4.4.3 Adjustment Rate and Capital Structure Adjustment

4.5 A Modified Partial Adjustment Model

4.6 Control Variables

4.6.1 Control Variables for Firm-Specific Effects

4.6.2 Control Variable for Industry Effect

4.7 Research Period and Sample

4.8 Operational Definitions - Dependent and Control Variables

4.8.1 Capital Structure Decisions

4.8.2 Control Variables

4.9 Conclusion

Chapter 5: The Impact of Macroeconomic Conditions on Capital Structure: Evidence from Taiwan
Chapter 6: The Impact of Economic Development on Capital Structure: Evidence from Taiwan

6.1 Introduction
6.2 Literature Review
6.3 Methodology
   6.3.1 Theoretical Model for Analyzing the Effect of Economic Development on Capital Structure
6.3.2 Operational Definitions 145
6.3.3 Research Sample and Period 147
6.3.4 Empirical Model for Testing the Effect of Economic Development on Capital Structure 147

6.4 Empirical Results and Analyses 149
6.4.1 Descriptive Statistics 149
6.4.2 Correlation Analysis 153
6.4.3 Regression Results and Analyses 158

6.5 Robustness Tests 165
6.5.1 Alternative Proxy for Future Economic Growth 165
6.5.1 Alternative Proxy for the Level of Economic Development 170

6.6 Conclusion 174

Chapter 7: The Impact of Industrial Policy on Capital Structure: Evidence from Taiwan 176

7.1 Introduction 176
7.2 Literature Review 177
7.3 Methodology 179
7.3.1 Theoretical Model for Analyzing the Effect of Government Industrial Policy on Capital Structure 179
7.3.2 Operational Definitions 183
7.3.3 Research Sample and Period 184
7.3.4 Empirical Model for Testing the Effect of Government Industrial Policy on Capital Structure 184

7.4 Empirical Results and Analyses 186
7.4.1 Descriptive Statistics 186
## Chapter 7: Analysis Results

7.4.2 Correlation Analysis  
7.4.3 Regression Results and Analyses  
7.5 Robustness Tests  
7.5.1 Stability over the Years of Economic Trough and Peak  
7.5.2 Alternative Proxies for Government Industrial Policy  
7.6 Conclusion

## Chapter 8: Consolidated Results and Analyses

8.1 Introduction  
8.2 Consolidated Theoretical Model  
8.3 Consolidated Empirical Model  
8.4 Consolidated Empirical Results and Analyses  
8.4.1 Impact of Macroeconomic Conditions  
8.4.2 Impact of Economic Development  
8.4.3 Impact of Government Industrial Policy  
8.4.4 Adjustment Rate or Speed  
8.4.5 Effects of Control Variables  
8.5 Robustness Tests  
8.5.1 Alternative Proxy for Economic Development  
8.5.2 Alternative Proxies for Government Industrial Policy  
8.6 Conclusion

## Chapter 9: Conclusion

9.1 Summary  
9.2 Conclusions and Suggestions for Future Research
Appendix 1  Recent Empirical Results in Testing the Theory of Capital Structure  

Appendix 2  Political and Economic Status of Taiwan: An Overview

Bibliography
Acknowledgements

As I near the end of my journey towards a Doctor of Philosophy at Griffith University (Brisbane, Australia), I recall those people whose footprints were beside me through the Ph.D. program. Accordingly, I would like to express sincerely my gratitude to them for their support and encouragement.

First of all, I thank from the bottom of my heart my principal supervisor, Associate Professor Eduardo Roca. Taking over the principal supervision in October 2006, Eduardo spent much time and effort in reviewing my research papers and the thesis and providing helpful comments and suggestions. His encouragement buoyed me and facilitated my progress. In particular, I will remember fondly my walks with Eduardo at South Bank, such a relaxing and stimulating environment that gave birth to many research ideas. I was so lucky to have had Eduardo’s support and assistance in having three conference papers presented in Australia and Vietnam in 2007 and one book chapter published in 2007. As well, he has encouraged me during my preparation of a conference paper to be presented in August 2008 in U.K. and a journal article yet to be published. All relate to the thesis research.

I also wish to thank several other Griffith University academics: my former principal supervisor, Associate Professor John Forster, Professors Christine Smith, Tom Nguyen and Chew Ng and my associate supervisor, Dr. Patti Cybinski. At the Campus Club, John and I had lively discussions that helped me to clarify the thesis topic. He also guided me through the Ph.D. confirmation process in June 2006. I enjoyed similar productive talks with Christine, Tom and Patti.
As well, I thank National Pingtung University of Science and Technology (NPUST) in Taiwan for granting me three years leave to study for my Ph.D. Without this leave permission from NPUST, I had no chance of completing my Ph.D. at Griffith University. I thank the Dean, Professor Wong, and the former Dean, Professor Lee, for their support and encouragement. In addition, I thank my colleagues in the Department of Business Administration of NPUST in Taiwan, particularly Department Head Liao, Professors Hung and Chang, Associate Professor Natty Cheng and Assistant Professors Henry Hsieh and F.Y Lai, and colleagues in the Graduate School of Finance and Banking, Associate Professors Bruce Hung and K. H. Lin, for their kind support and encouragement. I also thank Dr. Shern-Zong Li for helping collect financial data. The thesis would not have been empirically possible without his assistance.

I would like to thank also the administrative and logistics support staff at the Department of Accounting, Finance and Economics at Griffith University, in particular the secretaries Gayani and Laura. I also thank Mrs. Kathryn Watt for her competent editing assistance and friendship.

Finally, it would have been impossible for me to finish the Ph.D. program without the understanding of my dearest mother, who always fully supported me no matter what. Unfortunately, it is not possible for me to reciprocate her kindness as she passed away in the early stage of my Ph.D. program. I feel greatly indebted also to my wife, Helen, for giving me selfless support and continuous encouragement while I worked on my Ph.D. program in Australia. As well, special credit goes to my dear son and daughter, Sam and Mandy, for their understanding.
List of Tables

Table 3.1 Economic Development Plans of Taiwan 49

Table 3.2 Comparison in Industrial Average Debt Ratios across Macroeconomic Conditions in Taiwan 54

Table 3.3 Variation in Industrial Average Debt Ratios across the Shift in the Level of Economic Development in Taiwan 56

Table 3.4 Difference in the Debt Ratios across Industries of Taiwan 58

Table 3.5 Comparison of Firm-Specific Variables across the Textile, Plastics and Electronics Industries in Taiwan 61

Table 4.1 Relationship between Capital Structure Adjustment and Adjustment Rate in the Case of a Positive Adjustment Gap 77

Table 4.2 Relationship between Capital Structure Adjustment and Adjustment Rate in the Case of a Negative Adjustment Gap 79

Table 4.3 Relationship of Capital Structure Adjustment, Adjustment Rate and Spare Debt Capacity 81

Table 5.1A Descriptive Statistics for the Full Sample 111

Table 5.1B Descriptive Statistics for the Subsample with a Negative Adjustment 112

Table 5.1C Descriptive Statistics for the Subsample with a Positive Adjustment 113

Table 5.2A Correlation Matrix for Model Variables in the Full Sample 115

Table 5.2B Correlation Matrix for Model Variables in the Subsample with a Negative Adjustment Gap 116

Table 5.2C Correlation Matrix for Model Variables in the Subsample with a
Table 6.3B Correlation Matrix for Model Variables in the Subsample with a Negative Adjustment Gap in the Period from 1983 to 1995

Table 6.3C Correlation Matrix for Model Variables in the Subsample with a Positive Adjustment Gap in the Period from 1983 to 1995

Table 6.4 Regression Results for the Subsample with a Negative Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

Table 6.5 Regression Results for the Subsample with a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

Table 6.6 Regression Results for the Full Sample without Negative and Positive Adjustment Gaps Taken into Account

Table 6.7 Regression Results for the Subsample with a Negative Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

Table 6.8 Regression Results for the Subsample with a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

Table 6.9 Regression Results for the Subsample with a Negative Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

Table 6.10 Regression Results for the Subsample with a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

Table 7.1A Descriptive Statistics for the Full Sample

Table 7.1B Descriptive Statistics for the Subsample with a Negative Adjustment Gap in the Period from 1983 to 1995
Table 7.1C Descriptive Statistics for the Subsample with a Positive Adjustment Gap

Table 7.2A Correlation Matrix for Model Variables in the Full Sample

Table 7.2B Correlation Matrix for Model Variables in the Subsample with a Negative Adjustment Gap

Table 7.2C Correlation Matrix for Model Variables in the Subsample with a Positive Adjustment Gap

Table 7.3 Regression Results for the Subsample with a Negative Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

Table 7.4 Regression Results for the Subsample with a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

Table 7.5 Regression Results without Negative and Positive Adjustment Gaps Taken into Account

Table 7.6 Regression Results for the Subsample with a Negative Adjustment Gap at the Years of Economic Trough in the Period from 1983 to 1995

Table 7.7 Regression Results for the Subsample with a Negative Adjustment Gap at the Years of Economic Peak in the Period from 1983 to 1995

Table 7.8 Regression Results for the Subsample with a Positive Adjustment Gap at the Years of Economic Trough in the Period from 1983 to 1995

Table 7.9 Regression Results for the Subsample with a Positive Adjustment Gap at the Years of Economic Peak in the
Period from 1983 to 1995

Table 7.10 Regression Results for the Post-Policy Effect in the Case of a Negative Adjustment Gap in the Period from 1983 to 1995

Table 7.11 Regression Results for the Post-Policy Effect in the Case of a Positive Adjustment Gap in the Period from 1983 to 1995

Table 7.12 Regression Results for the Pre-Policy Effect in the Case of a Negative Adjustment Gap in the Period from 1983 to 1995

Table 7.13 Regression Results for the Pre-Policy Effect in the Case of a Positive Adjustment Gap in the Period from 1983 to 1995

Table 8.1 Summarized Regression Results for Debt Ratio Adjustment and Actual Debt Ratios in Chapters 5 to 7

Table 8.2 Consolidated Regression Results for Debt Ratio Adjustment of Firms in the Case of a Negative or a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

Table 8.3 Consolidated Regression Results for Actual Debt Ratio of Firms in the Case of a Negative or a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

Table 8.4 Comparative Summary of Regression Results for Debt Ratio Decisions in Chapters 5 to 7 and Chapter 8

Table 8.5 Consolidated Regression Results for Debt Ratio Adjustment of Firms in the Case of a Negative or a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

Table 8.6 Consolidated Regression Results for Actual Debt Ratio of Firms in the Case of a Negative or a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period
Table 8.7 Consolidated Regression Results for Debt Ratio Adjustment of Firms in the Case of a Negative or a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

Table 8.8 Consolidated Regression Results for Actual Debt Ratio of Firms in the Case of a Negative or a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

Table 8.9 Consolidated Regression Results for Debt Ratio Adjustment of Firms in the Case of a Negative or a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

Table 8.10 Consolidated Regression Results for Actual Debt Ratio of Firms in the Case of a Negative or a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

Table 8.11 Regression Results for Debt Ratio Adjustment and Actual Debt Ratio of Firms without Adjustment Gaps Taken into Account at the Years of Economic Peak and Trough in the Period from 1983 to 1995

Table A1 Summary of Recent Empirical Results in Testing the Theory of Capital Structure

Table A2.1 Economic Performance of Taiwan since the 1960s

Table A2.2 Comparison in Per Capita GDP (US$) - Taiwan versus Other Asian Countries

Table A2.3 Economic Development Plans of Taiwan
List of Figures

Figure 1.1  Structure of the Thesis 18

Figure 1.2  Research Framework 21

Figure 3.1  Business Cycles of Taiwan 48

Figure A1.1  Real GDP of Taiwan from 1962 to 2004 259

Figure A1.2  Comparison in Per Capita GDP - Taiwan versus Other Asian Countries 261

Figure A1.3  Real GDP Growth of Taiwan 262

Figure A1.4  Business Cycles of Taiwan 264

Figure A1.5  Changes in Industrial Structure of Taiwan 269
# List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEPD</td>
<td>Council for Economic Planning and Development</td>
</tr>
<tr>
<td>DFFITS</td>
<td>This acronym refers to the statistic used to measure the change in the predicted value for the $i$th observation in the regression model and is calculated by deleting the $i$th observation.</td>
</tr>
<tr>
<td>DGBAS</td>
<td>Directorate-General of Budget, Accounting and Statistics</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GLM</td>
<td>General Linear Models</td>
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<tr>
<td>IMF</td>
<td>International Monetary Fund</td>
</tr>
<tr>
<td>KMT</td>
<td>Kuomintang (a powerful political party in Taiwan)</td>
</tr>
<tr>
<td>MOEA</td>
<td>Ministry of Economic Affairs</td>
</tr>
<tr>
<td>NPV</td>
<td>Net Present Value</td>
</tr>
<tr>
<td>PAM</td>
<td>Partial Adjustment Model</td>
</tr>
<tr>
<td>MPAM</td>
<td>Modified Partial Adjustment Model</td>
</tr>
<tr>
<td>REG</td>
<td>A general-purpose procedure for regression in the SAS System</td>
</tr>
<tr>
<td>SAS</td>
<td>SAS computer software</td>
</tr>
<tr>
<td>TSMC</td>
<td>Taiwan Semiconductor Manufacturing Company</td>
</tr>
<tr>
<td>UMC</td>
<td>United Microelectronics Corporation</td>
</tr>
<tr>
<td>VIF</td>
<td>Variance Inflation Factor</td>
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<tr>
<td>WTO</td>
<td>World Trade Organization</td>
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</table>
Chapter 1

Introduction

This chapter discusses the research background and gaps on the topic and presents the research questions and objectives of the thesis. It also provides an overview of the theoretical framework and the research methodology, the significance and contributions of the thesis and the major findings in the research. Finally, the last section discusses the structure of the thesis.

1.1 Research Background, Gaps, Questions and the Objectives of the Thesis

This section discusses the research background of the thesis, the research gaps in the existing literature as well as the research questions and objectives of the thesis.

1.1.1 Research Background

The successful history of Taiwan's economic development has attracted attention from both policymakers in developing countries and those in economies in transition (Ghosh, 1994). With South Korea, Singapore and Hong Kong, Taiwan is considered to be one of the “Four Tigers in Asia”. According to the report of the Directorate-General of Budget, Accounting and Statistics (DGBAS) of Executive Yuan of Taiwan, the average per capita income of Taiwan was NT$1,407 or US$137 in 1951 but had jumped to NT$413,786 or US$12,381 by 2003.1 Similarly, average GDP per capita was NT$1,493 or US$145 in 1951 but had rose to NT$452,168 or US$13,529 by 2003 as reported by DGBAS. Taiwan’s economic development was completed in thirty years, rather than in the hundred years or more that other industrial countries experienced (Sun, 2001). As Kahn (1979) states, Taiwan is one of the two and a half heroes in the economic development of the world – the others being Korea and Japan. Consequently, through examining

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Taiwan’s economic development experience, government policymakers may receive guidance for formulating suitable industrial and economic policy for the economic development of their own countries (Liou, 2000).

Further, the Industrial Development Bureau of the Ministry of Economic Affairs of Taiwan asserts that this remarkable success in economic development has been achieved due to efforts from manufacturing industries themselves and from industrial development policy in Taiwan during the past forty years and more. The selected industries identified by Taiwanese government industrial policy in the course of Taiwan’s economic development benefited from government industrial policy measures such as easier credit access, lower interest rates, favorable tax deduction or lifting and other benefits. In addition, due to shifts in government industrial policy, the Taiwanese government supported and promoted strategically different selected industries in the different stages of Taiwan’s economic development, a point discussed further in Chapter 3. Potentially, firms could take advantage of government industrial policy through their capital structure decisions and increase the value of their firms, as Appelbaum (1993) argues. Appelbaum contends that, because the value of government intervention measures is not priced by the market, firms could take advantage of government intervention through capital structure choices and maximize the value of government intervention measures and hence extract this value to increase the value of their firms. If Appelbaum’s argument is correct, it should lead to a greater understanding of the role of debt used in the strategic sectors under government industrial policy.

Therefore, it is important to understand how, in response to shifts in government industrial policy, firms determine and adjust their capital structure over business cycles in the course of Taiwan’s economic development. The thesis tries to provide a better understanding of the adjustment behavior of capital structure decisions made by firms in Taiwan and also allows to be tested the effect of government industrial policy on capital structure in the course of Taiwan's economic development.

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2 Refer to the official website, [http://www.moeaidb.gov.tw/portal/english/about.jsp](http://www.moeaidb.gov.tw/portal/english/about.jsp), for detailed information.
1.1.2 Research Gaps

The capital structure decisions of firms have generated voluminous theoretical and empirical research. Over the last several decades most of the related research on the determinants and determination of capital structure focus on the effect of micro-factors at firm and industry levels (Harris and Raviv, 1991, Huang and Song, 2006). Almost all empirical research on capital structure has been concerned with measuring directly the determinants of capital structure and focusing on the micro-factors of capital structure with determinants at the firm and industry levels taken into account. Rarely do prior studies consider the effect of macro-level factors such as macroeconomic conditions (Ferri and Jones, 1979, Hackbarth, 2006, Korajczyk and Levy, 2003, Levy and Hennessy, 2007) and economic development (Chen, 2004b, Boyd and Smith, 1996) in the determination of capital structure. In addition, no other studies address the impact of government industrial policy on capital structure. Further discussion on the research gaps follows.

Firstly, Miller (1977) finds variation in the debt ratios of non-financial companies over the business cycles between the 1920s and the 1960s. He concludes that the cyclical movements of the economy result in lower debt ratios during periods of economic expansion. Ferri and Jones (1979) examine the determinants of capital structure and find the effect of firm size varies upon economic conditions. The findings of these studies do not provide direct evidence on the effect of macroeconomic conditions but suggest that capital structure is influenced by macroeconomic conditions. Consistent with the finding of Miller (1977), Korajczyk and Levy (2003), with financial constraints taken into account, examine the impact of macroeconomic conditions on capital structure decisions and find a countercyclical or negative effect on corporate leverage ratios for financially unconstrained firms. Hackbarth et al. (2006) analyze capital structure with credit risk under consideration in their model and contend that default thresholds are countercyclical and thus predict that market leverage ratios should be countercyclical. Levy and Hennessy (2007) analyze corporate financing over business cycles in their general equilibrium model and contend that capital structure is countercyclical for the less constrained firms. However, according to the agency theory of capital structure, capital structure is negatively related to future growth opportunities because firms
with limited growth opportunities tend to finance with more debt to mitigate the agency problem of conflicting interests between managers and shareholders (Stulz, 1990). Relatively speaking, investment and growth opportunities are more limited to firms at economic peak than at economic trough. Consequently, capital structure is expected to be related to macroeconomic conditions. The continuing debate on the effect of macroeconomic conditions reflects the need for further evidence.

Secondly, as argued by Stulz (1990), firms with limited growth opportunities tend to finance with more debt. He also contends that the optimal face value of debt increases if the probability that firms will have free cash flow increases. The higher the future economic growth, the higher is the probability that firms will have an increased free cash flow. In addition, Stulz (1990) argues that the future growth of economic development would have a positive effect on capital structure. On the other hand, the shift in the level of economic development in the long run would decrease future economic growth and, hence, the probability that firms will have free cash flow decreases. Thus, economic development is expected to affect capital structure.

Nonetheless, the impact of economic development on capital structure decisions is neglected by prior studies except those of Boyd and Smith (1996) and Chen (2004b). Boyd and Smith argue that efficiency in the financial intermediation of capital markets improves as the economy develops and thus firms would finance with more equity in the path of economic development. Based on their argument, capital structure tends to fall in the course of economic development. Chen examines the impact of economic development on corporate financial structure and finds that the relationship between economic development and capital structure is uncertain in the USA, Canada, Australia and Taiwan. However, Chen’s use of aggregate debt-to-equity ratio calculated from macroeconomic data as a proxy for corporate financial structure is not persuasive. For further evidence, the thesis uses corporate debt ratio as a proxy for capital structure of the listed firms in Taiwan to re-examine the impact of economic development on the adjustment behavior of capital structure decisions.

Appelbaum (1993) contends that firms can take advantage of government
intervention policy through their capital structure decisions to maximize the value of government intervention measures and extract this value to increase the value of their firms because government intervention measures are not priced in the market. If Appelbaum is correct, managers can take advantage of government industrial policy through their capital structure choices to maximize the value of government industrial policy and extract this value to increase the value of their firms. When firms have the opportunity to finance with cheaper debt under government industrial policy, they take advantage of government industrial policy measures through their capital structure decisions to maximize the value of government intervention measures and extract this value to increase the value of their firms. In this way, government industrial policy is expected to affect capital structure. No other studies, however, address the issue. The thesis fills the research gap to provide new evidence on the impact of government industrial policy on capital structure.

Further, most prior studies of capital structure focus on developed countries. Exceptions are a few studies (Booth, 2001, Delcoure, 2007, Wiwattanakantang, 1999) that focus on developing countries or economies in transition. By adopting different industrial policies in the course of its economic development, Taiwan, a natural laboratory of economic development, has a successful record of economic transition from being a less-developed country to becoming a newly industrialized country within only a few decades. Therefore, to fill this gap, the thesis investigates the impact of macro-level factors including macroeconomic conditions, economic development and government industrial policy on capital structure within the context of Taiwan.

The above discussion reflects the research gaps in the existing literature on capital structure that are discussed further in Chapter 2. The thesis addresses these gaps in existing studies to extend the work in order to test their impact on the adjustment behavior of capital structure decisions. To this writer’s best knowledge, no other research addresses the impact of macroeconomic conditions, economic development and government industrial policy on capital structure decisions, in particular on capital structure adjustment. The thesis fills the gap to provide empirical results within the context of Taiwan. This focus provides not only a new perspective on the adjustment behavior of capital structure decisions but also a helpful reference to
practitioners in corporate finance and to policy-makers in Taiwan, in the other developing countries or in economies in transition.

1.1.3 Research Questions and the Objectives of the Thesis

Based on the above discussion on the research background and research gaps, the research questions and objectives of the thesis are as follows:

*Do macroeconomic conditions affect the capital structure of the listed firms in the textile, plastic and electronics industries over business cycles in Taiwan? Do firms adjust their capital structure pro-cyclically or counter-cyclically? Is the effect of macroeconomic conditions on capital structure subject to the financial constraints of over-leverage and under-leverage?* The thesis tests the effect of macroeconomic conditions on capital structure of the listed firms in the textile, plastics and electronics industries over business cycles in Taiwan. It provides empirical results regarding whether the effect of macroeconomic conditions is pro-cyclical or counter-cyclical and whether or not the effect of macroeconomic conditions on capital structure is subject to the financial constraints of over-leverage and under-leverage.

*Does short-term future economic growth in the course of economic development affect capital structure of the listed firms in the textile, plastic and electronics industries in Taiwan? Does the long-term shift in the level of economic development affect capital structure decisions? Are the effects of future economic growth and the shift in the level of economic development on capital structure subject to the financial constraints of over-leverage and under-leverage?* The thesis examines the short-term and long-term impact of economic development on the capital structure of the listed firms in the textile, plastic and electronics industries in Taiwan. It offers empirical results as to whether with regard to the short-term and long-term impact of economic development is subject to the financial constraints of over-leverage and under-leverage.

*Does government industrial policy affect capital structure of the listed firms in the textile, plastic and electronics industries in Taiwan? Is the effect of government
industrial policy subject to the financial constraint of over-leverage or under-leverage? The thesis analyzes the effect of government industrial policy on the capital structure of the listed firms in the textile, plastic and electronics industries in Taiwan. In so doing, the thesis present empirical results relating to whether or not the effect of government industrial policy is subject to the financial constraints of over-leverage and under-leverage.

1.2 Overview of the Theoretical Framework and the Research Methodology

This section provides an overview of the theoretical framework and the research methodology used to accomplish the research objectives of the thesis.

1.2.1 Theoretical Framework

Based on the modern theory of capital structure rather than on the irrelevance theory of Modigliani and Miller (1958), firms maximize their value by choosing the optimal or target level of their capital structure in the real world. Firms try to maintain their target or optimal capital structure in order to maximize the value of their firm. In equilibrium, the actual capital structure of a firm is equal to the target or optimal capital structure and, therefore, the adjustment of a firm’s leverage towards the target capital structure from one period to another period is completed seamlessly.

A number of studies (Myers and Majluf, 1984, Narayanan, 1988) contend that shareholders can be better off when the firm builds up financial reserves or financial slack for future investment and growth opportunities. In addition, several surveys (Pinegar and Wilbricht, 1989, Allen, 1991, Graham and Harvey, 2001) point out the importance of financial flexibility or spare debt capacity in capital structure decisions because firms reserve spare debt capacity to maintain financial flexibility in order to avoid passing up valuable investment opportunities. Moreover, Barclay and Smith (2005) argue that an unexpected increase or decrease in profitability and attempts to exploit future investment and growth opportunities may cause a deviation from target leverage ratios. The spare debt capacity reserved for future
investment and growth opportunities allows firms to maintain financial flexibility; however, this is at the expense of the deviation from their optimal or target capital structure. Firms, therefore, trade off the costs of deviating away from the target capital structure against the benefits of reserving the spare debt capacity for future investment and growth opportunities and, eventually, determine the optimal adjustment from the level of their capital structure at the end of the previous period. The greater the investment and growth opportunities, the greater is the spare debt capacity reserved and the greater is the deviation away from the target or optimal capital structure.

Therefore, firms deviate away from the target capital structure in the short run although firms adjust towards the target capital structure in the long run as argued by prior studies (Taggart, 1977, Jalilvand and Harris, 1984, Marsh, 1982). The spare debt capacity reserved to maintain financial flexibility for future investment and for growth opportunities results in the deviation from the target capital structure in the short run as suggested by several studies (Myers and Majluf, 1984, Allen, 1991, Barclay and Smith, 2005, Graham and Harvey, 2001, Narayanan, 1988, Pinegar and Wilbricht, 1989). Corporate capital structure is adjusted to its level on the target from one period to another period if there is no consideration of spare debt capacity reserved to maintain financial flexibility for future investment opportunities and economic growth. Alternatively, firms may reserve spare debt capacity to maintain financial flexibility for future investment opportunities and economic growth and deviate away from their target capital structure in the short run. Therefore, corporate capital structure makes partial or incomplete adjustment to the target capital structure and deviates away from the target level with spare debt capacity reserved to maintain financial flexibility for future investment opportunities and economic growth taken into account in the short run. Yet firms adjust towards the target capital structure in the long run. In other words, the partial or incomplete adjustment causes the deviation from the target capital structure. The greater the demand for spare debt capacity to maintain financial flexibility for future investment and growth opportunities, the greater is the spare debt capacity reserved and the greater is the deviation from the target capital structure. A more detailed discussion appears in Chapter 4.
1.2.2 Research Methodology

As discussed above, the partial or incomplete adjustment of capital structure results in the deviation from the target capital structure. A dynamic econometric model, i.e. the partial or stock adjustment model, allows actual levels to deviate from equilibrium levels in the short run. In this adjustment, the model implicitly assumes that the target level is not equal to the previous actual level. In the partial adjustment model, the partial or incomplete adjustment can be expressed as a proportion of the gap between the target level and the level at the end of the previous period, i.e. the adjustment gap. The adjustment gap can be positive or negative depending upon the difference between the target level and the level at the end of the previous period. The actual adjustment made by firms is determined by the adjustment rate, i.e. the proportion of the adjustment gap, and by the financial constraint of a negative or a positive adjustment gap. The adjustment behavior in the partial adjustment model matches well with the adjustment behavior of capital structure decisions discussed further in Chapter 4. Therefore, the partial adjustment model is utilized in the thesis to investigate the impact of test variables on capital structure and to provide a better understanding of the adjustment behavior of capital structure decisions. As discussed in Chapter 4, the basic partial adjustment applied in the thesis is presented as follows:

$$\text{ADJ}_t = \gamma(\text{TCS}_t - \text{ACS}_{t-1})$$  \hspace{1cm} (1-1)

where, $\text{ADJ}_t$ = the capital structure adjustment at the end of period $t$,
$\text{TCS}_t$ = the target capital structure at the end of period $t$,
$\text{ACS}_{t-1}$ = the capital structure at the end of period $t-1$, and
$\gamma$ = the rate of adjustment towards the target capital structure.

In the application of the partial adjustment model, firms trade off the benefits against the costs of deviating away from the target capital structure in order to determine the optimal adjustment of capital structure from one period to another. The greater the spare debt capacity reserved for future investment and growth opportunities, the greater is the deviation away from the target capital structure. If
no investment and growth opportunities are available to firms, then firms reserve no spare debt capacity and adjust their capital structure exactly to the target or optimal level. In such a case, the adjustment rate or the proportion of the adjustment gap between the target level and the level at the end of the previous period is equal to one.

In trading off the benefits against the costs of the deviation from the target capital structure, firms make an optimal partial or incomplete adjustment and intentionally deviate away from the target or optimal capital structure in the short run. As shown in Equation 1-1, the actual adjustment is determined by the adjustment rate (\( \gamma \)) and the financial constraint of a negative or a positive adjustment gap, i.e. \( TCS_t - ACS_{t-1} \). Due to an adjustment rate that is assumedly greater than 0, a negative or a positive adjustment, i.e. decrease or increase in the level of capital structure, is subject to the financial constraint of negative or positive adjustment gap. In the case of a negative adjustment gap between the target capital structure and the previous level of capital structure, firms have the financial constraint of over-leverage relative to the target capital structure. Firms trade off the benefits against the costs of deviating away from the target capital structure. Realistically speaking, firms would try to rebalance to the target capital structure and gear down their over-leveraged ratio in order to reduce the default risk and avoid going into bankruptcy. On the other hand, in the case of a positive adjustment gap, firms have the financial constraint of under-leverage relative to the target capital structure. Firms trade off the benefits of reserving spare debt capacity to maintain financial flexibility for future investment and growth opportunities against the costs of deviating away from the target capital structure and make an optimal adjustment. Therefore, the financial constraint of over-leverage or under-leverage is taken into account in the application of the partial adjustment model. More analysis on capital structure adjustment in the application of the partial adjustment model is discussed in Chapter 4.

Further, in addition to the test variable(s), the common determinants of capital structure at the firm and industry level, as suggested by prior studies, are included as control variables in the estimation of the target capital structure in the application of the partial adjustment model. Control variables at the firm level include firm size,
growth opportunities, profitability, non-debt tax shields and asset tangibility. Industry types are used as control variables to capture industry effects. Therefore, the partial adjustment model for capital structure adjustment with financial constraints of over-leverage and under-leverage taken into account and utilized in the thesis to test the impact of test variables including macroeconomic conditions, economic development and government industrial policy can be expressed as follows:

\[ ADJ_t = \gamma \left( \sum_{j=1}^{c} \beta_j X_j^{FC} + \beta_t^{IND} IND_t + \beta_t^{TV} TV_t + \epsilon_t - ACS_{t-1} \right) \]  

(1-2)

where,

- \( ADJ_t \) = the capital structure adjustment at the end of period \( t \),
- \( \gamma \) = the adjustment rate that is determined by the spare debt capacity reserved for future investment and growth opportunities,
- \( \beta \) = the regression coefficient,
- \( X \): the variables at firm level,
- \( IND \): the dummy variable for industry types,
- \( TV \): the test variable,
- \( ACS_{t-1} \) = the actual capital structure at the end of period \( t-1 \), and
- \( \epsilon_t \) = the error term.

As can be seen from Equation 1-2, the thesis can test the impact of the test variable(s) on capital structure and investigate the adjustment behavior of capital structure decisions subject to the financial constraints of over-leverage and under-leverage in the application of the partial adjustment model. Further discussion on the application of the partial adjustment model for capital structure adjustment occurs in Chapter 4.

Finally, due to its successful economic transition from being a less-developed country to becoming a newly industrialized country within only a few decades, the thesis research is conducted within the context of Taiwan. In addition, the industries of textile, plastics and electronics - with different industry characteristics - received
financial support from government industrial policy and respectively played an important role in the periods of the 1960s, the 1970s to the mid-1980s, and the mid-1980s to the mid-1990s. Therefore, these three industries are chosen to test the impact of the shift in government industrial policy on capital structure. The thesis research is conducted during the period from 1983 to 1995 over three business cycles in the course of Taiwan’s economic development. The choice of this period takes into account the limited availability of data for the electronics industries before 1980, the potential impact of intervening factors such as the Asian Financial Crisis in 1997, the bubble economy and dot-com problems in the early 2000s, Taiwan’s implementation of a new tax policy in 1998, as well as the important shift in the level of Taiwan’s economic development in 1987. This approach allows a focused test of the impact of macroeconomic conditions, economic development and government industrial policy on capital structure decisions of the listed firms in these three industries in Taiwan.

1.3 Significance and Contributions of the Thesis

As mentioned earlier, most prior studies of capital structure have neglected potential determinants at the macroeconomic level and the impact of government industrial policy. In addition, most prior studies focus on the study of capital structure in developed countries rather than in less-developed or developing countries. A number of recent studies (Hackbart, 2006, Korajczyk and Levy, 2003, Levy and Hennessy, 2007) address the effect of macroeconomic conditions on capital structure and conclude a counter-cyclical or negative effect. Their findings, however, are not consistent with the agency theory of capital structure. Further evidence on the effect of macroeconomic conditions on capital structure and, in particular, research on developing or less-developed countries rather than on only developed countries is needed. Further, except for Boyd and Smith (1996) and Chen (2004b), prior studies fail to address the effect of economic development on capital structure decisions. As argued by Boyd and Smith, capital structure will be negatively related to economic development because the aggregate debt-to-equity ratio falls as the economy develops further. In her study based on the USA, Canada, Australia and Taiwan, however, Chen finds an uncertain relationship between the aggregate debt-to-equity ratio and economic development. While Appelbaum (1993) examines the
impact of government policy on capital structure decisions, no other studies investigate the effect of government industrial policy on capital structure decisions. In particular, no empirical evidence from developing countries or newly industrialized countries provides a helpful reference for practitioners and researchers in corporate finance and for policy-makers in industrial and economic development in Taiwan, in developing or less-developed countries and even in economies in transition.

The thesis fills the research gaps and provides further and new evidence on the effects of macroeconomic conditions, economic development and government industrial policy on capital structure, in particular, within the context of Taiwan. Indeed, based on the findings in the thesis, researchers may expand their work on the adjustment behavior of capital structure of firms in developing or less-developing countries and in economies in transition.

Further, in the application of the partial adjustment model, the thesis reformulates the model with financial constraints of over-leverage and under-leverage relative to the target capital structure to analyze the adjustment behavior of capital structure decisions. The thesis research takes financial constraints into account in the application of the partial adjustment model to avoid the problem of biased estimation encountered in previous related studies. The inclusion of the test variable examined in the empirical model to estimate the unobservable target capital structure also avoids the biased estimation that is encountered in previous related studies on the application of the partial adjustment model.

The thesis also provides further evidence on the effect of macroeconomic conditions in terms of future investment and growth opportunities guided by the agency theory of capital structure at the years of economic peak and trough. Moreover, the thesis provides new evidence on the short-term and long-term effects of economic development on the adjustment behavior of capital structure decisions. Based on the findings in the thesis, future research may expand the work on testing the superiority of the theories that explain capital structure across macroeconomic conditions in the course of economic development. More importantly, based on the findings in the thesis, future research may expand the work on the variation in the
agency problem across macroeconomic conditions, across the shifts in the level of economic development or across the shifts in the financial constraints of over-leverage and under-leverage.

Based on the argument of Appelbaum (1993), firms can take advantage of government policy to maximize the value of government intervention measures through capital structure decisions and extract this value to increase the value of their firms. Consequently, the issue that future research may address is whether or not government policy creates the agency problem for the firms that benefit from government policy. Are firms forced to finance with more or less to mitigate the agency problem of conflicts of interest between managers and shareholders that arise from government policy? Future research may provide evidence on the issue.

Finally, in the application of the partial adjustment model, an incidental contribution of the thesis provides further evidence on the variation in the adjustment rate of capital structure of firms with the financial constraints of over-leverage and under-leverage. Future research may expand the work to provide further evidence on the adjustment behavior of capital structure in developed or other developing countries with financial constraints taken into account.

1.4 Overview of the Major Findings of the Thesis

In order to control firm-specific effects, the variables of firm characteristics are included in the study as control variables. In addition, industry types are also included in the study to capture industry effects. An overview of the major findings

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3 The major results from the thesis have been presented in three refereed international scholarly conferences: (1) the Accounting and Finance Association of Australia and New Zealand held at the Gold Coast, Queensland, Australia from July 1 to 3, 2007, (2) the 15th Pacific Basin Finance, Economics, Accounting and Management Conference at Ho Chi Minh City in Vietnam on July 20 and 21, 2007, and (3) the World Association for Sustainable Development 2007 Conference held at the Nathan Campus of Griffith University, Brisbane, Queensland, Australia on October 29 to 31, 2007. One of these three conference papers has been published as a book chapter in Ahmed, A. (ed.), 2007, World Sustainable Development Outlook 2007: Knowledge Management and Sustainable Development in the 21st Century, Greenleaf, Sheffield, pp. 315-324. In addition, some parts of the thesis have also been written into a paper, which has been accepted for presentation at the Sixth International Conference of The World Association for Sustainable Development to be held in Brighton, UK, 27-29 August 2008. Some of the findings of the thesis were also presented in the Queensland University of Technology – Griffith University Finance Symposium organized by Professor of Finance, Michael Drew, and held at Griffith University in November 2006.
and the contributions of the thesis with respect to the impact of macroeconomic conditions, economic development and government industrial policy on the adjustment behavior of capital structure decisions for the listed firms in the textile, plastics and electronics industries at the years of economic peak and trough during the period from 1983 to 1995 over Business Cycles 6 to 8 in Taiwan is provided as follows:

1.4.1 Impact of Macroeconomic Conditions

The adjustment behavior of capital structure decisions is influenced by macroeconomic conditions. In addition, the effect of macroeconomic conditions varies upon the financial constraint of firms that are over-leveraged or under-leveraged relative to the target debt ratios. Macroeconomic conditions have a positive effect on the debt ratio adjustment and the actual debt ratio for firms with the financial constraint of under-leverage relative to their target debt ratios. However, the positive or pro-cyclical effect of macroeconomic conditions does not occur for firms with the financial constraint of over-leverage relative to their target debt ratios. Firms with over-leverage relative to their target debt ratios do not finance with more debt at the years of economic peak than at the years of economic trough. Finally, in brief, macroeconomic conditions have a significant positive effect on capital structure of firms with under-leverage but not for firms with over-leverage relative to the target debt ratios. The thesis provides further evidence on the impact of macroeconomic conditions on capital structure.

1.4.2 Impact of Economic Development

The adjustment behavior of capital structure decisions is affected by economic development. The impact of economic development varies upon the financial constraint of firms with over-leverage or under-leverage relative to the target debt ratios. The impact of economic development arises from the short-term future economic growth and the long-term shift in the level of economic development. The

Undoubtedly, the thesis also benefited from the writer’s discussions with and suggestions from Professor of Economics, Tom Nguyen of Griffith University, Professor of Finance, David Allen of Edith Cowan University, and Professor of Finance, Alex Chang and Professor of Economics, K. C. Peng and Associate Professor of Statistics and Finance, Natty Cheng of National Pingtung University of Science and Technology.
proxy for the short-term effect of future economic growth has a significant positive effect on the debt ratio adjustment and the actual debt ratio of firms with under-leverage relative to the target debt ratios. However, the short-term positive effect of economic development does not occur for firms with over-leverage relative to the target debt ratios. On the other hand, the proxy for the shift in the level of economic development has a significant negative effect on the debt ratio adjustment and the actual debt ratio for firms with the financial constraint of over-leverage relative to the target debt ratios. This finding on the long-term negative effect of economic development is consistent with the conclusion of Boyd and Smith (1996), that the aggregate debt-to-equity ratio will decline as an economy develops. However, the long-term negative effect of economic development does not occur for firms with under-leverage relative to the target capital structure. The thesis provides further evidence on the impact of economic development on capital structure.

1.4.3 Impact of Government Industrial Policy

Government industrial policy similar to the other government intervention measures affects the adjustment behavior of capital structure decisions. The impact of government industrial policy, however, varies upon the financial constraint of firms with over-leverage or under-leverage relative to the target capital structure. Providing cheaper credit and financial supports, government industrial policy has a significant positive effect on the debt ratio adjustment and the actual debt ratio for firms with under-leverage relative to the target debt ratios. This finding supports the conclusion of Appelbaum (1993) that firms take advantage of government policy through their capital structure decisions to maximize the value of government intervention measures and hence extract the value of government intervention to increase the value of their firms. The positive effect of government industrial policy, however, does not occur for firms with the financial constraint of over-leverage relative to the target debt ratios. Firms with the financial constraint of over-leverage do not finance with more debt to increase the default risk although they could finance with a cheaper debt under government industrial policy. Firms lose the value of government industrial policy if they go into bankruptcy. Further, Stulz (1990) contends that the optimal face value of debt increases with an increase in cash flow in order to mitigate the agency problem of conflicts of interest between
managers and shareholders. This finding on the impact of government industrial policy seems to suggest that the supporting measures of government industrial policy result in an increase in cash flow and hence the agency problem becomes worse for firms with under-leverage but not for firms with the financial constraint of over-leverage relative to the target capital structure.

1.5 Structure of the Thesis

The thesis is organized into nine chapters, as shown in Figure 1.1. A brief description of each of the nine chapters is provided below.

Chapter 1, Introduction, provides an overview of the thesis including the background and research gap of the study, the research questions and objectives, the research methodology and the structure and the research framework of the thesis.

Chapter 2, Literature Review and Hypotheses Development, reviews the related literature and shows the research gap between the thesis and the related literature. The thesis incorporates the factors of macroeconomic conditions, economic development and government industrial policy into the partial adjustment empirical model to investigate the changes in capital structure of the listed firms on the Taiwan Stock Exchange under government industrial policy over business cycles in different stages of economic development in Taiwan. Further, this chapter describes the formulation of the research hypotheses in the thesis based on the literature reviewed in Chapter 3.

Chapter 3, Taiwan as a Context for the Study of Capital Structure, presents an overview of the economic development of Taiwan from the early 1950s to the early 2000s in terms of the shift in the level of industrial development policy. The successful economic transition from being a less-developed country to becoming a newly industrialized country reflects a natural economic experiment that allows a test of the impact of macroeconomic conditions, economic development and government industrial policy on capital structure.
Figure 1.1 Structure of the Thesis
Chapter 4, *A Modified Partial Adjustment Model for Capital Structure*, contains the rationale for the application of the partial adjustment model and analyzes the adjustment behavior of capital structure decisions in the modified partial adjustment model. In order to avoid repetition in Chapters 5 to 8, control variables for firm characteristics and industry types, and the research period and sample are discussed in this chapter. In addition, in order to avoid repetition in the empirical studies in Chapters 5 to 8 of the thesis, the operational definitions for the dependent variable of capital structure decisions and the control variables for firm characteristics and industry types in the empirical model are also discussed in this chapter.

Chapter 5, *The Impact of Macroeconomic Conditions on Capital Structure: Evidence from Taiwan*, presents the test on the impact of macroeconomic conditions and the empirical results and analysis of the study.

Chapter 6, *The Impact of Economic Development on Capital Structure: Evidence from Taiwan*, presents the test on the impact of economic development and the empirical results and analysis of the study.

Chapter 7, *The Impact of Industrial Policy on Capital Structure: Evidence from Taiwan*, presents the test on the impact of government industrial policy and the empirical results and analysis of the study.

Chapter 8, *Consolidated Results and Analysis*, presents the consolidated empirical test on the impact of macroeconomic conditions, economic development and government industrial policy in order to avoid model specification and confirm the individual findings in Chapters 5, 6 and 7. The chapter also checks the robustness of the research to reach final conclusions on the impact of these test variables on capital structure.

Chapter 9, *Conclusion*, provides a summary and the conclusions of the thesis. It also contains suggestions for future research on the adjustment behavior of capital structure decisions.

The rationale for the design and structure of the thesis is as follows. Figure 1.1
indicates that the thesis is designed in such a way that Chapters 1, 2, 3, 4 and 9 are chapters that relate to and/or support the whole thesis while Chapters 5, 6, 7 and 8 are chapters that present the empirical results. Chapters 5, 6 and 7 discuss the results for the individual variables analyzed in the thesis – i.e. Chapter 5 for macroeconomic conditions, Chapter 6 for economic development and Chapter 7 for government industrial policy. Chapter 8 presents the results of the consolidated analysis for all three variables. Chapters 5, 6, and 7 are structured similarly and in a self-contained manner - each of these chapters has its own introduction, literature review, methodology, results and conclusion. This is intentionally done for the purpose of facilitating the publication of these chapters into journal articles.

Figure 1.2 shows the research framework of the thesis. As mentioned earlier, the partial adjustment model, discussed in detail in Chapter 4, is utilized in the thesis research to investigate the effects of macroeconomic conditions, economic development and government industrial policy on capital structure. As can be seen in the figure, in the application of the partial adjustment model, firm-specific variables such as firm size, growth opportunities, profitability, non-debt tax shields and asset tangibility, as well as industry type are included as control variables in the model, as suggested by prior empirical studies. In addition, in order to avoid a biased estimation in adjustment rate, both the control variables and the test variable(s) are included in the determination of the target capital structure. Further, in order to avoid repetition, the rationale for the application of the partial adjustment model and how the adjustment rate is estimated in the partial adjustment model used in the thesis are discussed in Chapter 4. The hypothesized effects of macroeconomic conditions, economic development and government industrial policy are tested in Chapters 5, 6, 7 and 8 within the context of Taiwan.
Figure 1.2 Research Framework

Test Variables
1. Macroeconomic Conditions (H1)
2. Economic Development (H2)
3. Government Industrial Policy (H3)

Control Variables
1. Firm Characteristics
2. Industry Type

Target Capital Structure (TCS_t)

Actual Capital Structure at the end of the previous period (ACS_{t-1})

Within the Context of Taiwan (Chapter 3)

Empirical Results:
Capital Structure Adjustment (Chapters 5, 6, 7 & 8)

Capital Structure Adjustment with financial constraint of Over-leverage (TCS_t < ACS_{t-1})

(H1 tested in Chapters 5 & 8)
(H2 tested in Chapters 6 & 8)
(H3 tested in Chapters 7 & 8)

Capital Structure Adjustment with financial constraint of Under-leverage (TCS_t > ACS_{t-1})

Negative or Positive Gap?

Negative Gap

Positive Gap
Chapter 2

Literature Review and Hypotheses Development

2.1 Introduction

Since the study of Modigliani and Miller (1958), studies of capital structure intensively focus on the determination or determinants of the optimal or target capital structure at firm and industry levels. These empirical studies identify generally accepted determinants of capital structure at firm and industry levels. At the same time, however, most prior studies neglect factors at the macroeconomic and governmental levels. Following the line of prior studies, this thesis fills the research gap by examining the effect of factors at macroeconomic and governmental levels on capital structure.

In addition, most previous research on capital structure concentrates on developed countries, in particular the United States of America, rather than on developing countries. A number of studies (Booth, 2001, Wiwattanakantang, 1999) address the issue and provide evidence on the firm-specific determinants of capital structure in developing countries. Another recent study (Delcoure, 2007) examines the firm-specific determinants of capital structure in emerging countries in Central and Eastern Europe. The thesis research is conducted within the context of Taiwan with its successful and relatively rapid record of economic transition from being a less-developed country to becoming a developing or newly industrialized country. This allows the thesis to provide new evidence on the effect of macroeconomic conditions, economic development and government industrial policy on capital structure as well as on the adjustment behavior of capital structure decisions. The findings in the thesis research also provide empirical support to the partial adjustment model’s application to the economy in developing countries.

The thesis research, however, does not intend to test the efficiency or the superiority of any of the theories that explain capital structure decisions. Following prior
studies on the adjustment of capital structure, the thesis research utilizes the partial adjustment model to investigate the effects of the test variables at the macroeconomic and governmental levels on capital structure.

2.2 Literature Review: The Determinants of Capital Structure

Much attention has been given to the determination or determinants of capital structure decisions since the irrelevance proposition was formulated by Modigliani and Miller in 1958. In their survey on the theory of capital structure, Harris and Raviv (1991) point out that capital structure models, although identifying a lot of potential determinants, have identified only a small proportion of the general principles of capital structure decisions. This indicates that there is still a long way to go before corporate finance researchers have a complete theory of capital structure.

The capital structure irrelevance proposition of Modigliani and Miller (1958) states that firm value is independent of financing in perfect capital markets in the absence of tax and bankruptcy costs. However, it is hard or impossible to have perfect capital markets in the real world. In addition, as argued by Myers (2003), if firm value is independent of its capital structure, then there would be no incentive to innovate in the design of securities and new financing schemes and, eventually, the market would disappear. Instead, financial innovation in the design of securities and financing schemes continuously exists in capital markets. This seems to support capital-structure relevance, so it is impossible to test directly the Modigliani and Miller’s irrelevance proposition (Myers, 2003).

Factors in the real world such as taxes, bankruptcy costs, product markets, asymmetric information and agency costs could not meet the conditions required by the capital structure irrelevance proposition of Modigliani and Miller (1958). Each of these factors could be dominant for some firms, in some industries or in some circumstances rather than in others. Conditional theories of capital structure include consideration of specific factors in their own model to explain how the factors affect the determination of corporate optimal capital structure where their firm value is
maximized. With factors taken into account, these conditional theories of capital structure reach different conclusions about how to determine the optimal capital structure for the maximization of firm value. This reflects the fact that the theories of capital structure differ relatively to their inclusion of one or more factors taken into account (Harris and Raviv, 1991, Myers, 2003). The major conditional models of capital structure after Modigliani and Miller’s irrelevance propositions are the trade-off theory, the pecking order theory and the agency theory.

As stated by Myers (2003), the irrelevance propositions of Modigliani and Miller are not controversial as a matter of theory in a frictionless market without tax and bankruptcy cost. Miller (1977) argues that the tax advantages of equity could completely balance off the tax deductibility of interest payments at the corporate level. The introduction of corporate and personal taxes does not change the irrelevance of capital structure at all. However, in the real world, actual tax rates do not appear to support the Miller equilibrium (Myers, 2003). Firms can take advantage of the tax deductibility of interest payments on debt although they have to deal with the threat or occurrence of default as well. The trade-off theory of capital structure includes tax benefits and the direct and indirect costs of financial distress. Firms with too much debt increase the bankruptcy cost and might lose the tax deductibility of interest payments on debt. On the other hand, firms with too little debt decrease dramatically the bankruptcy cost but lose the tax deductibility of interest payments. Therefore, optimal capital structure can be obtained where the tax benefits of debt financing counterbalance the costs of financial distress. The trade-off models contend that firms determine their target debt ratios by trading off the benefit of tax deductibility against the costs of bankruptcy and financial distress and, in addition, adjust their actual debt ratios towards the target ones (Myers, 2003).

The asymmetric information theory of capital structure posits that firm insiders or managers possess private information about the characteristics of a firm’s return stream or investment opportunities that is less known to outside investors. This is called information asymmetry. A branch of the asymmetric information theory starts with Ross (1977) and Leland Pyle (1977). Ross (1977) argues that managers know the true distribution of their firm’s returns while outside investors do not. A higher debt level is recognized by investors as a signal of higher quality. In addition,
managers can benefit if their firm’s securities are overvalued by the market but get penalized if the firm goes bankrupt. Therefore, managers of higher quality firms issue more debt as a signal to outside investors. However, managers of low quality firms do not issue more debt because low quality firms have higher marginal bankruptcy costs. Under the simple signaling model of Leland and Pyle (1977), an entrepreneur seeks financing of investment projects whose true quality is known only to him but not to outside investors. The entrepreneur's willingness to invest in his own project can serve as a signal to the lending market of true project quality. Signaling incurs welfare costs by inducing entrepreneurs to take a larger fraction of the equity in their own firms.

Another branch of the asymmetric information theory begins with Myers and Majluf (1984) and Myers (1984). They argue that capital structure choices of firms can be used to mitigate the impact of information asymmetry on the inefficiency in their investment decisions. Myers and Majluf (1984) show that if outside investors are less informed about the value of the firm’s assets than the insiders or managers are, then the equity of the firm may be mispriced by the market. If the firm needs to finance investment projects by issuing equity, the under-pricing problem may be so severe that new equity investors, i.e. new shareholders, capture more than the net present value, i.e. the NPV, of the investment projects and hence a net loss to existing shareholders occurs. In such a circumstance, even a positive NPV investment project will be rejected and an underinvestment occurs. This underinvestment problem can be avoided by the firm’s financing the investment projects with internal funds or issuing a security that is not so severely underpriced by the market. A riskless debt, or even a risky but not too risky debt, is preferred to equity. Therefore, firms finance new investments first with internal funds, then with low-risk debt and, finally, with equity as a last resort. This is generally called the pecking order theory of financing as cited by Myers (1984).

The agency theory, based on agency costs, originates with Jensen and Meckling (1976). Two types of conflicts in capital structure decisions arise from the agency problem among shareholders, managers and creditors. Conflict between shareholders and managers arises because managers are the agent of the principals, i.e. the shareholders, and do not hold 100% of the residual claim of their firm.
Managers have to bear the entire cost but do not capture the entire gain of their firm’s resources. Consequently, managers may not act completely in the interests of their firm’s shareholders when managing their firm’s resources. Instead, managers may transfer their firm’s resources to increase their own wealth rather than maximize the wealth of shareholders. This cost related to the agency problem between shareholders and managers is called an agency cost of equity. Another type of conflict between shareholders and creditors arises because the debt contract gives shareholders an incentive to invest sub-optimally. The debt contract provides that if an investment is carried out successfully enough to earn profits well above the face value of the debt, shareholders capture most of the gain. However, if the investment fails, creditors or debt-holders bear the costs of the failure because of limited liability to shareholders. Consequently, shareholders may still benefit from investing in very risky projects. Although they are still beneficial for shareholders, these investment projects may result in a decrease in the value of the debt. Therefore, the cost of the incentive to invest in value-decreasing projects created by debt is borne by the shareholders who issue the debt. This cost related to the agency problem between shareholders and creditors is called an agency cost of debt. Jensen and Meckling (1976) argue that, by trading off the agency cost of debt against the benefit of debt to mitigate the conflict between shareholders and managers, an optimal capital structure can be obtained. In order to mitigate the conflicts between shareholders and managers, Jensen (1986a) points out that debt financing reduces free cash flow available to managers to engage in the activities of transferring the resources to their private benefit. Stulz (1990) also argues that leverage should depend on the investment opportunities available to firms. He suggests that, in order to reduce the agency cost of equity, firms with valuable growth opportunities should finance with less debt to reserve spare debt capacity for future expansion. On the contrary, firms with limited growth opportunities should finance with more debt to constrain managers.

These theories overlap in terms of their inclusion of the factors considered in their model for the optimal capital structure (Myers, 2003). In fact, it is extremely difficult to construct a complete “conditional” theory of capital structure with all of these factors under consideration. As stated by Myers (2001), there is no universal theory of capital structure and indeed no reason to expect one. The contention of
Myers (2001) is confirmed by recent studies (see Appendix 1) which have yielded mixed results in the testing of capital structure theory.

Following the line of prior studies on capital structure, the thesis research expands the work to investigate the potential determinants of capital structure and to examine their effects on capital structure adjustment. Based on previous empirical and theoretical studies, the firm-specific determinants and industry type as control variables as well as the potential determinants as the test variables are discussed further as follows.

2.2.1 Firm Characteristics

As documented and concluded by most prior studies, the factors of firm characteristics that affect the optimal or target capital structure are mainly firm size, growth opportunities, profitability, non-debt tax shields and asset tangibility. These five factors are included to serve as control variables in the thesis research. A review of the literature on these firm-specific factors and their effects on capital structure included in the thesis follows.

2.2.1.1 Firm Size

Firms with a high bankruptcy risk tend to finance with less debt to avoid going bankrupt. Several studies address the issue of the relationship between firm size and bankruptcy risk. In an empirical study of bankruptcy risk, Warner (1977a) finds that the ratio of bankruptcy costs to the market value of railroad firms appears to decline as firm value or size increases. In addition, Ang, Chua and McConnell (1982) find that administrative costs of corporate bankruptcy is negatively related to the liquidating values of a firm, which is consistent with the finding of Warner (1977a). Further, Castanias (1983a) finds that the correlation coefficient between total assets (firm size) and failure rates is significantly negative. The findings in these studies suggest that large firms are less prone to bankruptcy and financial distress than small firms. Moreover, firms usually finance with debt from the financial intermediaries on a secured basis, a common lending practice among the financial intermediaries in Taiwan. Large firms generally have more liquid assets and fixed
assets that can be used as collateral for debt financing. Consequently, large firms have more capacity to finance with debt, which implies that capital structure will be positively related to firm size.

Several empirical studies such as Marsh (1982), Ranjan and Zingales (1995), Wald (1999) and Booth et al. (2001) find a positive relationship between capital structure and firm size, which is also consistent with the conclusion of Warner (1977a). On the contrary, however, Kester (1986b), Kim and Sorensen (1986), and Titman and Wessels (1988) find a negative relationship between capital structure and firm size. Further, it is interesting to note that Ferri and Jones (1979) find that this relationship does not remain positive in varied macroeconomic conditions.

Based on the findings of these prior studies, the effect of firm size on the determination of capital structure does not appear certain and, in addition, the relationship between firm size and capital structure appears to vary according to macroeconomic conditions. The factor of firm size is included as a control variable in the thesis research to investigate the significance of the test variables, namely macroeconomic conditions, economic development and government industrial policy, in the determination of capital structure. It is expected to provide additional evidence on the effect of firm size on the determination of capital structure choices.

2.2.1.2 Growth Opportunities

In the case of leveraged firms, if investment opportunities earn higher returns than the face value of debt, shareholders receive most of the gain from their investments. But, if the investments fail, the debt holders bear the loss due to limited liability and the shareholders might still benefit from their poor and risky investments. Furthermore, if a firm with limited growth opportunities finances risky investments with a new issue of debt, then the existing debt holders bear more risk than prior to the new issue of debt. Due to the conflicts of interest between shareholders and debt holders, firms can finance with more debt to expropriate the wealth from debt holders to shareholders. Consequently, firms with limited growth opportunities tend to finance with more debt. In other words, capital structure is negatively related to future growth opportunities based on the agency theory of capital structure.
Based on the asymmetric information model of capital structure (Myers and Majluf, 1984), however, management with superior information assumedly knows more about the value of the firm than the less-informed investors. Due to this asymmetric information problem, the market may underprice equity. Consequently, firms tend to finance their investment opportunities with the security less underpriced by the market. Further, as the pecking order theory of financing (Myers and Majluf, 1984) suggests, capital structure is determined by the pecking order of a firm’s desire to finance their investment opportunities, first with internally generated funds, then with low risk debt capital, and finally with equity capital. Therefore, based on the asymmetric information theory of capital structure, capital structure is positively related to growth opportunities.

Kim and Sorensen (1986) use annual growth rate of earnings before interest and taxes to measure growth opportunities to determine that capital structure is negatively related to growth opportunities. Chung (1993) also finds a negative relationship between growth opportunities and corporate debt level. Rajan and Zingales (1995) use the market-to-book ratio to measure growth opportunities and also find a negative relationship between capital structure and growth opportunities. In a market timing empirical study, Baker and Wurgler (2002) find that firms tend to gear down their leverage during periods of high investment opportunities. The evidence on growth opportunities yielded by these prior studies is consistent with the agency theory of capital structure.

However, comparing the capital and ownership structure in the U.S.A. and Japan, Kester (1986b) uses the annual rate of revenue growth to measure growth opportunities and finds a positive relationship between capital structure and growth opportunities. In a Taiwanese empirical research study, Chu, Wu and Chiou (1992) also find a positive relationship between capital structure and growth opportunities. These findings are consistent with the asymmetric information theory but do not support the agency theory of capital structure. Despite the discrepancy in the effect of growth opportunities on capital structure, the factor is included as a control variable in the thesis research.
2.2.1.3 Profitability

The reasoning of the relationship between profitability and capital structure is that, due to a low bankruptcy risk, profitable companies have more capacity to finance with additional debts. In addition, profitable companies tend to finance with more debt to take advantage of tax deductibility benefits. The greater the profit a firm can earn, the greater is the debt that can be used as a tax shield for the benefit of tax deductibility. Consequently, based on the pecking order theory of financing, a positive relationship is expected between capital structure and profitability. On the other hand, the greater the profit a firm can earn, the greater are the funds that the firm can reserve as internal funds to be used to finance its investments or to repay outstanding debts due to lack of investment opportunities. Myers and Majluf (1984) contend that firms first use up their internal funds to finance their investment opportunities and then turn to external capital financing. Their argument implies that the greater the profits of a firm, the less likely it is that a firm will exhaust its internal funds and then finance with external capital. Therefore, based on the pecking order theory of financing, a negative relationship is expected between capital structure and profitability.

The findings of several empirical studies such as Friend and Lang (1988), Kester (1986b) and Titman and Wessels (1988) are consistent with the conclusion of a negative relationship between capital structure and profitability. In a Taiwanese empirical study, Chu et al. (1992) also find that capital structure is negatively related to profitability among the listed firms in Taiwan.

Despite the inconsistent conclusion on the relationship between profitability and capital structure, the factor of profitability is included as a control variable in the thesis research. It is expected to provide additional evidence on the effect of profitability on capital structure with consideration of macroeconomic conditions and economic and industrial development policy.

2.2.1.4 Non-Debt Tax Shields

In the real world, taxes exist practically everywhere, for no country can maintain its
political system without taxation. Interest payments on a firm’s financial obligations or debts can be treated as a deduction from corporate operating income for tax taxation. Non-debt tax shields such as depreciation expenses can act as a substitute for the tax deduction of interest expenses. Consequently, given a level of operating income, the more the non-debt tax shields, the less is the benefit of tax deductibility of the debt used by a firm for taxation benefits. In other words, considering the tax deductibility of debt financing, non-debt tax shields have a negative impact on the tax deductibility of a firm’s interest expenses.

DeAngelo and Masulis (1980) present a model of capital structure choice with the existence of corporate and personal income tax and show that non-debt tax shields such as accounting depreciation and investment tax credits can substitute for debt. In other words, given a level of earnings, a firm can benefit more from non-debt tax shields than from tax deductions from the use of debt. Based on the analysis in DeAngelo and Masulis (1980), a negative relation between corporate debt financing and non-debt tax shields is expected.

Evidence by Downs (1993), Chu et al. (1992), Chaplinsky and Niehaus (1993) and Wald (1999) shows the crowding-out effect of non-debt tax shields on debt financing, which is consistent with the conclusion of DeAngelo and Masulis (1980). However, Bradley, Jarrell and Kim (1984) find a positive relationship between long-term debt ratios and non-debt tax shields. Further evidence on the relationship between capital structure and non-debt tax shields is needed. Hence, the factor of non-debt tax shields is included as a control variable in the thesis research.

2.2.1.5 Asset Tangibility

Based on the argument by Jensen and Meckling (1976), firms can finance with more debt and expropriate the wealth from debt holders to shareholders, causing the agency costs of debt. In order to decrease the agency costs of debt, some provisions or special covenants such as interest coverage requirements, refunding limitation and prohibitions against a firm’s investment in its unrelated line of business are additionally included in the debt contracts to protect debt-holders themselves and to avoid possible wealth transfer to shareholders. Consequently, as suggested by Rajan
and Zingales (1995), if firms can provide debt-holders with high collateral values of assets, firms can finance with more debt from debt-holders because the agency costs of debt are reduced by doing so. In other words, a positive relationship is expected between capital structure and asset tangibility.

Collateral or security is commonly required in lending practice in Taiwan. Usually, real estate and machinery or equipment are used as security for long-term lending by financial institutions while, on the other hand, personal guarantees or endorsements by key stakeholders or high liquidity riskless securities such as Treasury Bills are required for short-term lending in Taiwan. Consequently, the greater the collateral value of asset structure of a firm, the higher is the level of debt that a firm can finance. It is expected that capital structure will be positively related to asset tangibility.

Many previous studies confirm the positive relationship between capital structure and asset tangibility. Marsh (1982) finds a positive relationship between debt issues and asset composition. Friend and Lang (1988) also find a significantly positive relationship between capital structure and the collateral value of asset structure in publicly held corporations without non-managerial principal shareholders. In addition, Rajan and Zingales (1995) investigate the determinants of the capital structure choice of public firms in major industrialized countries and find a positive relationship between capital structure and asset tangibility or collateral value of asset structure. Wald (1999) investigates how firm characteristics affect capital structure in France, Germany, Japan, the United Kingdom, and the United States also finding a positive relationship between capital structure and the collateral value of asset structure. Therefore, asset tangibility is included as a control variable in the thesis research.

2.2.2 Industry Type

Many prior studies as summarized by Harris and Raviv (1991) suggest that the capital structure of firms varies across industries. In addition, firms within an industry tend to rely similarly on debt financing (Myers, 1984). The rationale of considering industry factors in the empirical model of the thesis follows.
Firms in the same industry operating in the same line of business and under the same regulations of government industrial policies - such as governmental supports, subsidies and tax benefits - face the same risk in addition to the risks from firm characteristics. In addition, firms in the same industry generally employ similar materials and similarly-trained workers to produce similar products for similar customers in the market. In other words, these firms face similar suppliers and customers in the same industry and, consequently, take similar levels of risk in addition to the risks arising from firm characteristics.

In a model to determine the choice of capital structure, Titman (1984) argues that a corporate liquidation decision is associated with the probability of its bankruptcy. A liquidation decision of a firm as the agent can impose costs on its principals i.e. the suppliers, workers and customers in terms of agency relationship. His analysis suggests that firms that manufacture products requiring specialized services and spare parts should finance with less debt due to high liquidation costs and a high bankruptcy probability. In addition, Alderson and Betker (1995) investigate the relationship between capital structure and the liquidation costs of assets for the firms under Chapter 11 of the Bankruptcy Code. The results of their study suggest that, in order to improve their financial status, those firms with assets of high liquidation costs tend to finance with less debt.

Similarly, the greater the specialty of products and services within an industry, the higher are the liquidation costs and the probability of bankruptcy. Consequently, based on the argument of Titman (1984), those firms with products and services of high specialty in an industry have a higher bankruptcy probability and should finance with less debt than the firms in other industries. Moreover, given the asymmetric information problem in the market, Myers (1984) concludes that average debt ratios will vary across industries due to the fact that the type and risk of assets and the external financing requirements are different from industry to industry.

A survey on the theory of capital structure by Harris and Raviv (1991) and several studies such as Bradley et al. (1984) and Kester (1986b) show that some industries like food and electronics finance with less debt but industries like paper, textile,
steel, and cement use more debt. In particular, Bradley et al. (1984) find that corporate leverage ratios vary across industries and, in addition, that strong evidence exists on intra-industry similarity in firm leverage ratios and on persistent inter-industry differences. The results of Bradley et al. (1984) show that the levels of debt financing in regulated industries are among the highest ranking, which supports the argument of Titman (1984). Moreover, in a Japanese study during the period from 1980 to 1983, Allen and Mizuno (1989) find that industry effects and profitability are the major determinants of corporate debt ratios of industrial and commercial companies in Japan. In brief, based on the above evidence, capital structure varies across industries and is usually more similar within the same industries than in different industries.

However, Balakrishnan and Fox (1993) use the variance component model to examine the effect of firm characteristics and industry factors on the determination of capital structure. They find that firm characteristics contribute more than 50% of total variance in the determination of capital structure compared to industry factors that contribute only about 10% of total variance, suggesting that industry factors are less important a determinant of capital structure than firm characteristics are. Moreover, Titman and Wessels (1988) use industry classification on the basis of uniqueness suggested by Titman (1984) and do not find strong evidence on industry effect on the determination of capital structure. In addition, in a Taiwanese empirical research on the determination of capital structure, Chu et al. (1992) use the same method of industry classification as Titman and Wessels (1988) but find a positive relationship between capital structure and industry uniqueness, which is not consistent with the conclusion of Titman (1984).

Based on the discussion above, the factor of industry type is included as control variable in the thesis research.

### 2.2.3 Macroeconomic Conditions

Economic output and growth fall during a period of recession but increase during a period of expansion, particularly at economic trough and peak. Some determinants of capital structure such as growth opportunities and profitability also vary with the
state of the economy over business cycles. There are more future growth opportunities available to firms at economic trough but fewer growth opportunities at economic peak. This relationship amongst macroeconomic conditions, firm-level factors and capital structure suggests that capital structure will be influenced by macroeconomic conditions.

The agency theories of capital structure argue that, due to conflicts of interest between shareholders and debt-holders, the management of firms tends to divert wealth from their creditors to their shareholders through the capital structure choice. Firms with limited future growth opportunities tend to finance with additional debt for their investment because the debt-holders bear the consequences for the loss if their investment fails.

Stulz (1990) analyzes the problem of managerial discretion and capital structure in his model and contends that financing policy, by influencing the resources under management control, can reduce the costs of overinvestment and underinvestment arising from the agency problem between management and shareholders. Stulz argues that management always benefits from increasing investment even when the firm invests in a negative NPV project. Thus, when cash flow is high, management will have the incentive to invest surplus funds in negative NPV investment opportunities, i.e. overinvestment. On the other hand, when cash flow is low, managers may not have sufficient funds to invest in positive NPV projects, thus resulting in underinvestment. This is because shareholders do not believe management pronouncements that cash flows are insufficient and may therefore not be willing to provide additional funding.

Consequently, Stulz argues that a firm’s financial policy could reduce the agency cost of managerial discretion. Issuing debt that forces management to pay out funds when cash flow is high can reduce the overinvestment cost but it can exacerbate the underinvestment cost when cash flow decreases. On the other hand, issuing equity that increases the resources under management control reduces the underinvestment cost but it can worsen the overinvestment when cash flow increases. Therefore, to reduce the cost of overinvestment and underinvestment, firms finance with more debt when cash flow increases but finance with less debt when cash flow decreases.
Jensen’s free cash flow theory (1986b) also asserts that, in the case of large free cash flow, debt can be used to motivate managers and their organizations to be efficient. Stulz concludes that the optimal face value of debt increases if cash flow increases or if the probability increases that the firm will have free cash flow. This implies that, in order to reduce the agency problem between management and shareholders, firms tend to finance with more debt at economic peak due to the increase in both cash flow and the probability that firms will have free cash flow. At economic trough, however, firms tend to finance with less debt due to the decrease in both cash flow and the probability that firms will have free cash flow.

During periods of economic expansion, in particular at economic peak, firms with limited future investment and growth opportunities in the future tend to finance with more debt based on the agency theory of capital structure. On the other hand, during periods of economic recession, in particular economic trough, firms with more growth opportunities in the future tend to finance with less debt in order to avoid passing up these investment opportunities. In other words, firms tend to finance with more debt during periods of economic peak due to the lack of future growth opportunities and, in addition, firms tend to reserve their spare debt capacity during periods of economic trough for growth opportunities during future economic expansion. In brief, based on the agency model and considering spare debt capacity, it can be expected that capital structure is negatively related to future macroeconomic conditions in terms of future investment and growth opportunities. Therefore, according to the agency theory of capital structure, capital structure is positively related to macroeconomic conditions in terms of future investment and growth opportunities.

Asymmetric information models, however, arrive at an opposite conclusion about the impact of free cash flow and profitability on capital structure. This is due to the asymmetric information problem between management and outside investors. The asymmetric information models assume that investors are less well-informed than management about the value of the firm’s assets. The information asymmetry contributes to the underpricing of a firm’s equity and thus underinvestment occurs. Ross (1977) argues that firms tend to issue debt to be taken as a valid signal of a more productive firm by trading off the tax advantage of increased debt and the cost
of an increased probability of bankruptcy. In addition, Myers and Majluf (1984) argue that there is a pecking order of financing: firms will finance new investment first with internal funds, then with debt, and finally with equity. Further, Narayanan (1988), assuming that debt is risky rather than assumedly risk-free in the model of Myers and Majluf (1984), analyzes this issue further in his model and concludes that debt is always better than equity, consistent with the pecking order theory of financing. Narayanan also contends that, in a world of asymmetric information regarding a new investment opportunity, a firm tends to finance with debt rather than with its undervalued equity to avoid underinvestment.

Additionally, Narayanan (1988) suggests that it is better to reserve financial slack so that future investment opportunities can be supplied from internal sources. Further, firms are likely to have more free cash flow during economic expansion than during economic recession and thus an underinvestment problem more likely occurs at economic trough than at economic peak. This implies that, based on the asymmetric information theory, at economic peak firms tend to finance with equity rather than with debt to avoid passing up valuable investment opportunities. Therefore, according to the asymmetric information models, capital structure is negatively related to macroeconomic conditions.

Miller (1977) reports that debt ratios of typical non-financial companies vary during business cycles between 1920 and 1960 and, in addition, tend to fall during periods of economic expansion. After examining the determinants of capital structure for the years during expansion and recession, respectively, Ferri and Jones (1979) suggest that capital structure seems to vary with macroeconomic conditions. However, they do not provide clear-cut evidence on the impact of macroeconomic conditions on capital structure. Further, Korajczyk and Levy (2003) investigate the impact of macroeconomic conditions on capital structure with financial constraints taken into account. They split their sample into two sub-samples, financially constrained and financially unconstrained, which allows them to test whether the tradeoff theory and the pecking order theory can explain the effects of financial constraints and macroeconomic conditions on capital structure decisions. Korajczyk and Levy find that corporate leverage is counter-cyclical for the financially unconstrained firms. Furthermore, Hackbarth et al. (2006) present a contingency-claims model and
analyze credit risk and capital structure. They argue that shareholders’ value-maximization default policy is characterized by a different threshold for each state and that default thresholds are countercyclical. Thus, their model predicts that market leverage should be countercyclical. Moreover, Levy and Hennessy (2007) also conclude that market leverage should be counter-cyclical.

It appears, therefore, that there is no theoretical agreement on the impact of macroeconomic conditions on capital structure. The thesis research therefore addresses this gap in presenting the empirical test on the impact of macroeconomic conditions in Chapter 5.

2.2.4 Economic Development

As mentioned earlier in the chapter, prior studies on capital structure focus mostly on determinants at firm and industry levels. Rarely do prior studies (Chen, 2004b, Boyd and Smith, 1996, Arnold and Walz, 2000, Michaelas, 1999) address the issue at economic level with economic development under consideration.

King and Levine (1993a) construct an endogenous growth model to examine the relationship between financial systems and economic growth. They find that better financial systems increase the probability of successful innovation in corporate activities and, consequently, lead to economic growth, and conclude that financial systems are important for economic growth and development. King and Levine (1993b) also find that the level of financial development is strongly associated with economic growth measured by real per capita GDP. Further, Levine and Zervos (1998) find that financial markets provide services positively important for economic growth, which is consistent with the findings of King and Levine (1993a, 1993b). In brief, the evidence that these studies provide suggests that economic growth and development is related to financial development.

Rajan and Zingales (1998) contend that financial development facilitates economic growth through reducing the cost of external finance to firms. Demirguc-Kunt and Maksimovic (1999) examine the impact of stock market development on the choice of capital structure of firms in thirty developing and industrial countries from 1980
to 1991. Their empirical results suggest that initial improvements in developing stock markets lead to higher debt-to-equity ratios of firms but further development in the already developed stock markets leads to a substitution of equity for debt financing. In addition, their results indicate that, in developing stock markets, large firms finance with more debts as their stock market develops; however, small firms do not appear to be significantly affected by stock market development. In brief, the findings of their empirical study suggest that corporate capital structure is related to economic development.

Stulz (1990) argues that firms finance with more debt when cash flow increases but finance with less debt when cash flow decreases in order to reduce the cost of overinvestment and underinvestment. He concludes that optimal face value of debt is positively related to the increase in cash flow and to the increase in the probability that the firm will have free cash flow. This implies that firms tend to finance with less debt in response to future economic growth or investment opportunities. In addition, economic growth varies over the business cycles and so does its impact on capital structure changes. The higher the economic growth expected, the greater is the spare debt capacity reserved for future growth. Therefore, capital structure changes are expected to be negatively related to future economic growth in the course of economic development.

Boyd and Smith (1996) argue that, due to intermediation costs, more developed economies could operate more efficiently than less mature economies. The development of a financial market tends to provide an economy with a more efficient capital market. At low levels of financial market development, there is practically no use of equity markets. Once the economy reaches a certain level of financial development, corporate financing via equity markets occurs due to the benefit of financial market development. Therefore, more equity financing is utilized as an economy develops. Corporate debt ratios decline in the course of economic development and are negatively related to the shift in the level of economic development.

However, Michaelas et al. (1999) find a positive relationship between GDP growth and long-term debt ratios of small and medium-sized enterprises in the United
Kingdom. Arnold and Walz (2000) incorporate a financial sector into an endogenous growth model to investigate the role played by the financial sector in the process of economic growth and its effect on corporate capital structure and economic growth of a country over time. In their endogenous growth model, the pattern of capital structure is evolved from self-financing towards a higher share of external financing from financial intermediaries due to increasing productivity in the financial sector. Their model concludes a positive relationship between capital structure and economic growth, concurring with Michaelas et al. (1999).

Moreover, Chen (2004b) argues that prior studies have not consciously investigated the impact of economic growth on capital structure. Chen investigates the relationship between capital structure and economic development in the U.S.A., Canada, Australia, and Taiwan. The results of Chen’s research indicate that the effect of economic development on the aggregate debt-equity ratio is uncertain. Chen finds that the growth rate of gross domestic product (GDP) has a negative effect on aggregate debt-to-equity ratios in Taiwan and that the effect is inconsistent among countries. However, Chen encounters a measurement problem because corporate financial structure is measured by macroeconomic aggregate debt-to-equity ratios calculated from the national balance sheet to examine its relationship with economic development.

The existing empirical work on capital structure does not provide consistent evidence on the effect of economic development. The thesis research therefore addresses this gap to provide further evidence on the effect of economic development. The empirical test on the impact of economic development is presented in Chapter 6.

### 2.2.5 Government Industrial Policy

Appelbaum (1993) presents a model to examine the impact of government intervention policy on capital structure decisions. He shows that companies can take advantage of government intervention such as bailouts, subsidies and taxation to maximize their value through wise capital structure decisions. As stated by Appelbaum (1993), government interventions are usually the result of interactions
between economic considerations and political pressures. These government interventions are undertaken for the purpose of helping and protecting certain “selected” industries according to economic, social and political factors. Industries that receive help and protection from government measures are usually ones in their infancy, of high risk or with high research and development needs (Appelbaum, 1993). However, these government measures are not priced by the market.

Therefore, Appelbaum argues that, through their capital structure decisions, firms supported by government measures can take advantage of the government’s protection and help to maximize the value of government measures and extract this value to increase the value of their firms. In an empirical study of corporate debt maturity in thirty countries during the period from 1980 to 1991, Demirguc-Kunt and Maksimovic (1999) use the level of government grants as a percentage of the real GDP to measure government subsidies. They find that government subsidies are positively related to the level of long-term debts financing. Their finding is consistent with that of Appelbaum (1993).

In addition to the reason offered by Appelbaum (1993), to stimulate economic growth and development, Taiwan’s government adopted diverse industrial policies to promote and support selected industries. Yet, the impact of government industrial policy on capital structure decisions has never been addressed by previous studies. Consequently, the thesis research includes government industrial policy in the empirical model to investigate its impact on capital structure of the listed firms in the textile, plastics and electronics industries of Taiwan. The empirical test on the impact of government industrial policy is presented in Chapter 7.

### 2.3 Hypothesized Effects of Test Variables

This section discusses the hypotheses development for the test variables and the hypothesized effects based on the theoretical and potential linking between test variables and capital structure. The hypothesized effects for the test variables - macroeconomic conditions, economic growth and development and government industrial policy on capital structure are presented as follows:
2.3.1 Hypothesized Effect of Macroeconomic Conditions

In response to the over-investment and under-investment problems arising from the agency problem between managers and shareholders, Stulz (1990) argues that firms can reduce the agency cost of managerial discretion through capital structure decisions. Issuing debt that forces management to pay out funds when cash flow is high can reduce the overinvestment cost. Issuing equity that increases the resources under management control reduces the underinvestment cost when cash flow is low. Therefore, firms finance with more debt when cash flow increases but finance with less debt when cash flow decreases. In addition, Stulz contends that the optimal face value of debt increases if cash flow increases or if the probability increases that the firm will have free cash flow. In order to mitigate the agency problem between management and shareholders, firms tend to finance with less debt at economic trough due to the decrease in both cash flow and the probability that firms will have free cash flow.

Further, based on the agency theory of capital structure during periods of economic expansion, particularly at economic peak, firms with limited future investment and growth opportunity tend to finance with more debt. On the other hand, during periods of economic recession, particularly at economic trough, firms with more growth opportunities in the future tend to finance with less debt in order to avoid passing up investment opportunities. Therefore, firms tend to finance with more debt during periods of economic peak due to the lack of future growth opportunities while they reserve their spare debt capacity during periods of economic trough for future growth opportunities during future economic expansion.

In brief, based on the agency theory of capital structure and with consideration of spare debt capacity reserved for future investment and growth opportunities, it is expected that capital structure adjustment will be positively related to macroeconomic conditions.

2.3.2 Hypothesized Effect of Economic Development

Based on the argument of Stulz (1990), firms tend to finance with more debt when
cash flow increases but with less debt when cash flow decreases in response to the problem of overinvestment and underinvestment, respectively. This implies that firms finance with less debt in response to future economic growth or investment opportunities. The higher the future economic growth, the lower is the debt level used and, in addition, the greater is the spare debt capacity reserved. Therefore, capital structure is expected to be negatively related to future economic growth. Similarly, according to the argument of Stulz (1990), capital structure is expected to be positively related to the level of economic development in terms of future growth opportunities. However, capital structure is expected to be negatively related to the level of economic development, as suggested by Boyd and Smith (1996).

2.3.3 Hypothesized Effect of Government Industrial Policy

Appelbaum (1993) analyzes the effect on capital structure decisions of government intervention such as bailout, subsidies and tax benefits other than corporate and personal taxes. He argues that firms with support from government policy can utilize the choice of capital structure to maximize the value of government policies and add the value to the value of their firm since government policy is not priced by the market. Intervention measures adopted by government industrial policy to facilitate industrial development and pursue economic growth are not priced by the market.

Based on the argument of Applebaum (1993), firms with support from government industrial policy can maximize the value of the industrial development policy through their capital structure decisions and add the value to the value of their firm. A firm with the financial constraint of over-leverage in terms of the target capital structure will gear down its debt leverage in order to avoid going bankrupt and losing the value of the government industrial policy. On the other hand, a firm with under-leverage will be fully financed with the debt of a lower interest rate provided by the government industrial policy in order to maximize the value of the government industrial policy and to increase the value of the firm.

In brief, government industrial policy will be positively related to capital structure for firms with under-leverage in terms of the target capital structure; however,
government industrial policy will be negatively related to capital structure for firms with the financial constraint of over-leverage because firms would gear down their leverage ratios in order to avoid going bankrupt and losing the value of government industrial policy.

2.3.4 Hypothesized Effects of Control Variables

2.3.4.1 Hypothesized Firm-Specific Effects

Based on prior empirical and theoretical studies, firm-specific factors such as firm size and asset tangibility are expected to have a positive effect on capital structure. Factors such as growth opportunities, profitability and non-debt tax shields are expected to have a negative effect on capital structure.

2.3.4.2 Hypothesized Industry Effect

Based on prior empirical and theoretical studies, industry type is expected to have an effect on capital structure. In addition, some industries like food and electronics finance with less debt but the other industries like textile, paper and cement finance with more debt (Bradley, 1984, Kester, 1986b).

2.5 Conclusion

As previously stated, the thesis does not set out to test the superiority or the efficiency of the capital structure theories that explain capital structure decisions. Following recent studies on capital structure, the thesis utilizes the partial adjustment model to investigate the effect of the test variables that have been neglected by most prior studies. This can provide new evidence on and a better understanding of the adjustment behavior of capital structure decisions. The potential determinants of capital structure, namely macroeconomic conditions, economic development and government industrial policy are examined in the thesis research. The hypothesized effects of these test variables on capital structure are separately tested and their regression results are presented in Chapter 5 to 7, respectively.
Chapter 3
Taiwan as a Context for the Study of Capital Structure

3.1 Introduction

As mentioned in Chapter 1, most prior studies of capital structure decisions have focused on developed countries, in particular the USA, rather than on developing and less-developed countries. To bridge this research gap, there is a need to gather further evidence from developing countries. This chapter discusses why Taiwan has been chosen as the context of the thesis for the study of capital structure. Through focusing on Taiwan, the thesis could provide a new perspective on understanding of and further evidence on how firms adjust their capital structure to maximize the value of their firms across the shifts both in macroeconomic conditions and in the level of economic development and government industrial policy.

This chapter provides a brief background of Taiwan in terms of its international political and economic status and then outlines the economic and industrial development of Taiwan since the 1950s.\(^4\) The importance of macro-level factors - macroeconomic conditions, economic development and government industrial policy - to capital structure of firms in Taiwan is then discussed. This is followed by a discussion on the importance to capital structure of firm-specific factors across industries over business cycles in Taiwan.

3.2 Taiwan as a Context for the Study

In order to facilitate a basic understanding of Taiwan as the context for the thesis, this section provides an overview of the political and economic history of Taiwan and its economic and industrial development since the 1950s. The first part of this section discusses the political and economic status of Taiwan. The second part of

\(^4\) More detailed about the political and economic overview of Taiwan is presented in Appendix 2.
this section covers briefly its economic and industrial development since the 1950s.

3.2.1 Political and Economic Status of Taiwan

Before the end of the Second World War, Taiwan had been colonized and governed by the Japanese government for about fifty years. On 25th October 1945 after the end of the Second World War, the Republic of China’s troops representing the Allied Forces led by the USA accepted the surrender of the Japanese military forces in Taiwan.\(^5\) In 1949, the Kuomintang, i.e. the KMT Party led by Chiang Kai-shek, retreated from mainland China to Taiwan. In addition, the government of the Republic of China moved from Nanjing to Taipei. Today, Taiwan is the name commonly used to refer to the territory governed by the Republic of China and is often referred to internationally as Chinese Taipei.

Despite its difficult and uncertain political status, Taiwan has successfully transformed itself within just a few decades. In 2007, Taiwan was ranked as the 19th highest in the list of countries sorted by gross domestic product, i.e. GDP, calculated on a purchasing power parity basis by the International Monetary Fund. In addition, for the same year, Taiwan was ranked as the 28\(^{th}\) highest in the list of countries sorted by the GDP per capita calculated on a purchasing power parity basis by the IMF.\(^6\) Taiwan enjoyed a spectacular economic performance from the 1960s through to the 1990s. The real GDP of Taiwan increased more than 24 times, from NT$441,611 million dollars in 1962 to NT$10,726,908 million Taiwan dollars in 2004. In addition, according to the official data of the Directorate-General of Budget, Accounting and Statistics, Executive Yuan of Taiwan, the per capita GDP of Taiwan increased dramatically from 1951. By 1987 it had increased by 111 times the 1951 level and by 2006 it had increased by 348 times.\(^7\) However, a decrease in the GDP and the GDP growth rate of Taiwan occurred in 1998 and 2001. The decrease in 1998 and 2001 occurred due to the Asian Financial Crisis and the change in the ruling party of the Taiwanese government.

The annual growth rates of real GDP vary over the business cycles. In particular, the

\(^{5}\) Please refer to http://en.wikipedia.org/wiki/Taiwan.  
\(^{6}\) Please refer to http://en.wikipedia.org/wiki/List_of_countries_by_GDP_%28PPP%29_per_capita.  
annual growth rate of real GDP appears higher at the years of economic peak, i.e. 1983, 1988 and 1994, than at the years of economic trough, i.e. 1985, 1990 and 1995, over Business Cycles 6 to 8. These years are selected for the thesis research according to the reference dates of economic peak and trough over the business cycles published by the top economic planning authority of Taiwan, the Council for Economic Planning and Development. The detail for the reference dates of the business cycles and the duration of expansion and contraction in each business cycle in Taiwan is shown in Figure 3.1.

3.2.2 Economic and Industrial Development of Taiwan

Taiwan started its economic development planning in 1953. This planning was formulated by a commission that was reorganized or renamed by the government over the various stages of Taiwan’s economic development. Since the first Four-Year Plan in 1953, Taiwan has implemented fourteen economic plans for its economic development. The industrial policy adopted by the government of Taiwan in the various stages of economic development shifted from labor-intensive industries in the 1960s, to heavy and petro-chemical industries in the 1970s, and then to high-tech and knowledge-intensive industries in the 1980s and 1990s (Wang, 1999). Taking into account changes in economic plan and industrial policy in the process of economic development, the economic development of Taiwan can be classified in six stages (Sun, 2001, The Council for the Economic Planning and Development, 2003, Chiang, 2004, Li, 1988). The economic development plans implemented by the Taiwanese Government from 1953 to 2008 are listed in Table 3.1.

---

8 Refer to Taiwan Yearbook 2005 by the Government Information Office of Taiwan and the Historical Review of National Economic Plans by the Council for Economic Planning and Development.
The Reference Dates of Business Cycles in Taiwan

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Trough</th>
<th>Peak</th>
<th>Trough</th>
<th>Duration (Month)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Expansion</td>
</tr>
<tr>
<td>1st</td>
<td>Nov. 1954</td>
<td>Nov. 1955</td>
<td>Sept. 1956</td>
<td>12</td>
</tr>
</tbody>
</table>

Source:

Figure 3.1 Business Cycles of Taiwan
### Table 3.1
Economic Development Plans of Taiwan

<table>
<thead>
<tr>
<th>Economic Plan No.</th>
<th>Name of Economic Plan</th>
<th>Period</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Four-Year Economic Plan</td>
<td>1953 - 1956</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Four-Year Economic Plan</td>
<td>1957 - 1960</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Four-Year Economic Plan</td>
<td>1961 - 1964</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Four-Year Economic Plan</td>
<td>1965 - 1968</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Four-Year Economic Plan</td>
<td>1969 - 1972</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Four-Year Economic Plan</td>
<td>1973 - 1976</td>
<td>Implemented for only three years due to the oil crisis</td>
</tr>
<tr>
<td>8</td>
<td>Four-Year Economic Plan</td>
<td>1982 - 1985</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Four-Year Economic Plan</td>
<td>1990 - 1993</td>
<td>Implemented for only one year</td>
</tr>
</tbody>
</table>


The first stage of Taiwan’s economic development was from 1953 to 1960. During this stage, the country encountered problems of supply shortage in the market and a lack of foreign reserve. The government of Taiwan regulated importing by means of foreign exchange control, tariff barriers and import limits in order to protect and promote the development of domestic industries. Industries protected by government industrial policy included those connected to fertilizers, cement, glass, textiles,
plastics, and electronics in which represented industries producing for domestic needs (Sun, 2001). This period is referred to as the Import Substitution Stage of economic development in Taiwan.

During the late 1950s, several economic issues challenged the government policy adopted in the 1950s. The economic growth in the import-substitution industries declined and industries serving the small domestic market could not create enough jobs to solve the unemployment problem in the rural areas of Taiwan. In addition, the capital expenditure and the import of raw material for import-substitution increased dramatically. Considering future economic development both domestically and overseas, the government decided to implement the second four-year economic development plan and to replace the import-substitution policy by an export-expansion policy in labor-intensive industries (Chiang, 2004). During the period from the 1960s to the early 1970s, the government switched from import-substitution to export-expansion in its industrial policy for labour-intensive industries and this resulted in export-driven economic growth. The textile industry was strategically promoted by the government industrial policy at this stage of economic development (Chu, 2003). As pointed out by Sun (2001), government policy measures implemented in the 1960s resulted in a rapid increase in export and economic growth in the mid 1960s and 1970s.

However, the infrastructure, including transportation and electricity, was expanded relatively too slowly to cope with the rapid economic growth. In addition, spare parts and raw materials were highly dependent on imports due to the large quantity of critical raw materials needed to develop domestic industries. Consequently, the government decided to develop heavy and petro-chemical industries to produce fundamental raw materials needed in mid-stream and lower-stream domestic industries (Chiang, 2004). During this period from the early 1970s to the early 1980s, the government continued to promote exports and accelerated initiatives to develop capital-intensive and technology-intensive industries in order to improve Taiwan’s industrial structure and its competitiveness in the global market. Heavy and petro-chemical industries such as the steel and plastics industries were emphasized strategically in this stage of economic development in Taiwan (Sun, 2001, Chiang, 2004, Chu, 2003).
From the late 1970s to the early 1980s, the Taiwanese government implemented economic and financial liberalization measures which were strongly suggested and recommended by several Taiwanese economists and by well-known foreign economists such as Friedrich A. Hayek and Milton Friedman (Sun, 2003). In the late 1980s, the Taiwanese government accelerated its economic and financial deregulation, hoping to help Taiwan maintain its economic growth in a reasonable path through the late 1990s into the early 2000s. The electronics industry was strategically promoted by the government industrial policy at this stage of economic development from the early 1980s to the mid-1990s (Industrial Development Bureau of the Ministry of Economic Affairs, 2004, Sun, 2001, Chu, 2003). The real GDP contribution from the industrial sector accounted for nearly 40% of Taiwan's GDP in 1986 but it continued to drop to nearly 30% of the GDP in the early 2000s.

From the late 1980s, the economy of Taiwan changed dramatically. Due to the accumulated trade surplus and the enormous amount of capital inflows, the Taiwan dollar had appreciated rapidly in the 1980s (Sun, 2001). During this time, an unfortunate result was that the competitiveness of Taiwan-made products in the international market decreased significantly and undermined the continuous growth of the Taiwanese economy. Many low-productivity and labor-intensive industries were transferred to mainland China and to some Southeast Asian countries. Consequently, during the period from the mid-1990s to 2000, the government of Taiwan introduced initiatives to encourage industrial upgrading. The structure of export products also changed dramatically due to the increase in industrial upgrading. Export products from high-tech industries increased from 18.4% in 1986 to 39.9% of Taiwan’s total exports in 1996 (Sun, 2001). Export products with 50% or more market share in the world market in 1996 included lap-top scanners - 95%, main boards - 74.2%, computer mouses - 65%, keyboards - 61% and PC power adaptors - 55.3% (Sun, 2001, Chiang, 2004). This expansion of Taiwan’s industrial base reflects the efficacy of government industrial policy.

Since 2000, Taiwan has faced increased challenges from liberalization and competition in domestic and international markets due to both its admission to the World Trade Organization on the 1st January of 2002 and the impact of mainland China’s economic boom. In response, as the primary goals of future economic
development, the government vowed to adhere to both the industrial policy of seeking superiority in global competitiveness and the policy of encouraging the development of creative and innovative industries (Industrial Development Bureau of the Ministry of Economic Affairs, 2004). As well, the Taiwanese government pledged to take into account quality of life in addition to economic growth when initiating future industrial and economic development planning. It was the government’s intention to transform Taiwan into “a green silicon island” during the first decade of the new century (The Council for the Economic Planning and Development, 2003).

Furthermore, in the early 2000s, the National Development Plan for the New Century from 2001 to 2004, the Plan to Develop a Knowledge-Based Economy, and the Global Logistics Development Plan became the first-priority missions for Taiwan’s economic development (The Council for the Economic Planning and Development, 2003). The government also implemented the new National Development Plan, Challenge 2008, designed to strengthen global competitiveness, upgrade the quality of life, and promote the sustainable development of Taiwan’s economy. Core industries promoted by the government policy for future economic development in Taiwan included digital content, semi-conductors, image displays and biotechnology (Industrial Development Bureau of the Ministry of Economic Affairs, 2004).

**3.3 Macro-Level Factors and Capital Structure**

As discussed above, it is important to know how important macro-level factors are in determining the capital structure of firms during Taiwan’s economic development. This section provides further explanation on the importance of macro-level factors, namely macroeconomic conditions, economic development and government industrial policy, in the determination of capital structure of firms in Taiwan. A preliminary analysis of the sample utilized in the thesis illustrates variation in the debt ratios of the listed firms in the textile, plastics and electronics industries in Taiwan. The preliminary analysis presented in the following subsections indicates the importance of the selected macro-level factors in determining capital structure for firms in Taiwan.
3.3.1 Macroeconomic Conditions and Capital Structure

In a Taiwanese empirical study of capital structure decisions, Chu, Wu and Chiou (1992) find that firm-specific variables such as firm size, growth opportunities, profitability, non-debt tax shields and asset tangibility have a significant effect on the determination of capital structure. Their findings suggest that firm characteristics play an important role in the determination of capital structure for the listed firms in Taiwan. Firm characteristics such as the level of sales and total assets, growth opportunities and profitability may vary upon macroeconomic conditions over business cycles. In particular, future growth opportunities available to firms vary upon the state of the current economy. Relatively speaking, firms tend to have limited growth opportunities at the years of economic peak and more growth opportunities at the years of economic trough. As suggested by prior empirical studies and by the theory of capital structure (Kim and Sorensen, 1986, Stulz, 1990, Jensen and Meckling, 1976), growth opportunities affect the determination of capital structure. The variation in the availability of future investment and growth opportunities reflects the possible variation in capital structure across macroeconomic conditions over business cycles.

As discussed in Section 3.3, the textile, plastics and electronics industries contributed significantly to the economic growth and development in Taiwan during the periods of the 1960s, the 1970s to the mid-1980s, and the mid-1980s to the mid-1990s. These three industries received financial support from government industrial policy during these periods of emphasis on industrial development. A preliminary analysis of the sample used in the thesis research is given to indicate the importance of macroeconomic conditions in capital structure decisions of firms in the textile, plastics and electronics industries in Taiwan. Using the SAS GLM procedure with the Scheffe’s test, Table 3.2 shows the variation in average debt ratios within the textile, plastics and electronics industries across the years of economic peak and trough over Business Cycles 6 to 8 during the period from 1983 to 1995.
Table 3.2
Comparison in Industrial Average Debt Ratios across Macroeconomic Conditions in Taiwan

<table>
<thead>
<tr>
<th>Industry</th>
<th>Business Cycle 6 Before 1987</th>
<th>Business Cycles 7 and 8 After 1987</th>
<th>Scheffe’s Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Economic Trough</td>
<td>Economic Peak</td>
<td></td>
</tr>
<tr>
<td>Plastics</td>
<td>0.54432 (10)</td>
<td>0.53188 (7)</td>
<td>NO</td>
</tr>
<tr>
<td>Textile</td>
<td>0.57948 (26)</td>
<td>0.56916 (18)</td>
<td>NO</td>
</tr>
<tr>
<td>Electronics</td>
<td>0.51293 (12)</td>
<td>0.49645 (6)</td>
<td>NO</td>
</tr>
</tbody>
</table>

Notes:
1. Sample size is shown in parenthesis.
2. YES and NO indicate whether comparisons are significant or not significant at a significance level of 5%.

Based on the Scheffe’s test, while controlling for the effect of the shift in the level of economic development in 1987, Table 3.2 shows that the average debt ratios, 0.54432 at economic trough and 0.53188 at economic peak, for the plastics industry are not significantly different across the years of economic peak and trough over Business Cycle 6 before 1987. In addition, the average debt ratios, 0.33547 at economic trough and 0.33836 at economic peak, for the plastics industry are not significantly different across the years of economic peak and trough over Business Cycles 7 to 8 after 1987.

On the other hand, before 1987, the average debt ratios, 0.57948 at economic trough and 0.56916 at economic peak, for the textile industry and the average debt ratios, 0.51293 at economic trough and 0.49645 at economic peak, for the electronics industry are not significantly different in each industry across the years of economic peak and trough over Business Cycle 6. After 1987, however, the average debt ratios, 0.41317 at economic trough and 0.47288 at economic peak, for the textile industry and the average debt ratios, 0.43742 at economic trough and 0.48156 at economic peak, for the electronics industry are significantly different in each industry across the...
years of economic peak and trough over Business Cycles 7 and 8. This finding seems to suggest a pro-cyclical or positive effect of macroeconomic conditions on capital structure.

This preliminary analysis of the sample used in the thesis research illustrates the variation in capital structure across macroeconomic conditions and the differences in capital structure among industries. Further robust evidence on the potential effect of macroeconomic conditions on capital structure decisions is presented in Chapters 5 and 8.

3.3.2 Economic Development and Capital Structure

Relative to the potential short-term effect of macroeconomic conditions on capital structure decisions, economic development reflects the short-term future economic growth and the long-term shift in the level of economic development. As argued by Boyd and Smith (1996), the aggregate debt-to-equity ratios tend to fall as the economy develops further due to the higher efficiency in the financial intermediation of capital markets in the course of economic development. Based on this argument, the corporate leverage ratio will decline in the path of economic development as the economy develops. Therefore, the short-term future economic growth and the long-term shift in the level of economic development are expected to have an impact on capital structure of firms in Taiwan.

A preliminary analysis of the sample used in the thesis research is given to illustrate the importance of economic development in capital structure decisions. Using the SAS GLM procedure with the Scheffe’s test, Table 3.3 shows the variation in industrial average debt ratios for firms in the textile, plastics and electronics industries across the periods before and after 1987 over Business Cycles 6 to 8 in the course of economic development in Taiwan.

As shown in the Economic Trough column in Table 3.3, the industrial average debt ratios for the plastics industry are significantly higher over Business Cycle 6 before 1987, i.e. 0.53188, than over Business Cycles 7 and 8 after 1987, i.e. 0.33547. Similarly, as shown in the Economic Peak column in the table, the industrial average
Debt ratios for the plastics industry are significantly higher over Business Cycle 6 before 1987, i.e. 0.54432, than over Business Cycles 7 and 8 after 1987, i.e. 0.33836.

### Table 3.3

**Variation in Industrial Average Debt Ratios across the Shift in the Level of Economic Development in Taiwan**

<table>
<thead>
<tr>
<th>Industry</th>
<th>Economic Trough</th>
<th>Economic Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Business Cycles 7 and 8 After 1987</td>
<td>Scheffe’s Test</td>
</tr>
<tr>
<td>Plastics</td>
<td>0.53188 (10)</td>
<td>0.33547 (38)</td>
</tr>
<tr>
<td>Textile</td>
<td>0.57948 (26)</td>
<td>0.41317 (100)</td>
</tr>
<tr>
<td>Electronics</td>
<td>0.51293 (12)</td>
<td>0.43742 (149)</td>
</tr>
</tbody>
</table>

Notes:
1. Sample size is shown in parenthesis.
2. YES and NO indicate whether comparisons are significant or not significant at a significance level of 5%.

On the other hand, during the years of economic trough, the industrial average debt ratios for the textile industry are significantly higher over Business Cycle 6 before 1987, i.e. 0.57948, than over Business Cycles 7 and 8 after 1987, i.e. 0.41317. During the years of economic peak, the industrial average debt ratios for the textile industry are significantly higher over Business Cycle 6 before 1987, i.e. 0.56916, than over Business Cycles 7 and 8 after 1987, i.e. 0.47288.

This does not occur, however, with the electronics industry. During the years of economic trough, the industrial average debt ratios for the electronics industry are not significantly different from each other over Business Cycle 6 before 1987, i.e. 0.51293, and over Business Cycles 7 to 8 after 1987, i.e. 0.43742. On the other hand, however, during the years of economic peak, the industrial average debt ratios for the electronics industry are not significantly different from each other over Business...
Cycle 6 before 1987, 0.49645, and over Business Cycles 7 and 8 after 1987, i.e. 0.48156.

It is interesting to know that, while controlling for the potential effect of macroeconomic conditions, the industrial average debt ratio seems to be higher before 1987 than after 1987 for firms in the textile and plastics industries. Further investigation on the potential impact of economic development on capital structure decisions is presented in Chapters 6 and 8.

### 3.3.3 Government Industrial Policy and Capital Structure

Usually, gross domestic product (GDP) varies over time in the course of a nation’s economic development. National GDP is derived from the contribution of GDP from each industry in a nation. Of course, economic growth and industrial structure may vary over time due to changes in government industrial policy. Further, regardless of the efficacy of industrial policy, it may vary over time in the process of economic development of a nation with industrial and economic development taken into account. Consequently, the degree of the contribution to the national GDP from an industry varies upon the government industrial policy in the process of economic development. Evidence gathered by several studies (Chou and Wu, 1990a) shows that the contribution of each industry to national GDP varies across industries in the different stages of Taiwan’s economic development.

As discussed previously in Section 2.2.5, no attention has been given by prior studies to the effect of government industrial policy on capital structure. Appelbaum (1993) argues that firms can take advantage of government policy intervention because government policy intervention measures are not priced by the market. Firms can maximize the value of these measures through their capital structure decisions and extract this value to increase the value of their firms. Based on Appelbaum’s argument, the capital structure of firms in an industry that benefits from government industrial policy is different from that of firms in industries that do not receive support from government industrial policy. The difference in capital structure compounds the difference already existent due to industry characteristics.
As discussed in Section 3.3, Taiwan has enjoyed its successful economic transition by implementing an industrial development policy as part of its economic development planning. The Taiwanese government implemented various industrial policy initiatives in order to promote industrial development for the purpose of economic growth and development and, consequently, certain industries received financial support. Regardless of the debate by economists over the efficacy of government industrial policy, the thesis examines the effect of government industrial policy on capital structure. A preliminary analysis of the sample used in the thesis research is given to illustrate the potential impact of government industrial policy on capital structure of firms in Taiwan. Using the SAS GLM procedure with the Scheffe’s test and controlling for the potential effects of macroeconomic conditions and economic development, Table 3.4 shows the comparison in industrial average debt ratios of firms in the textile, plastics and electronics industries across the period before and after 1987 in the course of Taiwan’s economic development.

### Table 3.4
Difference in the Debt Ratios across Industries of Taiwan

<table>
<thead>
<tr>
<th>Macroeconomic Conditions</th>
<th>Business Cycle 6 Before 1987</th>
<th>Business Cycles 7 and 8 After 1987</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Debt Ratio Comparisons Across Industries</td>
<td>Scheffe’s Test</td>
</tr>
<tr>
<td>Economic Trough</td>
<td>14&gt;13</td>
<td>NO</td>
</tr>
<tr>
<td></td>
<td>14&gt;23</td>
<td>NO</td>
</tr>
<tr>
<td></td>
<td>13&gt;23</td>
<td>NO</td>
</tr>
<tr>
<td></td>
<td>(48)</td>
<td></td>
</tr>
<tr>
<td>Economic Peak</td>
<td>14&gt;13</td>
<td>NO</td>
</tr>
<tr>
<td></td>
<td>14&gt;23</td>
<td>NO</td>
</tr>
<tr>
<td></td>
<td>13&gt;23</td>
<td>NO</td>
</tr>
<tr>
<td></td>
<td>(31)</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Sample size is shown in parenthesis.
2. 13: Plastics industry; 14: Textile industry; 23: Electronics industry.
3. YES and NO indicate whether comparisons are significant or not significant at a significance level of 5%.
As shown in the Business Cycle 6 Before 1987 column in Table 3.4, while controlling for the potential effects of macroeconomic conditions and economic development, the industrial average debt ratios are not significantly different within the textile, plastics and electronics industries before 1987 over Business Cycle 6 in Taiwan. According to the Scheffe’s test of SAS GLM procedure shown in the Scheffe’s Test column in Table 3.4, during the years of economic trough over Business Cycle 6 before 1987, the average debt ratio of the textile (14) industry is not significantly higher than those of the plastics (13) and electronics (23) industries. In addition, the average debt ratio of the plastics (13) industry is not significantly higher than that of the electronics (23) industry. The same results are found in the textile, plastics and electronics industries during the years of economic peak over Business Cycle 6 before 1987.

On the other hand, as shown in the Business Cycle 7 and 8 After 1987 column in Table 3.4, the average debt ratios of the textile (14) and electronics (23) industries are significantly higher than that of the plastics (13) industry during the years of economic trough over Business Cycles 7 and 8 after 1987. In addition, the average debt ratio of the electronics (23) industry is not significantly higher than that of the textile (14) industry. The same results are found for these three industries during the years of economic peak over Business Cycles 7 and 8 after 1987.

This preliminary analysis of the comparison in the industrial average debt ratios in the textile, plastics and electronics industries reflects the potential effect of government industrial policy on capital structure decisions. It is worth noting, however, that the difference in these industries results from the combined effect of industry types and government industrial policy. Further evidence on the potential impact of government industrial policy is presented in Chapters 7 and 8.

3.4 Firm Characteristics across Industries

As suggested by prior studies, firm-specific factors such as firm size, growth opportunities, profitability, non-debt tax shields and asset tangibility are the common determinants of corporate capital structure (Harris and Raviv, 1991, Huang and Song, 2006). A preliminary analysis of the sample used in the thesis research is conducted to investigate the difference of firm-specific factors in the textile, plastics and electronics industries.
industries in Taiwan. Using the SAS GLM procedure with the Scheffe’s test and controlling for the potential effects of macroeconomic conditions and economic development, Table 3.5 shows the comparison in firm-specific factors including firm size, growth opportunities, profitability, non-debt tax shields and asset tangibility in the textile, plastics and electronics industries across the period before and after 1987.

Looking at the intersection of the Economic Trough row and the Business Cycle 6 Before 1987 column and referring to the first and fourth firm-specific variables, i.e. Firm Size and Non-Debt Tax Shields, as shown in Table 3.5, firm size and non-debt tax shields are significantly larger in the plastics (13) industry than in the electronics (23) industry during the years of economic trough over Business Cycle 6 before 1987. In addition, firm size and non-debt tax shields are not significantly different between the plastics (13) industry and the textile (14) industry and between the textile (14) industry and the electronics (23) industry during the years of economic trough over Business Cycle 6 before 1987. Similarly, referring to the second firm-specific variable, Growth Opportunities, during the years of economic trough over Business Cycle 6 before 1987, growth opportunities are not significantly different in the textile, plastics and electronics industries. During the years of economic trough at the same period, the third firm-specific variable, Profitability, is higher in the electronics (23) industry than in the textile (14) industry but there is no significant difference in profitability between the plastics (13) and electronics (23) industries and between the textile (14) and plastics (13) industries. Finally, during the years of economic trough at the same period, the fifth firm-specific variable, Asset Tangibility, is significantly higher in the textile (14) industry than in the electronics (23) industry but there is no significant difference in asset tangibility between the plastics (13) and electronics (23) industries or between the textile (14) and plastics (13) industries as well.

Further, looking at the intersection of the Economic Peak row and the Business Cycle 6 Before 1987, there are significant differences in the firm-specific variables such as Firm Size, Growth Opportunities and Asset Tangibility during the years of economic peak over Business Cycle 6 before 1987. During the years of economic peak over Business Cycle 6 before 1987, however, there is no significant difference in some firm-specific variables such as profitability and non-debt tax shields.
Table 3.5
Comparison of Firm-Specific Variables across the Textile, Plastics and Electronics Industries in Taiwan

<table>
<thead>
<tr>
<th>Macroeconomic Conditions</th>
<th>Firm-Specific Variables</th>
<th>Business Cycle 6 Before 1987</th>
<th>Business Cycles 7 and 8 After 1987</th>
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<td>Firm Size</td>
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<td>Growth Opportunities</td>
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*Notes: 1. 13: Plastics industry; 14: Textile industry; 23: Electronics industry. 2. ** indicates significance at a level of 5% according to the Scheffe’s test. 3. Sample size: (a) 48 for the years of economic trough over Business Cycle 6 before 1987 (b) 31 for the years of economic peak over Business Cycle 6 before 1987 (c) 287 for the years of economic trough over Business Cycles 7 and 8 after 1987 (d) 259 for the years of economic peak over Business Cycles 7 and 8 after 1987.
On the other hand, looking at the intersection of the Economic Trough row and the Business Cycle 7 and 8 After 1987 column, there is no significant difference in the firm-specific variable, Firm Size, in the textile, plastics and electronics industries during the years of economic trough over Business Cycles 7 and 8 after 1987. During the same period, however, there are significant differences in the other firm-specific variables. Further, during the years of economic peak over Business Cycles 7 and 8 after 1987, there are significant differences in all firm-specific variables.

The findings above suggest that firm-specific factors and industry types should be taken into account as control variables in the thesis research.

3.5 Conclusion

With a successful economic transition from being a less-developed country to becoming a newly industrialized country within just a few decades, Taiwan is an excellent example of well-planned economic development. The Taiwanese government implemented diverse industrial development policy initiatives from the 1950s in order to pursue its objective of economic growth and development. For example, the textile, plastics and electronics industries benefited from government industrial policy support measures during the 1960s, the 1970s to the mid-1980s, and the mid-1980s to the mid-1990s. These industries played an important role in the course of Taiwan’s economic development.

Preliminary analyses of the sample used in the thesis research are made to investigate the potential effect of macro-level factors including macroeconomic conditions, economic development and government industrial policy. The findings from these preliminary analyses suggest that these macro-level variables are potential determinants of capital structure decisions in Taiwan. In addition, the findings from the preliminary analyses also suggest that firm-specific variables and industry types should be included as control variables in the thesis research.

In brief, the description of Taiwan’s background and the preliminary analyses of the sample used in the thesis point to the fact that Taiwan is an ideal context for the study of the impact of macroeconomic conditions, economic development and government
industrial policy on capital structure. Looking into the future in response to climate change, the Taiwanese government may impose environmental policy initiatives on firms and industries that might affect the capital structure of firms as they seek to maximize the value of their firms.
Chapter 4

A Modified Partial Adjustment Model for Capital Structure

4.1 Introduction

This chapter introduces the rationale for the application of the partial (or stock) adjustment model and the adjustment behavior in the partial adjustment model to analyze the adjustment behavior of capital structure and, in particular, to examine the significance of the test variables - macroeconomic conditions, economic development and government industrial policy - in the determination of capital structure. In addition, the operational definitions for the dependent variable of capital structure decisions and the control variables for firm characteristics and industry types in Chapters 5 to 8 of the thesis are also discussed.

A number of studies such as Fama and French (2002) and Flannery and Rangan (2006), apply the partial adjustment model to test the efficiency of the theories of capital structure by estimating the speed or rate of adjustment towards the target capital structure. Unfortunately, they do not reach a consistent conclusion on the superiority of the theories of capital structure due to discrepancies in the estimated adjustment speed. This is likely because there is no universal theory of capital structure and even no reason to expect one as Myers (2001) argues. However, their findings show support for the application of the partial adjustment model to the study of capital structure.

Moreover, a number of studies (Myers and Majluf, 1984, Narayanan, 1988) suggest that firms better reserve their borrowing capacity in order to maintain financial flexibility for future financial needs and avoid passing up investment and growth opportunities. In addition, a number of surveys (Pinegar and Wilbricht, 1989, Graham and Harvey, 2001, Allen, 1991) point out the importance of spare debt capacity or financial flexibility in capital structure decisions of listed firms in the U.S.A. and
Australia. The findings in these studies and surveys suggest that firms may deviate away from the optimal or target capital structure at which the firm value is maximized. Also, as argued by Barclay and Smith (2005), the unexpected increase or decrease in profitability and future investment opportunities can cause a deviation from the target capital structure. Therefore, firms may reserve spare debt capacity in order to maintain financial flexibility for future investment and growth opportunities and deviate away from their optimal or target capital structure in the short run.

Further, the partial adjustment model, a dynamic econometric model that allows the actual level to deviate away from the equilibrium in the short run, matches well with the adjustment behavior of capital structure decisions. The thesis, following the related studies on the adjustment of capital structure, utilizes the partial adjustment model. However, there are two improvements in the application of the partial adjustment model in the thesis research compared to previous studies. First, in the application of the partial adjustment model, the thesis includes the macro-level factors, namely macroeconomic conditions, economic development and government industrial policy, in the determination of the target capital structure. Second, in the application of the partial adjustment model, firms adjust their capital structure to rebalance to the target capital structure differently according to the gap between the target capital structure and the previous actual capital structure. Previous related studies in the application of the partial adjustment model do not include these two considerations and may bias the estimated adjustment speed. To the best of my knowledge, no other studies include these two considerations in the application of the partial adjustment model to investigate the impact of the macro-level factors on capital structure.

4.2 Rationale for the Use of the Modified Partial Adjustment Model

The modified partial adjustment model (MPAM) allows the thesis to test the impact of macroeconomic conditions, economic development and government industrial policy on capital structure in a more robust and unbiased manner. Unlike the previous applications of the PAM, the MPAM allows the adjustment gap to be either positive or negative, and the adjustment rate to be positive and even greater than 1. In so doing, the MPAM avoids the omitted variable problem.
The basis for the capital structure adjustment model utilized in the thesis is discussed in this section as follows: first, the work related to the adjustment of capital structure decisions is reviewed and discussed; second, the role of the spare debt capacity in the determination of capital structure and the matching of spare debt capacity with the partial adjustment model for the research on capital structure adjustment are discussed; third, the literature related to the target or optimal capital structure is reviewed; and, finally, both the generally accepted determinants of the optimal or target capital structure and the test variables, namely macroeconomic conditions, economic development and government industrial policy, used in the thesis research are discussed.

4.2.1 Capital Structure Adjustment

After the classical work of the modern theory of capital structure by Modigliani and Miller in 1958, many studies have aspired to explore the determination or determinants of optimal capital structure. Most prior studies implicitly assume that there is no discrepancy between the optimal or target capital structure and the capital structure chosen by firms in order to maximize the value of a firm. Some common determinants of the optimal capital structure decisions have been identified at firm and industry levels by these prior studies despite a discrepancy in the conclusions about some of these common determinants, as discussed in Chapter 2. Further, compared to the determinants of capital structure decisions at the firm and industry level, factors at the macroeconomic and governmental levels have been neglected by most prior studies. Moreover, the recent essential issue on capital structure decisions is whether firms adjust towards the target capital structure when dealing with competing capital structure theories such as the trade-off, market timing and pecking order theories.

According to the trade-off model theory of capital structure, firms have the optimal or target level of leverage ratio and they are regarded as moving towards their target leverage level. The main benefit of debt financing is the tax advantage of interest deductibility in the real business world. Firms determine their optimal or target capital structure by trading off the benefits against the costs of debt financing. In an economic way of thinking, the optimal level of capital structure is determined when
the marginal benefits of debt financing is equal to the marginal costs of debt financing and, in turn, the optimal adjustment of capital structure is determined and made over time.

In contrast, the market timing theory of capital structure argues that firms raise equity capital at times of high share prices but raise debt capital when share prices are low (Baker and Wurgler, 2002). The practice of market timing that benefits ongoing shareholders at the expense of entering or exiting shareholders can work only in inefficient capital markets. Consequently, in inefficient capital markets, managers tend to time the market if they think they can increase the value of ongoing shareholders. Graham and Harvey (2001) find in their survey on capital structure decisions that two-thirds of chief financial officers (CFOs) agree that whether their share is undervalued or overvalued is an important or very important consideration in their equity financing. This finding supports the argument of the market timing theory.

The pecking order theory of capital structure also argues that firms do not have a target capital structure. Due to the problem of information asymmetry between better-informed managers and less-informed outside investors, firms finance according to a pecking order: first with retained earnings, next with debt financing and, finally, with equity financing as a last resort (Myers and Majluf, 1984). This implies that managers do not intend to maintain a specific level of capital structure.

A number of recent studies (Fama and French, 2002, Flannery and Rangan, 2006) address the issue of whether or not firms adjust towards the target capital structure to evaluate the credibility of these competing capital structure theories. In the application of the partial adjustment model, these studies estimate the rate or speed of adjustment in the capital structure adjustment of firms. A fast rate of adjustment indicates a support for the trade-off theory but a slow rate of adjustment shows support for no target capital structure as the market timing and pecking order theories argue. Unfortunately, these recent studies have no consistent finding on the speed or rate of adjustment towards the target capital structure.

As Myers (2001) states, there is no universal or perfect theory of capital structure and nor there is any reason to expect one. Following these recent studies on capital
structure adjustment, the thesis utilizes the partial adjustment model to investigate the effect of macroeconomic conditions, economic development and government industrial policy on capital structure instead of testing the superiority or efficiency of the theories that explain capital structure of firms. In addition, the thesis research provides a better understanding of the adjustment behavior of capital structure decisions with these test variables taken into account. However, problems with the determination of the target capital structure and the estimation of the adjustment rate are found in these prior studies that include only the factors at firm and industry levels to determine the target capital structure. The studies fail to include macroeconomic and governmental factors. In addition, these prior studies implicitly assume that firms adjust at a uniform rate of adjustment rate over time. Based on the partial adjustment model, firms adjust differently according to whether a negative or a positive gap exists between the target capital structure and the previous level of capital structure. Not taking into account a negative or a positive gap may bias the estimated rate of adjustment in the application of the partial adjustment model.

4.2.2 Spare Debt Capacity

Myers and Majluf (1984) contend that shareholders can be better off when the firm reserves financial slack for future investment opportunities. Narayanan (1988) claims that it is better for firms to build up financial reserves for future investment opportunities. Brigham and Ehrhardt (2005) also suggest that financial flexibility is one of the factors on the checklist of capital structure choices. In order to respond to future growth opportunities, firms may deviate away from their target capital structure in order to reserve spare debt capacity or financial slack. The reserved spare debt capacity therefore allows firms to maintain financial flexibility; however, this will be at the expense of deviating away from their target leverage that is determined without considering financial flexibility. By maintaining financial flexibility, firms have to forego certain benefits associated with the optimal level of debt in exchange for the benefits arising from reserving borrowing capacity to respond to future financial needs. Firms, therefore, trade off the costs of deviating away from the target capital structure against the benefits of the spare debt capacity reserved for future investment and growth opportunities and eventually determine the optimal level of spare debt capacity. In short, in order to reserve spare debt capacity to maintain financial
flexibility for future investment and growth opportunities, firms adjust their capital structure and intentionally deviate away from their target capital structure. The greater the growth or investment opportunities that are expected, the more the spare debt capacity needs to be reserved to maintain financial flexibility for future investment and growth opportunities.

A few survey studies also have pointed out the importance of financial flexibility in determining capital structure. In a survey on the Fortune 500 Industrial companies, Pinegar and Wilbricht (1989) find that over 94% of the respondents indicate that it is important for firms to maintain financial flexibility in order to avoid passing up investment opportunities. Also, in an Australian survey, Allen (1991) undertakes a series of field interviews with the company secretaries and senior financial personnel of 48 Australian listed companies. His respondents also contend that firms would reserve their borrowing capacity and maintain financial flexibility to avoid foregoing valuable investment opportunities. In addition, the results of Graham and Harvey (2001) in an American survey show that financial flexibility is one of the important factors of capital structure considered by the management of firms. Moreover, as argued by Barclay and Smith (2005), an unexpected increase or decrease in profitability as well as attempts to exploit financing “windows of opportunity” can cause the deviation away from target leverage ratios even if managers do set their target level.

In brief, firms adjust their capital structure and may reserve spare debt capacity in order to maintain financial flexibility for unexpected financial needs and future investment and growth opportunities. By trading off the benefits against the costs of the deviation away from the target capital structure, firms determine their optimal adjustment of capital structure while considering spare debt capacity reserved for future investment and growth opportunities. Therefore, in the short run, firms adjust their capital structure and may intentionally deviate away from their optimal or target capital structure with spare debt capacity reserved for future investment opportunities. The greater the spare debt capacity reserved for future investment and growth opportunities and unexpected financial needs, the greater is the deviation away from the target capital structure.
Based on the discussion on the adjustment behavior of capital structure decisions, firms adjust their capital structure based on the trade-off between the benefits and the costs of the deviation away from the target capital structure. The optimal level of capital structure adjustment is determined to be when the marginal benefit of the spare debt capacity reserved to maintain flexibility for future investment and growth opportunities is equal to the marginal costs of the deviation away from the target capital structure. If the optimal level of capital structure adjustment is equal to the adjustment gap - the gap between the target capital structure at the end of the current year and the previous actual capital structure at the end of the previous year - firms would make a complete adjustment and, thus, the actual or observed capital structure is exactly equal to the target capital structure at the end of the current year. Otherwise, firms adjust their capital structure and deviate away from the target level with spare debt capacity reserved for future investment and growth opportunities or other consideration taken into account.

An econometric dynamic model that is called the partial adjustment model allows the actual level to deviate away from the equilibrium level and matches well with the adjustment behavior of capital structure addressed in the thesis research. Therefore, the partial adjustment model is utilized to investigate the impact of the test variables on capital structure and to provide evidence on the adjustment behavior of capital structure within the context of Taiwan.

The application of the partial adjustment model to the thesis research has two distinct advantages: first, the application of the partial adjustment model allows the thesis research to investigate the impact of test variables, namely macroeconomic conditions, economic development and government industrial policy, on capital structure in the modified partial adjustment model; and, second, the application of the partial adjustment model allows the research to provide new evidence on the adjustment behavior of corporate capital structure within the context of Taiwan. In the application of the partial adjustment model, however, the thesis research focuses on testing the impact of the test variables on capital structure rather than on testing which theory of capital structure could better explain the determination of capital structure.
4.2.3 Optimal or Target Capital Structure

Following the work of Modigliani and Miller (1958), much attention has been given to the determinants or determination of capital structure by both empirical and theoretical studies (Harris and Raviv, 1991, Myers, 2003). Most of these prior studies examine the determinants or determination of capital structure choices at firm and industry levels. The major common factors at firm level suggested by most prior empirical studies include firm size, growth opportunity, profitability, non-debt tax shields and asset tangibility (Harris and Raviv, 1991, Huang and Song, 2006). In addition to the factors at firm level, the characteristics of the industry in which firms operate their business affect capital structure as suggested by previous studies (Harris and Raviv, 1991). In the application of the partial adjustment model, the thesis includes the test variable(s) and the factors at the firm and industry level to estimate the target capital structure in order to avoid model misspecification.

4.3 The Partial (Stock) Adjustment Model

In the partial adjustment model, the quantity of an item that is to be owned in each period, for example the level of inventory and capital structure, depends on the amount of the item that is held at the end of the previous period and the desired or targeted amount held at the end of the current period. The gap between the target amount and the amount held at the end of the previous period is called the adjustment gap. The adjustment gap can be positive or negative depending on the difference between the target level and the actual level held at the end of the previous period. When the target level is higher than the actual level held at the end of the previous period, the adjustment gap is positive; when, however, the target level is lower than the level held at the end of the previous period, the adjustment gap is negative.

When firms adjust their capital structure, an incomplete adjustment leads to the deviation from the target capital structure. The incomplete adjustment is a proportion of the gap between the target capital structure of the current period and the actual capital structure of the previous period, i.e. the adjustment gap. The more that future investment and growth opportunities are available to firms, the greater is the spare debt capacity reserved to maintain financial flexibility for these opportunities. A
partial adjustment model implicitly assumes that the target capital structure is not equal to the previous actual capital structure and firms can make an incomplete or partial adjustment of capital structure to deviate away from the target capital structure. In addition, a partial adjustment model matches well with the spare debt capacity reserved for future investment and growth opportunities to reflect the deviation from the target capital structure. Therefore, the partial adjustment model is applied in the empirical studies of the thesis to explore the adjustment behavior of capital structure of firms.

In the application of the partial adjustment model to analyze the adjustment behavior of capital structure decisions of firms in the empirical studies of the thesis, the partial adjustment model for capital structure adjustment is expressed as follows:

\[
ADJ_t = \gamma (TCS_t - ACS_{t-1})
\]  \hspace{1cm} (4-1)

Where:
- \(ADJ_t\) = the capital structure adjustment at the end of period \(t\),
- \(TCS_t\) = the target capital structure at the end of period \(t\),
- \(ACS_{t-1}\) = the capital structure at the end of period \(t-1\),
- \(\gamma\) = the rate of adjustment towards the target capital structure that is determined by the trade-off between the benefits of the spare debt capacity reserved for future investment and growth opportunities and the costs of the deviation from the target capital structure.

As shown in Equation 4-1, i.e. the standard form of a partial adjustment model, capital structure adjustment depends upon the adjustment rate (\(\gamma\)) and the adjustment gap between the target capital structure and the previous actual capital structure, i.e. \((TCS_t - ACS_{t-1})\). In most of the applications of the partial adjustment model, the adjustment rate is restricted to be positive but less than one (i.e. \(0 < \gamma < 1\)). However, the adjustment rate is allowed to be equal to one and even greater than one (i.e. \(0 < \gamma\)) in the modified partial adjustment model for capital structure adjustment in the thesis. In other words, the capital structure adjustment model of the thesis allows firms to adjust their capital structure to be underleveraged, leveraged on target or overleveraged depending on the adjustment costs, i.e. the trade-off between the benefits of the spare debt capacity
reserved for future investment and growth opportunities and the costs of the deviation from the target capital structure.

Further, the adjustment gap can be positive or negative, depending on the levels of the target or optimal capital structure and the previous actual capital structure. If the level of the target capital structure is greater than that of the previous actual capital structure, the gap between the target capital structure and the previous actual capital structure is a positive adjustment gap. On the contrary, if the level of the target capital structure is less than that of the previous actual capital structure, then the gap between them is a negative adjustment gap. As discussed earlier in this chapter, firms trade off the benefits of the spare debt capacity reserved for future investment and growth opportunities and determine the optimal capital structure adjustment. The greater the spare debt capacity reserved for future investment and growth opportunities, the greater is the deviation from the target capital structure.

If there are no future investment and growth opportunities available to the firm, then the firm does not need to reserve spare debt capacity and adjust the actual capital structure exactly to the target or optimal level. Consequently, the adjustment rate or adjustment speed ($\gamma$) is equal to 1 and the capital structure adjustment is equal to the adjustment gap. There is no gap between the actual capital structure and the target capital structure and, therefore, the actual capital structure is exactly equal to the target capital structure. However, if firms need to reserve spare debt capacity for future investment and growth opportunities, the rate of adjustment towards the target capital structure is not equal to one and thus the adjustment is an incomplete or partial adjustment. This leads to the deviation away from the target capital structure. Further discussion now follows on capital structure adjustment in the case of positive and negative adjustment gaps and the relationship between capital structure adjustment and the adjustment gap is presented.

4.4 Capital Structure Adjustment in the Partial Adjustment Model

As shown in Equation 4-1 of the model for capital structure adjustment, capital structure adjustment (i.e. the change in capital structure) depends upon the adjustment
rate and the adjustment gap between the target capital structure and the previous actual capital structure. Should an adjustment gap exist between the target capital structure and the previous actual capital structure, firms trade off the benefits against the costs of the deviation from the target capital structure and then determine their capital structure adjustment. Further discussion follows on the application of the partial adjustment model to analyze the adjustment behavior of capital structure decisions, the capital structure adjustment in the case of positive and negative gaps between the target capital structure and the previous actual capital structure.

4.4.1 Positive Adjustment Gap and Capital Structure Adjustment

In the case of a positive adjustment gap, the level of the target capital structure is greater than that of the previous actual capital structure, i.e. $TCS_t > ACS_{t-1}$. As discussed earlier in the chapter, firms adjust their capital structure by trading off the benefits of the spare debt capacity reserved for future investment and growth opportunities against the costs of the deviation from the target capital structure. The greater the amount of investment and growth opportunities available to a firm, the greater should be the spare debt capacity reserved for these opportunities. Thus, the firm would adjust at a rate smaller than 1 towards the target capital structure in order to reserve spare debt capacity for future investment and growth opportunities. This leads to the deviation from the target capital structure. By trading off the benefits of the spare debt capacity reserved for future investment and growth opportunities against the costs of the deviation from the target capital structure, firms determine their optimal capital structure adjustment.

If the rate at which a firm adjusts its capital structure is less than 1 - thus allowing the firm to reserve the spare debt capacity in order to avoid passing up future investment and growth opportunities - then the adjustment that the firm makes is smaller than the adjustment gap between the target capital structure and the previous actual capital structure. Consequently, the actual capital structure of the firm is below the level of the target capital structure and the firm becomes underleveraged in terms of the target level. The relationship of the target capital structure ($TCS_t$), the actual capital structure of current period ($ACS_t$) and the previous actual capital structure ($ACS_{t-1}$) is now explained further.
Based on Equation 4-1, capital structure adjustment (ADJ_t), i.e. ACS_t − ACS_{t-1}, is equal to a proportion of the adjustment gap between the target capital structure and the previous actual capital structure, i.e. γ(TCS_t − ACS_{t-1}). Therefore, Equation 4-1 can be rewritten as follows:

$$ACS_t − ACS_{t-1} = γ(TCS_t − ACS_{t-1})$$ (4-1A)

The item of TCS_t is added and subtracted as well in the right side of Equation 4-1A and does not affect the equality of the two sides in the equation. In addition, the item of ACS_{t-1} in the left side of Equation 4-1A is moved to the right side of the equation. Then the equation for the actual capital structure is obtained and expressed as follows:

$$ACS_t = γ(TCS_t − ACS_{t-1}) + TCS_t − TCS_t + ACS_{t-1}$$ (4-1B)

Rearranging the right side of Equation 4-1B, the equation can be rewritten as follows:

$$ACS_t = TCS_t + (γ − 1)(TCS_t − ACS_{t-1})$$ (4-1C)

Because γ is positive but less than 1 and the adjustment gap is positive, the item of (γ − 1)(TCS_t − ACS_{t-1}) in Equation 4-1C is negative. In addition, the target capital structure in terms of debt ratio is not less than 0. Therefore, it can be concluded that the actual capital structure at the end of the current period (ACS_t) is less than the target capital structure at the end of the current period (TCS_t). In other words, the firm is underleveraged in terms of the target level.

Further, the capital structure adjustment is less than the positive adjustment gap. This indicates that the gap between the target capital structure and the actual capital structure is smaller than the gap between the target capital structure and the previous actual capital structure, i.e. (TCS_t − ACS_{t-1}). Therefore, the actual capital structure at the end of the current period (ACS_t) is higher than the previous actual capital structure (ACS_{t-1}). Therefore, the relationship of the target capital structure (TCS_t), the actual capital structure at the end of the current period (ACS_t) and the previous actual capital
structure (ACS_{t-1}) is expressed as ACS_{t-1} < ACS_t < TCS_t when the adjustment rate is smaller than 1 in the case of a positive adjustment gap.

If no future investment and growth opportunities are available to the firm, it would reserve no spare debt capacity and make a complete or full adjustment to the level of the target capital structure. The adjustment that the firm makes is exactly the same as the adjustment gap between the target capital structure and the previous actual capital structure. The rate of adjustment towards the target capital structure is equal to 1. The actual capital structure of the firm (ACS_t) is equal to the target capital structure (TCS_t). Thus, the firm is leveraged on target. Further, because \( \gamma \) is equal to 1, the item of \((\gamma - 1)(TCS_t - ACS_{t-1})\) in Equation 4-1C is equal to 0. Therefore, it can be concluded that the actual capital structure at the end of the current period (ACS_t) is equal to the target capital structure (TCS_t). In addition, the actual capital structure at the end of the current period is higher than the previous actual capital structure because the actual capital structure at the end of the current period is equal to the target capital structure and the target capital structure is greater than the previous actual capital structure. Therefore, the relationship of the target capital structure (TCS_t), the actual capital structure at the end of the current period (ACS_t) and the previous actual capital structure (ACS_{t-1}) is expressed as ACS_{t-1} < ACS_t = TCS_t when the adjustment rate is equal to 1 in the case of a positive adjustment gap.

If the firm adjusts its capital structure at a rate greater than 1, the capital structure adjustment is greater than the positive adjustment gap between the target capital structure and the previous actual capital structure. The actual capital structure is greater than the target capital structure and, thus, the firm becomes overleveraged in terms of the target level. Further, because \( \gamma \) is greater than 1 and the adjustment gap is positive, the item of \((\gamma - 1)(TCS_t - ACS_{t-1})\) is positive in the Equation 4-1C. Therefore, it can be concluded that the actual capital structure at the end of the current period (ACS_t) is greater than the target capital structure (TCS_t). In addition, because firms make an over-adjustment in the case of a positive adjustment gap, the actual capital structure at the end of the current period is higher than the previous actual capital structure. The relationship of the target capital structure, the actual capital structure at the end of the current period and the previous actual capital structure is expressed as
ACS_{t-1} < TCS_t < ACS_t when the adjustment rate is greater than 1 in the case of a positive adjustment gap.

In brief, in the case of a positive adjustment gap between the target capital structure and the previous actual capital structure, the capital structure adjustment is positively related to the adjustment rate. The theoretical relationship of the target capital structure at the end of the current period, the actual capital structure at the end of the current period and the previous actual capital structure in the case of a positive adjustment gap is summarized in Table 4.1.

<table>
<thead>
<tr>
<th>Adjustment Speed</th>
<th>Positive Adjustment Gap (TCS_t &gt; ACS_{t-1})</th>
<th>Relationship among ACS_{t-1}, TCS_t and ACS_t</th>
<th>ADJ_t</th>
<th>Status of leverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>γ&gt;1</td>
<td>ACS_{t-1} &lt; TCS_t &lt; ACS_t</td>
<td>Positive</td>
<td>Overleveraged</td>
<td></td>
</tr>
<tr>
<td>γ=1</td>
<td>ACS_{t-1} &lt; ACS_t = TCS_t</td>
<td>Positive</td>
<td>On target</td>
<td></td>
</tr>
<tr>
<td>0&lt;γ&lt;1</td>
<td>ACS_{t-1} &lt; ACS_t &lt; TCS_t</td>
<td>Positive</td>
<td>Underleveraged</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. TCSt: the target capital structure at the end of the period t.
2. ACSt: the actual capital structure at the end of the period t.
3. ACSt-1: the actual capital structure at the end of the period t-1.
4. ADJ_t: the actual adjustment of capital structure at the period t.

4.4.2 Negative Adjustment Gap and Capital Structure Adjustment

In the case of a negative adjustment gap, the level of the previous actual capital structure is greater than that of the target capital structure (i.e. TCS_t < ACS_{t-1}). In such circumstances, firms try to gear down their leverage in order to mitigate the overleveraged problem and avoid going bankrupt. Firms trade off the benefits of the
decrease in leverage for the lower bankruptcy risk against the costs of being still overleveraged in terms of the target capital structure and determine the optimal capital structure adjustment. The greater the decrease in leverage, the lower the bankruptcy risk. In addition, the greater the decrease in leverage, the greater is the spare debt capacity reserved for future investment and growth opportunities.

If the adjustment rate of capital structure is less than 1, the decrease in debt leverage is less than the negative adjustment gap. The actual capital structure is greater than the target capital structure. Based on Equation 4-1C, because the adjustment gap is negative and \( \gamma \) is less than 1, the item of \((\gamma - 1)(TCS_t - ACS_{t-1})\) is positive. Therefore, it can be concluded that the actual capital structure at the end of the current period is greater than the target capital structure. The firm is still overleveraged in terms of the target level. Further, because the decrease in leverage that the firm gears down is smaller than the size of the negative adjustment gap, the actual capital structure is less than the previous actual capital structure but higher than the target capital structure. Therefore, the relationship of target capital structure at the end of the current period (TCS\(_t\)), the actual capital structure at the end of the current period (ACS\(_t\)) and the previous actual capital structure (ACS\(_{t-1}\)) is expressed as TCS\(_t\) < ACS\(_t\) < ACS\(_{t-1}\) when the adjustment rate is smaller than 1 in the case of a negative adjustment gap.

If the adjustment rate of capital structure is equal to 1, the decrease in leverage is exactly equal to the negative adjustment gap. The actual capital structure is exactly the same as the target capital structure. Thus, the firm is leveraged on target. Based on Equation 4-1C, because \( \gamma \) is equal to 1, the item of \((\gamma - 1)(TCS_t - ACS_{t-1})\) is equal to 0. Therefore, it can be concluded that the actual capital structure at the end of the current period is equal to the target capital structure. Further, because the decrease in leverage that the firm gears down is equal to the negative adjustment gap, the actual capital structure is equal to the target capital structure but less than the previous actual capital structure. Therefore, the relationship of the target capital structure at the end of the current period (TCS\(_t\)), the actual capital structure at the end of the current period (ACS\(_t\)) and the previous actual capital structure (ACS\(_{t-1}\)) is expressed as ACS\(_t\) = TCS\(_t\) < ACS\(_{t-1}\) when the adjustment rate is equal to 1 in the case of a negative adjustment gap.
Finally, if the adjustment rate of capital structure is greater than 1, the decrease in leverage is greater than the size of the negative adjustment gap. Thus, the firm is underleveraged in terms of the target level. Based on Equation 4-1C, the item of \((\gamma - 1)(TCS_t - ACS_{t-1})\) is negative because \(\gamma\) is greater than 1 and the adjustment gap is negative. This shows that the decrease in leverage that the firm gears down is greater than the size of the negative adjustment gap. Therefore, it can be concluded that the actual capital structure at the end of the current period is less than the target capital structure. The firm is underleveraged in terms of the target level. Therefore, the relationship of the target capital structure at the end of the current period (\(TCS_t\)), the actual capital structure at the end of the current period (\(ACS_t\)) and the previous actual capital structure (\(ACS_{t-1}\)) is expressed as \(ACS_t < TCS_t < ACS_{t-1}\) when the adjustment rate is greater than 1 in the case of a negative adjustment gap.

In brief, capital structure adjustment is negatively related to the adjustment rate in the case of a negative adjustment gap between the target capital structure and the previous actual capital structure. The theoretical relationship of the target capital structure at the end of the current period, the actual capital structure at the end of the current period and the previous actual capital structure in the case of a negative adjustment gap is demonstrated in Table 4.2.

<table>
<thead>
<tr>
<th>Adjustment Speed</th>
<th>Relationship among (ACS_{t-1}), (TCS_t) and (ACS_t)</th>
<th>(\text{ADJ}_t)</th>
<th>Status of leverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\gamma &gt; 1)</td>
<td>(ACS_{t-1} &gt; TCS_t &gt; ACS_t)</td>
<td>Negative</td>
<td>Underleveraged</td>
</tr>
<tr>
<td>(\gamma = 1)</td>
<td>(ACS_{t-1} &gt; ACS_t = TCS_t)</td>
<td>Negative</td>
<td>On target</td>
</tr>
<tr>
<td>(0 &lt; \gamma &lt; 1)</td>
<td>(ACS_{t-1} &gt; ACS_t &gt; TCS_t)</td>
<td>Negative</td>
<td>Overleveraged</td>
</tr>
</tbody>
</table>

Notes:
1. \(TCS_t\): the target capital structure at the end of the period \(t\).
2. \(ACS_t\): the actual capital structure at the end of the period \(t\).
3. \(ACS_{t-1}\): the actual capital structure at the end of the period \(t-1\).
4. ADJ: the actual adjustment of capital structure at the period t.

4.4.3 Adjustment Rate and Capital Structure Adjustment

From the above analysis, the relationship between the adjustment rate and the capital structure adjustment in the case of positive and negative gaps between the target capital structure and the previous actual capital structure is as follows:

In the case of a positive adjustment gap between the target capital structure and the previous actual capital structure, the greater the amount of future investment and growth opportunities available to firms, the greater is the spare debt capacity reserved for future investment and growth opportunities. Thus, the smaller the rate of adjustment towards the target capital structure, the larger is the spare debt capacity reserved and the greater is the deviation from the target capital structure. In brief, capital structure adjustment is positively related to the adjustment rate but negatively related to the spare debt capacity that firms reserve for future investment and growth opportunities where a positive adjustment gap exists.

On the other hand, in the case of a negative adjustment gap between the target capital structure and the previous actual capital structure, firms try to gear down the leverage towards the target capital structure in order to mitigate their overleveraged problem. The greater the decrease in leverage in order to avoid going bankrupt, the greater is the rate of adjustment towards the target capital structure. In addition, the greater the spare debt capacity reserved for future investment and growth opportunities, the greater is the adjustment rate. Briefly speaking, capital structure adjustment is negatively related to the adjustment rate as well as to the spare debt capacity where a negative adjustment gap exists.

In brief, the relationship of the capital structure adjustment, the adjustment rate and the spare debt capacity in the partial adjustment model depends upon the positive and negative adjustment gaps between the target capital structure and the previous actual capital structure. The theoretical relationship of the capital structure adjustment, the adjustment rate and the spare debt capacity where positive and negative adjustment gaps exist between the target capital structure and the previous actual capital structure.
is summarized in Table 4.3.

<table>
<thead>
<tr>
<th>Adjustment Rate</th>
<th>Positive Adjustment Gap</th>
<th>Negative Adjustment Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADJ</td>
<td>SDC</td>
<td>ADJ</td>
</tr>
<tr>
<td>γ &gt; 1</td>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>γ = 1</td>
<td>Positive</td>
<td>Zero</td>
</tr>
<tr>
<td>0 &lt; γ &lt; 1</td>
<td>Positive</td>
<td>Positive</td>
</tr>
</tbody>
</table>

Notes:
1. ADJ: capital structure adjustment.
2. SDC: spare debt capacity.

Capital structure adjustment is positively related to the adjustment rate in the case of a positive adjustment gap but negatively related to the adjustment rate in the case of a negative adjustment gap between the target capital structure and the previous actual capital structure. In addition, capital structure adjustment is negatively related to the spare debt capacity reserved where positive and negative adjustment gaps exist. Therefore, the application of the partial adjustment model in examining the capital structure adjustment should take positive and negative adjustment gaps into account.

The modified partial adjustment model for capital structure adjustment model utilized in the empirical studies of the thesis is now discussed.

**4.5 A Modified Partial Adjustment Model for Capital Structure**

The partial adjustment model for capital structure decisions implicitly assumes that the target capital structure is not equal to the previous actual capital structure. Firms adjust their capital structure by trading off the benefits of the spare debt capacity reserved for future investment and growth opportunities against the costs of the deviation away from the target capital structure and determine the optimal capital structure adjustment to maximize the value of their firm and their shareholders’ wealth. Consequently, the greater the spare debt capacity reserved for future
investment and growth opportunities, the greater is the deviation from the target capital structure.

However, the target or optimal capital structure is unobservable. As suggested by prior studies of capital structure (Ferri and Jones, 1979, Flannery and Rangan, 2006, Harris and Raviv, 1991, Titman and Wessels, 1988, Chu et al., 1992), capital structure are influenced by firm and industry characteristics. Therefore, the target capital structure is assumed to be a linear function of the factors at firm and industry levels that are used as control variables as well as the test variable(s) examined in the empirical studies of the thesis. The linear equation for the target capital structure is written as follows:

\[
TCS_t = \sum_{j=1}^{c} \beta_{\beta_j} X_{\beta_j}^{FC} + \beta_{IND}^{IND} IND_t + \beta_{TV}^{TV} TV_t + \epsilon_t
\]

where:

- \(TCS_t\) = the target capital structure at the end of period t,
- \(\beta\) = the regression coefficient,
- \(X\): the variables at firm level,
- \(IND\): the dummy variables to indicate the industry types,
- \(TV\): the test variable,
- \(\epsilon_t\) = the error term.

Technically, Equation 4-2 is an expression for the long-run level of capital structure because it is expressed in terms of the optimal or target level of capital structure. By substituting \(TCS_t\) in Equation 4-2 into Equation 4-1 and rearranging, we obtain the equation for the capital structure adjustment as shown in Equation 4-3.

\[
ADJ_t = \gamma (\sum_{j=1}^{c} \beta_{\beta_j} X_{\beta_j}^{FC} + \beta_{IND}^{IND} IND_t + \beta_{TV}^{TV} TV_t - ACS_{t-1}) + \gamma \epsilon_t
\]

where:

- \(ADJ_t\) = the capital structure adjustment at the end of period t,
- \(\gamma\) = the adjustment rate that is determined by the spare debt capacity reserved for future investment and growth opportunities,
- \(\beta\) = the regression coefficient,
X: the variables at firm level,
IND: the dummy variable for industry types,
TV: the test variable,
ACS_{t-1} = the actual capital structure at the end of period t-1, and
\gamma_e = the error term.

Note that the error term, i.e. \gamma_e in Equation 4-3, is a multiple of the original error shown in Equation 4-2. Rearranging Equation 4-3, the capital structure adjustment model is expressed in the slightly different forms as shown in Equations 4-4 and 4-5.

\[ ADJ_i = \sum_{j=1}^{c} \beta_j X_{jt} + \gamma \beta_i^{IND} IND_i + \gamma \beta_i^{TV} TV_i - \gamma ACS_{t-1} + \gamma e_i \] (4-4)

\[ ADJ_i = \sum_{j=1}^{c} \delta_j X_{jt} + \delta_i^{IND} IND_i + \delta_i^{TV} TV_i - \gamma ACS_{t-1} + \gamma e_i \] (4-5)

As discussed earlier in this chapter, capital structure adjustment, including its size and direction, depends upon the adjustment rate as well as the adjustment gap between the target capital structure and the previous actual capital structure. The relationship between the capital structure adjustment and the adjustment rate varies according to whether a negative or a positive adjustment gap exists between the target capital structure and the previous actual capital structure. Therefore, the sample collected for the empirical studies of the thesis is split into two subsamples: positive adjustment gaps and negative adjustment gaps. This allows the investigation into the adjustment behavior of the capital structure of firms with the financial constraint of over-leverage or under-leverage in terms of the gap between the target capital structure and the previous actual capital structure.

Equations 4-4 and 4-5 are the generalized forms of the modified partial adjustment model that is utilized in the empirical studies presented in Chapters 5 to 8 of the thesis. Due to the application of the partial adjustment model to analyze the adjustment behavior of the capital structure decisions of firms, the thesis names the applied partial adjustment model as the capital structure adjustment model that is used as a tool to examine the significance of the test variables, namely macroeconomic
conditions, economic development and government industrial policy, in the

determination of the capital structure.

With respect to the partial regression coefficients as shown in Equations 4-4 and 4-5, the partial regression coefficient for the previous actual capital structure (ASC_{t-1}) is exactly equal to the adjustment rate (\gamma) of capital structure. The size of the adjustment rate reflects the tradeoff between the benefits and the costs of the deviation from the target capital structure in the determination of capital structure adjustment. On the other hand, the partial regression coefficients (\delta) of the control variables for firm characteristics (X) and industry type (IND), as well as the test variable (TV) in Equation 4-5, are the multiple (\gamma\beta) of the adjustment rate (\gamma) and the beta coefficient (\beta) of these variables in Equation 4-2 for the determination of the target capital structure. This indicates that the effect of these variables on the capital structure adjustment is only a proportion (\gamma) of their original effect on the target capital structure whenever firms adjust their capital structure and deviate away from the target.

In addition, since \text{ADJ}_t = \text{ACS}_t - \text{ACS}_{t-1}, by substituting the item of ACS_{t-1} for the capital structure adjustment (\text{ADJ}_t) in Equations 4-4 and 4-5 and rearranging, the equation of the capital structure adjustment model for the determination of actual capital structure is obtained and written as follows:

\[\text{ACS}_t = \sum_{j=1}^{c} \gamma\beta_j X_{jt}^E + \gamma\beta_{t}^{IND} IND_t + \gamma\beta_{t}^{TV} TV_t + (1 - \gamma)\text{ACS}_{t-1} + \gamma\varepsilon_t\]  

(4-4A)

\[\text{ACS}_t = \sum_{j=1}^{c} \delta_j X_{jt}^E + \delta_{t}^{IND} IND_t + \delta_{t}^{TV} TV_t + (1 - \gamma)\text{ACS}_{t-1} + \gamma\varepsilon_t\]  

(4-5A)

Equations 4-4A and 4-5A are the short-run equations for capital structure compared to the long-run equation, i.e. Equation 4-2. These equations reflect the fact that the partial adjustment model allows firms not only to adjust their capital structure with the spare debt capacity reserved for future investment and growth opportunities but also to deviate away from the target capital structure in the short run. If the adjustment rate is equal to 1, then Equations 4-4A and 4-5A are exactly the same as Equation 4-2. In other words, the actual capital structure is equal to the target capital structure.
Further, in order to avoid model misspecification, the variables at the firm and industry levels to represent firm characteristics and industry types are included as control variables in the empirical studies of the thesis. In addition, in order to avoid repetition in the empirical studies in Chapters 5 to 8, the factors at firm and industry levels used as control variables in the model and the research period and sample in the empirical studies of the thesis are discussed in this chapter.

4.6 Control Variables

As suggested by prior studies on capital structure, capital structure decisions are affected by firm characteristics and by industry types. In order to avoid model misspecification, the variables for firm characteristics and industry types are included in the partial adjustment model of capital structure that is utilized in the empirical studies of the thesis to examine the effect of the test variables, namely macroeconomic conditions, economic development and government industrial policy, on capital structure and to explore the adjustment behavior of capital structure decisions over time. The control variables at firm and industry levels included in the empirical studies of the thesis are now discussed further.

4.6.1 Control Variables for Firm-Specific Effects

Capital structure are influenced by firm characteristics such as firm size, growth opportunities, profitability, non-debt tax shields and asset tangibility, as suggested by prior studies (Harris and Raviv, 1991, Huang and Song, 2006). These firm-specific factors are included in the model and used as control variables in the thesis research. The thesis follows the measures of these firm-specific variables used by most prior studies. The firm-specific variables used as control variables in the thesis are now discussed separately.

4.6.1.1 Firm Size

According to the theory of portfolio investment, investment risk can be reduced
through diversification. Large firms have more capability to diversify their assets than small firms. This implies that, all other things being equal, large firms have a lower risk of bankruptcy than small firms. Warner (1977b) addresses the relationship between firm size and bankruptcy risk and found that the ratio of bankruptcy costs to market value of railroad firms appears to decline as firm size increases. In addition, Ang et al. (1982) find that administrative costs of corporate bankruptcy is negatively related to the liquidating values of firms. Castanias (1983b) also finds a negative relationship between total assets and failure rates. The findings of Ang et al. (1982) and Castanias (1983b) suggest that bankruptcy risk is negatively related to firm size. Further, several empirical studies such as Marsh (1982), Ranjan and Zingales (1995), Wald (1999) and Booth et al. (2001) find a positive relationship between capital structure and firm size. These prior studies suggest that large firms have a lower bankruptcy risk than small firms and, in addition, that capital structure is positively related to firm size. As a control on the effect of firm size on capital structure, the variable of firm size is included in the empirical studies of the thesis.

4.6.1.2 Growth Opportunities

If a firm with limited growth opportunity finances risky investments with a new issue of debt, then the existing debt-holders bear more risk than before the issue of the new debt. According to the agency theory of capital structure, firms with limited growth opportunities tend to finance with more debt due to the conflicts of interest between shareholders and debt-holders. Therefore, capital structure is negatively related to growth opportunities. Kim and Sorensen (1986) and Rajan and Zingales (1995) find a negative relationship between capital structure and growth opportunities. However, Kester (1986a) finds a positive relationship between capital structure and growth opportunities. In a Taiwanese empirical study, Chu et al. (1992) also find a positive relationship between total debt ratios and growth opportunities. Despite the mixed evidence among prior studies on the effect of growth opportunities in the choices of capital structure, the variable of growth opportunity is included as a control on capital structure in the empirical studies of the thesis.

4.6.1.3 Profitability
All other things being equal, the greater the profit a firm can earn, the greater are the funds that a firm can reserve. This increases the internal funds that can be used to finance investments or to repay outstanding debts when a lack of investment opportunities occurs. The pecking order theory of financing (Myers and Majluf, 1984) argues that firms tend to finance their investment opportunities first with internal funds, then with debt capital and finally with equity capital. Their argument implies that the more profits a firm earns, the less likely is a firm to exhaust its internal funds and to finance with external capital. Several empirical studies such as Friend and Lang (1988), Kester (1986a) and Titman and Wessels (1988) find a negative relationship between profitability and capital structure that is consistent with the pecking order theory of financing. Chu et al. (1992) also find a negative relationship between profitability and capital structure of the listed firms in Taiwan. As a control on the effect of profitability on capital structure, the variable of profitability is included in the empirical studies of the thesis.

### 4.6.1.4 Non-Debt Tax Shields

In their study, DeAngelo and Masulis (1980) present a model of capital structure choice with the existence of corporate and personal income tax. They conclude that non-debt tax shields can be a substitute for the tax deductibility of debt financing. Consequently, all other things being equal, the more non-debt tax shields that a firm has, the less is the benefit of tax deductibility of the debt to the firm. In other words, the tax deductions of debt financing can be crowded out by the non-debt tax shields. Evidence by Downs (1993), Chu et al. (1992), Chaplinsky and Niehaus (1993) and Wald (1999) shows the crowding-out effect of non-debt tax shields on debt financing. However, Bradley et al. (1984) find a positive relationship between long-term debt ratios and non-debt tax shields. Despite the mixed results among prior studies on the effect of non-debt tax shields, the variable of non-debt tax shields is included as a control on capital structure in the empirical studies of the thesis.

### 4.6.1.5 Asset Tangibility

Jensen and Meckling (1976) argue that firms tend to finance with more debt and divert wealth from existing debt-holders to shareholders. However, firms can finance
with more debt if firms can provide debt-holders with more collateral value of assets that reduces the agency costs of debt. Several prior studies confirm the positive relationship between capital structure and asset tangibility (Marsh, 1982, Friend and Lang, 1988, Rajan and Zingales, 1995, Wald, 1999). Findings in prior studies suggest that capital structure is positively related to asset tangibility. The variable of asset tangibility is included as a control on capital structure in the empirical studies of the thesis.

4.6.2 Control Variable for Industry Effect

In their study, Bradley et al. (1984) find a significant difference in the variance in firm leverage ratios. Among the twenty-five selected industries in their sample, the mean debt ratios for the electronics, petroleum-refining and textile industries were 16%, 24% and 33%, respectively. Reviewing the studies on capital structure, Harris and Raviv (1991) comment that the capital structure of firms is more similar to one another within the same industries than across different industries. This suggests that capital structure is influenced by industry type. In order to capture the industry effect on capital structure, dummy variables indicating industry types are included as control variables in the empirical studies of the thesis.

4.7 Research Period and Sample

The sample used in the thesis research includes the firms in the textile, plastics and electronics industries that are listed on the Taiwan Stock Exchange and that have complete financial data in the sample period of the thesis research. The reason for the selection of these three industries is that these industries played an important role in the course of Taiwan’s economic development from the 1960s to the mid-1990s due to the shift in the level of government industrial policy as described in Chapter 3. Further, the information electronics industry of Taiwan has been developing since the late 1970s and the early 1980s (Zang, 2004). In addition, the shift in the level of government industrial policy among the light manufacturing industry, petro-chemical industry and then the technology-intensive electronics industry was implemented to boost Taiwan’s industrial and economic development during the period of 1960s to the mid 1990s.
The sample period starts from 1983 and ends in 1995. The year 1983 is chosen as the starting point for the study due to reasons of data availability, particularly in relation to the electronics industry. The electronics industry in Taiwan started to take off only in the 1980s. This situation is illustrated by the case of such companies as Acer Incorporated (Acer), Taiwan Semiconductor Manufacturing Company Limited (TSMC) and United Microelectronics Corporation (UMC). The choice of 1995 as the end of the sample period risks judgment of the study as being “dated”; doing so, however, allows the thesis to control for and avoid a number of other intervening and complicating factors which occurred after 1995 such as the Asian Financial Crisis in 1997, the implementation of a new tax regime in Taiwan on January 1, 1998, the bubble economy and dot-com problems in the early 2000s and the change in Taiwanese government industrial policy which no longer just focused on certain specific industries such as textile, plastics and electronics. Further, the period 1983-1995 enables the thesis to capture the important shift in the economic development of Taiwan. Thus, given these considerations, the sample period 1983-1995 allows the thesis to examine in a robust and reliable manner the impact of macroeconomic conditions, economic development and government industrial policy in the context of Taiwan over three business cycles.

The research period covering three business cycles allows an examination on the effect of macroeconomic conditions, economic development and the government industrial policy on capital structure decisions and a better understanding of the adjustment behavior of capital structure decisions. Following a Taiwanese empirical study on corporate financial distress prediction over business cycles (Cheng et al., 2006), the thesis uses the annual financial data to investigate the impact of macroeconomic conditions, economic development and government industrial policy on capital structure decisions. In addition, the thesis research is conducted at the years of economic peak and trough during the period from 1983 to 1995 in the course of Taiwan’s economic development. According to the reference dates shown in the

9 Founded in 1976, Acer ranks as the world’s third largest vendor for total personal computers and the second largest vendor for laptop computers. TSMC, the world’s largest dedicated semiconductor foundry, was established in 1987. UMC, founded in 1980, is the first semiconductor company in Taiwan. Refer to http://global.acer.com/about/index.htm, http://global.acer.com/about/index.htm and http://www.umc.com/English/about/index.asp.
Business Indicators published by the Council for Economic Planning and Development of Executive Yuan of Taiwan, the years at the economic peak and trough are selected to illustrate the shifts in macroeconomic conditions. Therefore, the years of 1983, 1988 and 1994 closest to the reference dates of economic peak and the years of 1985, 1990 and 1995 closest to the reference dates of economic trough over three business cycles, respectively, are selected to represent the shifts in macroeconomic conditions.

4.8 Operational Definitions - Dependent and Control Variables

This section provides a discussion of the operational definitions of the dependent variable of capital structure decisions and control variables whereas the operational definitions for each of the test variable – macroeconomic conditions, economic development and government industrial policy – are described in the empirical Chapters – Chapters 5, 6 and 7, respectively. The control variables for firm characteristics and industry types used in the model have already been discussed in Section 4.6.

4.8.1 Capital Structure

Capital structure decisions made by firms determine the change in the level of capital structure from the level of capital structure at the end of the previous period to the level of capital structure at the end of the current period. Following prior empirical studies, the debt ratio (DR) is used as a proxy for capital structure. The debt ratio adjustment (dDR) - or the change in the total debt ratios from the actual debt ratio at the end of the previous period (DR_{t-1}) to the actual debt ratio at the end of the current period (DR_t) - is used as a proxy for capital structure adjustment, i.e. the change in the level of capital structure.

4.8.2 Control Variables

As mentioned in Chapter 1, to avoid repetition in the empirical studies of the thesis in Chapters 5, 6, 7 and 8, firm-specific variables including firm size, growth opportunity,
profitability, non-debt tax shields and asset tangibility are used as control variables in the thesis research (Harris and Raviv, 1991, Huang and Song, 2006).

The natural logarithm of net sales ($\ln S$) is used as the proxy for firm size (Titman and Wessels, 1988, Huang and Song, 2006, Rajan and Zingales, 1995, Wiwattanakantang, 1999, Chu et al., 1992, Booth, 2001). The annual growth rate of total assets ($gTA$) is used as the proxy for growth opportunity (Titman and Wessels, 1988, Bevan and Danbolt, 2002). The ratio of net operating income to total assets ($OITA$) is used to represent profitability (Titman and Wessels, 1988). The ratio of depreciation to total assets ($DEPTA$) is used as the proxy for non-debt tax shields (Kim and Sorensen, 1986, Titman and Wessels, 1988, Wiwattanakantang, 1999, Wald, 1999, Chu et al., 1992). Finally, the ratio of inventory plus net fixed asset to total assets ($INVFATA$) is used as the proxy for asset tangibility (Downs, 1993, Titman and Wessels, 1988, Wald, 1999, Chu et al., 1992). In addition, the dummy variables are used to capture the industry effect in the thesis research. The dummy variables, IND13 and IND14, with a value of 1 are used to indicate the selected plastics and textile industries, respectively. The dummy variables, IND13 and IND14, with a value of 0 are used to indicate the electronics industry.

4.9 Conclusion

This chapter outlines the rationale for the application of the partial or stock adjustment model on which the generalized model for capital structure adjustment is based, the adjustment behavior of capital structure in the partial adjustment model and the generalized model for capital structure adjustment utilized in the empirical studies of the thesis. Following several studies on the existence of the target capital structure and the importance of the spare debt capacity in capital structure decisions of firms, a partial adjustment model is utilized in the empirical studies of the thesis to investigate the impact of test variables, namely macroeconomic conditions, economic development and government industrial policy, on capital structure. In addition, the

10 A proxy of the market-to-book (MTB) ratio for growth opportunities is used by some studies of capital structure. However, a MTB ratio in excess of one does not exactly indicate that a firm has valuable growth opportunities as stated by Bevan and Danbolt (2002). In addition, Barcly and Smith (1999) find similar results obtained with MTB and other proxies for growth opportunities in cross-sectional regressions of capital structure.
application of the partial adjustment model allows the empirical studies of the thesis to explore the adjustment behavior of capital structure decisions.

In the application of the partial adjustment model, capital structure adjustment depends upon the adjustment rate and the adjustment gap between the target capital structure and the previous actual capital structure. Given the level of the previous actual capital structure, the adjustment gap might be positive or negative depending upon the level of the target capital structure. The relationship between capital structure adjustment and the adjustment rate varies according to whether positive and negative adjustment gaps exist. Capital structure adjustment is positively related to the adjustment rate but negatively related to the spare debt capacity where a positive adjustment gap exists between the target capital structure and the previous actual capital structure. On the other hand, capital structure adjustment is negatively related to the adjustment rate and to the spare debt capacity in the case of a negative adjustment gap between the target capital structure and the previous actual capital structure.

In the application of the partial adjustment model, prior studies do not take into account the gap between the target capital structure and the capital structure at the end of the previous period. Estimating the adjustment rate without the adjustment gap taken into account may bias the estimated rate of adjustment in the application of the partial adjustment model. In addition, prior studies in the application of the partial adjustment model on the adjustment of capital structure do not include the factors of macroeconomic conditions, economic development and government industrial policy in the determination of target capital structure. The thesis includes these factors in the determination of target capital structure and, in addition, takes into account the gap between the target capital structure and the capital structure at the end of the previous period to estimate the adjustment rate. These two considerations are neglected by related prior studies, a fact that may bias the estimated adjustment rate in the application of the partial adjustment model.
Chapter 5

The Impact of Macroeconomic Conditions on Capital Structure: Evidence from Taiwan

5.1 Introduction

Over the last several decades, a voluminous amount of studies has been conducted on capital structure. Focusing mainly on the effects of factors at the firm and industry levels, these studies have documented common determinants of capital structure. Among the factors of firm characteristics, as suggested by prior studies, capital structure is related to investment and growth opportunities. Investment and growth opportunities, however, may vary with macroeconomic conditions. There are more future investment and growth opportunities available to firms at economic trough compared to at economic peak. This suggests that the capital structure adjustment of firms would vary with the fluctuations of macroeconomic conditions in order to respond to future investment and growth opportunities, in particular, at economic trough and peak. Stulz (1990) contends that, in order to reduce the cost of overinvestment and underinvestment due to the agency problem between management and shareholders, firms would finance with more debt in response to the increase in both cash flow and the possibility that firms will have free cash flow. This implies that capital structure is positively related to macroeconomic conditions due to the increase in both cash flow at economic peak and the possibility that firms have more free cash flow at economic peak than at economic trough.

Very few studies, however, have directly investigated the role of macroeconomic conditions in the determination of capital structure. The effect of macroeconomic conditions on capital structure is an important area for future research.

* The findings from this chapter were written as a paper, which was presented at a refereed international scholarly conference hosted by the Accounting, and Finance Association of Australia and New Zealand held at the Gold Coast, Queensland, Australia from July 1 to 3, 2007, and in the Queensland University of Technology – Griffith University Finance Symposium, which was organized by Professor of Finance, Michael Drew, and held at Griffith University in November 2006. I am grateful for the helpful comments and suggestions from the conference and symposium participants.
conditions found by these few studies is not consistent with Stulz (1990). Korajczyk
and Levy (2003) examine the impact of macroeconomic conditions on capital
structure with financial constraints taken into account. Their empirical evidence
shows that, for financially unconstrained firms, corporate leverage is counter-cyclical.
Further, Hackbarth et al. (2006) present a contingency-claims model and analyze
credit risk and capital structure. Their model predicts that leverage is countercyclical.
Moreover, Levy and Hennessy (2007) develop a general equilibrium model to explain
corporate financing over business cycles and contend that capital structure is counter-
cyclical for the less constrained firms. Thus, there is a need for further research to
provide better understanding of the effect of macroeconomic conditions on capital
structure decisions.

Further, none of the existing studies on capital structure has also taken directly into
account another important factor referred to as financial flexibility or spare debt
capacity. Firms reserve spare debt capacity in order to respond to future financial
needs arising from growth or investment opportunities, which therefore gives them
and Majluf, 1984, Pinegar and Wilbricht, 1989). Because of this, firms may
intentionally deviate from their target or optimal capital structure in order to reserve
spare debt capacity which provides them with financial flexibility for future
investment and growth opportunities. In spite of the importance of financial flexibility
or spare debt capacity in the determination of capital structure being identified by
Myers and Majluf (1984), no quantitative evidence has been pursued empirically by
prior studies.

As mentioned previously, investment and growth opportunities vary over time due to
the fluctuation of macroeconomic conditions. Thus, firms reserve spare debt capacity
to maintain financial flexibility in order to avoid passing up future investment and
growth opportunities. This implies that firms take macroeconomic conditions into
account in determining their capital structure with spare debt capacity under
consideration, in particular at economic trough and peak. Therefore, without taking
macroeconomic conditions and financial flexibility into account, firms are not able to
adjust adequately their capital structure over time, in particular during economic
troughs and peaks. This study, therefore, addresses this gap in the literature to
investigate the significance of macroeconomic conditions, financial flexibility and the interactions of macroeconomic conditions with firm-level factors in the determination of capital structure.

Prior studies on capital structure have mostly been conducted based on developed countries rather than on emerging economies. Glen and Singh (2004) find that capital structure in emerging countries is different from that observed in developed countries. Taiwan has a successful experience of economic transition from an emerging country to a developed one. The textile, plastics and electronic industries played an important role in the economy of Taiwan during the period from the 1960s to the mid-1990s as discussed in Section 3.3. In particular, the electronics industry of Taiwan plays an important role in the world market due to the strategic support from the Taiwanese government (Hsu and Chiang, 2001). Taiwan was the third largest producer of laptop computers in 1995 with 27% of the world market share and with total electronic production value reaching $US40.6 billion in the same year, an increase of 58% since 1992 (Lee and Pecht, 1997). Therefore, the study is conducted within the context of the textile, plastics and electronics industries of Taiwan. This study could provide a new perspective on the effect of macroeconomic conditions on capital structure. The evidence found in the thesis research within the context of Taiwan could be a valuable reference for practitioners.

The partial adjustment model that matches with the adjustment behavior of capital structure, as discussed in Chapter 4, is utilized to explore the adjustment behavior of capital structure in the study of the thesis. The modified partial adjustment model for capital structure adjustment, discussed later in Section 5.3, allows an investigation of the effect of macroeconomic conditions and the interactions between macroeconomic conditions and firm-specific factors on capital structure. It also allows an exploration of the adjustment behavior of capital structure decisions of firms across macroeconomic conditions over selected business cycles.

5.2 Literature Review

After the fundamental work of Modigliani and Miller (1958), extensive studies have been conducted on capital structure decisions as discussed earlier in the Literature
Review of Chapter 2. Most of these studies have addressed the issue at firm and industry levels and have concluded some common determinants of capital structure (Harris and Raviv, 1991, Huang and Song, 2006). However, these prior studies rarely considered macroeconomic conditions. Further discussion on the research gap in the literature is presented as follows:

### 5.2.1 Macroeconomic Conditions and Capital Structure

Economic output and growth varies with macroeconomic conditions over business cycles, particularly at times of economic trough and peak. As well, some determinants of capital structure, such as growth opportunities and sale volume, also vary upon the current state of the economy. Firms have various investment and growth opportunities that depend upon future macroeconomic conditions, in particular economic peak and trough. The relationship among macroeconomic conditions, firm-specific factors and capital structure discussed above suggests that capital structure is related to macroeconomic conditions directly or indirectly.

Stulz (1990) considers the impact of managerial discretion in his model of capital structure decisions. He contends that financing policy, by influencing the resources under management control, can reduce the problem of overinvestment and underinvestment due to the conflicts of interest between management and shareholders. Stulz argues that, when cash flow is high, management tends to invest too much in negative NPV investment projects, i.e. overinvestment; on the contrary, when cash flow is low, management does not have sufficient funds to invest in positive NPV projects, i.e. underinvestment. Consequently, Stulz argues that a firm’s financial policy could reduce the costs of overinvestment and underinvestment. Issuing debt that forces management to pay out funds when cash flow is high can reduce the overinvestment problem. On the other hand, issuing equity to increase the resources under management control when cash flow is low can reduce the underinvestment problem.

In order to reduce the problem of overinvestment and underinvestment, firms finance with more debt when cash flow is high; on the contrary, firms finance with less debt when cash flow is low. Stulz concludes that the optimal face value of debt increases if
cash flow increases or if the probability increases that the firm will have free cash flow. As discussed earlier in this section, growth opportunities and sale volume vary with macroeconomic conditions. In order to reduce the costs of overinvestment and underinvestment, firms would finance with more debt at economic peak due to the increase in both cash flow and the probability that firms will have free cash flow but finance with less debt at economic trough due to the decrease in both cash flow and the probability that firms will have free cash flow. Therefore, according to the agency theory of capital structure, capital structure will be positively correlated to macroeconomic conditions.

However, the asymmetric information models come to an opposite conclusion about the impact of free cash flow and profitability on capital structure due to the asymmetric information problem between management and outside investors. The asymmetric information models assume that investors are less well-informed than inside management about the value of a firm’s assets. The information asymmetry contributes to the under-pricing of a firm’s equity and then underinvestment occurs. Firms tend to issue debt to be taken as a valid signal of a more productive firm (Ross, 1977). In addition, Myers and Majluf (1984) argue that there is a pecking order of financing: firms will finance new investment first with internal funds, then with debt, and, finally, with equity. Further, Narayanan (1988) contends that, in a world of asymmetric information regarding any new investment opportunity, firms tend to finance with debt rather than with undervalued equity to avoid underinvestment. Narayanan (1988) also suggests that it is better to reserve financial slack for future investment opportunities. Firms tend to finance with debt rather than equity at economic trough due to the asymmetric information problem. Therefore, according to the asymmetric information models, capital structure will be negatively correlated to macroeconomic conditions.

Miller (1977) reports that debt ratios of the typical non-financial companies varied with the business cycles between 1920 and 1960 and, in addition, debt ratios tended to fall during economic expansion periods. Korajczyk and Levy (2003) examine the impact of macroeconomic conditions on capital structure with financial constraints under consideration. Korajczyk and Levy find that corporate leverage is countercyclical for the financially unconstrained firms, which is not consistent with the
agency theory of capital structure. Further, Hack Barth et al. (2006) argue that the shareholders’ value-maximization default policy is characterized by a different threshold for each state and that default thresholds are countercyclical. They predict that market leverage should be countercyclical. Furthermore, Levy and Hennessy (2007) argue that, in their general equilibrium model with agency problems taken into account, capital structure would be counter-cyclical for the less constrained firms.

It appears, therefore, that there is no agreement about the impact of macroeconomic conditions on capital structure. The existing empirical work on capital structure, unfortunately, does not provide direct evidence on this issue. This study therefore addresses this gap to provide further evidence on the impact of macroeconomic conditions on capital structure and on the adjustment behavior of capital structure decisions across macroeconomic conditions over business cycles.

5.2.2 Interactions between Macroeconomic Conditions and Firm-Characteristics Factors

As suggested by prior studies, capital structure is related to firm-specific variables such as growth opportunities and firm size. In addition, as discussed in 5.2.1, firm-specific variables such as growth and sale volume vary with macroeconomic conditions over business cycles. Rarely do previous studies address the significance of the interactions between macroeconomic conditions and firm-level factors in the determination of capital structure. Ferri and Jones (1979) find that the relationship between firm size and capital structure is positive during economic expansion but not significant during economic recession. This suggests that the relationship between capital structure and its firm-specific determinants is influenced by macroeconomic conditions. Nonetheless, no other studies provide evidence on the impact of the interactions between firm-specific factors and macroeconomic conditions.

5.3 Methodology

A modified partial adjustment model as discussed in Chapter 4 is utilized to examine the impact of macroeconomic conditions and their interaction with firm-specific factors on capital structure. In addition, the model is utilized to explore the adjustment
behavior of capital structure decisions across the shift in macroeconomic conditions over the selected business cycles. The modified partial adjustment model for capital structure, the operational definitions of the variables, the research sample and period, and the empirical model used in the study are discussed further in the following subsections.

5.3.1 Theoretical Model for Analyzing the Effect of Macroeconomic Conditions on Capital Structure

As discussed in Chapter 4, the relationship between capital structure adjustment and the adjustment rate depends upon the case of a positive or a negative adjustment gap between the target capital structure and the previous actual capital structure. In the case of a positive adjustment gap between the target capital structure and the previous actual capital structure, capital structure adjustment is positively related to the adjustment rate. On the other hand, capital structure adjustment is negatively related to the adjustment rate in the case of a negative adjustment gap between the target capital structure and the previous actual capital structure. The modified partial adjustment model for capital structure utilized to analyze the adjustment behavior of capital structure of firms with the financial constraint of under-leverage or over-leverage in the case of a positive or a negative adjustment gap (as discussed in Chapter 4) is presented as follows:

\[
ADJ_t = \sum_{j=1}^{c} \gamma \beta_j X_{j, t}^{FC} + \gamma \beta_{IND}^{IND} IND_t + \gamma \beta_{TV}^{TV} TV_t - \gamma ACS_{t-1} + \gamma \epsilon_t
\]

where:
- \( ADJ_t \) = the capital structure adjustment at time t,
- \( \gamma \) = the adjustment rate that is determined by the spare debt capacity reserved for future investment and growth opportunities,
- \( \beta \) = the regression coefficient,
- \( X_{j, t}^{FC} \) = the variables at the firm level and \( j=1 \) to c at time t,
- \( IND_t \) = the dummy variable for industry types,
- \( TV_t \) = the test variable,
- \( ACS_{t-1} \) = the previous actual capital structure at time t, and
- \( \epsilon_t \) = the error term.
\[ \gamma \varepsilon_t = \text{the error term.} \]

The purpose of this research is to examine the effect of macroeconomic conditions and their interaction with firm-specific variables on capital structure over the selected business cycles in the sample period. Controlling for the effect of business cycles, the dummy variable BC is included in the capital structure adjustment model when testing the impact of macroeconomic conditions on capital structure. Therefore, the test variables of the study included in Equation 4-4 are expressed as follows.

\[ TV_t = EC_t + BC_t + X_{j\text{FC}}^t \times EC_t \quad (5-1) \]

where:

- TV: the test variable,
- EC: the dummy variable for the shift in macroeconomic conditions, 0 for economic recession and 1 for economic expansion,
- BC: the dummy variable for the business cycles,
- \( X_{j\text{FC}}^t \times EC \): the interactions between macroeconomic conditions and the firm-specific control variables and \( j=1 \) to \( c \) at time \( t \),

By substituting Equation 5-1 into Equation 4-4, the theoretical model for capital structure adjustment utilized in the study to examine the significance of macroeconomic conditions and their interaction with firm-specific variables in the determination of capital structure of firms with the financial constraint of under-leverage or over-leverage in the case of positive and negative adjustment gaps over selected business cycles, respectively, can be written as follows:

\[ \text{ADJ}_t = \sum_{j=1}^{c} \gamma \beta_{t\text{FC}} X_{jt}^t + \gamma \beta_\text{IND} \text{IND}_t + \gamma \beta_\text{EC}^t \text{EC}_t + \gamma \beta_\text{BC}^t \text{BC}_t + \sum_{k=1}^{c} \gamma \beta_{k\text{FC}} X_{jt}^t \times \text{EC}_t - \gamma \text{ACS}_{t-1} + \gamma \varepsilon_t \quad (5-2) \]

where:

- ADJ\(_t\) = the capital structure adjustment at time \( t \),
\( \gamma \) = the adjustment rate that is determined by the spare debt capacity reserved for future investment and growth opportunities,

\( \beta \) = the regression coefficient,

\( X^{jc}_j \): the variables at the firm level and \( j = 1 \) to \( c \) at time \( t \),

IND: the variable for industry types,

EC: the dummy variable for the shift in macroeconomic conditions, 0 for economic recession and 1 for economic expansion,

BC: the dummy variable for the business cycles,

\( X^{jc}_j \times EC \): the interactions between macroeconomic conditions and the firm-specific control variables and \( j = 1 \) to \( c \) at time \( t \),

\( ACS_{t-1} \) = the previous actual capital structure at time \( t \), and

\( \gamma \varepsilon \) = the error term.

By incorporating the control variables including firm-specific variables and the variable for industry types (discussed earlier in Chapter 4) into Equation 5-2, the theoretical model utilized in this study for the determination of capital structure with financial constraint of over-leverage or under-leverage in the case of a positive or a negative adjustment gap taken into account can be rewritten as follows:

\[
ADJ_i = \gamma \beta_1 \text{SIZE}_i + \gamma \beta_2 \text{GROWTH}_i + \gamma \beta_3 \text{PROFIT}_i + \gamma \beta_4 \text{NDTS}_i + \gamma \beta_5 \text{ASSETS}_i + \gamma \beta_{11} \text{IND}_i + \gamma \beta_{12} \text{EC}_i + \gamma \beta_{13} \text{BC} + \gamma \beta_{14} \text{SIZE}_i \times \text{EC}_i + \gamma \beta_{15} \text{GROWTH}_i \times \text{EC}_i + \gamma \beta_{16} \text{PROFIT}_i \times \text{EC}_i + \gamma \beta_{17} \text{NDTS}_i \times \text{EC}_i + \gamma \beta_{18} \text{ASSETS}_i \times \text{EC}_i - \gamma ACS_{t-1} + \varepsilon_i \tag{5-3}
\]

where:

ADJ : the capital structure adjustment,

\( \gamma \) : the rate of the adjustment towards the target capital structure,

\( \beta \) : the regression coefficient,

SIZE : firm size,

GROWTH : growth opportunities,

PROFIT : profitability,

NDTS : non-debt tax shields,
ASSET: asset tangibility,
IND: the dummy variable for industry types,
EC: the dummy variable, 0 for economic recession and 1 for economic expansion,
BC: the dummy variable for the business cycles,
SIZE × EC, GROWTH × EC, PROFIT × EC, NDTS × EC and ASSET × EC: the interactions between firm-level variables and macroeconomic conditions,
ACS_{t-1} = the previous actual capital structure at time t, and
γε = the error term.

Equation 5-3 shows the adjustment behavior of capital structure towards the target capital structure of firms with the financial constraint of under-leverage and over-leverage in the case of a positive or a negative adjustment gap across macroeconomic conditions over the business cycles. By substituting the item of ACS_{t-1} for the capital structure adjustment (ADJ_{t}) in Equation 5-3 since ADJ_{t} = ACS_{t} – ACS_{t-1} and rearranging, the equation for the determination of actual capital structure (ACS) of firms with the financial constraint of under-leverage and over-leverage in the case of a positive or a negative adjustment gap is obtained and written as follows:

ACS_{t} = γβ_{1} SIZE_{t} + γβ_{2} GROWTH_{t} + γβ_{3} PROFIT_{t} + γβ_{4} NDTS_{t} + γβ_{5} ASSET_{t}
+ γβ_{6} IND_{t} + γβ_{7} EC_{t} + γβ_{8} BC + γβ_{9} SIZE_{t} × EC_{t} + γβ_{10} GROWTH_{t} × EC_{t}
+ γβ_{11} PROFIT_{t} × EC_{t} + γβ_{12} NDTS_{t} × EC_{t} + γβ_{13} ASSET_{t} × EC_{t} + (1 - γ)ACS_{t-1} + γε_{t}  

Equation 5-3A is the theoretical model for the determination of “actual” capital structure of firms with the financial constraint of under-leverage or over-leverage in the case of a positive or a negative adjustment gap. The equation reflects the situation that firms adjust their capital structure over time and may deviate away from their target capital structure across the shift in macroeconomic conditions over the business cycles.

According to the modified partial adjustment model for capital structure (as discussed
in Chapter 4), the partial regression coefficient of the precious actual capital structure will be significantly greater than 0 and different from 1 whenever the deviation away from the target capital structure of firms occurs. In addition, capital structure adjustment will be positively related to the adjustment rate ($\gamma$) for firms with the financial constraint of under-leverage in the case of a positive adjustment gap but negatively related to the adjustment rate for firms with the financial constraint of over-leverage in the case of a negative adjustment gap between the target capital structure and the previous actual capital structure (see Equation 5-3). On the other hand, actual capital structure will be positively related to the adjustment rate for firms with the financial constraint of under-leverage in the case of a positive adjustment gap but negatively related to the adjustment rate for firms with the financial constraint of over-leverage in the case of a negative adjustment gap (see Equation 5-3A). Moreover, firms tend to gear down their debt leverage and rebalance to the target in order to avoid going bankrupt with the financial constraint of over-leverage in the case of a negative adjustment gap.

As suggested by Stulz (1990), firms with limited investment and growth opportunities, tend to finance with more debt. This implies that firms tend to finance with less debt at economic trough than at economic peak in terms of future investment and growth opportunities. Therefore, it is expected there will be a negative relationship between capital structure and macroeconomic conditions. In addition, the partial regression coefficient of the dummy variable for business cycle (BC) will be significantly different from 0 if there is a variation in the determination of capital structure over the business cycles. Furthermore, the partial regression coefficient of the variables for the interactions between firm-specific variables and macroeconomic conditions will be significantly different from 0 if there is a significant effect of the interactions on capital structure.

Further, in order to explore the adjustment behavior of capital structure across the shift in macroeconomic conditions, the study classifies the sample into 4 subsamples based on adjustment gaps and macroeconomic conditions. The modified partial adjustment model used to investigate the adjustment behavior of capital structure decisions of firms with a financial constraint in the case of a negative or a positive
adjustment gap during economic recession or expansion can be rewritten as follows:

\[
ADJ_t = \gamma \beta_{1t} \text{SIZE}_t + \gamma \beta_{2t} \text{GROWTH}_t + \gamma \beta_{3t} \text{PROFIT}_t + \gamma \beta_{4t} \text{NDTS}_t + \gamma \beta_{5t} \text{ASSETS}_t + \gamma \beta_{6t} \text{IND}_t + \gamma \beta_{7t} \text{BC} - \gamma \text{ACS}_{t-1} + \gamma \varepsilon_t
\]  
\[
\text{Equation 5-4}
\]

where:

- **ADJ** : the capital structure adjustment,
- **γ** : the rate of the adjustment towards the target capital structure,
- **β** : the regression coefficient,
- **SIZE** : firm size,
- **GROWTH** : growth opportunities,
- **PROFIT** : profitability,
- **NDTS** : non-debt tax shields,
- **ASSET** : asset tangibility,
- **IND** : the dummy variable for industry types,
- **BC** : the dummy variable for the business cycles,
- **ACS_{t-1}** = the previous actual capital structure at time t, and
- **γε** = the error term.

By substituting the item of ACS_t - ACS_{t-1} for the capital structure adjustment (ADJ_t) in Equation 5-4 since ADJ_t = ACS_t - ACS_{t-1} and rearranging, the equation for the determination of actual capital structure (ACS) of firms with the financial constraint of under-leverage and over-leverage in the case of a positive or a negative adjustment gap during economic recession or expansion is obtained and written as follows:

\[
\text{ACS}_t = \gamma \beta_{1t} \text{SIZE}_t + \gamma \beta_{2t} \text{GROWTH}_t + \gamma \beta_{3t} \text{PROFIT}_t + \gamma \beta_{4t} \text{NDTS}_t + \gamma \beta_{5t} \text{ASSETS}_t + \gamma \beta_{6t} \text{IND}_t + \gamma \beta_{7t} \text{BC} - (1 - \gamma)\text{ACS}_{t-1} + \gamma \varepsilon_t
\]  
\[
\text{Equation 5-4A}
\]

Equations 5-4 and 5-4A are the modified partial adjustment models for the determination of capital structure of firms with financial constraint in the case of a negative or a positive adjustment gap across macroeconomic conditions over selected
business cycles. As discussed in Chapter 4, firms tend to gear down the debt leverage and rebalance their capital structure to the target with the financial constraint of over-leverage in the case of a negative adjustment gap. In addition, firms are more likely to go bankrupt during bad macroeconomic conditions than during good macroeconomic conditions. Therefore, firms with the financial constraint of over-leverage in the case of a negative adjustment gap tend to adjust faster to rebalance their capital structure to the target during an economic recession than during an economic expansion. This implies that the adjustment rate of capital structure of firms with the financial constraint of over-leverage in the case of a negative adjustment gap is higher during an economic recession than during an economic expansion.

On the other hand, firms with the financial constraint of under-leverage in the case of a positive adjustment gap tend to reserve more spare debt capacity for investment and growth opportunities and deviate away from the target during an economic recession than during an economic expansion. This implies that the adjustment rate of capital structure of firms with the financial constraint of under-leverage in the case of a positive adjustment gap is lower during an economic recession than during an economic expansion.

5.3.2 Operational Definitions

The dependent variable of capital structure decisions and the explanatory variables, except the dummy variables, are calculated at book value of annual financial data collected in the thesis research. The control variables for firm characteristics and industry types used in the model have already been discussed in Section 4.6. The operational definitions for the capital structure decisions and the control variables used in this chapter have already been discussed in Chapter 4 – in Section 4.8.1 and Section 4.8.2, respectively. The operational definitions for the test variable of macroeconomic conditions are discussed in the following subsections.

5.3.2.1 Macroeconomic Conditions

The binary dummy variable (EC) is used as the proxy for macroeconomic conditions with a value of 0 for the years of economic trough and a value of 1 for the years of
5.3.2.2 Interaction between Firm-Specific Control Variables and Macroeconomic Conditions

In order to capture the potential interaction effect, the product of the firm-specific variables and the dummy variable for macroeconomic conditions is used to indicate the interaction between firm-specific variables and macroeconomic conditions as suggested by Jaccard and Turrisi (2003).

5.3.3 Research Sample and Period

As discussed in Section 4.7, the sample used in the study includes the firms in the textile, plastics and electronics industries that are listed on the Taiwan Stock Exchange and that have complete financial data in the sample period of the study. The reason for the selection of these three industries is that these three industries played an important role in the course of Taiwan’s economic development from the 1960s to the mid-1990s as discussed in Chapter 3. Those firms that experienced financial distress or trade suspension on the Taiwan Stock Exchange are excluded. Annual data used in this study was collected from the financial data bank of Taiwan Economic Journal.

In addition, due to the limited data on the electronics industry before 1980 and to control for a number of intervening and complicating factors which occurred after 1995 such as the Asian Financial Crisis in 1997, the implementation of a new tax policy in Taiwan in 1998 and the bubble economy and dot-com problems in the early 2000s, the study is conducted on the years of economic peak and trough during the period from 1983 to 1995 over three business cycles in Taiwan. According to the reference dates shown in the Business Indicators published by the Council for Economic Planning and Development of Executive Yuan of Taiwan, the years of the economic peak and trough are selected to represent the shifts in macroeconomic
conditions. Therefore, the years of 1983, 1988 and 1994 closest to the reference dates of economic peak and the years of 1985, 1990 and 1995 closest to the reference dates of economic trough over Business Cycles 6 to 8, respectively, are selected to represent the shifts in macroeconomic conditions.

**5.3.4 Empirical Model for Testing the Effect of Macroeconomic Conditions on Capital Structure**

This study is conducted within the context of the textile, plastics and electronics industries in Taiwan in the sample period from 1983 to 1995 over Business Cycles 6 to 8 in Taiwan. Incorporating the proxies for the variables into Equation 5-4, the empirical model for capital structure adjustment of firms with the financial constraint of over-leverage and under-leverage in the cases of a negative or a positive adjustment gap across economic peak and trough over Business Cycles 6 to 8, respectively, is expressed as follows:

\[
dDR_t = \gamma \beta_{10} \ln S_t + \gamma \beta_{21} gTA_t + \gamma \beta_{31} OITA_t + \gamma \beta_{41} DEPTA_t + \gamma \beta_{51} INVFATA_t + \gamma \beta_{61} IND13_t
\]

\[
+ \gamma \beta_{71} IND14_t + \gamma \beta_{81} ECDEPTA_t + \gamma \beta_{91} ECgTA_t + \gamma \beta_{10} EC ln S_t
\]

\[
+ \gamma \beta_{11} BC8_t + \gamma \beta_{12} BC7_t + \gamma \beta_{13} BC6_t + \gamma \beta_{14} BC5_t
\]

\[
= \gamma \beta_{10} \ln S_t \times EC_t + \gamma \beta_{21} gTA_t \times EC_t + \gamma \beta_{31} OITA_t \times EC_t
\]

\[
+ \gamma \beta_{41} DEPTA_t \times EC_t + \gamma \beta_{10} IND13 \times EC_t
\]

\[
+ \gamma \beta_{10} IND14 \times EC_t
\]

\[
dDR_{t-1} + \gamma \epsilon_t
\]

where:

- \(dDR_t\): the debt ratio adjustment at time \(t\),
- \(\gamma\): the adjustment rate that is determined by the spare debt capacity reserved for future investment and growth opportunities,
- \(\beta\): the regression coefficient,
- \(\ln S\) (firm size): natural logarithm of net sales,
- \(gTA\) (growth opportunities): the annual growth rate of total assets,
- \(OITA\) (profitability): the ratio of net operating income to total assets,
- \(DEPTA\) (non-debt tax shields): the ratio of depreciation to total assets,
- \(INVFATA\) (asset tangibility): the ratio of inventory plus net fixed asset to total assets,
- \(IND13\) and \(IND14\): the dummy variables with a value of 1 to indicate the
plastic and textile industries, respectively, and with a value of 0 to indicate the electronics industry,
EC: the dummy variable with a value of 0 for economic recession and 1 for economic expansion,
BC7 to BC8: the dummy variables with a value of 1 to indicate Business Cycles 7 to 8, respectively, and with a value of 0 to indicate Business Cycle 6,
\( \ln{S} \times EC, gTA \times EC, OITA \times EC, DEPTA \times EC \) and \( \text{INVFATA} \times EC \): the interactions between firm-level control variables and macroeconomic conditions,
\( \text{DR}_{t-1} \): the previous actual debt ratio at time \( t \), and
\( \gamma e \): the error term.

Equation 5-5 shows the adjustment behavior of debt ratios of firms with the financial constraint of under-leverage or over-leverage in the case of a positive or a negative adjustment gap across macroeconomic conditions over selected business cycles. By substituting the item of \( \text{DR}_t - \text{DR}_{t-1} \) for the capital structure adjustment (\( \text{dDR}_t \)) in Equation 5-5, since \( \text{dDR}_t = \text{DR}_t - \text{DR}_{t-1} \), and rearranging, the equation for the determination of actual debt ratio (DR) is obtained and written as follows:

\[
\text{DR}_t = \gamma \beta_1 \ln{S}_t + \gamma \beta_2 gTA_t + \gamma \beta_3 OITA_t + \gamma \beta_4 DEPTA_t + \gamma \beta_5 \text{INVFATA}_t \\
+ \gamma \beta_6^{\text{IND13}} \text{IND13}_t + \gamma \beta_7^{\text{IND14}} \text{IND14}_t + \gamma \beta_8^{\text{EC}} \text{EC}_t + \gamma \beta_9^{\text{BC7}} \text{BC7}_t \\
+ \gamma \beta_1^{\text{BC8}} \text{BC8}_t + \gamma \beta_6 \ln{S}_t \times \text{EC}_t + \gamma \beta_7 gTA_t \times \text{EC}_t + \gamma \beta_8 OITA_t \times \text{EC}_t \\
+ \gamma \beta_9 \text{DEPTA}_t \times \text{EC}_t + \gamma \beta_{10} \text{INVFATA}_t \times \text{EC}_t + (1 - \gamma) \text{DR}_{t-1} + \gamma e_t
\]  
(5-5A)

Equation 5-5A shows that firms adjust their debt ratios with the constraint of under-leverage or over-leverage in the case of a positive or a negative adjustment gap and may deviate away from the target debt ratios across the shift in macroeconomic conditions over the business cycles.

Note that the partial regression coefficient of each explanatory variable except the
previous actual debt ratio \((DR_{t-1})\) in Equations 5-5 and 5-5A is a multiple \((\gamma \beta)\) of the adjustment rate \((\gamma)\) and the original regression coefficient \((\beta)\) of each explanatory variable in the equation for the determination of the target debt ratio (as discussed in Section 4.5). This reflects the fact that, whenever the deviation away from the target debt ratio occurs, the effect of each variable on the debt ratio adjustment, except the previous actual debt ratio, is only a proportion, i.e. the adjustment rate \((\gamma)\), of the original effect of each variable in the determination of the target debt ratio (as discussed in Section 4.5).

Further, incorporating the proxies for the variables into Equation 5-4, the empirical model for capital structure decisions of firms with the financial constraint of over-leverage or under-leverage in the case of a negative or a positive adjustment gap at years of economic peak or trough over Business Cycles 6 to 8 is expressed as follows:

\[
dDR_t = \gamma \beta_{1t} \ln S_t + \gamma \beta_{2t} gTA_t + \gamma \beta_{3t} OITA_t + \gamma \beta_{4t} DEPTA_t + \gamma \beta_{5t} INVFATA_t \\
+ \gamma \beta_{6t}^{IND13} IND13_t + \gamma \beta_{7t}^{IND14} IND14_t + \gamma \beta_{8t}^{BC7} BC7_t + \gamma \beta_{9t}^{BC8} BC8_t \\
- \gamma DR_{t-1} + \gamma \varepsilon_t
\]  

(5-6)

where:

\(dDR_t\) : the debt ratio adjustment at time \(t\),

\(\gamma\) : the adjustment rate that is determined by the spare debt capacity reserved for future investment and growth opportunities,

\(\beta\) : the regression coefficient,

\(\ln S\) (firm size) : natural logarithm of net sales,

\(gTA\) (growth opportunities) : the annual growth rate of total assets,

\(OITA\) (profitability) : the ratio of net operating income to total assets,

\(DEPTA\) (non-debt tax shields) : the ratio of depreciation to total assets,

\(INVFATA\) (asset tangibility) : the ratio of inventory plus net fixed asset to total assets,

\(IND13\) and \(IND14\) : the dummy variables with a value of 1 to indicate the plastic and textile industries, respectively, and with a value of 0 to indicate the electronics industry,
BC7 to BC8: the dummy variables with a value of 1 to indicate Business Cycles 7 to 8, respectively, and with a value of 0 to indicate Business Cycle 6,

DR_{t-1}: the previous actual debt ratio at time t, and

γε: the error term.

By substituting the item of DR_t−DR_{t-1} for the capital structure adjustment (dDR_t) in Equation 5-6, since dDR_t=DR_t−DR_{t-1}, and rearranging, the equation for actual debt ratio (DR) of firms with the financial constraint of over-leverage or under-leverage in the case of a negative or a positive adjustment gap at years of economic peak or trough over Business Cycles 6 to 8, respectively, is obtained and written as follows:

\[
\begin{align*}
\text{DR}_t &= \gamma \beta_1 \ln S_t + \gamma \beta_2 \text{gTA}_t + \gamma \beta_3 \text{OITA}_t + \gamma \beta_4 \text{DEPTA}_t + \gamma \beta_5 \text{INVFATA}_t \\
&+ \gamma \beta^\text{IND13}_1 \text{IND13}_t + \gamma \beta^\text{IND14}_1 \text{IND14}_t + \gamma \beta^\text{BC7}_1 \text{BC7}_t + \gamma \beta^\text{BC8}_1 \text{BC8}_t \\
&+ (1 - \gamma) \text{DR}_{t-1} + \gamma \varepsilon_t 
\end{align*}
\]

Equations 5-6 and 5-6A show the capital structure adjustment and the actual level of capital structure for firms with the financial constraint of over-leverage or under-leverage in the case of a negative or a positive adjustment gap at years of economic peak or trough during the research period, respectively.

5.4 Empirical Results and Analyses

5.4.1 Descriptive Statistics

The sample consists of the listed firms with the standard industrial classification (SIC) codes from 1301 to 1399, 1401 to 1499 and 2301 to 2399 in the textile, plastics and electronics industries of Taiwan. The sample includes 627 observations of the listed firms in these industries during the years of economic peak (i.e. 1983, 1988 and 1994) and trough (i.e. 1985, 1990 and 1995) over Business Cycles 6 to 8 in Taiwan. The debt ratios and the previous actual debt ratios of the firms in the sample are less than 0.88. This indicates that no firm in the sample is in financial distress. The descriptive
statistics of the full sample are shown in Table 5.1A. The descriptive statistics of the subsamples with negative and positive adjustment are shown in Tables 5.1B and 5.1C, respectively. In addition, no observations of ‘zero’ capital structure adjustment are found in the sample that allows the empirical models, i.e. Equations 5-4 and 5-4A, used to examine the determination of debt ratio adjustment and actual debt ratios of the listed firms in the textile, plastics and electronics industries across macroeconomic conditions over Business Cycles 6 to 8.

Table 5.1A
Descriptive Statistics for the Full Sample

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADJ</td>
<td>627</td>
<td>-0.02276</td>
<td>0.09831</td>
<td>-0.46459</td>
<td>0.32244</td>
</tr>
<tr>
<td>DR_{t-1}</td>
<td>627</td>
<td>0.47338</td>
<td>0.17620</td>
<td>0.02426</td>
<td>0.89139</td>
</tr>
<tr>
<td>EC</td>
<td>627</td>
<td>0.46411</td>
<td>0.49911</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>BC7</td>
<td>627</td>
<td>0.37321</td>
<td>0.48404</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>BC8</td>
<td>627</td>
<td>0.50399</td>
<td>0.50038</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IND13</td>
<td>627</td>
<td>0.14514</td>
<td>0.35252</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IND14</td>
<td>627</td>
<td>0.38437</td>
<td>0.48683</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>lnS</td>
<td>627</td>
<td>21.48528</td>
<td>1.20916</td>
<td>15.99580</td>
<td>25.23950</td>
</tr>
<tr>
<td>gTA</td>
<td>627</td>
<td>0.31132</td>
<td>0.47841</td>
<td>-0.30866</td>
<td>4.93033</td>
</tr>
<tr>
<td>OITA</td>
<td>627</td>
<td>0.08304</td>
<td>0.08064</td>
<td>-0.16390</td>
<td>0.59860</td>
</tr>
<tr>
<td>DEPTA</td>
<td>627</td>
<td>0.03618</td>
<td>0.02387</td>
<td>0</td>
<td>0.18216</td>
</tr>
<tr>
<td>INV{FATA}</td>
<td>627</td>
<td>0.55177</td>
<td>0.17214</td>
<td>0.02850</td>
<td>0.89525</td>
</tr>
</tbody>
</table>

Notes:
- dDR = debt ratio adjustment; DR_{t-1} = the previous debt ratio at time t;
- EC = 0 for economic trough and 1 for economic peak;
- BC7 = 0 for Business Cycles 6 and 7, and 1 for Business Cycle 7;
- BC8 = 0 for Business Cycles 6 and 7, and 1 for Business Cycle 8;
- IND13 = 0 for the textile and electronics industries and 1 for the plastics industry;
- IND14 = 0 for the plastics and electronics industries and 1 for the textile industry;
- lnS = natural logarithm of net sales; gTA = annual growth rate of total assets; OITA = net operating income/total assets; DEPTA = depreciation/total assets; INVFATA = inventory plus net fixed assets/total assets.
Table 5.1B
Descriptive Statistics for the Subsample with a Negative Adjustment

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADJ</td>
<td>365</td>
<td>-0.08012</td>
<td>0.08166</td>
<td>-0.46459</td>
<td>-0.00074</td>
</tr>
<tr>
<td>DR_{t-1}</td>
<td>365</td>
<td>0.51783</td>
<td>0.16571</td>
<td>0.02426</td>
<td>0.89139</td>
</tr>
<tr>
<td>EC</td>
<td>365</td>
<td>0.44110</td>
<td>0.49720</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>BC7</td>
<td>365</td>
<td>0.41096</td>
<td>0.49268</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>BC8</td>
<td>365</td>
<td>0.46027</td>
<td>0.49910</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IND13</td>
<td>365</td>
<td>0.13699</td>
<td>0.34430</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IND14</td>
<td>365</td>
<td>0.40000</td>
<td>0.49057</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>lnS</td>
<td>365</td>
<td>21.49746</td>
<td>1.20031</td>
<td>17.99150</td>
<td>24.85870</td>
</tr>
<tr>
<td>gTA</td>
<td>365</td>
<td>0.26546</td>
<td>0.39324</td>
<td>-0.30866</td>
<td>2.55949</td>
</tr>
<tr>
<td>OITA</td>
<td>365</td>
<td>0.09603</td>
<td>0.08319</td>
<td>-0.09209</td>
<td>0.59860</td>
</tr>
<tr>
<td>DEPTA</td>
<td>365</td>
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<td>0.02482</td>
<td>0</td>
<td>0.18216</td>
</tr>
<tr>
<td>INVFATA</td>
<td>365</td>
<td>0.55681</td>
<td>0.17019</td>
<td>0.11636</td>
<td>0.89525</td>
</tr>
</tbody>
</table>

Notes:
- dDR = debt ratio adjustment;
- DR_{t-1} = the previous debt ratio at time t;
- EC = 0 for economic trough and 1 for economic peak;
- BC7 = 0 for Business Cycles 6 and 7, and 1 for Business Cycle 7;
- BC8 = 0 for Business Cycles 6 and 7, and 1 for Business Cycle 8;
- IND13 = 0 for the textile and electronics industries and 1 for the plastics industry;
- IND14 = 0 for the plastics and electronics industries and 1 for the textile industry;
- lnS = natural logarithm of net sales;
- gTA = annual growth rate of total assets;
- OITA = net operating income/total assets;
- DEPTA = depreciation/total assets;
- INVFATA = inventory plus net fixed assets/total assets.
Table 5.1C
Descriptive Statistics for the Subsample with a Positive Adjustment

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADJ</td>
<td>262</td>
<td>0.05716</td>
<td>0.05354</td>
<td>0.00030</td>
<td>0.32244</td>
</tr>
<tr>
<td>DR_{t-1}</td>
<td></td>
<td>0.41145</td>
<td>0.17192</td>
<td>0.03739</td>
<td>0.85977</td>
</tr>
<tr>
<td>EC</td>
<td></td>
<td>0.49618</td>
<td>0.50094</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>BC7</td>
<td>262</td>
<td>0.32061</td>
<td>0.46760</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>BC8</td>
<td>262</td>
<td>0.56489</td>
<td>0.49672</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IND13</td>
<td>262</td>
<td>0.15649</td>
<td>0.36401</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IND14</td>
<td>262</td>
<td>0.36260</td>
<td>0.48167</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>lnS</td>
<td></td>
<td>21.46830</td>
<td>1.22347</td>
<td>15.99580</td>
<td>25.23950</td>
</tr>
<tr>
<td>gTA</td>
<td>262</td>
<td>0.37520</td>
<td>0.57118</td>
<td>-0.08787</td>
<td>4.93033</td>
</tr>
<tr>
<td>OITA</td>
<td>262</td>
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<td>0.34304</td>
</tr>
<tr>
<td>DEPTA</td>
<td>262</td>
<td>0.03444</td>
<td>0.02241</td>
<td>0</td>
<td>0.12669</td>
</tr>
<tr>
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<td>262</td>
<td>0.54476</td>
<td>0.17489</td>
<td>0.02850</td>
<td>0.88304</td>
</tr>
</tbody>
</table>

Notes:
- dDR = debt ratio adjustment;
- DR_{t-1} = the previous debt ratio at time t;
- EC = 0 for economic trough and 1 for economic peak;
- BC7 = 0 for Business Cycles 6 and 7, and 1 for Business Cycle 7;
- BC8 = 0 for Business Cycles 6 and 7, and 1 for Business Cycle 8;
- IND13 = 0 for the textile and electronics industries and 1 for the plastics industry;
- IND14 = 0 for the plastics and electronics industries and 1 for the textile industry;
- lnS = natural logarithm of net sales;
- gTA = annual growth rate of total assets;
- OITA = net operating income/total assets;
- DEPTA = depreciation/total assets;
- INVFATA = inventory plus net fixed assets/total assets.
5.4.2 Correlation Analysis

The matrices of the correlation between the variables are shown in Tables 5.2A to 5.2C for the full sample as well as for the subsamples in the cases of a negative or a positive adjustment gap. As can be seen in these tables, the figure located below the coefficient of correlation is the probability of whether or not the coefficient of correlation is significantly different from zero. A number of correlation issues require further analysis:

1. The debt ratio adjustment, dDR, is statistically significant and negatively related to the previous actual debt ratios, DR_{t-1}. This reflects the fact that firms adjust their debt ratios with the level of debt ratios already used in the beginning of each period taken into account. The greater the debt ratios already used at the beginning of each period, the less is the debt ratio adjustment that firms would make.

2. The debt ratio adjustment is statistically significant and positively related to EC and negatively related to BC7 in the full sample over Business Cycles 6 to 8. But the debt ratio adjustment is not significantly related to BC8 in the full sample. However, the debt ratio adjustment is statistically significant and negatively related to BC7 but not significantly related to EC and BC8 in the subsample with negative adjustment (i.e. with the financial constraint of over-leverage) over Business Cycles 6 to 8. In addition, the debt ratio adjustment is statistically significant and positively related to BC7 as well as negatively related to BC8 but not significantly related to EC in the subsample with positive adjustment (i.e. with the financial constraint of under-leverage) over Business Cycles 6 to 8. This finding reflects the fact that the estimation might be flawed in the full sample for the effect of macroeconomic conditions on the debt ratio adjustment without negative and positive adjustment taken into account. The differences when these adjustment gaps are or are not taken into account are discussed in the regression results and analyses in the next subsection.
<table>
<thead>
<tr>
<th></th>
<th>dDR</th>
<th>DRt-1</th>
<th>EC</th>
<th>BC7</th>
<th>BC8</th>
<th>IND13</th>
<th>IND14</th>
<th>lnS</th>
<th>gS</th>
<th>OITA</th>
<th>DEPTA</th>
<th>INVFATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>dDR</td>
<td>1.00000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>DRt-1</td>
<td>-0.34047</td>
<td>1.00000</td>
<td></td>
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<tr>
<td>BC7</td>
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<td></td>
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</tr>
<tr>
<td>BC8</td>
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<tr>
<td>IND14</td>
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<td>0.08827</td>
<td>-0.32558</td>
<td>0.01908</td>
<td>0.01908</td>
<td>1.00000</td>
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</tr>
<tr>
<td>lnS</td>
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<td>0.7241</td>
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<td>0.0271</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>1.00000</td>
<td></td>
</tr>
<tr>
<td>gTA</td>
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<td>0.10277</td>
<td>0.8519</td>
<td>0.2642</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>0.6094</td>
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<td></td>
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</tr>
<tr>
<td>OITA</td>
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<td>0.022619</td>
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<td>DEPTA</td>
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<td>0.01953</td>
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<td>&lt;.0001</td>
<td>&lt;.0001</td>
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<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

Notes: 1. sample size = 627.  2. dDR_t = total debt ratio adjustment in the current year; DR_{t-1} = total debt ratio at the end of the previous year; EC = 0 for economic trough and 1 for economic peak; BC7 = 0 for Business Cycles 6 and 8 and 1 for Business Cycle 7; BC8 = 0 for Business Cycles 6 and 7 and 1 for Business Cycle 8; IND13 = the dummy variable with a value of 1 for the plastics industry; IND14 = the dummy variable with a value of 1 for the textile industry; lnS = natural logarithm of net sales; gTA = annual growth rate of total assets; OITA = net operating income/total assets; DEPTA = depreciation/total assets; INVFATA = inventory plus net fixed assets/total assets; lnS×EC, gTA×EC, OITA×EC, DEPTA×EC and INVFATA×EC = interactions between firm-specific variables and macroeconomic conditions.  3. The figure located below the coefficient of correlation is the probability of whether the coefficient of correlation is significantly different from zero or not.
Table 5.2B
Correlation Matrix for Model Variables in the Subsample with a Negative Adjustment Gap

<table>
<thead>
<tr>
<th></th>
<th>dDR</th>
<th>DR_{t-1}</th>
<th>EC</th>
<th>BC7</th>
<th>BC8</th>
<th>IND13</th>
<th>IND14</th>
<th>lnS</th>
<th>gS</th>
<th>OITA</th>
<th>DEPTA</th>
<th>INV FATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>dDR</td>
<td>1.00000</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
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<td>DR_{t-1}</td>
<td>-0.24582</td>
<td>1.00000</td>
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<tr>
<td>EC</td>
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<td>0.3082</td>
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<tr>
<td>BC7</td>
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<td>-0.06913</td>
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<td>0.0167</td>
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<td>0.0602</td>
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</tr>
<tr>
<td>IND13</td>
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<td>0.01517</td>
<td>0.05591</td>
<td>-0.17608</td>
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<tr>
<td>0.0227</td>
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<td>0.7727</td>
<td>0.2868</td>
<td>0.0007</td>
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<tr>
<td>IND14</td>
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<td>0.06524</td>
<td>-0.01577</td>
<td>0.04547</td>
<td>-0.10323</td>
<td>-0.32530</td>
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<tr>
<td>lnS</td>
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<td>-0.00741</td>
<td>-0.17006</td>
<td>0.11550</td>
<td>0.16208</td>
<td>0.02430</td>
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<td>0.0019</td>
<td>0.6436</td>
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<td>gTA</td>
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<td>-0.00732</td>
<td>-0.02823</td>
<td>-0.05776</td>
<td>0.12096</td>
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<td>-0.14754</td>
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<td>0.5909</td>
<td>0.2710</td>
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<td>0.0030</td>
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<td>0.0047</td>
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<tr>
<td>OITA</td>
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<td>-0.17772</td>
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<td>-0.00461</td>
<td>-0.03198</td>
<td>0.12179</td>
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<td>0.9300</td>
<td>0.5425</td>
<td>0.0199</td>
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<td>DEPTA</td>
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<td>-0.17341</td>
<td>-0.00424</td>
<td>0.00515</td>
<td>-0.06159</td>
<td>0.12528</td>
<td>0.24914</td>
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<td>0.3756</td>
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<td>INV FATA</td>
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</tr>
</tbody>
</table>

Notes: 1. sample size = 365.  2. dDR = total debt ratio adjustment in the current year; DR_{t-1} = total debt ratio at the end of the previous year; EC = 0 for economic trough and 1 for economic peak; BC7 = 0 for Business Cycles 6 and 8 and 1 for Business Cycle 7; BC8 = 0 for Business Cycles 6 and 7 and 1 for Business Cycle 8; IND13 = the dummy variable with a value of 1 for the plastics industry; IND14 = the dummy variable with a value of 1 for the textile industry; lnS = natural logarithm of net sales; gTA = annual growth rate of total assets; OITA = net operating income/total assets; DEPTA = depreciation/total assets; INV FATA = inventory plus net fixed assets/total assets; lnS×EC, gTA×EC, OITA×EC, DEPTA×EC and INV FATA×EC = interactions between firm-specific variables and macroeconomic conditions.  3. The figure located below the coefficient of correlation is the probability of whether the coefficient of correlation is significantly different from zero or not.
### Table 5.2C
Correlation Matrix for Model Variables in the Subsample with a Positive Adjustment Gap

<table>
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<tr>
<th></th>
<th>dDR</th>
<th>DRt-1</th>
<th>EC</th>
<th>BC7</th>
<th>BC8</th>
<th>IND13</th>
<th>IND14</th>
<th>lnS</th>
<th>gS</th>
<th>OITA</th>
<th>DEPTA</th>
<th>INVFATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>dDR</td>
<td>1.00000</td>
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<td>DRt-1</td>
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<td>BC8</td>
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<tr>
<td>IND13</td>
<td>-0.13594</td>
<td>-0.23048</td>
<td>-0.00722</td>
<td>-0.02577</td>
<td>0.06017</td>
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<td>IND14</td>
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<td>0.04941</td>
<td>0.06133</td>
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<td>-0.32486</td>
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</tr>
<tr>
<td>lnS</td>
<td>-0.21771</td>
<td>0.01376</td>
<td>-0.09388</td>
<td>-0.30902</td>
<td>0.35028</td>
<td>0.24722</td>
<td>-0.08392</td>
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</tr>
<tr>
<td>gTA</td>
<td>0.32379</td>
<td>0.04941</td>
<td>0.06133</td>
<td>-0.05882</td>
<td>-0.32486</td>
<td>1.00000</td>
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<td></td>
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</tr>
<tr>
<td>OITA</td>
<td>-0.19238</td>
<td>-0.14258</td>
<td>0.06657</td>
<td>-0.00393</td>
<td>0.10198</td>
<td>-0.35380</td>
<td>0.16342</td>
<td>0.13476</td>
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<tr>
<td>DEPTA</td>
<td>-0.25091</td>
<td>-0.11620</td>
<td>-0.05956</td>
<td>-0.06351</td>
<td>-0.02044</td>
<td>0.09322</td>
<td>0.14590</td>
<td>0.07045</td>
<td>-0.28825</td>
<td>0.10658</td>
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<tr>
<td>INVFATA</td>
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<td>0.07042</td>
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<td>-0.06555</td>
<td>0.41786</td>
<td>-0.18856</td>
<td>-0.19138</td>
<td>-0.12832</td>
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<td>1.00000</td>
</tr>
</tbody>
</table>

Notes: 1. sample size = 262. 2. dDR = total debt ratio adjustment in the current year; DRt-1 = total debt ratio at the end of the previous year; EC = 0 for economic trough and 1 for economic peak; BC7 = 0 for Business Cycles 6 and 8 and 1 for Business Cycle 7; BC8 = 0 for Business Cycles 6 and 7 and 1 for Business Cycle 8; IND13 = the dummy variable with a value of 1 for the plastics industry; IND14 = the dummy variable with a value of 1 for the textile industry; lnS = natural logarithm of net sales; gTA = annual growth rate of total assets; OITA = net operating income/total assets; DEPTA = depreciation/total assets; INVFATA = inventory plus net fixed assets/total assets; lnS×EC, gTA×EC, OITA×EC, DEPTA×EC and INVFATA×EC = interactions between firm-specific variables and macroeconomic conditions. 3. The figure located below the coefficient of correlation is the probability of whether the coefficient of correlation is significantly different from zero or not.
3. The debt ratio adjustment is not significantly related to industry types IND13 and IND14 in the full sample. However, the debt ratio adjustment is statistically significant and positively related to IND13 but not significantly related to IND14 in the subsample with a negative adjustment. On the other hand, the debt ratio adjustment is statistically significant and negatively related to IND13 but not significantly related to IND14 in the subsample with a positive adjustment.

4. The debt ratio adjustment is statistically significant and positively related to gTA and negatively related to OITA and DEPTA in the full sample. However, the debt ratio adjustment is statistically significant and positively related to \( lnS \) and negatively related to gTA and OITA in the subsample with a negative adjustment, i.e. with the financial constraint of over-leverage. On the other hand, the debt ratio adjustment is statistically significant and positively related to gTA and negatively related to \( lnS \), OITA and DEPTA in the subsample with a positive adjustment, i.e. with the financial constraint of under-leverage.

5. A high correlation amongst the explanatory variables in the empirical model is found such as the correlation between BC7 and BC 8, IND14 and INVFATA, and DEPTA and INVFATA. Therefore, the centering technique suggested by Cronbach (1987) is utilized to avoid the problem of multicollinearity.

**5.4.3 Regression Results Based on Equations 5-5 and 5-5A**

Based on Equations 5-5 and 5-5A, the regression results for the determination of the debt ratio adjustment and the actual debt ratio in the subsamples with a negative or a positive adjustment gap are shown in Tables 5.3 and 5.4, respectively.
Table 5.3
Regression Results in the Subsample with a Negative Adjustment Gap

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDR)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
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<tr>
<td>DR&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>-0.16260</td>
<td>-6.26&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>EC</td>
<td>0.00688</td>
<td>0.85</td>
</tr>
<tr>
<td>BC7</td>
<td>-0.05704</td>
<td>-6.86&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>BC8</td>
<td>-0.04843</td>
<td>-6.16&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>IND13</td>
<td>-0.00257</td>
<td>-0.21</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.01244</td>
<td>-1.30</td>
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<tr>
<td>lnS</td>
<td>0.01008</td>
<td>2.87&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>gTA</td>
<td>-0.02326</td>
<td>-1.95&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.15805</td>
<td>-3.00&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.40157</td>
<td>-2.01&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.07798</td>
<td>2.40&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>lnS×EC</td>
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<td>gTA×EC</td>
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<td>-2.91&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>OITA×EC</td>
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<td>1.45</td>
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<tr>
<td>DEPTA×EC</td>
<td>-0.35044</td>
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</tr>
<tr>
<td>INVFATA×EC</td>
<td>0.06416</td>
<td>1.10</td>
</tr>
</tbody>
</table>

Notes:
1. $dDR_t$ = total debt ratio adjustment in the current year;
   $DR_t$ = total debt ratio at the end of the current year;
   EC = 0 for economic trough and 1 for economic peak;
   BC7 = 0 for Business Cycles 6 and 8 and 1 for Business Cycle 7;
   BC8 = 0 for Business Cycles 6 and 7 and 1 for Business Cycle 8;
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   lnS = natural logarithm of net sales;
   gTA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
   lnS×EC, gTA×EC, OITA×EC, DEPTA×EC and INVFATA×EC = interactions between firm-specific variables and macroeconomic conditions.
2. <sup>a</sup>, <sup>b</sup> and <sup>c</sup> indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment ($\gamma$) and the regression coefficient ($\beta$) of each independent variable except the previous actual debt ratio ($DR_{t-1}$) as shown in Equations 5-5 and 5-5A.
4. | N | Adj. R-square | F value | Durbin-Watson D value |
<table>
<thead>
<tr>
<th></th>
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<td>(1)</td>
<td>365</td>
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<td>(2)</td>
<td>365</td>
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<td>89.36&lt;sup&gt;a&lt;/sup&gt;</td>
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</table>
5. VIF: Variance Inflation Factor
### Table 5.4
Regression Results in the Subsample with a Positive Adjustment Gap

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDR)</th>
<th></th>
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<th>(2) Dependent variable: Actual Debt Ratio (DR)</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
<td>VIF(^5)</td>
<td>Coefficient</td>
<td>t Value</td>
<td>VIF(^5)</td>
</tr>
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<td>-0.05021</td>
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<td>0.94979</td>
<td>43.79(^a)</td>
<td>1.62064</td>
</tr>
<tr>
<td>EC</td>
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<td>2.58(^b)</td>
<td>2.27459</td>
<td>0.01715</td>
<td>2.58(^b)</td>
<td>2.27459</td>
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<tr>
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<td>0.06881</td>
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<td>1.79011</td>
<td>0.06881</td>
<td>9.37(^a)</td>
<td>1.79011</td>
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<td>BC8</td>
<td>0.05585</td>
<td>8.20(^b)</td>
<td>2.71372</td>
<td>0.05585</td>
<td>8.20(^b)</td>
<td>2.71372</td>
</tr>
<tr>
<td>IND13</td>
<td>-0.00076</td>
<td>-0.08</td>
<td>1.53290</td>
<td>-0.00076</td>
<td>-0.08</td>
<td>1.53290</td>
</tr>
<tr>
<td>IND14</td>
<td>0.00715</td>
<td>0.92</td>
<td>2.25177</td>
<td>0.00715</td>
<td>0.92</td>
<td>2.25177</td>
</tr>
<tr>
<td>lnS</td>
<td>-0.00113</td>
<td>-0.36</td>
<td>1.51025</td>
<td>-0.00113</td>
<td>-0.36</td>
<td>1.51025</td>
</tr>
<tr>
<td>gTA</td>
<td>0.02919</td>
<td>4.40(^b)</td>
<td>1.49682</td>
<td>0.02919</td>
<td>4.40(^a)</td>
<td>1.49682</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.16450</td>
<td>-3.33(^a)</td>
<td>1.43955</td>
<td>-0.16450</td>
<td>-3.33(^a)</td>
<td>1.43955</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.47091</td>
<td>-2.64(^a)</td>
<td>1.66117</td>
<td>-0.47091</td>
<td>-2.64(^a)</td>
<td>1.66117</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.06826</td>
<td>2.69(^a)</td>
<td>2.03613</td>
<td>0.06826</td>
<td>2.69(^a)</td>
<td>2.03613</td>
</tr>
<tr>
<td>lnS×EC</td>
<td>-0.00659</td>
<td>-1.13</td>
<td>1.32686</td>
<td>-0.00659</td>
<td>-1.13</td>
<td>1.32686</td>
</tr>
<tr>
<td>gTA×EC</td>
<td>-0.02806</td>
<td>-2.18(^b)</td>
<td>1.44795</td>
<td>-0.02806</td>
<td>-2.18(^b)</td>
<td>1.44795</td>
</tr>
<tr>
<td>OITA×EC</td>
<td>0.13604</td>
<td>1.49</td>
<td>1.22317</td>
<td>0.13604</td>
<td>1.49</td>
<td>1.22317</td>
</tr>
<tr>
<td>DEPTA×EC</td>
<td>-0.28625</td>
<td>-0.83</td>
<td>1.54321</td>
<td>-0.28625</td>
<td>-0.83</td>
<td>1.54321</td>
</tr>
<tr>
<td>INVFATA×EC</td>
<td>0.08207</td>
<td>1.84(^c)</td>
<td>1.57982</td>
<td>0.08207</td>
<td>1.84(^c)</td>
<td>1.57982</td>
</tr>
</tbody>
</table>

**Notes:**
1. \(dDR\(_t\)\) = total debt ratio adjustment in the current year;
   \(DR\(_t\)\) = total debt ratio at the end of the current year;
   \(DR\(_{t-1}\)\) = total debt ratio at the end of the previous year;
   EC = 0 for economic trough and 1 for economic peak;
   BC7 = 0 for Business Cycles 6 and 8 and 1 for Business Cycle 7;
   BC8 = 0 for Business Cycles 6 and 7 and 1 for Business Cycle 8;
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   lnS = natural logarithm of net sales;
   gTA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
   lnS×EC, gTA×EC, OITA×EC, DEPTA×EC and INVFATA×EC = interactions between firm-specific variables and macroeconomic conditions.
2. \(^a\), \(^b\) and \(^c\) indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable except the previous actual debt ratio (DR\(_{t-1}\)) as shown in Equations 5-5 and 5-5A.
4. | N | Adj. R-square | F value | Durbin-Watson D value |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>262</td>
<td>0.7262</td>
<td>44.43(^a)</td>
</tr>
<tr>
<td>(2)</td>
<td>262</td>
<td>0.9175</td>
<td>183.18(^a)</td>
</tr>
</tbody>
</table>
5. VIF: Variance Inflation Factor
As shown in Note 4 of Table 5.3, the explanatory power, i.e. adjusted R-square, of the models for the determination of the debt ratio adjustment and the actual debt ratio in the subsample with a negative adjustment gap is 43.10% and 79.48%, respectively. In addition, no serious residual auto-correlation problems are found according to the value of Durbin-Watson D that is close to 2, i.e. 1.928 as also shown in Note 4 of the table. Further, as can be seen in the VIF column of Table 5.3, the values of variance inflation factor (VIF) much less than the critical value of 10 are often regarded as indicating no problematic multicollinearity (Chatterjee and Price, 1991). Furthermore, no sample observations with values of DFFITS are greater than 1 that indicates no outlier effect in the subsample with a negative adjustment gap (Belsey, 1980).

On the other hand, the explanatory power, i.e. adjusted R-square, of the models for the determination of the debt ratio adjustment and the actual debt ratio in the subsample with a negative adjustment gap is 72.62% and 91.75%, respectively, as shown in Note 4 of Table 5.4. In addition, no serious residual auto-correlation problems are found according to the value of Durbin-Watson D that is close to 2, i.e. 2.058, as also shown in Note 4 of Table 5.4. Further, no serious multicollinearity problem is found according to the values of variance inflation factor (VIF) shown in the VIF column of Table 5.4 that are much less than the critical value of 10. Furthermore, no sample observations with values of DFFITS are greater than 1 that indicates no outlier effect in the subsample with a positive adjustment gap (Belsey, 1980).

Further analyses on the regression results in the subsamples with negative and positive adjustment gap over Business Cycles 6 to 8 shown in Tables 5.3 and 5.4 are now discussed.

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11 Variance inflation factor (VIF) is a measure of multicollinearity. If R-square, is the amount of variability of an independent variable i that is explained by all of the other independent variables in the regression model, then VIF is calculated as 1 / (1 - R-square). A VIF value greater than 10 is often regarded as a signal that the data have multicollinearity problem.

12 DFFITS is a t-like statistic to measure the influence of observation on the estimates. Large values of DFFITS indicate high influence of the observations on the estimates. A general cutoff to consider is 2. DFFITS value is calculated as \( \text{DFFITS} = \frac{(y_i - \hat{y}_i)}{(\sigma_i \sqrt{h_i})} \). Refer to SAS/STAT User’s Guide (Volume 2) for detail information of DFFITS calculation.
5.4.3.1 Control Variables for Firm Characteristics

According to the t-value shown in the t-value columns in Table 5.3 in the subsample with a negative adjustment gap, i.e. with the financial constraint of over-leverage, all firm-specific variables are significantly related to the determination of the debt ratio adjustment and the actual debt ratio during the period from 1983 to 1995 over Business Cycles 6 to 8 in Taiwan. In addition, the effects of these firm-specific variables on the debt ratio adjustment and the actual debt ratio are consistent with the finding of prior studies on the determination of capital structure. Firm size ($lnS$) and asset tangibility (INVFATA) are statistically significant and positively related to the debt ratio adjustment and the actual debt ratio and growth opportunities (gTA), profitability (OITA) and non-debt tax shields (DEPTA) are statistically significant and negatively related to the debt ratio adjustment and the actual debt ratio.

On the other hand, according to the t-value shown in the t-value columns in Table 5.4 in the subsample with a positive gap, i.e. with the financial constraint of under-leverage, all firm-specific variables except firm size ($lnS$) are significantly related to the determination of the debt ratio adjustment and the actual debt ratio during the period from 1983 to 1995 over Business Cycles 6 to 8. Growth opportunities (gTA) and asset tangibility (INVFATA) are statistically significant and positively related to the debt ratio adjustment and the actual debt ratio. In addition, profitability (OITA) and non-debt tax shields (DEPTA) are statistically significant and negatively related to the debt ratio adjustment and the actual debt ratio.

Based on the findings above, the effects of firm size and growth opportunities vary with the negative and positive adjustment gaps, i.e. with the financial constraints of over-leverage or under-leverage faced by firms. This illustrates the variation in the determination of capital structure according to the financial constraints of over-leverage and under-leverage. The findings suggest that, with the financial constraint of over-leverage, large firms tend to finance with more debt than small firms. However, the debt ratio adjustment and the actual debt ratio are not influenced by the effect of firm size for firms with the financial constraint of under-leverage. Further, with the financial constraint of over-leverage, firms tend to gear down debt leverage in response to future investment and growth opportunities. However, firms, with the
financial constraint of under-leverage, finance with more debt despite future investment and growth opportunities.

5.4.3.2 Control Variables for Industry Effect

According to the t-value shown in the t-value columns in Tables 5.3 and 5.4, the debt ratio adjustment and the actual debt ratio are not significantly related to industry type for the listed firms in the textile, plastics and electronics industries in the subsamples with a positive or a negative gap. The finding is not consistent with most prior studies. However, the finding seems to support the conclusion of Balakrishnan and Fox (1993) that capital structure is mostly determined by factors of firm characteristics instead of by industry factors.

5.4.3.3 Macroeconomic Conditions and Their Interactions with Firm-Specific Variables

According to the t-value shown in the t-value columns in Table 5.3 in the subsample with a negative adjustment gap, the dummy proxy for macroeconomic conditions, i.e. EC, in the subsample with a negative adjustment gap is not significantly related to the debt ratio adjustment and the actual debt ratio of the listed firms in the textile, plastics and electronics industries during the period from 1983 to 1995 over Business Cycles 6 to 8 in Taiwan. On the other hand, according to the t-value shown in Table 5.4 in the subsample with a positive adjustment gap, the dummy proxy for macroeconomic conditions is, as expected, statistically significant and positively related to the debt ratio adjustment and the actual debt ratio of the listed firms in the textile, plastics and electronics industries over Business Cycles 6 to 8 in Taiwan. The result in the subsample with a positive adjustment gap is consistent with the conclusion of Stulz (1990) that firms finance with less debt in response to future investment and growth opportunities. In addition, the findings in the subsamples with a negative or a positive adjustment gap suggest that the effect of macroeconomic conditions varies according to whether the adjustment gap between the target debt ratio and the previous actual debt ratio is positive or negative.

Second, according to the t-value shown in the t-value columns in Table 5.3, the
interaction between growth opportunities and macroeconomic conditions, i.e. gTA×EC, is statistically significant and negatively related to the debt ratio adjustment and the actual debt ratio in the subsample with a negative adjustment gap. The results show that the effect of growth opportunities on the debt ratio adjustment and the actual debt ratio is augmented by macroeconomic conditions although macroeconomic conditions do not have a direct effect on the debt ratio adjustment and the actual debt ratio in the subsample with a negative adjustment gap. On the other hand, according to the t-value shown in Table 5.4, the interaction between growth opportunities and macroeconomic conditions, i.e. gTA×EC, is statistically significant and negatively related to the debt ratio adjustment and the actual debt ratio in the subsample with a positive adjustment gap. The interaction between asset tangibility and macroeconomic conditions is statistically significant and positively related to the debt ratio adjustment and the actual debt ratio in the subsample with a positive adjustment gap. The findings on the interaction effect in the subsamples with a negative or a positive adjustment gap illustrate the variation in the effect of interactions between firm-specific variables and macroeconomic conditions on the debt ratio adjustment and the actual debt ratio. The effect of the interaction between firm characteristics and macroeconomic conditions varies according to whether the adjustment gap between the target debt ratio and the previous actual debt ratio is negative or positive.

In brief, the findings above suggest that the effects of macroeconomic conditions and their interaction with firm-specific variables vary according to whether firms have a financial constraint of over-leverage or under-leverage, i.e. a negative or a positive adjustment gap between the target debt ratio and the previous actual debt ratio.

5.4.3.4 Adjustment Rate

Looking at the t-value shown in column t-value of Tables 5.3 and 5.4, the previous actual debt ratio (DR_{t-1}) is statistically significant and negatively related to the debt ratio adjustment (dDR) in the case of a negative and a positive gap over Business Cycles 6 to 8 for the listed firms in the textile, plastics an electronics industry of Taiwan. The regression coefficient of the previous actual debt ratio in the empirical
model for the determination of the debt ratio adjustment, i.e. Equation 5-5, is exactly equal to the negative value of the adjustment rate of debt ratio ($-\gamma$). Alternatively, the regression coefficient of the previous actual debt ratio in the empirical model for the determination of actual debt ratio, i.e. Equation 5-5A, is exactly equal to 1 minus the adjustment rate of debt ratio adjustment ($1-\gamma$). Therefore, the adjustment rate of debt ratio is 0.16260 (or $1-0.83740$) according to the regression coefficients of the previous actual debt ratio for the determination of the debt ratio adjustment and the actual debt ratio in Table 5.3. On the other hand, as shown in Table 5.4, the adjustment rate of debt ratio is 0.05021 (or $1-0.94979$) according to the regression coefficients of the previous actual debt ratio for the determination of the debt ratio adjustment and the actual debt ratio in the subsample with a positive adjustment gap. The adjustment rate of debt ratio found in the case of both a positive and a negative adjustment gap shown in Tables 5.3 and 5.4 is much lower than a rapid adjustment rate of 0.343 per year found by Flannery and Rangan (2006). In addition, the effect of the explanatory variables, except the previous actual debt ratio, on the debt ratio adjustment is a proportion of the regression coefficients of these variables in Equations 5-5 and 5-5A. The proportion depends upon the adjustment rate in Equations 5-5 and 5-5A.

The findings above suggest that the adjustment rate of debt ratio is faster for firms with a negative adjustment gap, i.e. a financial constraint of over-leverage, than for those with a positive adjustment gap, i.e. a financial constraint of under-leverage. Firms with the financial constraint of over-leverage tend to gear down their leverage due to the high risk of bankruptcy and adjust faster to rebalance their debt ratio towards the target level. This implies that firms adjust at a different rate of debt ratio adjustment over time when they have a negative or a positive adjustment gap between the target debt ratio and the previous actual debt ratio - a finding that does not support the constant adjustment rate of Flannery and Rangan (2006). The major discrepancy between the findings of the thesis and that of Flannery and Rangan arises from the following: (a) the use of a different sample and different time period – the thesis is based on an emerging market at the years 1983 to 1995 while Flannery and Rangan use a developed country (USA) data at the years 1965 to 2001, and (b) the thesis takes into account macroeconomic conditions as well as the gap between the target capital structure and the previous capital structure, while Flannery and Rangan do not do so.
Moreover, in order to contrast the difference when negative and positive adjustment gaps are or are not taken into account in the estimation of the modified partial adjustment model utilized in the study, the regression results for the determination of the debt ratio adjustment and the actual debt ratio in the full sample when negative and positive adjustment gaps are not taken into account are shown in Table 5.5.

### Table 5.5
Regression Results in the Full Sample without the Dummy Variable for Negative and Positive Adjustment Gaps

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDR)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DR_{t-1}</td>
<td>-0.23597</td>
<td>-11.04^a</td>
</tr>
<tr>
<td>IND13</td>
<td>0.00005</td>
<td>0.00</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.01173</td>
<td>-1.44</td>
</tr>
<tr>
<td>EC</td>
<td>0.02748</td>
<td>4.05^a</td>
</tr>
<tr>
<td>BC7</td>
<td>-0.01455</td>
<td>-1.99^b</td>
</tr>
<tr>
<td>BC8</td>
<td>-0.01321</td>
<td>-1.95^c</td>
</tr>
<tr>
<td>lnS</td>
<td>0.00921</td>
<td>2.94^a</td>
</tr>
<tr>
<td>gTA</td>
<td>0.03148</td>
<td>3.84^a</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.34547</td>
<td>-7.44^a</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.58540</td>
<td>-3.30^a</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.11677</td>
<td>4.30^a</td>
</tr>
<tr>
<td>lnS×EC</td>
<td>-0.00936</td>
<td>-1.54</td>
</tr>
<tr>
<td>gTA×EC</td>
<td>-0.01871</td>
<td>-1.16</td>
</tr>
<tr>
<td>OITA×EC</td>
<td>0.11080</td>
<td>1.24</td>
</tr>
<tr>
<td>DEPTA×EC</td>
<td>-0.47607</td>
<td>-1.38</td>
</tr>
<tr>
<td>INVFATA×EC</td>
<td>0.13123</td>
<td>2.72^a</td>
</tr>
</tbody>
</table>

Notes:
1. dDR = total debt ratio adjustment in the current year;
   DR = total debt ratio at the end of the current year;
   DR_{t-1} = total debt ratio at the end of the previous year;
   EC = 0 for economic trough and 1 for economic peak;
   BC7 = 0 for Business Cycles 6 and 8 and 1 for Business Cycle 7;
   BC8 = 0 for Business Cycles 6 and 7 and 1 for Business Cycle 8;
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   lnS = natural logarithm of net sales;
   gTA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
   lnS×EC, gTA×EC, OITA×EC, DEPTA×EC and INVFATA×EC = interactions between firm-specific variables and macroeconomic conditions.
2. ^a, ^b and ^c indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable.
4. Case N Adj. R-square F value Durbin-Watson D value
   (1) 627 0.2551 14.42^a 1.289
   (2) 627 0.7510 119.22^a 1.289
5. VIF: Variance Inflation Factor
As shown in Note 4 in Table 5.5, the adjusted R-square for the model without negative and positive adjustment gaps taken into account is much lower than that for the model used in the study. In addition, based on Equations 5-5 and 5-5A, the regression coefficient of the previous actual debt ratio is respectively equal exactly to the negative value of the adjustment rate (−γ) and to 1 minus the adjustment rate (1−γ). The adjustment rate of debt ratio (0.23597 or 1−0.76403) shown in Table 5.5 is much lower than a rapid adjustment rate of 0.343 per year found by Flannery and Rangan (2006). In addition, the adjustment rate of debt ratio shown in Table 5.5 is overestimated without the adjustment gaps taken into account. It is also much higher than the adjustment rates of 0.16260 and 0.05021 shown respectively in Tables 5.3 and 5.4 with negative and positive adjustment gaps taken into account. These additional regression results reflect the fact that, as discussed in Section 4.9, the estimation should take into account whether the adjustment gap between the target capital structure and the previous actual capital structure is negative or positive.

### 5.4.4 Regression Results Based on Equations 5-6 and 5-6A

Based on Equations 5-6 and 5-6A, the regression results for the determination of the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of over-leverage or under-leverage in the case of a negative or a positive adjustment gap at years of economic trough and peak are shown in Tables 5.6 to 5.9, respectively.

As shown in the variance inflation factor (VIF) columns of Tables 5.6 to 5.9, the values of VIF are much less than the critical value of 10 suggested by Chatterjee and Price (1991). Hence, no serious multicollinearity problem exists. In addition, according to the values of Durbin-Watson D shown in Note 4 of these tables that are close to 2, no serious residual auto-correlation problem is found. Moreover, no observations exist with values of DFFITS (Belsey, 1980) greater than one, indicating no outlier effect in the subsample with a negative adjustment gap. Further analyses on the regression results are now discussed.
### Table 5.6
**Regression Results in the Subsample with a Negative Adjustment Gap during Years of Economic Trough**

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDR)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DR$_{t-1}$</td>
<td>-0.19206</td>
<td>-5.41$^a$</td>
</tr>
<tr>
<td>IND13</td>
<td>0.02961</td>
<td>1.64</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.00242</td>
<td>-0.18</td>
</tr>
<tr>
<td>BC7</td>
<td>-0.06927</td>
<td>-6.33$^a$</td>
</tr>
<tr>
<td>BC8</td>
<td>-0.05580</td>
<td>-5.33$^a$</td>
</tr>
<tr>
<td>lnS</td>
<td>0.01088</td>
<td>2.16$^b$</td>
</tr>
<tr>
<td>gTA</td>
<td>0.01444</td>
<td>0.90</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.22741</td>
<td>-2.78$^a$</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.39065</td>
<td>-1.32</td>
</tr>
<tr>
<td>INVATA</td>
<td>0.05281</td>
<td>1.14</td>
</tr>
</tbody>
</table>

**Notes:**
1. dDR$_t$ = total debt ratio adjustment in the current year; DR$_t$ = total debt ratio at the end of the current year; DR$_{t-1}$ = total debt ratio at the end of the previous year; IND13 = the dummy variable with a value of 1 for the plastics industry; IND14 = the dummy variable with a value of 1 for the textile industry; BC7 = 0 for Business Cycles 6 and 8 and 1 for Business Cycle 7; BC8 = 0 for Business Cycles 6 and 7 and 1 for Business Cycle 8; lnS = natural logarithm of net sales; gTA = annual growth rate of total assets; OITA = net operating income/total assets; DEPTA = depreciation/total assets; INVATA = inventory plus net fixed assets/total assets.
2. $^a$, $^b$ and $^c$ indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment ($\gamma$) and the regression coefficient ($\beta$) of each independent variable except the previous actual debt ratio (DR$_{t-1}$) as shown in Equations 5-6 and 5-6A.
4. N Adj. R-square F value Durbin-Watson D value
   (1) 204 0.4538 17.95$^a$ 1.739
   (2) 204 0.7737 70.76$^a$ 1.739
5. VIF: Variance Inflation Factor
Table 5.7
Regression Results in the Subsample with a Negative Adjustment Gap during Years of Economic Peak

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDR)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DRt-1</td>
<td>-0.11738</td>
<td>-3.28(^a)</td>
</tr>
<tr>
<td>IND13</td>
<td>-0.03423</td>
<td>-2.12(^b)</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.01893</td>
<td>-1.43</td>
</tr>
<tr>
<td>BC7</td>
<td>-0.03936</td>
<td>-3.33(^a)</td>
</tr>
<tr>
<td>BC8</td>
<td>-0.03680</td>
<td>-3.89(^a)</td>
</tr>
<tr>
<td>lnS</td>
<td>0.00968</td>
<td>2.04(^b)</td>
</tr>
<tr>
<td>gTA</td>
<td>-0.06439</td>
<td>-3.76(^a)</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.05180</td>
<td>-0.79</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.46369</td>
<td>-1.76(^c)</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.10371</td>
<td>2.37(^b)</td>
</tr>
</tbody>
</table>

Notes:
1. dDR\(_t\) = total debt ratio adjustment in the current year;
   DR\(_t\) = total debt ratio at the end of the current year;
   DR\(_{t-1}\) = total debt ratio at the end of the previous year;
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   BC7 = 0 for Business Cycles 6 and 8 and 1 for Business Cycle 7;
   BC8 = 0 for Business Cycles 6 and 7 and 1 for Business Cycle 8;
   lnS = natural logarithm of net sales;
   gTA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
2. \(^a\), \(^b\), \(^c\) indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (\(\gamma\)) and the regression coefficient (\(\beta\)) of each independent variable except the previous actual debt ratio (DR\(_{t-1}\)) as shown in Equations 5-6 and 5-6A.
4. N Adj. R-square F value Durbin-Watson D value
   (1) 161 0.4279 13.04\(^a\) 2.014
   (2) 161 0.8324 80.98\(^a\) 2.014
5. VIF: Variance Inflation Factor

129
### Table 5.8
Regression Results in the Subsample with a Positive Adjustment Gap during Years of Economic Trough

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDR)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DR_{t-1}</td>
<td>-0.02657</td>
<td>-0.87</td>
</tr>
<tr>
<td>IND13</td>
<td>0.01205</td>
<td>0.95</td>
</tr>
<tr>
<td>IND14</td>
<td>0.00784</td>
<td>0.74</td>
</tr>
<tr>
<td>BC7</td>
<td>0.06725</td>
<td>7.47*</td>
</tr>
<tr>
<td>BC8</td>
<td>0.06442</td>
<td>7.55*</td>
</tr>
<tr>
<td>lnS</td>
<td>-0.00089</td>
<td>-0.21</td>
</tr>
<tr>
<td>gTA</td>
<td>0.04293</td>
<td>4.53*</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.20157</td>
<td>-2.94*</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.34516</td>
<td>-1.30</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.03299</td>
<td>0.89</td>
</tr>
</tbody>
</table>

Notes:
1. $dDR_t$ = total debt ratio adjustment in the current year;
   $DR_t$ = total debt ratio at the end of the current year;
   $DR_{t-1}$ = total debt ratio at the end of the previous year;
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   BC7 = 0 for Business Cycles 6 and 8 and 1 for Business Cycle 7;
   BC8 = 0 for Business Cycles 6 and 7 and 1 for Business Cycle 8;
   lnS = natural logarithm of net sales;
   gTA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
2. \*\*, \*, and \* indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment ($\gamma$) and the regression coefficient ($\beta$) of each independent variable except the previous actual debt ratio (DR_{t-1}) as shown in Equations 5-6 and 5-6A.
4. N | Adj. R-square | F value | Durbin-Watson D value |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>132</td>
<td>0.7092</td>
<td>33.19*</td>
</tr>
<tr>
<td>(2)</td>
<td>132</td>
<td>0.9095</td>
<td>133.73*</td>
</tr>
</tbody>
</table>
5. VIF: Variance Inflation Factor
### Table 5.9
Regression Results in the Subsample with a Positive Adjustment Gap during Years of Economic Peak

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDR)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DR&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>-0.06875</td>
<td>-2.18&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>IND13</td>
<td>-0.01472</td>
<td>-0.96</td>
</tr>
<tr>
<td>IND14</td>
<td>0.00973</td>
<td>0.86</td>
</tr>
<tr>
<td>BC7</td>
<td>0.08964</td>
<td>8.24&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>BC8</td>
<td>0.06640</td>
<td>8.16&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>lnS</td>
<td>-0.00243</td>
<td>-0.50</td>
</tr>
<tr>
<td>gTA</td>
<td>0.01324</td>
<td>1.41</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.09592</td>
<td>-1.34</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.66503</td>
<td>-2.80&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.11632</td>
<td>3.30&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Notes:
1. dDR<sub>t</sub> = total debt ratio adjustment in the current year;
   DR<sub>t</sub> = total debt ratio at the end of the current year;
   DR<sub>t-1</sub> = total debt ratio at the end of the previous year;
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   BC7 = 0 for Business Cycles 6 and 8 and 1 for Business Cycle 7;
   BC8 = 0 for Business Cycles 6 and 7 and 1 for Business Cycle 8;
   lnS = natural logarithm of net sales;
   gTA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
2. <sup>a</sup>, <sup>b</sup> and <sup>c</sup> indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable except the previous actual debt ratio (DR<sub>t-1</sub>) as shown in Equations 5-6 and 5-6A.
4. | N | Adj. R-square | F value | Durbin-Watson D value |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>130</td>
<td>0.7290</td>
<td>35.97&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>(2)</td>
<td>130</td>
<td>0.9204</td>
<td>151.35&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
5. VIF: Variance Inflation Factor
5.4.4.1 Control Variables for Firm Characteristics

According to the t-value shown in the t-value column of Table 5.6, firm-specific variables such as firm size (\(\ln S\)) and profitability (OITA) are significantly related to the debt ratio adjustment and the actual debt ratio at years of economic trough over Business Cycles 6 to 8. However, according to the t-value shown in the t-value column of Table 5.7, firm-specific variables such as firm size (\(\ln S\)), growth opportunities (gTA), non-debt tax shields (DEPTA) and asset tangibility (INVFATA) are significantly related to debt ratio adjustment and actual debt ratio at years of economic peak over Business Cycles 6 to 8. These results show the variation in the determination of the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of over-leverage in the case of a negative adjustment gap across years at economic trough and peak over Business Cycles 6 to 8 for the textile, plastics and electronics industries in Taiwan.

On the other hand, according to the t-value shown in the t-value column in Table 5.8, firm-specific variables such as growth opportunities (gTA) and profitability (OITA) are significantly related to the debt ratio adjustment and the actual debt ratio at years of economic trough over Business Cycles 6 to 8. However, according to the t-value shown in the t-value column of Table 5.9, firm-specific variables such as non-debt tax shields (DEPTA) and asset tangibility (INVFATA) are significantly related to the debt ratio adjustment and the actual debt ratio at years of economic peak over Business Cycles 6 to 8. These results show the variation in the determination of the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of under-leverage in the case of a positive adjustment gap across years at economic trough and peak over Business Cycles 6 to 8 for the textile, plastics and electronics industries in Taiwan.

5.4.4.2 Control Variables for Industry Effect

As shown in Tables 5.6 to 5.9, the debt ratio adjustment and the actual debt ratio are significantly related to the effect of industry type for the listed firms with the financial constraint of over-leverage in the case of a negative adjustment gap at years of economic peak in the plastic, textile and electronics industries over Business Cycles 6
to 8. These results are similar to those based on Equations 5-5 and 5-5A discussed earlier. The finding seems to support the conclusion of Balakrishnan and Fox (1993).

5.4.4.3 The Effect of Business Cycles

As shown in Tables 5.6 to 5.9, the dummy variables for business cycles BC7 and BC8 are statistically significant and negatively related to the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of over-leverage in the case of a negative adjustment gap for the textile, plastics and electronics industries during the sample period. On the other hand, the dummy variables for these business cycles are statistically significant and positively related to the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of under-leverage in the case of a positive adjustment gap for the textile, plastics and electronics industries. The finding shows the variation in the determination of the debt ratio adjustment and the actual debt ratio across business cycles for firms with financial constraints of over-leverage or under-leverage in the case of negative or positive adjustment gaps during the period from 1983 to 1995.

5.4.4.4 Adjustment Rate

As shown in Tables 5.7 to 5.10, the previous actual debt ratio (DR\(_{t-1}\)) is, as expected, statistically significant and negatively related to the debt ratio adjustment (dDR) but positively related to the previous actual debt ratio (DR) in the cases of both negative and positive gaps between the target debt ratio and the previous debt ratio at years of economic trough and peak over Business Cycles 6 to 8 for the listed firms in the textile, plastics and electronics industry of Taiwan. The results indicate that the adjustment rate is significantly related to the debt ratio adjustment and the actual debt ratio when firms adjust their debt leverage and deviate away from the target debt ratio.

Based on Equation 5-6, the regression coefficient of the previous actual debt ratio in the empirical model for the determination of the debt ratio adjustment is exactly equal to the negative value of the adjustment rate of debt ratio (\(-\gamma\)). On the other hand, based on Equation 5-6A, the regression coefficient of the previous actual debt ratio in
the empirical model for the determination of the actual debt ratio is exactly equal to 
one minus the adjustment rate of debt ratio adjustment \((1-\gamma)\).

Therefore, the adjustment rate of debt ratio for firms with the financial constraint of 
over-leverage in the case of a negative adjustment gap at years of economic trough is 
0.19206 (i.e. \(1-0.80794\)) according to the regression coefficients of the previous 
actual debt ratio for the determination of debt ratio adjustment and actual debt ratio as 
shown in Table 5.6. The adjustment rate of debt ratio for firms with the financial 
constraint of over-leverage in the case of a negative adjustment gap at years of 
economic peak is 0.11738 (i.e. \(1-0.88262\)) according to the regression coefficients of 
the previous actual debt ratio for the determination of the debt ratio adjustment and 
the actual debt ratio as shown in Table 5.7. The results show that firms, with the 
financial constraint of over-leverage in the case of a negative adjustment gap, adjust 
the debt ratio at a faster rate at economic trough than they do at economic peak to gear 
down the debt leverage to rebalance to the target debt ratio in order to avoid going 
bankrupt.

On the other hand, the adjustment rate of debt ratio for firms with the financial 
constraint of under-leverage in the case of a positive adjustment gap at years of 
economic trough is 0.02657 (i.e. \(1-0.97343\)) according to the regression coefficients 
of the previous actual debt ratio for the determination of the debt ratio adjustment and 
the actual debt ratio as shown in Table 5.8. The adjustment rate of debt ratio for firms 
with the financial constraint of under-leverage in the case of a positive adjustment gap 
at years of economic peak is 0.06875 (i.e. \(1-0.93125\)) according to the regression 
coefficients of the previous actual debt ratio for the determination of the debt ratio 
adjustment and the actual debt ratio as shown in Table 5.9. The results show that firms, 
with the financial constraint of under-leverage in the case of a positive adjustment gap, 
adjust debt ratio at a slower rate at economic trough than they do at economic peak to 
rebalance to the target debt ratio in order to reserve spare debt capacity for future 
investment and growth opportunities.

In brief, the findings on the variation in the adjustment rate of debt ratio do not 
support the constant adjustment rate as Flannery and Rangan (2006) conclude. The
findings show that the adjustment rate of debt ratios varies upon both macroeconomic conditions and the financial constraint of over-leverage or under-leverage in an adjustment gap between the target debt ratio and the previous actual debt ratio for the listed firms in the textile, plastics and electronics industries over Business Cycles 6 to 8. The adjustment rate is negatively related to the debt ratio adjustment for the listed firms with the financial constraint of over-leverage in the case of a negative adjustment gap in the textile, plastics and electronics industries over Business Cycles 6 to 8. On the contrary, the adjustment rate is positively related to the debt ratio adjustment for the listed firms with the financial constraint of under-leverage in the case of a positive adjustment gap in the textile, plastics and electronics industries over Business Cycles 6 to 8. The discrepancy in the findings between the thesis and Flannery and Rangan (2006) may have been due to the same reasons explained in Section 5.4.3.4.

5.5 Conclusion

The thesis research utilizes the modified partial adjustment model to examine the adjustment behavior of capital structure decisions for the listed firms in the textile, plastics and electronics industries across years of economic trough and peak over Business Cycles 6 to 8 in Taiwan. With controls for the effect of firm characteristics and industry types, the finding shows a significant effect of macroeconomic conditions on the debt ratio adjustment and, in addition, the variation in the effect of macroeconomic conditions on the debt ratio adjustment. Macroeconomic conditions have a positive effect on the debt ratio adjustment and the actual debt ratio for firms with the financial constraint of under-leverage in the case of a positive adjustment gap. No significant effect, however, appears on the determination of the debt ratio adjustment and the actual debt ratio for firms with the financial constraint of over-leverage in the case of a negative adjustment gap. The interactions between macroeconomic conditions and firm-specific variables vary according to whether firms have a negative or a positive adjustment gap.

Further, the incidental finding is that the adjustment rate of debt ratios varies according to macroeconomic conditions as well as to the financial constraint of over-leverage or under-leverage in the adjustment gap between the target debt ratio and the
previous actual debt ratio for the listed firms in the textile, plastics and electronics industries over Business Cycles 6 to 8. Firms tend to adjust at a faster rate when firms have a negative adjustment gap with the financial constraint of over-leverage to gear down leverage due to the high risk of bankruptcy. The adjustment rate is negatively related to the debt ratio adjustment for the listed firms with the financial constraint of over-leverage in the case of a negative adjustment gap in the textile, plastics and electronics industries over Business Cycles 6 to 8. On the contrary, the adjustment rate is positively related to the debt ratio adjustment for the listed firms with the financial constraint of under-leverage in the case of a positive adjustment gap in the textile, plastics and electronics industries over Business Cycles 6 to 8. The evidence on the variation in the adjustment rate of debt ratio does not support the constant adjustment rate over time as Flannery and Rangan (2006) conclude. The major discrepancy between the findings of the thesis and that of Flannery and Rangan arises from the following: (a) the use of a different sample and different time period – the thesis is based on an emerging market at the years 1983 to 1995 while Flannery and Rangan use a developed country (USA) data at the years 1965 to 2001, and (b) the thesis takes into account macroeconomic conditions as well as the gap between the target capital structure and the previous capital structure, while Flannery and Rangan do not do so.

Finally, Taiwan has a most successful record of economic transition. Within this context, the findings of this study provide new evidence on the effect of macroeconomic conditions on the debt ratio adjustment and the determination of the actual debt ratio for firms with financial constraint of over-leverage and under-leverage in the case of negative and positive adjustment gaps. Future research might address the adjustment behavior of capital structure decisions across countries in order to provide further evidence on the effect of macroeconomic conditions and on the variation in the adjustment rate of capital structure decisions, in particular, between developing and developed countries.
Chapter 6

The Impact of Economic Development on
Capital Structure: Evidence from Taiwan

6.1 Introduction

As discussed in Section 2.2, most prior studies address the determination of capital structure at firm and industry levels (Harris and Raviv, 1991, Titman and Wessels, 1988, Huang and Song, 2006). Rarely do these studies on capital structure decisions consider the effect of economic development. Boyd and Smith (1996) argue that, as an economy develops further, firms finance with more equity due to higher efficiency in the financial intermediation of capital markets. This implies that the debt ratios of firms are negatively related to economic development due to the greater equity used in the course of economic development. Chen (2004b) addresses the effect of economic development on capital structure decisions and finds mixed results among USA, Canada, Australia, and Taiwan. In her research sample, Chen finds a negative relationship between the economic growth rate and the aggregate debt-to-equity ratios in Taiwan, a relatively low-income country, but she finds a positive relationship in the USA, a relatively high-income country.

However, Stulz (1990) argues that, due to the cost of overinvestment and underinvestment arising from the agency problem between management and shareholders, firms finance with more debt when the probability increases that the firm will have free cash flow. This happens when future economic growth occurs. Based on Stulz’s argument, firms tend to finance with more debt in order to mitigate the agency problem in the course of economic development in terms of the increase in

※ The findings contained in chapter have been written as a paper, which was presented at a refereed international scholarly conference, the 15th Pacific Basin Finance, Economics, Accounting and Management Conference at Ho Chi Minh City in Vietnam on July 20 and 21, 2007. In addition, parts of the chapter have also been written into a paper which has been accepted for presentation at the Sixth International Conference of The World Association for Sustainable Development to be held in Brighton, UK, 27-29 August 2008.
probability that firms will have free cash flow. This implies that debt ratio is positively related to economic development.

Further, several prior studies (Jalilvand and Harris, 1984, Taggart, 1977, Marsh, 1982, Flannery and Rangan, 2006, Hovakimian et al., 2001) document the existence of target capital structure and the behavior of adjustment towards their target capital structure over time. Moreover, Myers and Majluf (1984) and Narayanan (1988) claim that shareholders can be better off when a firm reserves spare debt capacity for future investment and growth opportunities. In addition, several surveys (Allen, 1991, Graham and Harvey, 2001, Pinegar and Wilbricht, 1989) document qualitative evidence on the importance of spare debt capacity in capital structure choices. Based on these prior studies, it is possible to infer that firms would trade off the benefits of the spare debt capacity reserved for future investment and growth opportunities against the costs of the deviation from the target capital structure and so may deviate away from the target capital structure in the short run.

As discussed in Section 4.5, the modified partial adjustment model matches well with the adjustment behavior of capital structure decisions - that firms adjust their capital structure and may deviate away from the target capital structure in the short run. The modified partial adjustment model is utilized to examine the significance of economic development in the determination of capital structure choices and to investigate the adjustment behavior of capital structure decisions of firms with the financial constraint of over-leverage or under-leverage in the course of economic development.

In addition, as discussed in Section 3.3, Taiwan has had a successful experience in the economic transition from being a less developed country (or LDC) to becoming a newly industrialized country (or NIC). The study is conducted within the context of the textile, plastics and electronics industries of Taiwan. Each of these three industries played an important role in the course of economic development in Taiwan as discussed in Section 3.3. Therefore, this study could provide a new perspective on the effect of economic development on capital structure decisions and the adjustment behavior of capital structure in the course of economic development. The evidence found in the thesis research within the context of Taiwan could be a valuable reference for practitioners and policymakers of economies in transition.
Furthermore, in the application of the partial adjustment model, this study utilizes the modified partial adjustment model to test the significance of economic development in capital structure choices and to explore the adjustment behavior of the capital structure of firms with the financial constraint of over-leverage or under-leverage in the course of economic development. In doing so, this paper could provide evidence on the following questions: (1) Does economic development affect capital structure adjustment? (2) Does the effect of economic development on capital structure adjustment vary across the shift in the level of economic development? and (3) In the application of the modified partial adjustment model, does the adjustment rate of capital structure remain constant in the course of economic development for firms with a financial constraint of over-leverage or under-leverage in the case of a negative or a positive adjustment gap between the target capital structure and the previous actual capital structure?

6.2 Literature Review

Following the work of Modigliani and Miller (1958), prior studies on capital structure rarely consider the effect of economic development. A few studies can be excepted (Chen, 2004b, Boyd and Smith, 1996). However, these few studies have no consistent conclusions regarding the effect of economic development on capital structure choices. Further, several studies document both the existence of target capital structure and the behavior of adjustment towards the target capital structure (Jalilvand and Harris, 1984, Taggart, 1977, Marsh, 1982, Flannery and Rangan, 2006, Hovakimian et al., 2001). In addition, several studies argue that spare debt capacity or financial flexibility is an important factor of capital structure decisions (Narayanan, 1988, Allen, 1991, Graham and Harvey, 2001, Pinegar and Wilbricht, 1989, Myers and Majluf, 1984). This paper incorporates the concept of spare debt capacity into the partial adjustment model to investigate the effect of economic development on capital structure adjustment and the behavior of sustainable adjustment towards the target capital structure. A further review of literature follows.

Boyd and Smith (1996) contend that well-developed economies could lose fewer resources than less mature economies due to the presence of intermediation costs.
The evolution of financial market development tends to provide an economy with a more efficient capital market. Consequently, at low levels of financial market development, there is no use of equity market. Once the economy develops further, equity capital financing can be found due to the benefit of financial markets development. In other words, the efficiency of capital markets could be improved as the economy becomes further developed and the intermediation cost of capital markets declines. Thus, Boyd and Smith contend that equity capital financing increases as the economy develops further. This argument implies that capital structure is negatively related to economic development.

In conducting a study on the effect of economic development on capital structure in the USA, Canada, Australia and Taiwan, Chen (2004b) finds mixed results in the relationship between corporate financial structure and economic development among these nations. She finds a negative effect of economic development on aggregate debt-to-equity ratios during the period from 1965 to 2001 in Taiwan but a positive effect during the period from 1946 to 2002 in the USA. Based on Chen’s finding, the effect of economic development on the aggregate debt-equity ratios is uncertain. It is interesting to note that Chen calculates aggregate debt-to-equity ratio from the National Balance Sheet and the Flow of Funds Accounts as a proxy for corporate capital structure in examining the impact of economic development on capital structure.

Further, Stulz (1990) analyzes the problem of managerial discretion and capital structure in his model and contends that financing policy, by influencing the resources under management’s control, can reduce the costs of overinvestment and underinvestment arising from the agency problem between management and shareholders. Stulz argues that, when cash flow is high, management will have the incentive to invest too much in negative NPV investment opportunities, i.e. overinvestment. On the other hand, when cash flow is low, managers may not have sufficient funds to invest in positive NPV projects where underinvestment occurs. Consequently, Stulz (1990) argues that, to reduce the cost of overinvestment and underinvestment, firms finance with more debt when cash flow increases but finance with less debt when cash flow decreases. This implies that firms, due to the agency problem between management and shareholders, finance with less debt in response to
the future increase in cash flow arising from economic growth. Therefore, a negative relationship is expected between capital structure adjustment and future economic growth (i.e. growth opportunities). In addition, Stulz contends that the optimal face value of debt increases if cash flow increases or the probability increases that the firm will have free cash flow. This implies that firms finance with more debt when the economy reaches a higher level of the real GDP (i.e. an increase in cash flow). Therefore, based on the argument of Stulz (1990), it is expected that capital structure adjustment and the level of capital structure is positively related to economic development in terms of the level of the real GDP.

6.3 Methodology

This section discusses the theoretical model for capital structure decisions, the research sample and period, the variables used in the study and their measures. Also discussed is the empirical model used in the study both to examine the significance of economic development in capital structure decisions and to provide evidence on the adjustment behavior of the capital structure of firms with the financial constraint of over-leverage and under-leverage in the course of economic development.

6.3.1 Theoretical Model for Analyzing the Effect of Economic Development on Capital Structure

As discussed in Chapter 4, the relationship between capital structure adjustment and the adjustment rate depends upon whether a positive or a negative adjustment gap exists between the target capital structure and the previous actual capital structure. In the case of a positive adjustment gap, capital structure adjustment is positively related to the adjustment rate. On the other hand, capital structure adjustment is negatively related to the adjustment rate and the spare debt capacity in the case of a negative adjustment gap. The modified partial adjustment model for capital structure adjustment utilized to investigate the adjustment behavior with the financial constraint of under-leverage or over-leverage in the case of a positive or a negative adjustment gap (presented in Chapter 4) is expressed as follows:
ADJ_t = \sum_{j=1}^{c} \gamma \beta_{jj} x_{jj}^{'FC} + \gamma \beta_{i}^{IND} IND_{t} + \gamma \beta_{i}^{TV} TV_{t} - \gamma ACS_{t-1} + \gamma \epsilon_{i} \quad (4-4)

where:

ADJ_t = the capital structure adjustment at the end of period t,

\gamma = the adjustment rate that is determined by the adjustment cost by trading off the benefits and the costs of the deviation from the target capital structure,

\beta = the regression coefficient,

X: the variable at firm level,

IND: the dummy variable for industry types,

TV: the test variable,

ACS_{t-1} = the actual capital structure at the end of period t-1, and

\gamma \epsilon_{i} = the error term.

In order to examine the effect of economic growth and development on capital structure adjustment, the variables for economic development are included in the model. Therefore, the item of TV in Equation 4-4 shown above is rewritten as follows:

TV_{t} = ED_{t} + SED_{t} \quad (6-1)

where:

TV: the test variable,

ED: the variable for future economic growth of economic development,

SED: the dummy variable for the shift in the level of economic development,

By substituting Equation 6-1 into Equation 4-4, the theoretical model for capital structure adjustment utilized in the study to investigate the effect of economic development on capital structure adjustment of firms with a financial constraint of under-leverage or over-leverage in the case of a positive or a negative adjustment gap is rewritten as follows:
\[
ADJ_t = \sum_{j=1}^{c} \gamma_{j} \beta_{j} X_{jt}^{FC} + \gamma_{IND} \beta_{IND} \text{IND}_t + \gamma_{ED} \beta_{ED} \text{ED}_t + \gamma_{SED} \beta_{SED} \text{SED}_t - \gamma_{ACS} \text{ACS}_{t-1} + \gamma_{e_t}
\]  
(6-2)

where:

\(ADJ_t\) = the capital structure adjustment at period \(t\),
\(\gamma\) = the adjustment rate that is determined by the adjustment cost by trading off the benefits and the costs of the deviation from the target capital structure,
\(\beta\) = the regression coefficient,
\(X\): the variable at firm level,
\(\text{IND}\): the dummy variable for industry types,
\(\text{ED}\): the variable for future economic growth,
\(\text{SED}\): the dummy variable for the shift in the level of economic development,
\(\text{ACS}_{t-1}\) = the actual capital structure at the end of period \(t-1\), and
\(\gamma_{e_t}\) = the error term.

By incorporating the control variables including firm-specific variables and the variable for industry types discussed in Section 4.6 into Equation 6-2, the theoretical model utilized in this study for the determination of capital structure adjustment with a positive or a negative adjustment gaps taken into account can be rewritten as follows:

\[
ADJ_t \quad \begin{align*}
&= \gamma_{1} \beta_{1} \text{SIZE}_t + \gamma_{2} \beta_{2} \text{GROWTH}_t + \gamma_{3} \beta_{3} \text{PROFIT}_t + \gamma_{4} \beta_{4} \text{NDTS}_t + \gamma_{5} \beta_{5} \text{ASSETS}_t \\
&\quad + \gamma_{IND} \beta_{IND} \text{IND}_t + \gamma_{ED} \beta_{ED} \text{ED}_t + \gamma_{SED} \beta_{SED} \text{SED}_t - \gamma_{ACS} \text{ACS}_{t-1} + \gamma_{e_t}
\end{align*}
\]  
(6-3)

where:

\(\text{ADJ}\) : the capital structure adjustment,
\(\gamma\) : the rate of adjustment towards the target capital structure,
\(\beta\) : the regression coefficient,
\(\text{SIZE}\) : firm size,
\(\text{GROWTH}\) : growth opportunities,
\(\text{PROFIT}\) : profitability,
\(\text{NDTS}\) : non-debt tax shields,
\(\text{ASSET}\) : asset tangibility,
IND: the dummy variable for industry types,
ED: the variable for future economic growth,
SED: the dummy variable for the shift in the level of economic development,
ACS\(_{t-1}\): the previous actual capital structure at time \(t\), and
\(\gamma\epsilon\): the error term.

Equation 6-3 shows the behavior of adjustment towards the target capital structure for firms with the financial constraint of over-leverage or under-leverage in the case of a negative or a positive adjustment gap between the target capital structure and the previous actual capital structure across different stages of economic development. Based on the argument of Stulz (1990), capital structure adjustment is influenced by economic development in terms of future economic growth and the shift in the level of economic development. It is expected that the variable ED for future economic growth and the variable for the shift in the level of economic development are negatively and positively related to capital structure adjustment, respectively.

By substituting the item of ACS\(_{t-1}\)–ACS\(_{t-1}\) for the capital structure adjustment (\(\text{ADJ}_t\)) in Equation 6-3 since \(\text{ADJ}_t = ACS_t - ACS_{t-1}\) and rearranging, the equation for the determination of the actual capital structure (ACS) of firms with the financial constraint of over-leverage or under-leverage in the case of a negative or a positive adjustment gap across the shift in the stage or level of economic development is obtained and written as follows:

\[
\begin{align*}
\text{ACS}_t &= \gamma_{\beta_1} \text{SIZE}_t + \gamma_{\beta_2} \text{GROWTH}_t + \gamma_{\beta_3} \text{PROFIT}_t + \gamma_{\beta_4} \text{NDTS}_t + \gamma_{\beta_5} \text{ASSETS}_t \\
&\quad + \gamma_{\beta_1}^{\text{IND}} \text{IND}_t + \gamma_{\beta_1}^{\text{ED}} \text{ED}_t + \gamma_{\beta_1}^{\text{SED}} \text{SED} + \left(1 - \gamma\right)\text{ACS}_{t-1} + \gamma\epsilon_t 
\end{align*}
\]  

(6-3A)

Equation 6-3A is the theoretical model for the determination of the actual capital structure for firms with the financial constraint of under-leverage or over-leverage where a positive or a negative adjustment gap exists in the course of economic development. The equation reflects the behavior that firms adjust their capital structure and may deviate away from their target capital structure in the course of economic development when the adjustment rate is not equal to 1. When the
adjustment rate is equal to 1, then the actual capital structure is exactly the same as the target capital structure that contributes to no gap between the actual capital structure and the target capital structure.

According to the modified partial adjustment model for capital structure adjustment as discussed in Chapter 4, the partial regression coefficient of the precious actual capital structure will be significantly greater than 0 and different from 1 whenever the deviation away from the target capital structure of firms occurs. In addition, capital structure adjustment will be positively related to the adjustment rate (γ) for firms with the financial constraint of under-leverage in the case of a positive adjustment gap but negatively related to the adjustment rate for firms with the financial constraint of over-leverage in the case of a negative adjustment gap between the target capital structure and the previous actual capital structure as shown in Equation 6-3. On the other hand, the actual capital structure will be positively related to the adjustment rate for firms with the financial constraint of under-leverage in the case of a positive adjustment gap but negatively related to the adjustment rate for firms with the financial constraint of over-leverage in the case of a negative adjustment gap as shown in Equation 6-3A.

### 6.3.2 Operational Definitions

The dependent variable of capital structure decisions and the explanatory variables, except the dummy variables, are calculated at book value of annual financial data collected in the thesis research. The control variables for firm characteristics and industry types used in the model have already been discussed in Section 4.6. The operational definitions for the capital structure and the control variables used in this chapter have already been discussed in Chapter 4 – in Section 4.8.1 and Section 4.8.2, respectively. The operational definitions for the test variable of economic development in this chapter are discussed as follows:

With regards to the test variable of economic development, the future annual growth rate of the real GDP (FgGDP) is used as a proxy for its short-term impact of economic development. The future annual growth rate of the real GDP is calculated as the ratio of the real GDP of the next year minus the real GDP of the current year divided by the real GDP of the current year. In addition, the binary dummy variable (SED) of the
shift in the level of economic development is another proxy for the long-term impact of economic development. Table 6.1 shows the growth of the real GDP of Taiwan from 1982 to 2001.

### Table 6.1

**Annual Growth Rate of the Real GDP of Taiwan from 1982 to 2001**

<table>
<thead>
<tr>
<th>Year</th>
<th>Real GDP (million New Taiwan dollars)</th>
<th>gGDP*</th>
<th>Future gGDP**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>2,679,939</td>
<td>3.55%</td>
<td>8.45%</td>
</tr>
<tr>
<td>1983</td>
<td>2,906,311</td>
<td>8.45%</td>
<td>10.60%</td>
</tr>
<tr>
<td>1984</td>
<td>3,214,370</td>
<td>10.60%</td>
<td>4.95%</td>
</tr>
<tr>
<td>1985</td>
<td>3,373,562</td>
<td>4.95%</td>
<td>11.64%</td>
</tr>
<tr>
<td>1986</td>
<td>3,766,144</td>
<td>11.64%</td>
<td>12.74%</td>
</tr>
<tr>
<td>1987</td>
<td>4,246,134</td>
<td>12.74%</td>
<td>7.84%</td>
</tr>
<tr>
<td>1988</td>
<td>4,579,049</td>
<td>7.84%</td>
<td>8.23%</td>
</tr>
<tr>
<td>1989</td>
<td>4,956,018</td>
<td>8.23%</td>
<td>5.39%</td>
</tr>
<tr>
<td>1990</td>
<td>5,223,394</td>
<td>5.39%</td>
<td>7.55%</td>
</tr>
<tr>
<td>1991</td>
<td>5,617,967</td>
<td>7.55%</td>
<td>7.49%</td>
</tr>
<tr>
<td>1992</td>
<td>6,038,610</td>
<td>7.49%</td>
<td>7.01%</td>
</tr>
<tr>
<td>1993</td>
<td>6,462,148</td>
<td>7.01%</td>
<td>7.11%</td>
</tr>
<tr>
<td>1994</td>
<td>6,921,479</td>
<td>7.11%</td>
<td>6.42%</td>
</tr>
<tr>
<td>1995</td>
<td>7,366,118</td>
<td>6.42%</td>
<td>6.10%</td>
</tr>
<tr>
<td>1996</td>
<td>7,815,617</td>
<td>6.10%</td>
<td>6.37%</td>
</tr>
<tr>
<td>1997</td>
<td>8,313,215</td>
<td>6.37%</td>
<td>4.33%</td>
</tr>
<tr>
<td>1998</td>
<td>8,673,131</td>
<td>4.33%</td>
<td>5.32%</td>
</tr>
<tr>
<td>1999</td>
<td>9,134,467</td>
<td>5.32%</td>
<td>5.78%</td>
</tr>
<tr>
<td>2000</td>
<td>9,662,544</td>
<td>5.78%</td>
<td>-2.22%</td>
</tr>
<tr>
<td>2001</td>
<td>9,447,649</td>
<td>-2.22%</td>
<td>3.94%</td>
</tr>
</tbody>
</table>


Notes:
- * : gGDP=(real GDP_t – real GDP_{t-1})/real GDP_{t-1}.
- ** : Future gGDP=(real GDP_{t+1} – real GDP_t)/real GDP_t.

According to the changes in the annual growth rate of the real GDP of Taiwan as shown in Table 6-1, the annual growth rate of the real GDP is upward for the years before 1987 but downward for the years after 1987. Therefore, the research period of the study is split into two sub-periods in the course of Taiwan’s economic development. The binary dummy SED with a value of 0 is used to indicate the sub-period before 1987 while the binary dummy SED with a value of 1 is used to indicate the sub-period after 1987.
6.3.3 Research Sample and Period

As discussed in Section 4.7, the sample used in the study includes the firms in the textile, plastics and electronics industries that are listed on the Taiwan Stock Exchange and that have complete financial data during the sample period of the study. The reason for the selection of these three industries in the research is that these three industries played an important role in the course of economic development of Taiwan from the 1960s to the mid-1990s, as discussed in Section 4.7. However, the firms that experienced financial distress or trade suspension on the Taiwan Stock Exchange are excluded. Annual data used in this study are collected from the financial data bank of the Taiwan Economic Journal.

Further, due to the limited data availability on the electronics industry before 1980 and to control for a number of intervening and complicating factors including the Asian Financial Crisis in 1997, the implementation of a new tax policy in Taiwan in 1998 and the bubble economy and dot-com problems in the early 2000s, the study is conducted at the years of economic peak and trough during the period from 1983 to 1995 over three business cycles in Taiwan. In addition, the selection of the period from 1983 to 1995 allows the study to capture the important shift in the level of economic development of Taiwan. The years at the economic peak and trough during the research period from 1983 to 1995 are selected to represent the shifts in future investment and growth opportunities according to the reference dates shown in the Business Indicators published by the Council for Economic Planning and Development of Executive Yuan of Taiwan. Therefore, the years of 1983, 1988 and 1994, closest to the reference dates of economic peak, and the years of 1985, 1990 and 1995, closest to the reference dates of economic trough, are selected to indicate the shifts in future investment and growth opportunities.

6.3.4 Empirical Model for Testing the Effect of Economic Development on Capital Structure

This study is conducted within the context of the textile, plastics and electronics industries at the years of economic peak and trough in the sample period from 1983 to
1995 in the course of economic development in Taiwan. Incorporating the proxies for
the variables into Equations 6-3 and 6-3A, the empirical model for the capital
structure adjustment and the actual capital structure of firms with the financial
constraint of under-leverage or over-leverage in the case of positive or negative
adjustment gaps in the course of economic development is expressed as follows:

\[
dDR_t = \gamma \beta_1 \ln S_t + \gamma \beta_2 gTA_t + \gamma \beta_3 OITA_t + \gamma \beta_4 DEPTA_t + \gamma \beta_5 INVFATA_t \\
+ \gamma \beta_6 IND13 t + \gamma \beta_7 IND14 t + \gamma \beta_8 FgGDP_t + \gamma \beta_9 SED_t \\
- \gamma \Delta R_{t-1} + \gamma \epsilon_t \\
\]

(6-4)

\[
DR_t = \gamma \beta_1 \ln S_t + \gamma \beta_2 gTA_t + \gamma \beta_3 OITA_t + \gamma \beta_4 DEPTA_t + \gamma \beta_5 INVFATA_t \\
+ \gamma \beta_6 IND13 t + \gamma \beta_7 IND14 t + \gamma \beta_8 FgGDP_t + \gamma \beta_9 SED_t \\
+ (1 - \gamma) \Delta R_{t-1} + \gamma \epsilon_t \\
\]

(6-4A)

where:
- \(dDR_t\): the debt ratio adjustment at period \(t\),
- \(DR_t\): the actual debt ratio at the end of period \(t\),
- \(\gamma\): the rate of adjustment towards the target debt ratios,
- \(\beta\): the regression coefficient,
- \(\ln S\) (firm size): natural logarithm of net sales,
- \(gTA\) (growth opportunities): the annual growth rate of total assets,
- \(OITA\) (profitability): the ratio of net operating income to total assets,
- \(DEPTA\) (non-debt tax shields): the ratio of depreciation to total assets,
- \(INVFATA\) (asset tangibility): the ratio of inventory plus net fixed asset to total
  assets,
- IND13 and IND14: the dummy variables with a value of 1 to indicate the
  plastic and textile industries, respectively, and with a
  value of 0 to indicate the electronics industry,
- FgGDP: the future annual growth rate of real GDP,
- SED: the binary dummy variable with a value of 0 to indicate the period
  before 1987 and 1 to indicate the period after 1987 in the course of
economic development in Taiwan,

\[ \text{DR}_{t-1} : \text{the actual debt ratio at the end of period } t-1, \text{ and} \]

\[ \gamma \varepsilon : \text{the error term.} \]

Equations 6-4 and 6-4A show that firms, with the financial constraint of under-leverage or over-leverage, adjust their debt ratios by trading off the benefits and costs of the deviation from the target debt ratios in the case of a positive or a negative adjustment gap and deviate away from the target debt ratios in the course of economic development. When firms adjust the debt ratios at a rate of 1 and make a full or complete adjustment, the actual debt ratio at the end of the current period is exactly the same as the target debt ratio and, therefore, no deviation away from the target debt ratio exists. Based on the argument of Stulz (1990), the variables of FgGDP and SED, as the respective proxies for economic development and the shift in the level of economic development, are positively related to the debt ratio adjustment (dDR) and to the actual debt ratio (DR).

In addition, the partial regression coefficient of each explanatory variable except the previous actual debt ratio (\( \text{DR}_{t-1} \)) in Equations 6-4 and 6-4A is a multiple \((\gamma \beta)\) of the adjustment rate \((\gamma)\) and the original regression coefficient \((\beta)\) of each explanatory variable in the equation for the determination of the target debt ratio, as discussed in Section 4.4 of Chapter 4. This reflects that, whenever any deviation away from the target debt ratio occurs, the effect of each variable on the debt ratio adjustment, except the previous actual debt ratio, is only a proportion, i.e. the adjustment rate \((\gamma)\), of the original effect of each variable in the determination of the target debt ratios.

### 6.4 Empirical Results and Analyses

#### 6.4.1 Descriptive Statistics

The sample used in the study consists of the listed firms with the standard industrial classification (SIC) codes from 1301 to 1399, 1401 to 1499 and 2301 to 2399 in the textile, plastics and electronics industries of Taiwan. The sample includes 625 observations of the listed firms in these industries at the years of economic peak and
trough during the period from 1983 to 1995 in Taiwan. No firm in the sample is in financial distress. The descriptive statistics of the full sample, the subsample with a negative adjustment gap and the subsample with a positive adjustment gap are shown in Tables 6.2A, 6.2B and 6.2C. In addition, no observations of ‘zero’ capital structure adjustment are found that allows us to utilize the modified partial adjustment model to investigate the effect of economic growth and development on capital structure adjustment and the adjustment behavior of capital structure.

### Table 6.2A
Descriptive Statistics for the Full Sample at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>dDR</td>
<td>625</td>
<td>-0.02270</td>
<td>0.09530</td>
<td>-0.46459</td>
<td>0.24626</td>
</tr>
<tr>
<td>DR_t</td>
<td>625</td>
<td>0.45049</td>
<td>0.17013</td>
<td>0.01396</td>
<td>0.87985</td>
</tr>
<tr>
<td>DR_{t-1}</td>
<td>625</td>
<td>0.47319</td>
<td>0.17577</td>
<td>0.02426</td>
<td>0.89139</td>
</tr>
<tr>
<td>FgGDP</td>
<td>625</td>
<td>0.07481</td>
<td>0.01632</td>
<td>0.06102</td>
<td>0.11637</td>
</tr>
<tr>
<td>SED</td>
<td>625</td>
<td>0.87360</td>
<td>0.33257</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IND13</td>
<td>625</td>
<td>0.14560</td>
<td>0.35299</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IND14</td>
<td>625</td>
<td>0.38240</td>
<td>0.48636</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>lnS</td>
<td>625</td>
<td>21.48038</td>
<td>1.21425</td>
<td>15.99580</td>
<td>25.23950</td>
</tr>
<tr>
<td>gTA</td>
<td>625</td>
<td>0.30676</td>
<td>0.47413</td>
<td>-0.30866</td>
<td>4.93033</td>
</tr>
<tr>
<td>OITA</td>
<td>625</td>
<td>0.08269</td>
<td>0.08109</td>
<td>-0.16390</td>
<td>0.59860</td>
</tr>
<tr>
<td>DEPTA</td>
<td>625</td>
<td>0.03625</td>
<td>0.02388</td>
<td>0</td>
<td>0.18216</td>
</tr>
<tr>
<td>INVFATA</td>
<td>625</td>
<td>0.55128</td>
<td>0.17178</td>
<td>0.02850</td>
<td>0.87785</td>
</tr>
</tbody>
</table>

Notes:
- dDR = the debt ratio adjustment at year t;
- DR_t = the debt ratio at the end of year t;
- DR_{t-1} = the debt ratio at the end of year t-1;
- SED: 0 for the years before 1987 and 1 for the years after 1987;
- FgGDP = the future annual growth rate of the real GDP = (real GDP_{t+1} – real GDP_t)/real GDP_t;
- IND13 = 0 for the industries of textile and electronics and 1 for the plastics industry;
- IND14 = 0 for the industries of plastics and electronics and 1 for the textile industry;
- lnS = natural logarithm of net sales;
- gTA = annual growth rate of total assets;
- OITA = net operating income/total assets;
- DEPTA = depreciation/total assets;
- INVFATA = inventory plus net fixed assets/total assets.
Table 6.2B
Descriptive Statistics for the Subsample with a Negative Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>dDR</td>
<td>363</td>
<td>-0.07919</td>
<td>0.07906</td>
<td>-0.46459</td>
<td>-0.00074</td>
</tr>
<tr>
<td>DR_t</td>
<td>363</td>
<td>0.43758</td>
<td>0.16676</td>
<td>0.01396</td>
<td>0.85717</td>
</tr>
<tr>
<td>DR_{t-1}</td>
<td>363</td>
<td>0.51677</td>
<td>0.16543</td>
<td>0.02426</td>
<td>0.89139</td>
</tr>
<tr>
<td>FgGDP</td>
<td>363</td>
<td>0.07554</td>
<td>0.01629</td>
<td>0.06102</td>
<td>0.11637</td>
</tr>
<tr>
<td>SED</td>
<td>363</td>
<td>0.87052</td>
<td>0.33619</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IND13</td>
<td>363</td>
<td>0.13774</td>
<td>0.34510</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IND14</td>
<td>363</td>
<td>0.39669</td>
<td>0.48989</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>lnS</td>
<td>363</td>
<td>21.49185</td>
<td>1.20738</td>
<td>17.99150</td>
<td>24.85870</td>
</tr>
<tr>
<td>gTA</td>
<td>363</td>
<td>0.26535</td>
<td>0.39479</td>
<td>-0.30866</td>
<td>2.55949</td>
</tr>
<tr>
<td>OITA</td>
<td>363</td>
<td>0.09560</td>
<td>0.08396</td>
<td>-0.09209</td>
<td>0.59860</td>
</tr>
<tr>
<td>DEPTA</td>
<td>363</td>
<td>0.03725</td>
<td>0.02473</td>
<td>0</td>
<td>0.18216</td>
</tr>
<tr>
<td>INVFATA</td>
<td>363</td>
<td>0.55599</td>
<td>0.16996</td>
<td>0.11636</td>
<td>0.87785</td>
</tr>
</tbody>
</table>

Notes:
- dDR = the debt ratio adjustment at year t;
- DR_t = the debt ratio at the end of year t;
- DR_{t-1} = the debt ratio at the end of year t-1;
- SED: 0 for the years before 1987 and 1 for the years after 1987;
- FgGDP=the future annual growth rate of the real GDP
  \[\frac{(real \ GDP_{t+1} - real \ GDP_t)}{real \ GDP_t};\]
- IND13 = 0 for the industries of textile and electronics and 1 for the plastics industry;
- IND14 = 0 for the industries of plastics and electronics and 1 for the textile industry;
- lnS = natural logarithm of net sales;
- gTA = annual growth rate of total assets;
- OITA = net operating income/total assets;
- DEPTA = depreciation/total assets;
- INVFATA = inventory plus net fixed assets/total assets.
Table 6.2C
Descriptive Statistics for the Subsample with a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>dDR</td>
<td>262</td>
<td>0.05557</td>
<td>0.04955</td>
<td>0.0002970</td>
<td>0.24626</td>
</tr>
<tr>
<td>DRt</td>
<td>262</td>
<td>0.46838</td>
<td>0.17342</td>
<td>0.11334</td>
<td>0.87985</td>
</tr>
<tr>
<td>DRt-1</td>
<td>262</td>
<td>0.41281</td>
<td>0.17206</td>
<td>0.03739</td>
<td>0.85977</td>
</tr>
<tr>
<td>FgGDP</td>
<td>262</td>
<td>0.07379</td>
<td>0.01635</td>
<td>0.06102</td>
<td>0.11637</td>
</tr>
<tr>
<td>SED</td>
<td>262</td>
<td>0.87786</td>
<td>0.32807</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IND13</td>
<td>262</td>
<td>0.15649</td>
<td>0.36401</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IND14</td>
<td>262</td>
<td>0.36260</td>
<td>0.48167</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>lnS</td>
<td>262</td>
<td>21.46450</td>
<td>1.22585</td>
<td>15.99580</td>
<td>25.23950</td>
</tr>
<tr>
<td>gTA</td>
<td>262</td>
<td>0.36412</td>
<td>0.56178</td>
<td>-0.09487</td>
<td>4.93033</td>
</tr>
<tr>
<td>OITA</td>
<td>262</td>
<td>0.06480</td>
<td>0.07342</td>
<td>-0.16390</td>
<td>0.34304</td>
</tr>
<tr>
<td>DEPTA</td>
<td>262</td>
<td>0.03486</td>
<td>0.02263</td>
<td>0</td>
<td>0.12669</td>
</tr>
<tr>
<td>INVFATA</td>
<td>262</td>
<td>0.54475</td>
<td>0.17440</td>
<td>0.02850</td>
<td>0.87682</td>
</tr>
</tbody>
</table>

Notes:
- dDR = the debt ratio adjustment at year t;
- DRt = the debt ratio at the end of year t;
- DRt-1 = the debt ratio at the end of year t-1;
- SED: 0 for the years before 1987 and 1 for the years after 1987;
- FgGDP = the future annual growth rate of the real GDP = (real GDP_{t+1} – real GDP_t)/real GDP_t;
- IND13 = 0 for the industries of textile and electronics and 1 for the plastics industry;
- IND14 = 0 for the industries of plastics and electronics and 1 for the textile industry;
- lnS = natural logarithm of net sales;
- gTA = annual growth rate of total assets;
- OITA = net operating income/total assets;
- DEPTA = depreciation/total assets;
- INVFATA = inventory plus net fixed assets/total assets.
6.4.2 Correlation Analysis

Table 6.3A contains the matrix of the correlation between the variables for the observations in the full sample at the years of economic peak and trough in the period from 1983 to 1995. In addition, Tables 6.3B and 6.3C contain correlation matrices for the model variables. These tables reveal the correlation for the observations in the subsamples at the years of economic peak and trough in the period from 1983 to 1995 in the cases of negative or positive adjustment gaps between the target debt ratios and the previous actual debt ratios, respectively. The figure located below the coefficient of correlation, as shown in these tables, is the probability of whether or not the coefficient of correlation is significantly different from zero. A number of salient points need further elaboration:

1. As shown in Tables 6.3A to 6.3C, the debt ratio adjustment, dDR, is negatively related to the previous actual debt ratios, DR\textsubscript{t-1}, in the full sample as well as the subsamples with negative or positive adjustment gaps. This shows that firms adjust their debt ratios with the level of debt ratios held in the beginning of each period taken into account. The greater the debt ratios held in the beginning of each period, the less is the increase in debt ratios that the firm adjusts.

2. The actual debt ratio (DR\textsubscript{t}) held at the end of each year is statistically significant and positively related to the previous actual debt ratio (DR\textsubscript{t-1}). This reflects that firms adjust their debt ratios with the previous actual debt ratio taken into account.

3. The debt ratio adjustment, dDR, is not significantly related to the proxies for economic growth (FgGDP) and the shift in the level of economic development (SED). However, in the subsample with a negative adjustment gap, dDR is not significantly related to FgGDP but statistically significant and negatively related to SED. In the subsample with a positive adjustment gap, dDR is not significantly related to FgGDP and SED. However, actual debt ratio (DR) is statistically significant and positively related to future economic growth (FgGDP) but negatively related to the shift in the level of economic development (SED) for the observations in the full sample as well as in the subsamples with negative or positive adjustment gaps. The results show that it is better to analyze the adjustment behavior of debt ratios taking into account the adjustment gap as well as the shift in the level of economic development.
Table 6.3A
Correlation Matrix for Model Variables at the Years of Economic Peak and Trough in the Period from 1983 to 1995

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<th>SED</th>
<th>IND13</th>
<th>IND14</th>
<th>lnS</th>
<th>gS</th>
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Notes: 1. sample size = 625.  2. dDR_t = total debt ratio adjustment at year t; DR_t = total debt ratio at the end of year t; DR_t-1 = total debt ratio at the end of year t-1; SED: 0 for the years before 1987 and 1 for the years after 1987; FgGDP: the future annual growth rate of the real GDP = (real GDP_{t+1} - real GDP_t)/real GDP_t; IND13 = the dummy variable with a value of 1 for the plastics industry; IND14 = the dummy variable with a value of 1 for the textile industry; lnS = natural logarithm of net sales; gTA = annual growth rate of total assets; OITA = net operating income/total assets; DEPTA = depreciation/total assets; INVFATA = inventory plus net fixed assets/total assets. 3. The figure located below the coefficient of correlation is the probability whether or not the coefficient of correlation is significantly different from 0.
Table 6.3B  
Correlation Matrix for Model Variables in the Subsample with a Negative Adjustment Gap in the Period from 1983 to 1995

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<th>SED</th>
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<th>gS</th>
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<td>Notes: 1. sample size = 363. 2. dDR_t = total debt ratio adjustment at year t; DR_t = total debt ratio at the end of year t; DR_{t-1} = total debt ratio at the end of year t-1; SED: 0 for the years before 1987 and 1 for the years after 1987; FgGDP: the future annual growth rate of the real GDP = (real GDP_{t+1} - real GDP_t)/real GDP_t; IND13 = the dummy variable with a value of 1 for the plastics industry; IND14 = the dummy variable with a value of 1 for the textile industry; lnS = natural logarithm of net sales; gTA = annual growth rate of total assets; OITA = net operating income/total assets; DEPTA = depreciation/total assets; INVFATA = inventory plus net fixed assets/total assets. 3. The figure located below the coefficient of correlation is the probability whether or not the coefficient of correlation is significantly different from 0.</td>
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## Table 6.3C
Correlation Matrix for Model Variables in the Subsample with a Positive Adjustment Gap in the Period from 1983 to 1995

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<th>IND14</th>
<th>lnS</th>
<th>gS</th>
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</tr>
<tr>
<td>IND13</td>
<td>0.1498</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>1.00000</td>
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<td></td>
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</tr>
<tr>
<td>IND14</td>
<td>-0.13307</td>
<td>-0.26989</td>
<td>-0.23370</td>
<td>-0.06055</td>
<td>0.06441</td>
<td>1.00000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lnS</td>
<td>0.0313</td>
<td>&lt;0.001</td>
<td>0.0001</td>
<td>0.3289</td>
<td>0.2990</td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>gTA</td>
<td>-0.19232</td>
<td>-0.04467</td>
<td>0.01036</td>
<td>-0.26245</td>
<td>0.11581</td>
<td>0.24808</td>
<td>-0.08789</td>
<td>1.00000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OITA</td>
<td>0.7016</td>
<td>0.3964</td>
<td>0.3344</td>
<td>0.0075</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.1560</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.02378</td>
<td>0.05260</td>
<td>0.05987</td>
<td>0.16473</td>
<td>-0.20359</td>
<td>-0.32486</td>
<td>1.00000</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.0018</td>
<td>0.4715</td>
<td>0.8675</td>
<td>&lt;0.001</td>
<td>0.0612</td>
<td>&lt;0.001</td>
<td>0.1560</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: 1. sample size = 262.  2. dDR<sub>t</sub> = total debt ratio adjustment at year <em>t</em>; DR<sub>t</sub> = total debt ratio at the end of year <em>t</em>; DR<sub>t-1</sub> = total debt ratio at the end of year <em>t-1</em>; SED: 0 for the years before 1987 and 1 for the years after 1987; FgGDP: the future annual growth rate of the real GDP = (real GDP<sub>t+1</sub> – real GDP<sub>t</sub>)/real GDP<sub>t</sub>; IND13 = the dummy variable with a value of 1 for the plastics industry; IND14 = the dummy variable with a value of 1 for the textile industry; lnS = natural logarithm of net sales; gTA = annual growth rate of total assets; OITA = net operating income/total assets; DEPTA = depreciation/total assets; INVFATA = inventory plus net fixed assets/total assets. 3. The figure located below the coefficient of correlation is the probability whether or not the coefficient of correlation is significantly different from 0.
4. The debt ratio adjustment, $d_{DR}$, is not significantly related to the dummy proxies for industry types in the full sample of the study. However, in the subsample with a negative adjustment gap, the debt ratio adjustment is statistically significant and positively related to industry types, IND13 and IND14. In the subsample with a positive adjustment gap, the debt ratio adjustment is statistically significant and negatively related to the dummy variable for the plastic industry, IND13, but not significantly related to the dummy for the textile industry, IND14. On the other hand, the actual debt ratio (DR) is negatively related to the dummy variable, IND13, for the observations in the full sample as well as in the subsamples with negative or positive adjustment gaps. However, the actual debt ratio (DR) is positively related to the dummy variable, IND14, for the observations in the full sample and in the subsample with a negative adjustment gap. The results suggest that the adjustment behavior of capital structure is influenced by the industry types and the negative or positive adjustment gaps as well.

5. The debt ratio adjustment is statistically significant and positively related to $g_{TA}$ (growth opportunities) but negatively related to OITA (profitability) in the full sample. However, $d_{DR}$ is statistically significant and positively related to $lnS$ (firm size) and INVFATA (asset tangibility) but negatively related to $g_{TA}$ and OITA in the subsample with a negative adjustment gap. In addition, $d_{DR}$ is statistically significant and positively related to $g_{TA}$ and negatively related to $lnS$, OITA and DEPTA (non-debt tax shields) in the subsample with a positive adjustment gap. On the other hand, actual debt ratio (DR) is negatively related to profitability (OITA) and non-debt tax shields (DEPTA) and positively related to asset tangibility (INVFATA) for the observations in the full sample as well as in the subsamples with negative or positive adjustment gaps.

6. High correlation between the explanatory variables is found both in the subsamples with negative or positive adjustment gaps such as the correlation between FgGDP and SED, IND14 and INVFATA, and DEPTA and INVFATA. Therefore, the centering technique suggested by Cronbach (1987) is utilized to eliminate multicollinearity.
6.4.3 Regression Results and Analyses

The regression results based on Equations 6-4 and 6-4A for the determination of debt ratio adjustment and actual debt ratios of the listed firms with the financial constraint of over-leverage or under-leverage in the cases of negative or positive adjustment gaps are shown in Tables 6.4 and 6.5.

Table 6.4
Regression Results for the Subsample with a Negative Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDRt)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DRt)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DR$_{t-1}$</td>
<td>-0.13904</td>
<td>-5.33$^a$</td>
</tr>
<tr>
<td>SED</td>
<td>-0.02844</td>
<td>-3.29$^a$</td>
</tr>
<tr>
<td>FgGDP</td>
<td>-0.03950</td>
<td>-0.26</td>
</tr>
<tr>
<td>IND13</td>
<td>0.00697</td>
<td>0.52</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.00385</td>
<td>-0.36</td>
</tr>
<tr>
<td>lnS</td>
<td>0.01086</td>
<td>3.19$^a$</td>
</tr>
<tr>
<td>gTA</td>
<td>-0.01712</td>
<td>-1.50</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.11165</td>
<td>-2.17$^b$</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.33976</td>
<td>-1.76$^c$</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.07865</td>
<td>2.48$^b$</td>
</tr>
</tbody>
</table>

Notes:
1. dDR$_t$ = the debt ratio adjustment at year $t$;
2. DR$_t$ = the debt ratio at the end of year $t$;
3. DR$_{t-1}$ = the debt ratio at the end of year $t-1$;
4. SED: 0 for the years before 1987 and 1 for the years after 1987.
5. FgGDP = the future annual growth rate of the real GDP = (real GDP$_{t+1}$ – real GDP$_t$)/real GDP$_t$;
6. IND13 = the dummy variable with a value of 1 for the plastics industry;
7. IND14 = the dummy variable with a value of 1 for the textile industry;
8. lnS = natural logarithm of net sales;
9. gTA = annual growth rate of total assets;
10. OITA = net operating income/total assets;
11. DEPTA = depreciation/total assets;
12. INVFATA = inventory plus net fixed assets/total assets;
13. $a$, $b$, and $c$ indicate the significance level of 1%, 5% and 10%, respectively.
14. The value of the coefficient is the product of the rate of adjustment ($\gamma$) and the regression coefficient ($\beta$) of each independent variable except the previous actual debt ratio (DR$_{t-1}$).

(1) 363 0.4908 35.99$^a$ 1.963
(2) 363 0.8044 150.30$^a$ 1.963

5. VIF: Variance Inflation Factor
Table 6.5
Regression Results for the Subsample with a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDR_t)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DR_t)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DR_{t-1}</td>
<td>-0.08257</td>
<td>-4.22a</td>
</tr>
<tr>
<td>SED</td>
<td>0.03418</td>
<td>5.33a</td>
</tr>
<tr>
<td>FgGDP</td>
<td>0.86044</td>
<td>7.78a</td>
</tr>
<tr>
<td>IND13</td>
<td>-0.02183</td>
<td>-2.46b</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.01523</td>
<td>-2.08b</td>
</tr>
<tr>
<td>lnS</td>
<td>0.00181</td>
<td>0.68</td>
</tr>
<tr>
<td>gTA</td>
<td>0.02017</td>
<td>3.54a</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.16775</td>
<td>-3.94a</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.50407</td>
<td>-3.41a</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.06235</td>
<td>2.88a</td>
</tr>
</tbody>
</table>

Notes:
1. dDR_t = the debt ratio adjustment at year t;
   DR_t = the debt ratio at the end of year t;
   DR_{t-1} = the debt ratio at the end of year t-1;
   SED: 0 for the years before 1987 and 1 for the years after 1987;
   FgGDP = the future annual growth rate of the real GDP = (real GDP_{t+1} – real GDP_t)/real GDP_t;
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   lnS = natural logarithm of net sales;
   gTA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
2. a, b and c indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable except the previous actual debt ratio (DR_{t-1}).
4. N  Adj. R-square  F value  Durbin-Watson D value
   (1) 262  0.7198  68.29a  2.038
   (2) 262  0.9392  405.47a  2.038
5. VIF: Variance Inflation Factor

As shown in Note 4 in Tables 6.4 and 6.5, a large value of the F-test for testing the utility of the modified partial adjustment model used in the study indicates that most of the variation in the debt ratio adjustment and the actual debt ratio is explained by Equations 6-4 and 6-4A. In addition, the adjusted R-squares are 49.08% and 71.98% for the determination of the debt ratio adjustment in the case of a negative or a positive adjustment gap, respectively. The adjusted R-squares are 80.44% and 93.92% for the determination of the actual debt ratio in the case of a negative or a positive adjustment gap, respectively. The findings indicate that the fit of the modified partial adjustment model for the determination of debt ratio adjustment is moderately good.
and the fit of the modified partial adjustment model for the determination of the actual debt ratio is quite good. In addition, as shown in the VIF column of Tables 6.4 and 6.5, the values of the variance inflation factor (VIF) for the explanatory variables are less than 10, that is, the general rule of testing multicollinearity. The findings show no evidence of the existence of problematic multicollinearity in the study. Further, the values of Durbin-Watson D values shown in Note 4 in Tables 6.4 and 6.5 are close to 2. The result indicates no serious first-order autocorrelation problem. Further analyses on the regression results based on Equations 6-4 and 6-4A follow.

### 6.4.3.1 Adjustment Rate

Based on Equation 6-4, the regression coefficient of the previous actual debt ratio is equal to the negative value of the adjustment rate ($\gamma$). In addition, the regression coefficient of the previous actual debt ratio in Equation 6-4A is equal to 1 minus the adjustment rate of debt ratio adjustment ($1-\gamma$). Therefore, it is expected that, if the adjustment rate ($\gamma$) is less than 1, the previous actual debt ratio ($DR_{t-1}$) will be negatively related to the debt ratio adjustment ($dDR$) based on Equation 6-4 and positively related to the actual debt ratio ($DR$) based on Equation 6-4A. In addition, it is expected that, if the adjustment rate ($\gamma$) is greater than 1, the previous actual debt ratio ($DR_{t-1}$) will be negatively related to the debt ratio adjustment ($dDR$) and the actual debt ratio ($DR$) based on Equations 6-4 and 6-4A.

According to the regression coefficients of the previous actual debt ratio for the determination of debt ratio adjustment and actual debt ratio in Table 6.4, the adjustment rate of debt ratios is 0.13904 (or $1-0.86096$) in the subsample of a negative adjustment gap. On the other hand, as shown in Table 6.5, the adjustment rate of debt ratio is 0.08257 (or $1-0.91743$) in the subsample of a positive adjustment gap. This shows that firms, with the financial constraint of over-leverage in the case of a negative adjustment gap, adjust their debt ratios at a faster rate than those with the financial constraint of under-leverage in the case of a positive adjustment gap. This implies that, by trading off the benefits of reducing the bankruptcy risk against the costs of the deviation away from the target debt ratio, firms with the financial constraint of over-leverage in the case of a negative adjustment gap tend to gear down
their debt leverage and rebalance the target debt ratio. On the other hand, firms with under-leverage in the case of a positive adjustment gap trade off the benefits of the spare debt capacity reserved for future investment and growth opportunities against the costs of the deviation away from the target debt ratio and, consequently, rebalance their debt ratio at a slower speed.

In addition, the effect of the explanatory variables, except the previous actual debt ratio, on debt ratio adjustment is a proportion of the effect of these variables on the determination of the target debt ratio. The proportion of the effect of these variables on the determination of debt ratio adjustment and actual debt ratio depends upon the adjustment rate based on Equations 6-4 and 6-4A. The coefficients of the explanatory variables, except the previous actual debt ratio, are a multiple of the adjustment rate and the regression coefficients of these variables on the determination of the target debt ratio shown in Equation 4-2.

In brief, the findings on adjustment rate suggest that firms with the financial constraint of over-leverage or under-leverage adjust their debt ratios at a faster rate in the case of a negative adjustment gap than in the case of a positive adjustment gap. In other words, the adjustment behavior of debt ratio varies with the financial constraint of over-leverage or under-leverage in the case of negative or positive adjustment gaps. The findings suggest that the adjustment rate of debt ratio is faster for firms with the financial constraint of over-leverage in the case of a negative adjustment gap between the target debt ratio and the previous actual debt ratio than for those with the financial constraint of under-leverage in the case of a positive adjustment gap. This finding in the variation in the adjustment of debt ratio does not support the constant adjustment rate concluded by Flannery and Rangan (2006).

### 6.4.3.2 Economic Development

With respect to the effect of economic growth and development, as shown in Table 6.4, the proxy for the shift in the level of economic development (SED) is statistically significant and negatively related to debt ratio adjustment (dDR) and actual debt ratio (DR). However, the proxy for future economic growth (FgGDP) is not significantly related to the debt ratio adjustment (dDR) and the actual debt ratio (DR) in the
subsample with a negative adjustment gap. In addition, the adjustment rate (0.13904) is less than 1 and, therefore, firms are still overleveraged after their adjustment in the subsample with a negative adjustment gap, as discussed in Section 4.4.2. This indicates that the listed firms in the textile, plastics and electronics industries in Taiwan with the financial constraint of over-leverage in the case of a negative adjustment gap tend to gear down the debt leverage in order to reduce the bankruptcy risk. The negative relationship between the level of economic development and the debt ratio adjustment is not consistent with Stulz but supports the conclusion of Boyd and Smith (1996).

On the other hand, as shown in Table 6.5, the proxies for future economic growth (FgGDP) and the shift in the level of economic development (SED) are statistically significant and positively related to the debt ratio adjustment (dDR) and the actual debt ratio (DR) in the subsample of a positive adjustment gap between the target debt ratio and the previous actual debt ratio. The positive relationship between the level of economic development and the debt ratio adjustment and the actual debt ratio is consistent with Stulz (1990). However, the positive relationship between the future economic growth and the debt ratio adjustment and the actual debt ratio does not support the conclusion of Boyd and Smith (1996). In addition, due to the adjustment rate being less than 1, firms are still underleveraged after the adjustment of their debt ratios, as discussed in Section 4.4.1. The result suggests that, in the course of economic development, firms with the financial constraint of under-leverage in the case of a positive adjustment gap tend to finance more with debt or gear up the debt ratios.

In brief, the findings suggest that the effect of economic growth and development on debt ratio decisions varies according to the case of negative or positive adjustment gaps between the target debt ratio and the previous actual debt ratio. The findings also suggest that firms with the financial constraint of over-leverage in terms of the target debt ratios tend to gear down their debt ratios in order to reduce the bankruptcy risk. In addition, firms with the financial constraint of under-leverage in the case of a positive adjustment gap tend to finance with more debt. The findings on the variation in the effects of economic growth and the shift in the level of economic development on capital structure decisions in the cases of negative or positive adjustment gaps are
not completely consistent with either Stulz (1990) or Boyd and Smith (1996). This might support the argument of Myers (2001) that there is no universal theory for capital structure choices or no reason to expect one.

6.4.3.3 Control Variables for Firm Characteristics

In the subsample of a negative adjustment gap, the firm-specific variables such as firm size ($\text{lnS}$) and asset tangibility (INVFATA) are statistically significant and positively related to the debt ratio adjustment and the actual debt ratio for the listed firms with the financial constraint of over-leverage in the textile, plastics and electronics industries in Taiwan. In addition, the firm-specific variables such as profitability (OITA) and non-debt tax shields (DEPTA) are statistically significant and negatively related to the debt ratio adjustment and the actual debt ratio.

On the other hand, the firm-specific variables such as growth opportunities (gTA) and asset tangibility (INVFATA) are statistically significant and positively related to the debt ratio adjustment and the actual debt ratio for the listed firms with the financial constraint of under-leverage in the case of a positive adjustment gap between the target debt ratio and the previous actual debt ratio. The firm-specific variables such as profitability (OITA) and non-debt tax shields (DEPTA) are statistically significant and negatively related to the debt ratio adjustment and the actual debt ratio for the listed firms with the financial constraint of under-leverage in the case of a positive adjustment gap.

The results illustrate the variation in the firm-specific effects on the debt ratio decisions for the listed firms with the financial constraint of over-leverage in the case of a negative adjustment gap. Moreover, it is interesting to note that the effect of firm size and growth opportunities on the debt ratio adjustment and the actual debt ratio varies according to the case of negative or positive adjustment gaps. This is likely because firms with the financial constraint of under-leverage do not really have to gear down their debt ratios in order to reserve the spare debt capacity for future investment and growth opportunities.
6.4.3.4 Control Variables for Industry Effect

With respect to the industry effect, the debt ratio adjustment and the actual debt ratio are not significantly related to the effect of industry types (IND13 and IND14) for the listed firms in the textile, plastics and electronics industries in the subsample of a negative adjustment gap. However, the debt ratio adjustment and the actual debt ratio are statistically significant and negatively related to the effect of industry types in the subsample of a positive adjustment gap. This finding suggests that the debt ratio adjustment and actual debt ratios of firms are higher in the electronics industry than in the textile and plastics industries. The results illustrate the variation in the industry effect on the debt ratio adjustment and the actual debt ratio in the cases of negative or positive adjustment gaps. It is likely that, in the case of a positive adjustment gap, firms do not have to gear down their debt ratios due to their under-leverage and, in addition, firms in the electronics industry have higher growth than those in the textile and plastics industries.

In addition, Table 6.6 shows the regression results for the determination of the debt ratio adjustment and the actual debt ratio of firms in the full sample when adjustment gaps are not taken into account in the application of the partial adjustment model. As shown in Note 4 of Table 6.6, the adjusted R-squares for debt ratio adjustment and actual debt ratio (0.2309 and 0.7629) without adjustment gaps taken into account are much lower than those shown in Note 4 in Table 6.4 (0.4908 and 0.8044) and in Table 6.5 (0.7198 and 0.9392) with adjustment gaps taken into account. In addition, based on Equations 6-4 and 6-4A, the regression coefficient of the previous actual debt ratio is respectively equal exactly to the negative value of the adjustment rate ($-\gamma$) and to 1 minus the adjustment rate ($1-\gamma$). The adjustment rate of debt ratio (0.24342 or 1–0.75658) shown in Table 6.6 is overestimated without the adjustment gaps taken into account and is much higher than the adjustment rates of 0.13904 and 0.08257 shown respectively in Tables 6.4 and 6.5 with adjustment gaps taken into account. These findings reflect the fact that, in the application of the partial adjustment model for capital structure adjustment, the estimation should take into account whether the adjustment gap between the target capital structure and the previous actual capital structure is negative or positive.
### Table 6.6
Regression Results for the Full Sample without Negative and Positive Adjustment Gaps Taken into Account

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDRt)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DRt)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>Drt-1</td>
<td>-0.24342</td>
<td>-11.25a</td>
</tr>
<tr>
<td>SED</td>
<td>-0.00683</td>
<td>-0.92</td>
</tr>
<tr>
<td>FgGDP</td>
<td>0.70240</td>
<td>5.43a</td>
</tr>
<tr>
<td>IND13</td>
<td>-0.01332</td>
<td>-1.19</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.02260</td>
<td>-2.51b</td>
</tr>
<tr>
<td>lnS</td>
<td>0.01088</td>
<td>3.60a</td>
</tr>
<tr>
<td>gTA</td>
<td>0.02615</td>
<td>3.21a</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.33835</td>
<td>-7.45a</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.53202</td>
<td>-3.09a</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.11598</td>
<td>4.33a</td>
</tr>
</tbody>
</table>

Notes:
1. dDRt = the debt ratio adjustment at year t; DRt = the debt ratio at the end of year t; DRt-1 = the debt ratio at the end of year t-1; SED: 0 for the years before 1987 and 1 for the years after 1987; FgGDP=the future annual growth rate of the real GDP=(real GDPt+1 – real GDPt)/real GDPt; IND13 = the dummy variable with a value of 1 for the plastics industry; IND14 = the dummy variable with a value of 1 for the textile industry; lnS = natural logarithm of net sales; gTA = annual growth rate of total assets; OITA = net operating income/total assets; DEPTA = depreciation/total assets; INVFATA = inventory plus net fixed assets/total assets; 2. a, b and c indicate the significance level of 1%, 5% and 10%, respectively. 3. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable except the previous actual debt ratio (DRt-1). 4. N | Adj. R-square | F value | Durbin-Watson D value | (1) 625 | 0.2309 | 19.76a | 1.228 | (2) 625 | 0.7629 | 202.06a | 1.228 | 5. VIF: Variance Inflation Factor

### 6.5 Robustness Tests

#### 6.5.1 Alternative Proxy for Future Economic Growth

In considering an alternative proxy for future economic growth in the course of economic development, the future annual growth rate of the real per capita GDP (FgPCGDP) is used to test robustness in the same research period. Tables 6.7 and 6.8 present the results for the effect of the alternative proxy of economic development on the debt ratio adjustment and the actual debt ratio of firms with the financial
constraint of over-leverage or under-leverage in the case of a negative or positive adjustment gap, respectively.

Table 6.7
Regression Results for the Subsample with a Negative Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDRt)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DRt)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DRt _t-1</td>
<td>-0.14009</td>
<td>-5.37a</td>
</tr>
<tr>
<td>SED</td>
<td>-0.02866</td>
<td>-3.32a</td>
</tr>
<tr>
<td>FgPCGDP</td>
<td>-0.02881</td>
<td>-0.17</td>
</tr>
<tr>
<td>IND13</td>
<td>0.00643</td>
<td>0.48</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.00431</td>
<td>-0.40</td>
</tr>
<tr>
<td>lnS</td>
<td>0.01092</td>
<td>3.21a</td>
</tr>
<tr>
<td>gTA</td>
<td>-0.01736</td>
<td>-1.52</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.11331</td>
<td>-2.20b</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.34663</td>
<td>-1.80c</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.07912</td>
<td>2.49b</td>
</tr>
</tbody>
</table>

Notes:
1. \(dDR_{t} = \) the debt ratio adjustment at year \(t\);
2. \(DR_{t} = \) the debt ratio at the end of year \(t\);
3. \(DR_{t-1} = \) the debt ratio at the end of year \(t-1\);
4. SED: 0 for the years before 1987 and 1 for the years after 1987,
5. \(FgPCGDP = \)the future annual growth rate of the real per capita GDP
6. \(= \) (real PCGDP\_t+1 \(- \) real PCGDP\_t)/real PCGDP\_t;
7. IND13 = the dummy variable with a value of 1 for the plastics industry;
8. IND14 = the dummy variable with a value of 1 for the textile industry;
9. \(lnS = \) natural logarithm of net sales;
10. \(gTA = \) annual growth rate of total assets;
11. \(OITA = \) net operating income/total assets;
12. \(DEPTA = \) depreciation/total assets;
13. \(INVFATA = \) inventory plus net fixed assets/total assets;
14. \(\gamma, b, \) and \(c\) indicate the significance level of 1%, 5% and 10%, respectively.
15. The value of the coefficient is the product of the rate of adjustment \((\gamma)\) and the regression coefficient \((b)\) of each independent variable except the previous actual debt ratio (\(DR_{t-1}\)).
16. N, Adj. R-square, F value, Durbin-Watson D value
17. VIF: Variance Inflation Factor
Table 6.8
Regression Results for the Subsample with a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDR)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DR_{t-1}</td>
<td>-0.08332</td>
<td>-4.26^a</td>
</tr>
<tr>
<td>SED</td>
<td>0.03376</td>
<td>5.26^a</td>
</tr>
<tr>
<td>FgPCGDP</td>
<td>0.99508</td>
<td>7.83^a</td>
</tr>
<tr>
<td>IND13</td>
<td>-0.02227</td>
<td>-2.51^b</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.01560</td>
<td>-2.13^b</td>
</tr>
<tr>
<td>lnS</td>
<td>0.00173</td>
<td>0.65</td>
</tr>
<tr>
<td>gTA</td>
<td>0.02001</td>
<td>3.51^a</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.16731</td>
<td>-3.94^a</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.50531</td>
<td>-3.42^a</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.06244</td>
<td>2.89^a</td>
</tr>
</tbody>
</table>

Notes:
1. dDR\_t = the debt ratio adjustment at year t; DR\_t = the debt ratio at the end of year t; DR\_t-1 = the debt ratio at the end of year t-1; SED: 0 for the years before 1987 and 1 for the years after 1987; FgPCGDP = the future annual growth rate of the real per capita GDP = (real PCGDP\_t+1 – real PCGDP\_t)/real PCGDP\_t; IND13 = the dummy variable with a value of 1 for the plastics industry; IND14 = the dummy variable with a value of 1 for the textile industry; lnS = natural logarithm of net sales; gTA = annual growth rate of total assets; OITA = net operating income/total assets; DEPTA = depreciation/total assets; INVFATA = inventory plus net fixed assets/total assets; 2. a, b and c indicate the significance level of 1%, 5% and 10%, respectively. 3. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable except the previous actual debt ratio (DR\_t-1). 4. N | Adj. R-square | F value | Durbin-Watson D value  
(1) 262 | 0.7205 | 68.53^a | 2.032  
(2) 262 | 0.9393 | 406.60^a | 2.032 5. VIF: Variance Inflation Factor
As shown in Note 4 of Tables 6.7 and 6.8, a large value of the F-test for testing the utility of the empirical model indicates a high percentage of variation in the debt ratio adjustment and the actual debt ratio that can be explained by the regression models. Also, as shown in Note 4, the high adjusted R-square reflects the good fit of the modified partial adjustment model for the determination of the actual debt ratios of firms in the textile, plastics and electronics industries.

Further, as shown in the VIF column of Tables 6-7 and 6-8, the values of the VIF for the explanatory variables are less than 10. The finding shows no evidence of the existence of problematic multicollinearity. Finally, the Durbin-Watson D values shown in Note 4 of the tables are close to 2. This indicates no serious first-order autocorrelation problem.

In addition, a number of findings results from an examination of Table 6.7 showing the actual debt ratio during the period from 1983 to 1995 in the case of a negative adjustment gap. First, according to the t-value in the t-value column in the table for the subsample with a negative adjustment gap, the long-term effect of the shift in the level of economic development (SED) has a significant negative effect on the debt ratio adjustment and the actual debt ratio during the period from 1983 to 1995. This implies that debt ratios decline for firms with the financial constraint of over-leverage in the textile, plastics and electronics industries as the economy develops further. The finding is consistent with Boyd and Smith (1996). However, the short-term economic growth (FgPCGDP) of economic development does not have a significant effect on the debt ratio adjustment and the actual debt ratio during the period from 1983 to 1995. Second, industry effect does not affect the debt ratio adjustment and the actual debt ratio of firms in these industries during the sample period. Third, the firm-specific variables such as firm size, profitability, non-debt tax shields, and asset tangibility have a significant effect on the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of over-leverage in the textile, plastic and electronic industries during the sample period. Finally, based on Equation 6-4, the rate of debt ratio adjustment is equal to the negative value of the regression coefficient of the previous debt ratio (DR_{t-1}), i.e. 0.14009. The above findings are almost the same as those shown in Table 6.4 for the subsample with a negative adjustment gap at the years of economic peak and trough in the period from 1983 to 1995.
Table 6.8 shows the regression results for the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of under-leverage in the case of a positive adjustment gap during the period from 1983 to 1995. After examining the t-value in the t-value column in the table, it is possible to make a number of findings. First, the proxy for the shift in the level of economic development (SED) has a significant positive effect on the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of under-leverage during the sample period. This implies that debt ratios of firms with the financial constraint of under-leverage increase as the economy develops further. The finding supports the conclusion of Stulz (1990). In addition, the proxy for the short-term economic growth of economic development (FgPCGDP) has a positive effect on the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of under-leverage during the sample period. The evidence in the short-term effect of economic growth on capital structure does not support Stulz (1990). Second, the proxies for industry type (IND13 and IND14) have a significant negative effect on the determination of the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of under-leverage. The results indicate that the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of under-leverage are lower in the textile and plastics industries than in the electronics industry. Third, firm-specific variables such as growth opportunities, profitability, non-debt tax shields and asset tangibility affect the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of under-leverage in the textile, plastics and electronics industries. Finally, based on Equation 6-4A, the adjustment rate is equal to 1 minus the regression coefficient of the previous actual debt ratio (DR_{t-1}). The above findings are almost the same as those found in Table 6-5 in the previous section.

As a whole, the results from an alternative proxy for the short-term economic growth of economic development shown in Tables 6.7 and 6.8 are almost the same as those in Tables 6.4 and 6.5. The results demonstrate the variation in both the long-term effect of the shift in the level of economic development and the short-term effect of economic growth on the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of over-leverage and under-leverage in the textile, plastics and electronics industries during the period from 1983 to 1995. This reflects that the impact of economic development in the determination of the debt ratio adjustment and
the actual debt ratio depends on the existence of financial constraint of a firm, i.e. over-leverage or under-leverage. The findings are not fully consistent with Boyd and Smith (1996), neither would they completely support Stulz (1990).

6.5.2 Alternative Proxy for the Level of Economic Development

In considering an alternative proxy for the level of economic development, the real per capita GDP (PCGDP) is used to test robustness in the same research period. Tables 6.9 and 6.10 present the results for the effect of the alternative proxy for the level of economic development on the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of over-leverage and under-leverage in the case of a negative and positive adjustment gap, respectively.

As shown in Note 4 in Tables 6.9 and 6.10, a large value of the F-test for testing the utility of the modified partial adjustment model used in the study indicates that most of the variation in the debt ratio adjustment and the actual debt ratio is explained by the regression equations. In addition, the adjusted R-squares are 48.78% and 71.36% for the determination of the debt ratio adjustment in the case of a negative or a positive adjustment gap, respectively. The adjusted R-squares are 80.33% and 93.78% for the determination of the actual debt ratio in the case of a negative or a positive adjustment gap, respectively. In addition, as shown in the VIF column of Tables 6.9 and 6.10, the values of the variance inflation factor (VIF) for the explanatory variables are less than 10, that is, the general rule of testing multicollinearity. The findings show no evidence of the existence of problematic multicollinearity. Further, the values of Durbin-Watson D values shown in Note 4 in Tables 6.9 and 6.10 are close to 2. The result indicates no serious first-order autocorrelation problem. Further analyses on the regression results follow.
Table 6.9
Regression Results for the Subsample with a Negative Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDR&lt;sub&gt;t&lt;/sub&gt;)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DR&lt;sub&gt;t&lt;/sub&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DR&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>-0.14071</td>
<td>-5.38&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>PCGDP</td>
<td>-0.00574</td>
<td>-2.83&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>FgGDP</td>
<td>0.38980</td>
<td>1.51</td>
</tr>
<tr>
<td>IND13</td>
<td>0.00608</td>
<td>0.45</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.00451</td>
<td>-0.42</td>
</tr>
<tr>
<td>lnS</td>
<td>0.01161</td>
<td>3.42&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>gTA</td>
<td>-0.01642</td>
<td>-1.42</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.11609</td>
<td>-2.25&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.33011</td>
<td>-1.68&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.07720</td>
<td>2.41&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Notes:
1. dDR<sub>t</sub> = the debt ratio adjustment at year t;
2. DR<sub>t</sub> = the debt ratio at the end of year t;
3. DR<sub>t-1</sub> = the debt ratio at the end of year t-1;
4. PCGDP: the real per capita GDP,
5. FgGDP: the future annual growth rate of the real GDP=(real GDP<sub>t+1</sub> – real GDP<sub>t</sub>)/real GDP<sub>t</sub>;
6. IND13 = the dummy variable with a value of 1 for the plastics industry;
7. IND14 = the dummy variable with a value of 1 for the textile industry;
8. lnS = natural logarithm of net sales;
9. gTA = annual growth rate of total assets;
10. OITA = net operating income/total assets;
11. DEPTA = depreciation/total assets;
12. INVFATA = inventory plus net fixed assets/total assets;
13. *<sup>a</sup>, <sup>b</sup> and <sup>c</sup> indicate the significance level of 1%, 5% and 10%, respectively.
14. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable except the previous actual debt ratio (DR<sub>t-1</sub>),
15. N: Adj. R-square F value Durbin-Watson D value
   (1) 363 0.4878 35.58<sup>a</sup> 1.966
   (2) 363 0.8033 149.23<sup>a</sup> 1.966
16. VIF: Variance Inflation Factor
Table 6.10  
Regression Results for the Subsample with a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDRt)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DRt)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DRt-1</td>
<td>-0.08203</td>
<td>-4.13ᵃ</td>
</tr>
<tr>
<td>PCGDP</td>
<td>0.01521</td>
<td>11.47ᵃ</td>
</tr>
<tr>
<td>FgGDP</td>
<td>0.47703</td>
<td>2.37ᵇ</td>
</tr>
<tr>
<td>IND13</td>
<td>-0.02022</td>
<td>-2.26ᵇ</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.01575</td>
<td>-2.12ᵇ</td>
</tr>
<tr>
<td>lnS</td>
<td>0.00075</td>
<td>0.28</td>
</tr>
<tr>
<td>gTA</td>
<td>0.02238</td>
<td>3.92ᵃ</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.16478</td>
<td>-3.83ᵃ</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.51145</td>
<td>-3.39ᵃ</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.06411</td>
<td>2.90ᵃ</td>
</tr>
</tbody>
</table>

Notes:
1. dDRt = the debt ratio adjustment at year t; DRt = the debt ratio at the end of year t; DRt-1 = the debt ratio at the end of year t-1;
PCGDP: the real per capita GDP;
FgGDP=the future annual growth rate of the real GDP=(real GDP_{t+1} – real GDP_t)/real GDP_t;
IND13 = the dummy variable with a value of 1 for the plastics industry;
IND14 = the dummy variable with a value of 1 for the textile industry;
lnS = natural logarithm of net sales;
gTA = annual growth rate of total assets;
OITA = net operating income/total assets;
DEPTA = depreciation/total assets;
INVFATA = inventory plus net fixed assets/total assets;
2.ᵃ,ᵇ andᶜ indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable except the previous actual debt ratio (DRt-1).
4. N | Adj. R-square | F value | Durbin-Watson D value
---|-------------|-------|------------------------
(1) 262 | 0.7136 | 66.27ᵃ | 2.044 |
(2) 262 | 0.9378 | 396.20ᵃ | 2.044 |
5. VIF: Variance Inflation Factor
Table 6.9 shows the regression results for the debt ratio adjustment and the actual debt ratio during the period from 1983 to 1995 in the case of a negative adjustment gap. According to the t-value in the t-value column in the table, the long-term effect of the level of economic development (PCGDP) has a significant negative effect on the debt ratio adjustment and the actual debt ratio during the period from 1983 to 1995. This implies that debt ratios decline for firms with the financial constraint of over-leverage in the textile, plastics and electronics industries as the economy develops further. The finding is consistent with Boyd and Smith (1996). However, the short-term future economic growth (FgGDP) of economic development does not affect the debt ratio adjustment and the actual debt ratio during the period from 1983 to 1995. Second, industry effect does not affect the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of over-leverage in the textile, plastic and electronic industries during the sample period. Third, the firm-specific variables such as firm size, profitability, non-debt tax shields, and asset tangibility have a significant effect on the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of over-leverage in these three industries during the sample period. Finally, based on Equation 6-4, the rate of debt ratio adjustment is equal to the negative value of the regression coefficient of the previous debt ratio (DR_{t-1}), i.e. 0.14071. The above findings are almost the same as those shown in Table 6.4 in Section 6.4.3 and in Table 6.7 in Section 6.5.1.

Table 6.10 shows the regression results for the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of under-leverage in the case of a positive adjustment gap during the period from 1983 to 1995. First, according to the t-value in the t-value column in the table, the proxy for the level of economic development (PCGDP) has a significant positive effect on the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of under-leverage during the sample period. This implies that debt ratios of firms with the financial constraint of under-leverage increase as the economy develops further. The finding supports the conclusion of Stulz (1990) but it is not consistent with Boyd and Smith (1996). In addition, the proxy for the short-term future economic growth of economic development (FgGDP) has a positive effect on the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of under-leverage during the sample period. The evidence in the short-term effect of economic growth on capital structure
does not support Stulz (1990). Second, the proxies for industry type (IND13 and IND14) have a significant negative effect on the determination of the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of under-leverage. The results indicate that the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of under-leverage are lower in the textile and plastics industries than in the electronics industry. Third, firm-specific variables such as growth opportunities, profitability, non-debt tax shields and asset tangibility affect the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of under-leverage in the textile, plastics and electronics industries. Finally, based on Equation 6-4A, the adjustment rate is equal to 1 minus the regression coefficient of the previous actual debt ratio (DR_{t-1}). The above findings are almost the same as those found in Table 6-5 in the previous section.

On the whole, the regression results with the alternative proxy for the level of economic development are similar to the findings in Section 6.4.3 and Section 6.5.1.

### 6.6 Conclusion

The modified partial adjustment model, with negative or positive adjustment gaps taken into account, is utilized in the thesis research to examine the impact of economic development on capital structure decisions and to explore the adjustment behavior of capital structure decisions of the listed firms in the textile, plastics and electronics industries in the course of Taiwan’s economic development.

By controlling the effects of firm characteristics and industry types, the results show that economic development including future economic growth and the shift in the level of economic development has an impact on the determination of debt ratio adjustment and actual debt ratio. The findings show a negative relationship between the shift in the level of economic development and the debt ratio adjustment in the case of a negative adjustment gap between the target debt ratio and the previous actual debt ratio at the years of economic trough and peak in the period from 1983 to 1995 in Taiwan. This finding is consistent with Boyd and Smith (1996).

However, the results also show a positive relationship between the shift in the level of economic development and the debt ratio adjustment in the case of a positive adjustment gap between the target debt ratio and the previous actual debt ratio at the years of economic trough and peak in the period from 1983 to 1995 in Taiwan. This finding is consistent with Boyd and Smith (1996).
economic development and the debt ratio adjustment in the case of a positive adjustment gap between the target debt ratio and the previous actual debt ratio at the years of economic trough and peak during the sample period. The positive relationship between the debt ratio adjustment and economic development is consistent with Stulz (1990). The findings in this study illustrate the variation in the effect of economic development on the debt ratio adjustment and the actual debt ratio of firms with financial constraint of over-leverage or under-leverage in the case of negative or positive adjustment gaps.

In addition, with respect to the robustness of the modified partial adjustment model, the regression results when using an alternative proxy for economic development shown in Tables 6.7 and 6.8 are almost the same as those shown in Tables 6.4 and 6.5. Economic development has a significant positive effect on the debt ratio adjustment and the actual debt ratio for firms with the financial constraint of under-leverage in the case of a positive adjustment gap between the target debt ratio and the previous actual debt ratio. However, a negative effect occurs on the debt ratio adjustment and the actual debt ratio for firms with the financial constraint of over-leverage in the case of a negative adjustment gap. Moreover, firms with the financial constraint of over-leverage in the case of a negative adjustment gap adjust their debt ratios faster than those with the financial constraint of under-leverage in the case of a positive adjustment gap. The incidental findings illustrate the variation in the adjustment rate of debt ratios for firms with the financial constraint of over-leverage or under-leverage in the case of negative or positive adjustment gaps in the course of economic development. This finding does not support the constant adjustment rate over time as Flannery and Ragan (2006) conclude.

On the whole, within the context of Taiwan, this study provides new evidence on the effect of economic development on the adjustment behavior of capital structure decisions with negative or positive adjustment gaps taken into account. The findings on the impact of economic development could be a helpful reference for practitioners of corporate finance and for policy-makers in Taiwan, in developing countries or in economies in transition.
Chapter 7

The Impact of Industrial Policy on Capital Structure: Evidence from Taiwan#

7.1 Introduction

As discussed in Chapter 2, most prior studies have given attention to the determination and determinants of capital structure only at the firm and industry levels. No other studies except Appelbaum (1993) address the issue with government policy taken into account. In addition, no other studies have given attention to the impact of government industrial policy on capital structure decisions. To fill the research gap, this study investigates the topic.

Appelbaum (1993) analyzes the effect of government interventions - such as bailouts, subsidies and tax benefits other than corporate and personal taxes - on capital structure decisions and concludes that, since government policy is neither adjusted for risk nor priced in the market, firms can maximize the value of government intervention through their capital structure decisions. However, no other studies have empirically examined the impact of government industrial policy on capital structure decisions. In the course of its successful record of economic development, Taiwan implemented various industrial development policies to pursue industrial development and economic growth. The textile, plastics and electronics industries were supported under government industrial policies implemented from the 1960s to the 1990s. These policies contributed significantly to economic growth in the course of Taiwan’s economic development as discussed in Chapter 3. As argued by Appelbaum (1993),

# Parts of the chapter were written as a paper entitled “The impact of industrial policy on capital structure with financial flexibility, macroeconomic conditions and economic growth and development taken into account: evidence from Taiwan” which was presented at a refereed international scholarly conference, the World Association for Sustainable Development 2007 Conference held at the Nathan Campus of Griffith University, Brisbane, Queensland, Australia on October 29 to 31, 2007. In addition, the revised conference paper has been published as a book chapter in Ahmed, A. (ed.), 2007, World Sustainable Development Outlook 2007: Knowledge Management and Sustainable Development in the 21st Century, Greenleaf, Sheffield, pp. 315-324.
government industrial policy, like other government intervention measures, is neither adjusted for risk nor priced in the market and, therefore, firms can maximize the value of government industrial policy through their capital structure decisions and increase their firm’s value and shareholders’ wealth as well. More importantly, the evidence found in the thesis research using Taiwan as the context could be a valuable reference for practitioners and policymakers of economies in transition.

Further, Myers and Majluf (1984) and Narayanan (1988) argue that shareholders are better off when firms reserve spare debt capacity for future investment and growth opportunities. In addition, several surveys (Allen, 1991, Graham and Harvey, 2001, Pinegar and Wilbricht, 1989) also contend that spare debt capacity or financial flexibility should be taken into account in the choices of capital structure. Moreover, several studies (Jalilvand and Harris, 1984, Taggart, 1977, Marsh, 1982, Flannery and Rangan, 2006, Hovakimian et al., 2001) argue that firms adjust towards the target capital structure in the long run but deviate away from the target capital structure in the short run. Based on the argument of these prior studies, firms would trade off the benefits of the spare debt capacity reserved for future investment and growth opportunities against the costs of the deviation from the target capital structure and deviate away from the target capital structure in the short run. As discussed in Chapter 4, the partial adjustment model matches well with the adjustment behavior of capital structure decisions and allows actual capital structure to deviate away from the target capital structure in the short run. Therefore, the modified partial adjustment model with negative or positive adjustment gaps taken into account is utilized in the study not only to examine the significance of government industrial policy in the determination of capital structure choices but also to explore the adjustment behavior of capital structure of firms due to the shift in the level of government industrial policy in the course of economic development.

7.2 Literature Review

After the work of Modigliani and Miller (1958), studies have focused mostly on the determination and determinants of capital structure decisions at firm and industry levels only. Except for Appelbaum (1993), rarely do prior studies of capital structure decisions consider the issue of the effect of government policy. More importantly,
there is no attention given to the significance of government industrial development policy in the determination of capital structure adjustment. Appelbaum (1993) analyzes the effect of government interventions - such as bailouts, subsidies and tax benefit other than corporate and personal taxes - on the determination of capital structure decisions. He argues that firms with support from government policy can utilize the choice of capital structure to maximize the value of government policies and add the value to their firm value since government policy is neither adjusted for risk nor priced in the market. Similarly, as in the case of government intervention (Appelbaum, 1993), industrial development policy implemented to facilitate industrial development and pursue economic growth is neither adjusted for risk nor priced in the market. This implies that firms supported by government industrial policy can maximize the value of the industrial development policy through their capital structure decisions and add the value to their firm value.

From the 1950s, Taiwan’s government implemented diverse industrial policies for the purpose of its industrial development as well as for its economic growth and development (Chiang, 2004, Chu, 2003). During the 1950s, an industrial policy based on import substitution was implemented to promote the development of light manufacturing industries, such as the food and cement industries, in response to high unemployment and other economic problems in Taiwan. Then, during the 1960s and the early 1970s, an industrial policy based on export expansion was implemented by the Taiwanese government to promote light manufacturing industries such as the textile industry in order to increase exports for further economic growth and development due to the limited domestic demand. Further, during the period between the early 1970s and the mid-1980s, an import substitution industrial policy was implemented again by the Taiwanese government to promote the heavy and petro-chemical industries, such as the steel and plastics industries. During the period from the mid-1980s to the early 1990s, Taiwan carried out financial liberalization and adopted an industrial policy that promoted strategic industries with high market share potential, value addition, industry spillovers and technological intensity as well as those with low energy demand and pollution, such as the electronics, high-tech machinery and bio-technology industries. From the mid-1990s to the present, Taiwan has continued to promote the development of high-tech industries and those industries related to the knowledge-based economy. However, no other studies have given
attention to the impact of the shift in the level of industrial policy on capital structure decisions. Accordingly, this study tries to fill this research gap within the context of the textile, plastics and electronics industries in the course of industrial development in Taiwan.

7.3 Methodology

This section describes the theoretical model for capital structure adjustment, the research sample and period, the variables used in the study and their measures and the empirical model used in the study to examine the effect of government industrial policy on capital structure adjustment. In addition, this section provides evidence of the adjustment behavior of capital structure over the periods when a shift occurred in government industrial policy.

7.3.1 Theoretical Model for Analyzing the Effect of Government Industrial Policy on Capital Structure

As discussed in Chapter 4, the relationship between capital structure adjustment and the adjustment rate depends upon whether there is a positive or a negative adjustment gap between the target capital structure and the previous actual capital structure. In the case of a positive adjustment gap between the target capital structure and the previous actual capital structure, capital structure adjustment is positively related to the adjustment rate. On the other hand, capital structure adjustment is negatively related to the adjustment rate and spare debt capacity in the case of a negative adjustment gap between the target capital structure and the previous actual capital structure. The modified partial adjustment model for capital structure adjustment utilized to investigate the adjustment behavior with financial constraint of under-leverage or over-leverage in the case of positive or negative adjustment gaps presented in Chapter 4 is expressed as follows:

\[
ADJ_i = \sum_{j=1}^{\cdot} \gamma \beta_{jt} X_{jt} + \gamma \beta_{j}^{IND} IND_i + \gamma \beta_{j}^{TVT} TV_i - \gamma ACS_{t-1} + \varepsilon_i
\]  

(4-4)

where:
ADJ\textsubscript{t} = the capital structure adjustment at the end of period \textit{t},
\gamma = the adjustment rate that is determined by the adjustment cost by trading off the benefits and the costs of the deviation from the target capital structure,
\beta = the regression coefficient,
\text{X: the variable at firm level,}
\text{IND: the dummy variable for industry types,}
\text{TV: the test variable,}
\text{ACS\textsubscript{t-1} = the actual capital structure at the end of period \textit{t-1}, and}
\gamma \varepsilon\textsubscript{t} = the error term.

In order to examine the significance of government industrial development policy on capital structure decisions, the variable for the shift in the level of government development policy is included in the model. Therefore, the item of TV in Equation 4-4 shown above is rewritten as follows:

\[ TV'_t = GIP_t \]  

(7-1)

where:

TV: the test variable,
GIP: the dummy variable for the shift in the level of government industrial policy,

By substituting Equation 7-1 into Equation 4-4, the theoretical model for capital structure adjustment utilized in the study to investigate the effect of government industrial development policy on the capital structure adjustment of firms with financial constraint of under-leverage or over-leverage in the case of positive or negative adjustment gaps is rewritten as follows:

\[
ADJ_t = \sum_{j=1}^{\infty} \gamma \beta_j X_{jt}^{FC} + \gamma \beta_{t}^{IND} \text{IND}_t + \gamma \beta_{t}^{GIP} GIP_t - \gamma ACS_{t-1} + \gamma \varepsilon_t
\]  

(7-2)

where:
ADJ_t = the capital structure adjustment at period t,

γ = the adjustment rate that is determined by the adjustment cost by trading off the benefits and the costs of the deviation from the target capital structure,

β = the regression coefficient,

X: the variable at firm level,

IND: the dummy variable for industry types,

GIP: the dummy variable for the shift in the level of government industrial policy,

ACS_{t-1} = the actual capital structure at the end of period t-1, and

γε = the error term.

By incorporating the control variables including firm-specific variables and the variable for industry types discussed in Chapter 4 into Equation 7-2, the theoretical model utilized in this study for the determination of capital structure adjustment with positive or negative adjustment gaps taken into account can be written as follows:

\[ ADJ_t = \gamma \beta_{1t} \text{SIZE}_t + \gamma \beta_{2t} \text{GROWTH}_t + \gamma \beta_{3t} \text{PROFIT}_t + \gamma \beta_{4t} \text{NDTS}_t + \gamma \beta_{5t} \text{ASSETS}_t \]
\[ + \gamma \beta_{6t} \text{IND}_t + \gamma \beta_{7t} \text{GIP}_t - \gamma \text{ACS}_{t-1} + \gamma \epsilon_t \]

(7-3)

where:

ADJ : the capital structure adjustment,

γ : the rate of adjustment towards the target capital structure,

β : the regression coefficient,

SIZE : firm size,

GROWTH : growth opportunities,

PROFIT : profitability,

NDTS : non-debt tax shields,

ASSET : asset tangibility,

IND : the dummy variable for industry types,

GIP : the dummy variable for the shift in the level of government industrial policy,
ACS$_{t-1}$: the actual capital structure at time t-1, and  
$\gamma e$: the error term.

Equation 7-3 shows the behavior of adjustment towards the target capital structure for firms with the financial constraint of over-leverage or under-leverage in the case of negative or positive adjustment gaps between the target capital structure and the previous actual capital structure across shifts in government industrial policy in the course of industrial development. Based on the argument of Appelbaum (1993), capital structure adjustment (ADJ) is positively related to government industrial development policy (GIP).

By substituting the item of ACS$_t$–ACS$_{t-1}$ for the capital structure adjustment (ADJ$_t$) in Equation 7-3 since ADJ$_t$ = ACS$_t$ – ACS$_{t-1}$ and rearranging, the equation for the determination of the actual capital structure (ACS) of firms with the financial constraint of over-leverage or under-leverage in the case of negative or positive adjustment gaps across the shift in the level of government industrial development policy is obtained and written as follows:

\[
\text{ACS}_t = \gamma \beta_{1t} \text{SIZE}_t + \gamma \beta_{2t} \text{GROWTH}_t + \gamma \beta_{3t} \text{PROFIT}_t + \gamma \beta_{4t} \text{NDTS}_t + \gamma \beta_{5t} \text{ASSETS}_t + \gamma \beta_{6t} \text{GIP}_t + (1 - \gamma) \text{ACS}_{t-1} + \gamma e_t 
\]

Equation 7-3A is the theoretical model for the determination of the actual capital structure for firms with the financial constraint of under-leverage or over-leverage where positive or negative adjustment gaps exist over the period with a shift in government industrial policy. The equation reflects the behavior that, when the adjustment rate is not equal to 1, firms adjust their capital structure and may deviate away from their target capital structure over periods when there is a shift in government industrial policy. Based on the argument of Appelbaum (1993), actual capital structure (ACS) is positively related to government industrial policy (GIP). Moreover, firms with the financial constraint of over-leverage in the case of a negative adjustment gap tend to gear down their debt leverage and rebalance to the target in order to avoid going bankrupt.
According to the modified partial adjustment model for capital structure adjustment as discussed in Chapter 4, the partial regression coefficient of the previous actual capital structure will be significantly greater than 0 and different from 1 whenever the deviation occurs away from the target capital structure of firms. In addition, the capital structure adjustment will be positively related to the adjustment rate (γ) for firms with the financial constraint of under-leverage in the case of a positive adjustment gap between the target capital structure and the previous actual capital structure but negatively related to the adjustment rate for firms with the financial constraint of over-leverage in the case of a negative adjustment gap as illustrated in Equation 7-3. On the other hand, the actual capital structure will be positively related to the adjustment rate for the firms with the financial constraint of under-leverage in the case of a positive adjustment gap but negatively related to adjustment rate for firms with the financial constraint of over-leverage in the case of a negative adjustment gap as illustrated in Equation 7-3A.

7.3.2 Operational Definitions

The dependent variable of capital structure decisions and the explanatory variables, except the dummy variables, are calculated at book value of annual financial data collected in the thesis research. The control variables for firm characteristics and industry types used in the model have already been discussed in Section 4.6. The operational definitions for the capital structure decisions and the control variables used in this chapter have already been discussed in Chapter 4 – in Section 4.8.1 and Section 4.8.2, respectively. The operational definitions for the test variable of government industrial policy in this chapter are discussed as follows:

For the test variable, government industrial policy, the dummy variable, GOVIND, is used as the proxy for government industrial policy which indicates the shift in the level of the government industrial policy. The dummy variable, GOVIND, with a value of 0 or 1 is used for firms in the industry without or with support from government industrial policy, respectively. Based on the argument of Appelbaum (1993), capital structure decisions are influenced by government industrial development policy. The greater the support given to firms under government industrial policy, the higher is the leverage ratio of the firms.
7.3.3 Research Sample and Period

As discussed in Section 4.7, the sample used in the study includes the firms in the textile, plastics and electronics industries that are listed on the Taiwan Stock Exchange and that have complete financial data in the sample period of the study. The reason for the selection of these three industries is that these three industries played an important role in the course of the economic development of Taiwan from the 1960s to the mid-1990s, as discussed in Chapter 4. Firms that experienced financial distress or trade suspension on the Taiwan Stock Exchange are excluded. Annual data used in this study were collected from the financial data bank of the Taiwan Economic Journal.

Further, due to the limited availability of data on the electronics industry before 1980 and in order to control for intervening and complicating factors such as the Asian Financial Crisis in 1997, the implementation of a new tax policy in Taiwan in 1998, the bubble economy and dot-com problems in the early 2000s and the shift in the Taiwanese government industrial policy which no longer focused on some specific industries, the study is conducted at the years of economic peak and trough during the period from 1983 to 1995 in Taiwan. The years at the economic peak and trough over three business cycles during the research period of 1983 to 1995 were selected to control the effect of the shifts in macroeconomic conditions on capital structure decisions according to the reference dates shown in the Business Indicators published by the Council for Economic Planning and Development of Executive Yuan of Taiwan. Therefore, the years of 1983, 1988 and 1994, closest to the reference dates of economic peak, and the years of 1985, 1990 and 1995, closest to the reference dates of economic trough, respectively, were selected to indicate the shifts in macroeconomic conditions. The use of the research sample and period already outlined (See Section 4.7) allows the study to examine whether a shift in the level of government industrial policy affects capital structure.

7.3.4 Empirical Model for Testing the Effect of Government Industrial Policy on Capital Structure

This study is conducted within the context of the textile, plastics and electronics
industries in Taiwan at the years of economic trough and peak during the period of 1983 to 1995 in the process of Taiwan’s industrial development. Incorporating the proxies for the variables into Equation 7-3, the empirical model for the capital structure adjustment (dDR) and the actual debt ratio (DR) of firms with the financial constraint of under-leverage or over-leverage in the case of a positive or a negative adjustment gap in the process of industrial development is expressed as follows:

\[
\begin{align*}
\text{dDR}_t &= \gamma \beta_{2t} \ln S_t + \gamma \beta_{3t} \text{gTA}_t + \gamma \beta_{4t} \text{OITA}_t + \gamma \beta_{5t} \text{DEPTA}_t + \gamma \beta_{6t} \text{INVFATA}_t \\
&+ \gamma \beta_{1t} \text{IND13}_t + \gamma \beta_{1t} \text{IND14}_t + \gamma \beta_{1t} \text{GOVIND}_t - \gamma \text{DR}_{t-1} + \gamma \varepsilon_t \\
\text{DR}_t &= \gamma \beta_{2t} \ln S_t + \gamma \beta_{3t} \text{gTA}_t + \gamma \beta_{4t} \text{OITA}_t + \gamma \beta_{5t} \text{DEPTA}_t + \gamma \beta_{6t} \text{INVFATA}_t \\
&+ \gamma \beta_{1t} \text{IND13}_t + \gamma \beta_{1t} \text{IND14}_t + \gamma \beta_{1t} \text{GOVIND}_t \\
&+ (1 - \gamma) \text{DR}_{t-1} + \gamma \varepsilon_t
\end{align*}
\]

(7-4)

where:
- dDR\(_t\) : the debt ratio adjustment at year t,
- DR\(_t\) : the actual debt ratio at the end of year t,
- \(\gamma\) : the rate of adjustment towards the target debt ratios,
- \(\beta\) : the regression coefficient,
- \(\ln S\) (firm size) : natural logarithm of net sales,
- gTA (growth opportunities) : the annual growth rate of total assets,
- OITA (profitability) : the ratio of net operating income to total assets,
- DEPTA (non-debt tax shields) : the ratio of depreciation to total assets,
- INVFATA (asset tangibility) : the ratio of inventory plus net fixed asset to total assets,
- IND13 and IND14 : the dummy variables with a value of 1 to indicate the plastic and textile industries, respectively, and with a value of 0 to indicate the electronics industry,
- GOVIND\(_t\) : the binary dummy variable with a value of 1 to indicate the industry supported by the government industrial policy at year t and otherwise with a value of 0,
$DR_{t-1}$: the actual debt ratio at the end of year $t-1$, and

$\gamma e$: the error term.

Equations 7-4 and 7-4A show that firms, with the financial constraint of under-leverage or over-leverage, adjust their debt ratios by trading off the benefits and costs of the deviation from the target debt ratios in the case of positive or negative adjustment gaps and deviate away from the target debt ratios in the process of industrial development. When firms adjust the debt ratios at a rate of 1 and make a complete or full adjustment, the actual debt at the end of the current period is exactly the same as the target debt ratio and, therefore, no deviation exists. Based on the argument of Appelbaum (1993), it is expected that debt ratio adjustment (dDR) and actual debt ratio (DR) would be positively related to government industrial policy (GOVIND).

In addition, note that the partial regression coefficient of each explanatory variable, except the previous actual debt ratio ($DR_{t-1}$), in Equations 7-4 and 7-4A is a multiple ($\gamma \beta$) of the adjustment rate ($\gamma$) and the original regression coefficient ($\beta$) of each explanatory variable in the equation for the determination of the target debt ratio as discussed in Section 4.4. This reflects that, whenever the deviation away from the target debt ratio occurs, the effect of each variable on the debt ratio adjustment, except the previous actual debt ratio, is only a proportion, i.e. the adjustment rate ($\gamma$), of the original effect of each variable in the determination of the target debt ratios.

7.4 Empirical Results and Analyses

7.4.1 Descriptive Statistics

The sample consists of the listed firms with the standard industrial classification (SIC) codes from 1301 to 1399, 1401 to 1499 and 2301 to 2399 in the textile, plastics and electronics industries of Taiwan. The descriptive statistics of the full sample and the subsamples in the case of negative or positive adjustment gaps are shown in Tables 7.1A to 7.1C, respectively.
The sample includes 641 observations of the listed firms in these industries at the years of economic trough and peak during the period from 1983 to 1995 in Taiwan. No firm in the sample is in financial distress. In the study, there are 373 observations and 268 observations in the subsamples with a negative or a positive adjustment gap, respectively. In addition, no observations of ‘zero’ capital structure adjustment are found in the sample thus allowing the use of the empirical models, i.e. Equations 7-4 and 7-4A, to investigate the determination of debt ratio adjustment and actual debt ratios of the listed firms in the plastic, textile and electronics industries in the course of industrial development in Taiwan.

Table 7.1A
Descriptive Statistics for the Full Sample

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>dDR</td>
<td>641</td>
<td>-0.02281</td>
<td>0.09985</td>
<td>-0.46459</td>
<td>0.32244</td>
</tr>
<tr>
<td>DR&lt;sub&gt;t&lt;/sub&gt;</td>
<td>641</td>
<td>0.45305</td>
<td>0.17148</td>
<td>0.01396</td>
<td>0.87985</td>
</tr>
<tr>
<td>DR&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>641</td>
<td>0.47585</td>
<td>0.17761</td>
<td>0.02426</td>
<td>0.89139</td>
</tr>
<tr>
<td>GOVIND&lt;sub&gt;t&lt;/sub&gt;</td>
<td>641</td>
<td>0.46802</td>
<td>0.49937</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IND13</td>
<td>641</td>
<td>0.14197</td>
<td>0.34929</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IND14</td>
<td>641</td>
<td>0.38846</td>
<td>0.48778</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>lnS</td>
<td>641</td>
<td>21.46372</td>
<td>1.21745</td>
<td>15.99580</td>
<td>25.23950</td>
</tr>
<tr>
<td>gTA</td>
<td>641</td>
<td>0.32325</td>
<td>0.50973</td>
<td>-0.30866</td>
<td>4.93033</td>
</tr>
<tr>
<td>OITA</td>
<td>641</td>
<td>0.08181</td>
<td>0.08160</td>
<td>-0.16390</td>
<td>0.59860</td>
</tr>
<tr>
<td>DEPTA</td>
<td>641</td>
<td>0.03611</td>
<td>0.02391</td>
<td>0</td>
<td>0.18216</td>
</tr>
<tr>
<td>INVFATA</td>
<td>641</td>
<td>0.55212</td>
<td>0.17412</td>
<td>0.02850</td>
<td>0.89525</td>
</tr>
</tbody>
</table>

Notes:
- dDR<sub>t</sub> = the debt ratio adjustment at year t;
- DR<sub>t</sub> = the actual debt ratio at the end of year t;
- DR<sub>t-1</sub> = the actual debt ratio at the end of year t-1;
- GOVIND<sub>t</sub>: the binary dummy variable with a value of 1 to indicate the industry supported by the government industrial policy at period t and otherwise with a value of 0,
- IND13 = 0 for the textile and electronics industries and 1 for the plastics industry;
- IND14 = 0 for the plastics and electronics industries and 1 for the textile industry;
- lnS = natural logarithm of net sales;
- gTA = annual growth rate of total assets;
- OITA = net operating income/total assets;
- DEPTA = depreciation/total assets;
- INVFATA = inventory plus net fixed assets/total assets.
Table 7.1B
Descriptive Statistics for the Subsample with a Negative Adjustment Gap

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>dDR</td>
<td>373</td>
<td>-0.08128</td>
<td>0.08236</td>
<td>-0.46459</td>
<td>-0.00074</td>
</tr>
<tr>
<td>DRt</td>
<td>373</td>
<td>0.44002</td>
<td>0.16717</td>
<td>0.01396</td>
<td>0.85717</td>
</tr>
<tr>
<td>DRt-1</td>
<td>373</td>
<td>0.52130</td>
<td>0.16779</td>
<td>0.02426</td>
<td>0.89139</td>
</tr>
<tr>
<td>GOVINDt</td>
<td>373</td>
<td>0.47721</td>
<td>0.50015</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IND13</td>
<td>373</td>
<td>0.13405</td>
<td>0.34116</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IND14</td>
<td>373</td>
<td>0.40214</td>
<td>0.49099</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>lnS</td>
<td>373</td>
<td>21.48034</td>
<td>1.20493</td>
<td>17.99150</td>
<td>24.85870</td>
</tr>
<tr>
<td>gTA</td>
<td>373</td>
<td>0.28741</td>
<td>0.46116</td>
<td>-0.30866</td>
<td>3.75064</td>
</tr>
<tr>
<td>OITA</td>
<td>373</td>
<td>0.09524</td>
<td>0.08438</td>
<td>-0.09209</td>
<td>0.59860</td>
</tr>
<tr>
<td>DEPTA</td>
<td>373</td>
<td>0.03707</td>
<td>0.02477</td>
<td>0</td>
<td>0.18216</td>
</tr>
<tr>
<td>INVFATA</td>
<td>373</td>
<td>0.55635</td>
<td>0.17386</td>
<td>0.08518</td>
<td>0.89525</td>
</tr>
</tbody>
</table>

Notes:
- \( dDR_t \) = the debt ratio adjustment at year \( t \);
- \( DR_t \) = the actual debt ratio at the end of year \( t \);
- \( DR_{t-1} \) = the actual debt ratio at the end of year \( t-1 \);
- \( GOVIND_t \): the binary dummy variable with a value of 1 to indicate the industry supported by the government industrial policy at period \( t \) and otherwise with a value of 0,
- \( IND13 = 0 \) for the textile and electronics industries and 1 for the plastics industry;
- \( IND14 = 0 \) for the plastics and electronics industries and 1 for the textile industry;
- \( \ln S \) = natural logarithm of net sales;
- \( gTA \) = annual growth rate of total assets;
- \( OITA \) = net operating income/total assets;
- \( DEPTA \) = depreciation/total assets;
- \( INVFATA \) = inventory plus net fixed assets/total assets.
Table 7.1C
Descriptive Statistics for the Subsample with a Positive Adjustment Gap

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>dDR</td>
<td>268</td>
<td>0.05858</td>
<td>0.05496</td>
<td>0.00030</td>
<td>0.32244</td>
</tr>
<tr>
<td>DR_t</td>
<td>268</td>
<td>0.47118</td>
<td>0.17601</td>
<td>0.11334</td>
<td>0.87985</td>
</tr>
<tr>
<td>DR_{t-1}</td>
<td>268</td>
<td>0.41261</td>
<td>0.17172</td>
<td>0.03739</td>
<td>0.85977</td>
</tr>
<tr>
<td>GOVIND_t</td>
<td>268</td>
<td>0.45522</td>
<td>0.49892</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IND13</td>
<td>268</td>
<td>0.15299</td>
<td>0.36065</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>IND14</td>
<td>268</td>
<td>0.36940</td>
<td>0.48355</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>lnS</td>
<td>268</td>
<td>21.44058</td>
<td>1.23656</td>
<td>15.99580</td>
<td>25.23950</td>
</tr>
<tr>
<td>gTA</td>
<td>268</td>
<td>0.37315</td>
<td>0.56762</td>
<td>-0.09487</td>
<td>4.93033</td>
</tr>
<tr>
<td>OITA</td>
<td>268</td>
<td>0.06312</td>
<td>0.07375</td>
<td>-0.16390</td>
<td>0.34304</td>
</tr>
<tr>
<td>DEPTA</td>
<td>268</td>
<td>0.03478</td>
<td>0.02262</td>
<td>0</td>
<td>0.12669</td>
</tr>
<tr>
<td>INVFATA</td>
<td>268</td>
<td>0.54623</td>
<td>0.17462</td>
<td>0.02850</td>
<td>0.88304</td>
</tr>
</tbody>
</table>

Notes:
- dDR_t = the debt ratio adjustment at year t;
- DR_t = the actual debt ratio at the end of year t;
- DR_{t-1} = the actual debt ratio at the end of year t-1;
- GOVIND_t: the binary dummy variable with a value of 1 to indicate the industry supported by the government industrial policy at period t and otherwise with a value of 0;
- IND13 = 0 for the textile and electronics industries and 1 for the plastics industry;
- IND14 = 0 for the plastics and electronics industries and 1 for the textile industry;
- lnS = natural logarithm of net sales;
- gTA = annual growth rate of total assets;
- OITA = net operating income/total assets;
- DEPTA = depreciation/total assets;
- INVFATA = inventory plus net fixed assets/total assets.

7.4.2 Correlation Analysis

The matrices of the correlation between the variables are shown in Tables 7.2A to 7.2C for the full sample as well as for the subsamples in the case of a negative or a positive adjustment gap. As shown in these tables, the figure located below the coefficient of correlation is the probability of whether or not the coefficient of correlation is significantly different from zero. A number of correlation issues require further discussion.
Table 7.2A
Correlation Matrix for Model Variables in the Full Sample

<table>
<thead>
<tr>
<th></th>
<th>dDR</th>
<th>DR_t</th>
<th>DR_t-1</th>
<th>GOVIND_t</th>
<th>IND13</th>
<th>IND14</th>
<th>lnS</th>
<th>gS</th>
<th>OITA</th>
<th>DEPTA</th>
<th>INVFATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>dDR</td>
<td>1.00000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DR_t</td>
<td>0.22863</td>
<td>1.00000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;.0001</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DR_t-1</td>
<td>-0.34144</td>
<td>0.83695</td>
<td>1.00000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>INVFATA</td>
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<td>0.21184</td>
<td>0.18830</td>
<td>-0.42631</td>
<td>-0.04372</td>
<td>0.47794</td>
<td>-0.13705</td>
<td>-0.29776</td>
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</table>

Notes:
1. sample size = 641. 2. dDR_t = the debt ratio adjustment at year t; DR_t-1 = the actual debt ratio at the end of year t-1; GOVIND_t: the binary dummy variable with a value of 1 to indicate the industry strongly supported by government industrial policy at year t and otherwise with a value of 0; IND13 = the dummy variable with a value of 1 for the plastics industry; IND14 = the dummy variable with a value of 1 for the textile industry; lnS = natural logarithm of net sales; gTA = annual growth rate of total assets; OITA = net operating income/total assets; DEPTA = depreciation/total assets; INVFATA = inventory plus net fixed assets/total assets;
3. The figure located below the coefficient of correlation is the probability of whether or not the coefficient of correlation is significantly different from zero or not.
Table 7.2B
Correlation Matrix for Model Variables in the Subsample with a Negative Adjustment Gap

<table>
<thead>
<tr>
<th></th>
<th>dDR</th>
<th>DR_t</th>
<th>DR_{t-1}</th>
<th>GOVIND_t</th>
<th>IND13</th>
<th>IND14</th>
<th>lnS</th>
<th>gS</th>
<th>OITA</th>
<th>DEPTA</th>
<th>INVFATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>dDR</td>
<td>1.00000</td>
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<td></td>
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<td></td>
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<td>DR_t</td>
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<td></td>
<td></td>
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<td>DR_{t-1}</td>
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<tr>
<td>GOVIND_t</td>
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<td>IND14</td>
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<td>0.09289</td>
<td>0.05835</td>
<td>-0.78358</td>
<td>-0.32268</td>
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<td>gTA</td>
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<td>-0.14903</td>
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<td>-0.17124</td>
<td>0.21064</td>
<td>0.12229</td>
<td>-0.31415</td>
<td>0.03918</td>
<td>0.18784</td>
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Notes:
1. sample size = 373. 2. dDR_t = the debt ratio adjustment at year t; DR_{t-1} = the actual debt ratio at the end of year t-1; GOVIND_t: the binary dummy variable with a value of 1 to indicate the industry strongly supported by government industrial policy at year t and otherwise with a value of 0, IND13 = the dummy variable with a value of 1 for the plastics industry; IND14 = the dummy variable with a value of 1 for the textile industry; lnS = natural logarithm of net sales; gTA = annual growth rate of total assets; OITA = net operating income/total assets; DEPTA = depreciation/total assets; INVFATA = inventory plus net fixed assets/total assets; 3. The figure located below the coefficient of correlation is the probability of whether or not the coefficient of correlation is significantly different from zero or not.
<table>
<thead>
<tr>
<th></th>
<th>dDR</th>
<th>DRt</th>
<th>DRt(-1)</th>
<th>GOVINDt</th>
<th>IND13</th>
<th>IND14</th>
<th>lnS</th>
<th>gTA</th>
<th>OITA</th>
<th>DEPTA</th>
<th>INVFATA</th>
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<tr>
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<tr>
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<td>-0.14875</td>
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<td>-0.13456</td>
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Notes:
1. sample size = 268.
2. dDRt = the debt ratio adjustment at year t; DRt\(-1) = the actual debt ratio at the end of year t-1; GOVINDt: the binary dummy variable with a value of 1 to indicate the industry strongly supported by government industrial policy at year t and otherwise with a value of 0, IND13 = the dummy variable with a value of 1 for the plastics industry; IND14 = the dummy variable with a value of 1 for the textile industry; lnS = natural logarithm of net sales; gTA = annual growth rate of total assets; OITA = net operating income/total assets; DEPTA = depreciation/total assets; INVFATA = inventory plus net fixed assets/total assets.
3. The figure located below the coefficient of correlation is the probability of whether or not the coefficient of correlation is significantly different from zero or not.
1. As shown in Table 7.2A, the debt ratio adjustment (dDR) is not significantly related to the shift in the level of government industrial policy (GOVIND) in the full sample. However, the debt ratio adjustment is statistically significant and negatively related to GOVIND in the subsample with a negative adjustment gap, as shown in Table 7.2B. In addition, the debt ratio adjustment is statistically significant and positively related to GOVIND in the subsample with a positive adjustment gap, as shown in Table 7.2C. These findings reflect the fact that the adjustment gaps should be taken into account in the application of the partial adjustment model.

2. As shown in Tables 7.2A to 7.2C, the debt ratio adjustment (dDR) is statistically significant and negatively related to the previous actual debt ratios (DR\(_{t-1}\)). This reflects the fact that firms adjust their debt ratios with the level of debt ratios already used in the beginning of each period taken into account. The higher the debt ratios already used at the beginning of each period, the lower is the debt ratio adjustment that firms make.

3. As can be seen in Table 7.2A, the debt ratio adjustment is not significantly related to the industry types, IND13 and IND14, in the full sample. However, as can be seen in Table 7.2B, the debt ratio adjustment is statistically significant and positively related to IND13 in the subsample with a negative adjustment gap. In addition, as shown in Table 7.2C, the debt ratio adjustment is statistically significant and negatively related to IND13 in the subsample with a positive adjustment gap. These findings also reflect the fact that the adjustment gaps should be taken into account in the application of the partial adjustment model.

4. As seen in Tables 7.2A to 7.2C, high inter-correlation between the explanatory variables is found, e.g., the correlations between GOVIND and IND14, IND14 and INVFATA, and DEPTA and INVFATA. Therefore, the centering technique suggested by Cronbach (1987) is utilized to avoid problematic multicollinearity.

### 7.4.3 Regression Results and Analyses

The regression results based on Equations 7-4 and 7-4A for the determination of the
debt ratio adjustment and actual debt ratios of the listed firms with the financial constraint of over-leverage or under-leverage in the case of a negative or a positive adjustment gap are shown in Tables 7-3 and 7-4.

### Table 7.3
Regression Results for the Subsample with a Negative Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDRt)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DRt)</th>
</tr>
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<tr>
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<td>Coefficient</td>
<td>t Value</td>
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<td>DR_t-1</td>
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<tr>
<td>GOVIND_t</td>
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<td>-0.92</td>
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<td>IND13</td>
<td>0.00203</td>
<td>0.15</td>
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<tr>
<td>IND14</td>
<td>-0.01828</td>
<td>-1.73(^c)</td>
</tr>
<tr>
<td>lnS</td>
<td>0.01238</td>
<td>3.55(^a)</td>
</tr>
<tr>
<td>gTA</td>
<td>-0.01924</td>
<td>-1.93(^c)</td>
</tr>
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<td>OITA</td>
<td>-0.13896</td>
<td>-2.78(^a)</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.53812</td>
<td>-2.77(^a)</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.09111</td>
<td>2.84(^a)</td>
</tr>
</tbody>
</table>

Notes:
1. dDR\_t = the debt ratio adjustment at year t; DR\_t = the debt ratio at the end of year t;
   DR\_t-1 = the debt ratio at the end of year t-1;
   GOVIND\_t: the binary dummy variable with a value of 1 to indicate the industry strongly supported by government industrial policy at year t and otherwise with a value of 0,
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   lnS = natural logarithm of net sales; gTA = annual growth rate of total assets;
   OITA = net operating income/total assets; DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
2. \(^a\), \(^b\) and \(^c\) indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (\(\gamma\)) and the regression coefficient (\(\beta\)) of each independent variable except the previous actual debt ratio (DR\_t-1).
4. N Adj. R-square F value Durbin-Watson D value
(1) 373 0.4908 30.18\(^a\) 1.999
(2) 373 0.7868 153.99\(^a\) 1.999
5. VIF: Variance Inflation Factor
Table 7.4
Regression Results for the Subsample with a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDR&lt;sub&gt;t&lt;/sub&gt;)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DR&lt;sub&gt;t&lt;/sub&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
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<td>DR&lt;sub&gt;t-1&lt;/sub&gt;</td>
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<td>-3.04&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>10.54&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>IND13</td>
<td>0.06821</td>
<td>6.51&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>0.08146</td>
<td>10.25&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>lnS</td>
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<tr>
<td>gTA</td>
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</tr>
<tr>
<td>INVFATA</td>
<td>0.05404</td>
<td>2.23&lt;sup&gt;b&lt;/sup&gt;</td>
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</tbody>
</table>

Notes:
1. dDR<sub>t</sub> = the debt ratio adjustment at year t; DR<sub>t</sub> = the debt ratio at the end of year t;
   DR<sub>t-1</sub> = the debt ratio at the end of year t-1;
   GOVIND<sub>t</sub>: the binary dummy variable with a value of 1 to indicate the industry strongly supported by government industrial policy at year t and otherwise with a value of 0,
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   lnS = natural logarithm of net sales; gTA = annual growth rate of total assets;
   OITA = net operating income/total assets; DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
2. <sup>a</sup>, <sup>b</sup> and <sup>c</sup> indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable except the previous actual debt ratio (DR<sub>t-1</sub>).
4. N Adj. R-square F value Durbin-Watson D value
   (1) 268 0.7252 79.60<sup>a</sup> 2.043
   (2) 268 0.9152 322.17<sup>a</sup> 2.043
5. VIF: Variance Inflation Factor

As can be seen in Note 4 in Tables 7-3 and 7-4, a large value for the F-test for testing the utility of the modified partial adjustment model used in the study indicates that most of the variation in the debt ratio adjustment and the actual debt ratio is explained by Equations 7-4 and 7-4A. In addition, as shown in Note 4 in Table 7.3, the adjusted R-squares for the determination of the debt ratio adjustment and the actual debt ratio in the case of a negative adjustment gap are 41.31% and 78.68%, respectively. Table 7.4 shows that the adjusted R-squares for the determination of the debt ratio adjustment and the actual debt ratio in the case of a positive adjustment gap are 72.52% and 91.52%, respectively. These findings indicate that the fit of the modified partial adjustment model for the determination of debt ratio adjustment is moderately good and the fit of the modified partial
adjustment model for the determination of the actual debt ratio is quite good.

In addition, as shown in the VIF column in Tables 7.3 and 7.4, the values of the variance inflation factors (VIFs) for the explanatory variables are much less than 10, the general rule for testing multicollinearity. This finding shows no evidence of the existence of problematic multicollinearity in the study. Further, as can be seen in Note 4 in Tables 7.3 and 7.4, the Durbin-Watson D values are close to 2 that indicates no serious first-order autocorrelation problem. Further analysis of the regression results based on Equations 7-4 and 7-4A follows:

7.4.3.1 Government Industrial Policy

According to the t-value shown in the t-value column in Table 7.3, the proxy for government industrial policy to indicate the shift in the level of government industrial policy (GOVIND) is not significantly related to the debt ratio adjustment and the actual debt ratio in the subsample with a negative adjustment gap between the target debt ratio and the previous actual debt ratio. The result shows that the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of over-leverage in the case of a negative adjustment gap are not influenced by the government industrial policy. This is likely because, despite support from government industrial policy, firms with the financial constraint of over-leverage try to gear down their debt ratios to reduce the risk of bankruptcy. Firms do not finance with more debt to take advantage of the benefits from government industrial policy in order to avoid going bankrupt. The findings of the study with regard to the firms with negative adjustment gap do not support Appelbaum (1993).

On the other hand, as can be seen in the t-value column in Table 7.4, the proxy for government industrial policy (GOVIND) is statistically significant and positively related to the debt ratio adjustment and the actual debt ratio in the subsample of a positive adjustment gap. The result indicates that government industrial policy affects the determination of the debt ratio adjustment and the actual debt ratios of firms with the financial constraint of under-leverage where a positive adjustment gap exists. With the financial constraint of under-leverage, firms adjust debt ratios greater than those firms without support from government industrial policy and take
advantage of the benefits from government industrial policy. The results of the study regarding the firms with the financial constraint of under-leverage support Appelbaum (1993).

These findings demonstrate the variation in the impact of government industrial policy on the determination of the debt ratio adjustment and the actual debt ratio of firms with the financial constraints of over-leverage or under-leverage in the case of negative or positive adjustment gaps in the textile, plastics and electronics industries in Taiwan. Due to the financial constraint of over-leverage, firms covered by the government industrial policy still gear down their leverage to reduce the risk of going bankrupt rather than finance with more debt in order to take advantage of the benefits from government industrial policy, as argued by Appelbaum (1993). In addition, the findings imply that, for the sake of industrial policy efficacy, government industrial policy should be taken into account. In brief, government industrial policy affects capital structure decisions of firms according to whether or not a positive adjustment exists. The findings suggest that firms, with the financial constraint of under-leverage in the case of a positive adjustment gap, tend to have a higher leverage ratio when supported by government industrial policy. However, although supported by government industrial policy, firms with the financial constraint of over-leverage in the case of a negative adjustment gap tend to gear down their leverage ratios in order to reduce the risk of bankruptcy.

7.4.3.2 Adjustment Rate

According to the t-value shown in the t-value columns in Tables 7.3 and 7.4, the previous actual debt ratio (DR_{t-1}) is statistically significant and negatively related to the debt ratio adjustment (dDR) in the case of a negative or a positive gap for the listed firms in the textile, plastics and electronics industries of Taiwan. Based on Equation 7-4, the regression coefficient of the previous actual debt ratio is equal to the negative value of the adjustment rate (\(\gamma\)). Alternatively, the regression coefficient of the previous actual debt ratio in Equation 7-4A is equal to 1 minus the adjustment rate (1\(−\gamma\)).
Therefore, as shown in the Coefficient column in Table 7.3, the adjustment rate of debt ratios is 0.15305 or (1−0.84695) according to the regression coefficients of the previous actual debt ratio for the determination of the debt ratio adjustment and the actual debt ratio of the firms with the financial constraint of over-leverage in the case of a negative adjustment gap. On the other hand, as shown in the Coefficient column in Table 7.4, the adjustment rate of debt ratio is 0.06282 or (1−0.93718) according to the regression coefficients of the previous actual debt ratio for the determination of the debt ratio adjustment and the actual debt ratio of the firms with the financial constraint of under-leverage in the subsample with a positive adjustment gap.

This finding shows that firms with the financial constraint of over-leverage in the case of a negative adjustment gap adjust their debt ratios faster than those with the financial constraint of under-leverage in the case of a positive adjustment gap. This is likely because firms with the financial constraint of over-leverage in the case of a negative adjustment gap tend to gear down their debt ratios and adjust towards the target debt ratios by trading off the benefits of reducing the bankruptcy risk against the costs of the deviation away from the target debt ratios. The finding in the variation in the adjustment rate does not support the constant adjustment rate as Flannery and Rangan (2006) conclude.

In addition, the coefficients of the explanatory variables, except the previous actual debt ratio, are a multiple of the adjustment rate and the regression coefficients of these variables on the determination of the target debt ratio shown in Equation 4-2. The effect of the explanatory variables, except the previous actual debt ratio, on debt ratio adjustment is a proportion of the effect of these variables on the determination of the target debt ratio. The proportion of the effect of these variables on the determination of debt ratio adjustment and actual debt ratio depends upon the adjustment rate based on Equations 7-4 and 7-4A. The finding in the variation in the adjustment rate in the cases of a negative or a positive adjustment gap reflects that the proportional effect of the determinants of debt ratio decisions is greater in the case of a negative adjustment gap than in the case of a positive adjustment gap.
7.4.3.3 Control Variables for Firm Characteristics

According to the t-value shown in the t-value column in Table 7.3, the variables such as firm size \((\ln S)\) and asset tangibility \((\text{INVFATA})\) are statistically significant and positively related to the debt ratio adjustment and the actual debt ratio for the listed firms with the financial constraint of over-leverage in the textile, plastics and electronics industries in Taiwan. Firm-specific variables such as growth opportunities \((gTA)\), profitability \((OITA)\) and non-debt tax shields \((\text{DEPTA})\) are statistically significant and negatively related to the debt ratio adjustment and the actual debt ratio of the firms with the financial constraint of over-leverage in the case of a negative adjustment gap.

On the other hand, according to the t-value shown in the t-value column in Table 7.4 in the case of a positive adjustment gap, firm-specific variables such as growth opportunities \((gTA)\) and asset tangibility \((\text{INVFATA})\) are statistically significant and positively related to the debt ratio adjustment and the actual debt ratio of the listed firms with the financial constraint of under-leverage. In addition, firm-specific variables such as profitability \((OITA)\) and non-debt tax shields \((\text{DEPTA})\) are statistically significant and negatively related to the debt ratio adjustment and the actual debt ratio for the listed firms with the financial constraint of under-leverage in the case of a positive adjustment gap. However, firm size \((\ln S)\) is not significantly related to the debt ratio adjustment and the actual debt ratio for firms in the case of a positive adjustment gap.

Moreover, the proxy for growth opportunities \((gTA)\) is negatively related to the debt ratio adjustment and the actual debt ratio for firms with the financial constraint of over-leverage in the case of a negative adjustment gap. However, \(gTA\) is positively related to the debt ratio adjustment and the actual debt ratio for firms with the financial constraint of under-leverage in the case of a positive adjustment gap. This is likely because firms with under-leverage have enough debt capacity for future investment and growth opportunities and still finance with more debt. These results illustrate the variation in the firm-specific effects on the debt ratio adjustment and the actual debt ratios for the listed firms with the financial constraint of over-leverage or under-leverage in the case of a negative or a positive adjustment gap in
the textile, plastics and electronics industries. The finding in this study also provides further evidence on the effect of firm-specific characteristics on the determination of capital structure.

7.4.3.4 Control Variables for Industry Effect

According to the t-value shown in the t-value column in Table 7.3, the debt ratio adjustment and the actual debt ratio are statistically significant and negatively related to the dummy variable, IND14, for the textile industry in the case of a negative adjustment gap. The result suggests that, due to the financial constraint of over-leverage, firms gear down their debt ratios in order to reduce bankruptcy risk more in the textile industry than they do in the plastics and electronics industries.

On the other hand, as can be seen in the t-value column in Table 7.4 in the case of a positive adjustment gap, the debt ratio adjustment and the actual debt ratio are statistically significant and positively related to the dummy variables, IND13 and IND14, for the plastics and textile industries. The result indicates that firms, with the financial constraint of under-leverage in the case of a positive adjustment gap, adjust their debt ratios faster in the textile and plastics industries than in the electronics industry. This is likely because firms have higher growth in the electronics industry and, therefore, adjust the debt ratios less than in the textile and plastics industries in order to reserve spare debt capacity for future investment and growth opportunities. In addition, in the case of a positive adjustment gap, firms have higher debt ratios in the textile and plastics industries than in the electronics industry. This is because firms have greater growth in the electronics industry than in the textile and plastics industries and, therefore, have lower debt ratios in the case of a positive adjustment gap. The finding is consistent with most prior studies.

Moreover, Table 7.5 shows the regression results for the determination of the debt ratio adjustment and the actual debt ratio of firms in the full sample when adjustment gaps are not taken into account. In so doing, Table 7.5 illustrates the difference when negative and positive adjustment gaps are not taken into account in the application of the partial adjustment model.
Table 7.5
Regression Results without Negative and Positive Adjustment Gaps Taken into Account

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDRₜ)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DRₜ)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DRₜ₋₁</td>
<td>-0.24066</td>
<td>-11.29ᵃ</td>
</tr>
<tr>
<td>GOVINDₜ</td>
<td>0.04262</td>
<td>4.69ᵃ</td>
</tr>
<tr>
<td>IND13</td>
<td>0.02933</td>
<td>2.55ᵇ</td>
</tr>
<tr>
<td>IND14</td>
<td>0.02489</td>
<td>2.80ᵇ</td>
</tr>
<tr>
<td>lnS</td>
<td>0.00807</td>
<td>2.61ᵃ</td>
</tr>
<tr>
<td>gTA</td>
<td>0.02771</td>
<td>3.59ᵃ</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.31401</td>
<td>-6.97ᵃ</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.51524</td>
<td>-2.97ᵃ</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.12659</td>
<td>4.67ᵃ</td>
</tr>
</tbody>
</table>

Notes:
1. dDRₜ = the debt ratio adjustment at year t;
   DRₜ = the debt ratio at the end of year t;
   DRₜ₋₁ = the debt ratio at the end of year t-1;
   GOVINDₜ: the binary dummy variable with a value of 1 to indicate the industry strongly supported
   by government industrial policy at year t and otherwise with a value of 0,
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   lnS = natural logarithm of net sales;
   gTA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
2.ᵃ,ᵇ and ᶜ indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (γ) and the regression
   coefficient (β) of each independent variable except the previous actual debt ratio (DRₜ₋₁).
4. N Adj. R-square F value Durbin-Watson D value
   (1) 641 0.2154 20.55ᵃ 1.282
   (2) 641 0.7340 197.50ᵃ 1.282
5. VIF: Variance Inflation Factor

As can be seen in Note 4 in Table 7.5, the adjusted R-squares for the determination of the debt ratio adjustment and the actual debt ratio (0.2154 and 0.7340) without adjustment gaps taken into account are much lower than those found in Note 4 in Table 7.3 (0.4908 and 0.7868) and in Table 7.4 (0.7252 and 0.9152) with adjustment gaps taken into account. In addition, based on Equations 7-4 and 7-4A, respectively, the regression coefficient of the previous actual debt ratio is exactly equal to the negative value of the adjustment rate (−γ) and to 1 minus the adjustment rate (1−γ). The adjustment rate (0.24066) shown in Table 7.5 is overestimated without adjustment gaps taken into account and is much higher than the adjustment rates.
shown in Tables 7.3 and 7.4 (0.15305 and 0.06282). These findings reflect the importance of taking adjustment gaps into account in the application of the partial adjustment model to estimate the debt ratio adjustment and the actual debt ratio.

7.5 Robustness Tests

7.5.1 Stability over the Years of Economic Trough and Peak

In order to test the stability of the modified partial adjustment model, the empirical models for debt ratio adjustment and actual debt ratio as shown in Equations 7-4 and 7-4A are utilized to examine the debt ratio adjustment and the actual debt ratio at years of economic peak and economic trough, respectively, in the period from 1983 to 1995. The regression results for the debt ratio adjustment and the actual debt ratio at the years of economic trough and peak during the period from 1983 to 1995 in the case of a negative adjustment gap are shown in Tables 7.6 to 7.7 respectively.

According to the t-value shown in the t-value column in Table 7.6, government industrial policy does not have a significant effect on the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of over-leverage in the case of a negative adjustment gap at the years of economic trough during the period from 1983 to 1995. Similarly, as can be seen in Table 7.7, government industrial policy does not have a significant effect on the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of over-leverage in the case of a negative adjustment gap at the years of economic peak during the period from 1983 to 1995. These findings on the effect of government industrial policy on the determination of the debt ratio adjustment and the actual debt ratio are consistent with the results shown in Table 7.3.
Table 7.6
Regression Results for the Subsample with a Negative Adjustment Gap at the Years of Economic Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable:</th>
<th>(2) Dependent variable:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Debt Ratio Adjustment (dDRt)</td>
<td>Actual Debt Ratio (DRt)</td>
</tr>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DRt-1</td>
<td>-0.19901</td>
<td>-5.60a</td>
</tr>
<tr>
<td>GOVINDt</td>
<td>-0.02324</td>
<td>-1.08</td>
</tr>
<tr>
<td>IND13</td>
<td>0.01626</td>
<td>0.72</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.02725</td>
<td>-1.32</td>
</tr>
<tr>
<td>lnS</td>
<td>0.01515</td>
<td>3.07a</td>
</tr>
<tr>
<td>gTA</td>
<td>-0.00970</td>
<td>-0.71</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.16424</td>
<td>-2.19b</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.76574</td>
<td>-2.82a</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.08589</td>
<td>1.87c</td>
</tr>
</tbody>
</table>

Notes:
1. dDRt = the debt ratio adjustment at year t;
   DRt = the debt ratio at the end of year t;
   DRt-1 = the debt ratio at the end of year t-1;
   GOVINDt: the binary dummy variable with a value of 1 to indicate the industry strongly supported by government industrial policy at year t and otherwise with a value of 0,
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   lnS = natural logarithm of net sales;
   gTA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
2. a, b and c indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable except the previous actual debt ratio (DRt-1).
4. N  Adj. R-square  F value  Durbin-Watson D value
   (1) 209  0.4426  19.44a  1.826
   (2) 209  0.7596  74.36a  1.826
5. VIF: Variance Inflation Factor
### Table 7.7
Regression Results for the Subsample with a Negative Adjustment Gap at the Years of Economic Peak in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDRt)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DRt)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DRt-1</td>
<td>-0.10545</td>
<td>-2.85^a</td>
</tr>
<tr>
<td>GOVINDt</td>
<td>0.01598</td>
<td>0.79</td>
</tr>
<tr>
<td>IND13</td>
<td>-0.00885</td>
<td>-0.46</td>
</tr>
<tr>
<td>IND14</td>
<td>0.00050</td>
<td>0.03</td>
</tr>
<tr>
<td>lnS</td>
<td>0.00984</td>
<td>2.06^b</td>
</tr>
<tr>
<td>gTA</td>
<td>-0.03395</td>
<td>-2.46^b</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.10578</td>
<td>-1.70^c</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.58559</td>
<td>-2.47^b</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.12307</td>
<td>2.99^a</td>
</tr>
</tbody>
</table>

Notes:
1. dDRt = the debt ratio adjustment at year t; DRt = the debt ratio at the end of year t; DRt-1 = the debt ratio at the end of year t-1;
   GOVINDt: the binary dummy variable with a value of 1 to indicate the industry strongly supported by government industrial policy at year t and otherwise with a value of 0;
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   lnS = natural logarithm of net sales;
   gTA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
2. ^a, ^b and ^c indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable except the previous actual debt ratio (DRt-1).
4. N Adj. R-square F value Durbin-Watson D value
   (1) 164 0.3977 13.03^a 2.023
   (2) 164 0.8319 91.19^a 2.023
5. VIF: Variance Inflation Factor

Further, the regression results for the debt ratio adjustment and the actual debt ratio at the years of economic trough and peak during the period from 1983 to 1995 in the case of a positive adjustment gap are shown in Tables 7.8 to 7.9 respectively.
### Table 7.8
Regression Results for the Subsample with a Positive Adjustment Gap at the Years of Economic Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDR&lt;sub&gt;t&lt;/sub&gt;)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DR&lt;sub&gt;t&lt;/sub&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DR&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>-0.05068</td>
<td>-1.73&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>GOVIND&lt;sub&gt;t&lt;/sub&gt;</td>
<td>0.05646</td>
<td>3.55&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>IND13</td>
<td>0.04310</td>
<td>2.53&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>IND14</td>
<td>0.06332</td>
<td>4.03&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>lnS</td>
<td>-0.00268</td>
<td>-0.68</td>
</tr>
<tr>
<td>gTA</td>
<td>0.05451</td>
<td>5.85&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.12170</td>
<td>-1.82&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>DEPTA</td>
<td>0.64823</td>
<td>2.97&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>INVFATA</td>
<td>-0.07887</td>
<td>-2.35&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Notes:
1. dDR<sub>t</sub> = the debt ratio adjustment at year t;
2. DR<sub>t</sub> = the debt ratio at the end of year t;
3. GOVIND<sub>t</sub>: the binary dummy variable with a value of 1 to indicate the industry strongly supported by government industrial policy at year t and otherwise with a value of 0;
4. IND13 = the dummy variable with a value of 1 for the plastics industry;
5. IND14 = the dummy variable with a value of 1 for the textile industry;
6. lnS = natural logarithm of net sales;
7. gTA = annual growth rate of total assets;
8. OITA = net operating income/total assets;
9. DEPTA = depreciation/total assets;
10. INVFATA = inventory plus net fixed assets/total assets;
11. a, b and c indicate the significance level of 1%, 5% and 10%, respectively.
12. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable except the previous actual debt ratio (DR<sub>t-1</sub>).
Table 7.9
Regression Results for the Subsample with a Positive Adjustment Gap at the Years of Economic Peak in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDRt)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DRt)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DR(_{t-1})</td>
<td>-0.03774</td>
<td>-1.18</td>
</tr>
<tr>
<td>GOVIND(_t)</td>
<td>0.15179</td>
<td>6.83(^a)</td>
</tr>
<tr>
<td>IND13</td>
<td>0.14323</td>
<td>6.44(^a)</td>
</tr>
<tr>
<td>IND14</td>
<td>0.15180</td>
<td>8.22(^a)</td>
</tr>
<tr>
<td>lnS</td>
<td>-0.00686</td>
<td>-1.39</td>
</tr>
<tr>
<td>gTA</td>
<td>0.02667</td>
<td>2.77(^a)</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.04654</td>
<td>-0.64</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.20246</td>
<td>-0.86</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.08509</td>
<td>2.30(^b)</td>
</tr>
</tbody>
</table>

Notes:
1. dDR\(_t\) = the debt ratio adjustment at year t;
   DR\(_t\) = the debt ratio at the end of year t;
   DR\(_{t-1}\) = the debt ratio at the end of year t-1;
   GOVIND\(_t\): the binary dummy variable with a value of 1 to indicate the industry strongly supported by government industrial policy at year t and otherwise with a value of 0;
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   lnS = natural logarithm of net sales;
   gTA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
2. \(^a\), \(^b\) and \(^c\) indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable except the previous actual debt ratio (DR\(_{t-1}\)).
4. N, Adj. R-square, F value, Durbin-Watson D value
   (1) 134  0.6913  34.35\(^a\)  2.090
   (2) 134  0.9056  143.90\(^a\)  2.090
5. VIF: Variance Inflation Factor

According to the t-value shown in the t-value column in Table 7.8, government industrial policy has a significant positive effect on the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of under-leverage in the case of a positive adjustment gap at the years of economic trough during the period from 1983 to 1995. Similarly, as can be seen in Table 7.9, government industrial policy also has a significant positive effect on the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of under-leverage in the case of a positive adjustment gap at the years of economic peak during the period from 1983 to 1995. These findings on the effect of government industrial policy on the determination of
the debt ratio adjustment and the actual debt ratio are consistent with the results shown in Table 7.4. In brief, the findings on the effect of government industrial policy and the variation in its effect on the determination of the debt ratio adjustment and the actual debt ratio across the years of economic trough and peak during the period from 1983 to 1995, as shown in Tables 7.6 to 7.9, are consistent with the results found in Tables 7.3 and 7.4.

Furthermore, as shown in Tables 7.6 and 7.7, the adjustment rate based on Equations 7-4 and 7-4A is 0.19901 (i.e. $1 - 0.80099$) and 0.10545 (i.e. $1 - 0.89454$) at the years of economic trough and peak, respectively, in the case of negative adjustment gaps during the period from 1983 to 1995. Similarly, as shown in Tables 7.8 and 7.9, the adjustment rate is 0.05068 (i.e. $1 - 0.94932$) and 0.03774 (i.e. $1 - 0.96226$) at the years of economic trough and peak, respectively, in the case of positive adjustment gaps during the period from 1983 to 1995. The results show that firms adjust their debt ratios faster in the case of a negative adjustment gap than in the case of a positive adjustment gap. These findings on the variation in the adjustment rate in the case of a negative or a positive adjustment gap, as found in Tables 7.6 to 7.9, are consistent with the findings found in Tables 7.3 and 7.4.

Moreover, as shown in Tables 7.6 to 7.9, the results with respect to the industry effect and the firm-specific effects on the determination of the debt ratio adjustment and the actual debt ratio are almost the same as those shown in Tables 7.3 and 7.4. On the whole, the results over the years of economic trough and peak in the case of negative or positive adjustment gaps reflect the stability of the modified partial adjustment model utilized in this study.

### 7.5.2 Alternative Proxies for Government Industrial Policy

To test the robustness of the empirical models used in the study, alternative proxies are used to test the effect of government industrial policy. The alternative dummy variables, $GOVIND_{t-1}$ and $GOOVIND_{t+1}$, indicate that firms in a specific industry are financially supported by the government industrial policy at years $t-1$ and $t+1$, respectively. In other words, the dummy $GOVIND_{t-1}$ and $GOOVIND_{t+1}$, included in
the empirical model represent the post-policy effect and the expected pre-policy effect of government industrial policy, respectively. The regression results for the post-policy effect of government industrial policy in the case of negative and positive adjustment gaps are shown in Tables 7.10 and 7.11, respectively.

Table 7.10
Regression Results for the Post-Policy Effect in the Case of a Negative Adjustment Gap in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient (1)</th>
<th>t Value</th>
<th>VIF$^3$</th>
<th>Coefficient (2)</th>
<th>t Value</th>
<th>VIF$^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR$_{t-1}$</td>
<td>-0.15305</td>
<td>-5.90$^a$</td>
<td>1.26747</td>
<td>0.84695</td>
<td>32.63$^a$</td>
<td>1.26747</td>
</tr>
<tr>
<td>GOVIND$_{t-1}$</td>
<td>-0.00954</td>
<td>-0.92</td>
<td>3.23194</td>
<td>0.00954</td>
<td>-0.92</td>
<td>3.23194</td>
</tr>
<tr>
<td>IND13</td>
<td>0.00203</td>
<td>0.15</td>
<td>1.49035</td>
<td>0.00203</td>
<td>0.15</td>
<td>1.49035</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.01828</td>
<td>-1.73$^c$</td>
<td>2.79623</td>
<td>-0.01829</td>
<td>-1.73$^c$</td>
<td>2.79623</td>
</tr>
<tr>
<td>lnS</td>
<td>0.01238</td>
<td>3.55$^a$</td>
<td>1.10206</td>
<td>0.01238</td>
<td>3.55$^a$</td>
<td>1.10206</td>
</tr>
<tr>
<td>gTA</td>
<td>-0.01924</td>
<td>-1.93$^c$</td>
<td>1.82489</td>
<td>-0.01924</td>
<td>-1.93$^c$</td>
<td>1.82489</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.13796</td>
<td>-2.78$^a$</td>
<td>2.51390</td>
<td>-0.13897</td>
<td>-2.78$^a$</td>
<td>2.51390</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.53812</td>
<td>-2.77$^a$</td>
<td>4.68326</td>
<td>-0.53815</td>
<td>-2.77$^a$</td>
<td>4.68326</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.09111</td>
<td>2.84$^a$</td>
<td>1.94377</td>
<td>0.09111</td>
<td>2.84$^a$</td>
<td>1.94377</td>
</tr>
</tbody>
</table>

Notes:
1. dDR$_t$ = the debt ratio adjustment at year $t$;
2. DR$_t$ = the debt ratio at the end of year $t$;
3. DR$_{t-1}$ = the debt ratio at the end of year $t-1$;
4. GOVIND$_{t-1}$: the binary dummy variable with a value of 1 to indicate the industry financially supported by government industrial policy at year $t-1$ and otherwise with a value of 0;
5. IND13 = the dummy variable with a value of 1 for the plastics industry;
6. IND14 = the dummy variable with a value of 1 for the textile industry;
7. lnS = natural logarithm of net sales;
8. gTA = annual growth rate of total assets;
9. OITA = net operating income/total assets;
10. DEPTA = depreciation/total assets;
11. INVFATA = inventory plus net fixed assets/total assets;
12. $^a$, $^b$ and $^c$ indicate the significance level of 1%, 5% and 10%, respectively.
13. The value of the coefficient is the product of the rate of adjustment ($\gamma$) and the regression coefficient ($\beta$) of each independent variable except the previous actual debt ratio (DR$_{t-1}$).
| (1) | 373 | 0.4131 | 30.18$^a$ | 1.999 |
| (2) | 373 | 0.7868 | 153.99$^a$ | 1.999 |

5. VIF: Variance Inflation Factor
Table 7.11
Regression Results for the Post-Policy Effect in the Case of a Positive Adjustment Gap in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDR_t)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DR_t)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DR_t-1</td>
<td>-0.06282</td>
<td>-3.04^a</td>
</tr>
<tr>
<td>GOVIND_t-1</td>
<td>0.08856</td>
<td>10.54^a</td>
</tr>
<tr>
<td>IND13</td>
<td>0.06821</td>
<td>6.51^a</td>
</tr>
<tr>
<td>IND14</td>
<td>0.08146</td>
<td>10.25^a</td>
</tr>
<tr>
<td>lnS</td>
<td>-0.00360</td>
<td>-1.23</td>
</tr>
<tr>
<td>gTA</td>
<td>0.03151</td>
<td>4.93^a</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.11851</td>
<td>-2.53^b</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.30668</td>
<td>-1.88^c</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.05404</td>
<td>2.23^b</td>
</tr>
</tbody>
</table>

Notes:
1. dDR_t = the debt ratio adjustment at year t;
   DR_t = the debt ratio at the end of year t;
   DR_t-1 = the debt ratio at the end of year t-1;
   GOVIND_{t-1}: the binary dummy variable with a value of 1 to indicate the industry financially supported by government industrial policy at year t-1 and otherwise with a value of 0,
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   lnS = natural logarithm of net sales;
   gTA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
2. ^a, ^b and ^c indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (\( \gamma \)) and the regression coefficient (\( \beta \)) of each independent variable except the previous actual debt ratio (DR_{t-1}).
4. 
<table>
<thead>
<tr>
<th>N</th>
<th>Adj. R-square</th>
<th>F value</th>
<th>Durbin-Watson D value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) 268</td>
<td>0.7252</td>
<td>79.60^a</td>
<td>2.043</td>
</tr>
<tr>
<td>(2) 268</td>
<td>0.9152</td>
<td>322.17^a</td>
<td>2.043</td>
</tr>
</tbody>
</table>
5. VIF: Variance Inflation Factor

According to the t-value shown in the t-value column in Table 7.10, the dummy variable (GOVIND_{t-1}) for the post-policy effect of government industrial policy is not significantly related to the debt ratio adjustment and the actual debt ratio in the case of a negative adjustment gap for the listed firms in the textile, plastics and electronics industries in Taiwan. On the other hand, as can be seen in Table 7.11, the dummy variable (GOVIND_{t-1}) for the post-policy effect of government industrial policy is statistically significant and positively related to the debt ratio adjustment and the actual debt ratio in the case of a positive adjustment gap for firms in the textile, plastics and electronics industries.
The findings above suggest that firms, with the financial constraint of under-leverage in the case of a positive adjustment gap, tend to finance with more debt after the year of termination of government industrial policy. However, as shown in Table 7.10, the post-policy effect of government industrial policy disappears when a negative adjustment gap exists. In addition, as shown in the Coefficient column in Tables 7.10 to 7.11, the adjustment rate is faster in the case of a negative adjustment gap (i.e. 0.15305) than in the case of a positive adjustment gap (i.e. 0.06282) with post-policy effect taken into account. The finding on the variation in adjustment rate of debt ratios by using alternative proxies for government industrial policy is consistent with those found in Tables 7.3 and 7.4.

Further, the regression results for the pre-policy effect of government industrial policy in the case of negative and positive adjustment gaps are shown in Tables 7.12 and 7.13, respectively. According to the t-value shown in the t-value column in Table 7.12, the dummy variable (GOVIND\(_{t+1}\)) for the pre-policy effect of government industrial policy is not significantly related to the debt ratio adjustment and the actual debt ratio in the case of a negative adjustment gap for the listed firms in the textile, plastics and electronics industries in Taiwan. On the other hand, as can be seen in Table 7.13, the dummy variable (GOVIND\(_{t+1}\)) for the pre-policy effect of government industrial policy is statistically significant and positively related to the debt ratio adjustment and the actual debt ratio in the case of a positive adjustment gap for firms in the textile, plastics and electronics industries. This suggests that firms, with the financial constraint of under-leverage in the case of a positive adjustment gap, tend to finance with more debt after the year of termination of government industrial policy. However, as shown in Table 7.12, the pre-policy effect of government industrial policy disappears when a negative adjustment gap exists.

In addition, as shown in the Coefficient column in Tables 7.12 to 7.13, the adjustment rate is faster in the case of a negative adjustment gap (i.e. 0.14994) than in the case of a positive adjustment gap (i.e. 0.06276) with pre-policy effect taken into account. The finding on the variation in adjustment rate of debt ratios by using alternative proxies for government industrial policy is consistent with those found in Tables 7.3 and 7.4.
Table 7.12
Regression Results for the Pre-Policy Effect in the Case of a Negative Adjustment Gap in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDR&lt;sub&gt;t&lt;/sub&gt;)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DR&lt;sub&gt;t&lt;/sub&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DR&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>-0.14994</td>
<td>-5.76&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>GOVIND&lt;sub&gt;t+1&lt;/sub&gt;</td>
<td>-0.01338</td>
<td>-1.24</td>
</tr>
<tr>
<td>IND13</td>
<td>-0.00144</td>
<td>-0.10</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.02027</td>
<td>-1.90&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>lnS</td>
<td>0.01222</td>
<td>3.50&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>gTA</td>
<td>-0.01850</td>
<td>-1.86&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.12938</td>
<td>-2.53&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.50291</td>
<td>-2.59&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.08713</td>
<td>2.71&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Notes:
1. dDR<sub>t</sub> = the debt ratio adjustment at year t;
   DR<sub>t</sub> = the debt ratio at the end of year t;
   DR<sub>t-1</sub> = the debt ratio at the end of year t-1;
   GOVIND<sub>t+1</sub>: the binary dummy variable with a value of 1 to indicate the industry financially supported by government industrial policy at year t+1 and otherwise with a value of 0.
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   lnS = natural logarithm of net sales;
   gTA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
2. <sup>a</sup>, <sup>b</sup> and <sup>c</sup> indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable except the previous actual debt ratio (DR<sub>t-1</sub>).
4. N Adj. R-square F value Durbin-Watson D value
   (1) 373 0.4143 30.31<sup>a</sup> 2.003
   (2) 373 0.7868 153.99<sup>a</sup> 2.003
5. VIF: Variance Inflation Factor
### Table 7.13
Regression Results for the Pre-Policy Effect in the Case of a Positive Adjustment Gap in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Dependent variable: Debt Ratio Adjustment (dDR&lt;sub&gt;t&lt;/sub&gt;)</th>
<th>(2) Dependent variable: Actual Debt Ratio (DR&lt;sub&gt;t&lt;/sub&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DR&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>-0.06276</td>
<td>-3.18&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>GOVIND&lt;sub&gt;t+1&lt;/sub&gt;</td>
<td>0.10904</td>
<td>12.06&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>IND13</td>
<td>0.08424</td>
<td>8.05&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>IND14</td>
<td>0.08842</td>
<td>11.44&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>lnS</td>
<td>-0.00175</td>
<td>-0.63</td>
</tr>
<tr>
<td>gTA</td>
<td>0.02900</td>
<td>4.74&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.16250</td>
<td>-3.57&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.46657</td>
<td>-2.94&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.07059</td>
<td>3.02&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Notes:
1. dDR<sub>t</sub> = the debt ratio adjustment at year t;
   DR<sub>t</sub> = the debt ratio at the end of year t;
   DR<sub>t-1</sub> = the debt ratio at the end of year t-1;
   GOVIND<sub>t+1</sub>: the binary dummy variable with a value of 1 to indicate the industry financially supported by government industrial policy at year t+1 and otherwise with a value of 0;
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   lnS = natural logarithm of net sales;
   gTA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
2. <sup>a</sup>, <sup>b</sup> and <sup>c</sup> indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable except the previous actual debt ratio (DR<sub>t-1</sub>);
4. N = 268
   Adj. R-square = 0.7486
   F value = 89.65<sup>a</sup>
   Durbin-Watson D value = 2.077
5. VIF: Variance Inflation Factor

### 7.6 Conclusion

In the application of the partial adjustment model with negative and positive adjustment gaps taken into account, this study investigates the effect of government industrial policy on the debt ratio adjustment and the determination of the actual debt ratio for the listed firms in the textile, plastics and electronics industries in Taiwan.

Controlling for the effects of firm characteristics and industry types, the results
show that debt ratio adjustment and actual debt ratio are influenced by government industrial policy. However, the effect of government industrial policy on debt ratio decisions depends upon whether a negative or a positive adjustment gap exists. The debt ratio adjustment and the actual debt ratio are not significantly related to government industrial policy for firms with the financial constraint of over-leverage in the case of a negative adjustment gap between the target debt ratio and the previous actual debt ratio. The findings of the study with respect to firms with the financial constraint of over-leverage are not consistent with those of Appelbaum (1993). On the other hand, in the case of a positive adjustment gap, the debt ratio adjustment and the actual debt ratio are positively related to government industrial policy for firms with the financial constraint of under-leverage in the case of a positive adjustment gap. The results of the study in firms with the financial constraint of under-leverage are in line with Appelbaum (1993). As a whole, the findings do not completely support Appelbaum (1993) and suggest that government industrial policy affects the capital structure of firms according to whether or not a positive adjustment gap exists. Future research might address whether or not the debt ratio adjustment and the determination of the actual debt ratios are influenced by monetary policy. Such an investigation could provide a better understanding of how monetary policy affects the debt ratio adjustment and the determination of the actual debt ratio of firms in the case of negative or positive adjustment gaps between the target debt ratio and the previous actual debt ratio.

Further, the findings show that firms adjust their debt ratios faster in the case of a negative adjustment gap than in the case of a positive adjustment gap. This is likely because firms, with the financial constraint of over-leverage, adjust at a faster rate to gear down their debt ratios in order to reduce the risk of bankruptcy in the case of a negative adjustment gap. The finding on the variation in the adjustment rate in the case of negative or positive adjustment gaps does not support the constant adjustment rate as Flannery and Rangan (2006) conclude. Government industrial policy-makers might provide specific measures to promote industrial development for firms with the financial constraint of over-leverage in the case of a negative adjustment gap in order to improve the efficacy of their industrial policy. Once again, future research could address the impact of monetary policy on the variation in the adjustment rate of debt ratio, in particular with the shift in monetary policy.
taken into account. This could provide a better understanding of how firms adjust their debt ratios in response to the shift in monetary policy and become a helpful reference for policy-makers.
Chapter 8

Consolidated Results and Analyses*

8.1 Introduction

As mentioned in Section 2.4, all of the test variables found to have a significant effect on debt ratio adjustment and actual debt ratios in Chapters 5 to 7 are included in the empirical models of debt ratio adjustment and actual debt ratio. This inclusion allows for a further robustness check and for final conclusions to be drawn on the impact of these test variables on the determination of debt ratio adjustment and actual debt ratio.

The empirical results found in Chapter 5 show that macroeconomic conditions have a positive effect on debt ratio adjustment and actual debt ratio for the listed firms with under-leverage in the textile, plastics and electronics industries. The findings are consistent with the argument of Stulz (1990) that firms with limited growth opportunities finance with more debt in order to mitigate the agency problem and avoid over-investment. However, the positive effect of macroeconomic conditions disappears for firms with the financial constraint of over-leverage, suggesting that the determination of debt ratio adjustment and actual debt ratio varies according to where the financial constraint of over-leverage or under-leverage exists.

The empirical results found in Chapter 6 show that economic development affects the determination of debt ratio adjustment and actual debt ratio for the listed firms with under-leverage in the textile, plastics and electronics industries. However, the effect of economic development varies for firms with financial constraint of over-

* Parts of the chapter were reported in a paper entitled “The impact of industrial policy on capital structure with financial flexibility, macroeconomic conditions and economic growth and development taken into account: evidence from Taiwan” presented at a refereed international scholarly conference, the World Association for Sustainable Development 2007 Conference held at the Nathan Campus of Griffith University, Brisbane, Queensland, Australia on October 29 to 31, 2007. The revised conference paper has been published as a book chapter in Ahmed, A. (ed.). 2007, World Sustainable Development Outlook 2007: Knowledge Management and Sustainable Development in the 21st Century, Greenleaf, Sheffield, pp. 315-324.
leverage or under-leverage. The shift in the level of economic development has a positive effect on the debt ratio adjustment and the actual debt ratio for firms with under-leverage but a negative effect for firms with over-leverage. The future growth of economic development has a positive effect on the debt ratio adjustment and the actual debt ratio for firms with under-leverage but the effect does not appear to be positive for firms with over-leverage.

The empirical results found in Chapter 7 show that government industrial policy has a significant effect on the determination of debt ratio adjustment and actual debt ratio. However, the effect varies for firms with financial constraint of over-leverage or under-leverage. Government industrial policy has a positive effect on debt ratio adjustment and actual debt ratio for firms with under-leverage but the effect disappears for firms with over-leverage. In addition, under the financial constraint of under-leverage, firms with more growth in the electronics industry finance with less debt than those in the textile and plastics industries. On the other hand, under the financial constraint of over-leverage, firms gear down their leverage ratios more in the textile industry than in the plastics and electronics industries.

In brief, the empirical results shown in Chapters 5 to 7 show that macroeconomic conditions, economic development and government industrial policy have a significant effect on the debt ratio adjustment and the actual debt ratios at the years of economic peak and trough during the period from 1983 to 1995 for the listed firms in the textile, plastics and electronics industries in Taiwan. Their effects vary, however, according to whether the financial constraint of firms is overleveraged or underleveraged. The findings on the effects of these test variables and control variables in Chapters 5 to 7 are summarized in Table 8.1.
Table 8.1
Summarized Regression Results for Debt Ratio Adjustment and Actual Debt Ratios in Chapters 5 to 7

<table>
<thead>
<tr>
<th>Variables</th>
<th>Negative adjustment gap</th>
<th>Positive adjustment gap</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CH 5</td>
<td>CH 6</td>
</tr>
<tr>
<td>Adjustment rate</td>
<td>16.3%</td>
<td>13.9%</td>
</tr>
<tr>
<td>Macroeconomic conditions</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Shift in business cycles or in the level of economic development</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Economic development</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Government industrial policy</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Plastics industry</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Textile industry</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Firm size</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Growth opportunities</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Profitability</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Non-debt tax shields</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Asset tangibility</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Macroeconomic conditions’ interaction with:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firm size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth opportunities</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Profitability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-debt tax shields</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asset tangibility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macroeconomic conditions’ interaction with:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firm size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth opportunities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profitability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-debt tax shields</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asset tangibility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R-square (dDR)</td>
<td>0.4310</td>
<td>0.4908</td>
</tr>
<tr>
<td>Adjusted R-square (DR)</td>
<td>0.7948</td>
<td>0.8044</td>
</tr>
</tbody>
</table>

8.2 Consolidated Theoretical Model

As discussed in Chapter 4, the adjustment behavior of capital structure of firms with a financial constraint of over-leverage or under-leverage in the case of a negative or a positive adjustment gap is expressed as follows:

\[
ADJ_i = \sum_{j=1}^{C} \gamma \beta_{ij} X_{ij}^{FC} + \gamma \beta_{ij}^{IND} IND_i + \gamma \beta_{ij}^{TV} TV_i - \gamma ACS_{i-1} + \gamma \epsilon_i \tag{4-4}
\]

where:

\( ADJ_i \) = the capital structure adjustment at period \( t \),
\( ACS_i \) = the actual capital structure at the end of period \( t \),
\( \gamma \) = the adjustment rate,
\[ \beta = \text{the regression coefficient,} \]
\[ X_{j}^{c}: \text{the variables at the firm level and } j=1 \text{ to } c \text{ at period } t, \]
\[ \text{IND}_t: \text{the dummy variable for industry types,} \]
\[ TV: \text{the test variable,} \]
\[ \text{ACS}_{t-1} = \text{the actual capital structure at the end of period } t-1, \text{ and} \]
\[ \gamma \epsilon_t = \text{the error term.} \]

Based on Equation 4-4, the theoretical models of capital structure adjustment (ADJ) and actual capital structure (ACS) used in Chapter 5 to examine the hypothesized effect of macroeconomic conditions are expressed, respectively, as follows:

**ADJ,**
\[
\begin{align*}
\text{ADJ}_i &= \gamma \beta_1 \text{SIZE}_i + \gamma \beta_2 \text{GROWTH}_i + \gamma \beta_3 \text{PROFIT}_i + \gamma \beta_4 \text{NDTS}_i + \gamma \beta_5 \text{ASSETS}_i \\
&+ \gamma \beta_{1i} \text{IND}_i + \gamma \beta_{1}^{EC} \text{EC}_i + \gamma \beta_{1}^{BC} \text{BC} + \gamma \beta_{1}^{EC} \text{SIZE}_i \times \text{EC}_i + \gamma \beta_{1i} \text{GROWTH}_i \times \text{EC}_i \\
&+ \gamma \beta_{1i} \text{PROFIT}_i \times \text{EC}_i + \gamma \beta_{1i} \text{NDTS}_i \times \text{EC}_i + \gamma \beta_{1i} \text{ASSET}_i \times \text{EC}_i \\
&- \gamma \text{ACS}_{t-1} + \gamma \epsilon_i \\
&= \gamma \beta_{1i} \text{SIZE}_i + \gamma \beta_{1i} \text{GROWTH}_i + \gamma \beta_{1i} \text{PROFIT}_i + \gamma \beta_{1i} \text{NDTS}_i + \gamma \beta_{1i} \text{ASSETS}_i \\
&+ \gamma \beta_{1i} \text{IND}_i + \gamma \beta_{1i} \text{EC}_i + \gamma \beta_{1i} \text{BC} + \gamma \beta_{1i} \text{SIZE}_i \times \text{EC}_i + \gamma \beta_{1i} \text{GROWTH}_i \times \text{EC}_i \\
&+ \gamma \beta_{1i} \text{PROFIT}_i \times \text{EC}_i + \gamma \beta_{1i} \text{NDTS}_i \times \text{EC}_i + \gamma \beta_{1i} \text{ASSET}_i \times \text{EC}_i \\
&+ (1 - \gamma) \text{ACS}_{t-1} + \gamma \epsilon_i
\end{align*}
\]

**ACS,**
\[
\begin{align*}
\text{ACS}_i &= \gamma \beta_1 \text{SIZE}_i + \gamma \beta_2 \text{GROWTH}_i + \gamma \beta_3 \text{PROFIT}_i + \gamma \beta_4 \text{NDTS}_i + \gamma \beta_5 \text{ASSETS}_i \\
&+ \gamma \beta_{1i} \text{IND}_i + \gamma \beta_{1i} \text{ED}_i + \gamma \beta_{1i} \text{SED} - \gamma \text{ACS}_{t-1} + \gamma \epsilon_i \\
&= \gamma \beta_{1i} \text{SIZE}_i + \gamma \beta_{1i} \text{GROWTH}_i + \gamma \beta_{1i} \text{PROFIT}_i + \gamma \beta_{1i} \text{NDTS}_i + \gamma \beta_{1i} \text{ASSETS}_i \\
&+ \gamma \beta_{1i} \text{IND}_i + \gamma \beta_{1i} \text{ED}_i + \gamma \beta_{1i} \text{SED} + (1 - \gamma) \text{ACS}_{t-1} + \gamma \epsilon_i
\end{align*}
\]
Based on Equation 4-4, the theoretical models of capital structure adjustment (ADJ) and actual capital structure (ACS) used in Chapter 7 to examine the hypothesized effect of government industrial policy are expressed, respectively, as follows:

$$\begin{align*}
\text{ADJ}_t & = \gamma \beta_1 \text{SIZE}_t + \gamma \beta_2 \text{GROWTH}_t + \gamma \beta_3 \text{PROFIT}_t + \gamma \beta_4 \text{NDTS}_t + \gamma \beta_5 \text{ASSETS}_t \\
& + \gamma \beta_6 \text{IND}_t + \gamma \beta_7 \text{GIP}_t - \gamma \text{ACS}_{t-1} + \gamma \varepsilon_t
\end{align*}$$

$$\begin{align*}
\text{ACS}_t & = \gamma \beta_1 \text{SIZE}_t + \gamma \beta_2 \text{GROWTH}_t + \gamma \beta_3 \text{PROFIT}_t + \gamma \beta_4 \text{NDTS}_t + \gamma \beta_5 \text{ASSETS}_t \\
& + \gamma \beta_6 \text{IND}_t + \gamma \beta_7 \text{GIP}_t - (1 - \gamma)\text{ACS}_{t-1} + \gamma \varepsilon_t
\end{align*}$$

(7-3)

(7-3A)

With consideration to robustness and model misspecification, these three test variables are included in Equation 4-4 to run consolidated regression in order to confirm their effects on capital structure adjustment and on actual capital structure. With the inclusion of these test variables, the consolidated theoretical models for capital structure adjustment and actual capital structure of firms with the financial constraint of under-leverage or over-leverage in the case of a positive or a negative adjustment gap are written as follows:\(^{13}\)

$$\begin{align*}
\text{ADJ}_t & = \gamma \beta_1 \text{SIZE}_t + \gamma \beta_2 \text{GROWTH}_t + \gamma \beta_3 \text{PROFIT}_t + \gamma \beta_4 \text{NDTS}_t + \gamma \beta_5 \text{ASSETS}_t \\
& + \gamma \beta_6 \text{IND}_t + \gamma \beta_7 \text{GIP}_t + \gamma \text{SED}_t + \gamma \varepsilon_t
\end{align*}$$

$$\begin{align*}
\text{ACS}_t & = \gamma \beta_1 \text{SIZE}_t + \gamma \beta_2 \text{GROWTH}_t + \gamma \beta_3 \text{PROFIT}_t + \gamma \beta_4 \text{NDTS}_t + \gamma \beta_5 \text{ASSETS}_t \\
& + \gamma \beta_6 \text{IND}_t + \gamma \beta_7 \text{GIP}_t + (1 - \gamma)\text{ACS}_{t-1} + \gamma \varepsilon_t
\end{align*}$$

(8-1)

(8-1A)

\(^{13}\) The dummy variables of BC for the shift in business cycles in Equation 5-3 and SED for the shift in the level of economic development in Equation 6-3 are used to capture the time effect. The dummy variable SED is used to capture the time effect in Chapter 8.
where:

- $ADJ_t$: the capital structure adjustment at period $t$,
- $ACS_t$: the capital structure at the end of period $t$,
- $\gamma$: the adjustment rate,
- $\beta$: the regression coefficient,
- $SIZE$: firm size,
- $GROWTH$: growth opportunities,
- $PROFIT$: profitability,
- $NDTS$: non-debt tax shields,
- $ASSET$: asset tangibility,
- $IND$: the dummy variable for industry types,
- $EC$: the dummy variable for the shift in macroeconomic conditions, 0 for economic recession and 1 for economic expansion,
- $SIZE \times EC$, $GROWTH \times EC$, $PROFIT \times EC$, $NDTS \times EC$ and $ASSET \times EC$: the interactions between firm-level variables and macroeconomic conditions,
- $ED$: the variable for future economic growth of economic development,
- $SED$: the dummy variable for the shift in the level of economic development,
- $GIP$: the dummy variable for the shift in the level of government industrial policy,
- $ACS_{t-1}$: the actual capital structure at the end of period $t-1$, and
- $\gamma e$: the error term.

Based on Equations 8-1 and 8-1A, i.e. the consolidated theoretical models for capital structure adjustment and actual capital structure, the means by which the consolidated empirical models are obtained is discussed in the next section.

### 8.3 Consolidated Empirical Model

Incorporating the proxies for the variables as discussed in Chapters 5 to 7 into Equations 8-3 and 8-3A, the consolidated empirical models for debt ratio adjustment and actual debt ratios of firms with financial constraint of over-leverage or under-leverage where a negative or a positive adjustment gap exists are expressed,
respectively, as follows:

\[ d\text{DR}_t = \gamma_t \ln S_t + \gamma_{2t} g\text{TA}_t + \gamma_{3t} \text{OITA}_t + \gamma_{4t} \text{DEPTA}_t + \gamma_{5t} \text{INVFATA}_t + \gamma_{6t} \text{ED}_t \]

\[ + \gamma_{7t} g\text{TA}_t \times \text{EC}_t + \gamma_{8t} \text{OITA}_t \times \text{EC}_t + \gamma_{9t} \text{DEPTA}_t \times \text{EC}_t \]

\[ + \gamma_{10t} \text{INVFATA}_t \times \text{EC}_t + \gamma_{11t} \text{EPFGDP}_t + \gamma_{12t} \text{GDP}_t + \gamma_{13t} \text{SED}_t + \gamma_t \epsilon_t \quad (8-2) \]

\[ \text{DR}_t = \gamma_t \ln S_t + \gamma_{2t} g\text{TA}_t + \gamma_{3t} \text{OITA}_t + \gamma_{4t} \text{DEPTA}_t + \gamma_{5t} \text{INVFATA}_t + \gamma_{6t} \text{ED}_t \]

\[ + \gamma_{7t} g\text{TA}_t \times \text{EC}_t + \gamma_{8t} \text{OITA}_t \times \text{EC}_t + \gamma_{9t} \text{DEPTA}_t \times \text{EC}_t \]

\[ + \gamma_{10t} \text{INVFATA}_t \times \text{EC}_t + \gamma_{11t} \text{EPFGDP}_t + \gamma_{12t} \text{GDP}_t + \gamma_{13t} \text{SED}_t + \gamma_t \epsilon_t \quad (8-2A) \]

where:

- \( d\text{DR}_t \) : the debt ratio adjustment at year t,
- \( \text{DR}_t \) : the actual debt ratios at the end of year t,
- \( \gamma \) : the adjustment rate,
- \( \beta \) : the regression coefficient,
- \( \ln S \) (firm size) : natural logarithm of net sales,
- \( g\text{TA} \) (growth opportunities) : the annual growth rate of total assets,
- \( \text{OITA} \) (profitability) : the ratio of net operating income to total assets,
- \( \text{DEPTA} \) (non-debt tax shields) : the ratio of depreciation to total assets,
- \( \text{INVFATA} \) (asset tangibility) : the ratio of inventory plus net fixed asset to total assets,
- IND13 and IND14 : the dummy variables with a value of 1 to indicate the plastic and textile industries, respectively, and with a value of 0 to indicate the electronics industry,
- EC : the dummy variable with a value of 0 for economic trough and 1 for economic peak,
- \( \ln S \times \text{EC}, g\text{TA} \times \text{EC}, \text{OITA} \times \text{EC}, \text{DEPTA} \times \text{EC} \) and \( \text{INVFATA} \times \text{EC} \) : the interactions between firm-level control variables and macroeconomic
conditions,
FgGDP: the future annual growth rate of real GDP,
SED: the binary dummy variable with a value of 0 to indicate the period
before 1987 and 1 to indicate the period after 1987 in the course of
economic development in Taiwan,
GOVIND_t: the binary dummy variable with a value of 1 to indicate the
industry supported by the government industrial policy at year t
and otherwise with a value of 0,
DR_{t-1} : the actual debt ratio at the end of year t-1, and
γε: the error term.

Based on the consolidated empirical models for the debt ratio adjustment and the
actual debt ratio, the consolidated empirical results and analysis are obtained and
discussed in the next section.

8.4 Consolidated Empirical Results and Analyses

The consolidated regression results for the debt ratio adjustment and the actual debt
ratios of firms with financial constraint of over-leverage or under-leverage in the
case of a negative or a positive adjustment gap between the target debt ratio and the
previous actual debt ratio are presented in Tables 8.2 and 8.3, respectively. Further
analysis now follows on the effects of the test variables including macroeconomic
conditions, economic development and government industrial policy, as well as the
control variables.
### Table 8.2
Consolidated Regression Results for Debt Ratio Adjustment of Firms in the Case of a Negative or a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>Negative Adjustment Gap</th>
<th>Positive Adjustment Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>$D_{t-1}$</td>
<td>-0.14591</td>
<td>-5.53$^a$</td>
</tr>
<tr>
<td>$EC$</td>
<td>0.01492</td>
<td>1.19</td>
</tr>
<tr>
<td>$SED$</td>
<td>-0.04608</td>
<td>-1.85$^c$</td>
</tr>
<tr>
<td>$FgGDP$</td>
<td>-0.23054</td>
<td>-0.44</td>
</tr>
<tr>
<td>$GOVIND_{t-1}$</td>
<td>-0.01576</td>
<td>-1.40</td>
</tr>
<tr>
<td>$IND13$</td>
<td>-0.01008</td>
<td>-0.73</td>
</tr>
<tr>
<td>$IND14$</td>
<td>-0.02536</td>
<td>-2.19$^b$</td>
</tr>
<tr>
<td>$lnS$</td>
<td>0.01096</td>
<td>3.21$^a$</td>
</tr>
<tr>
<td>$gTA$</td>
<td>0.00365</td>
<td>0.25</td>
</tr>
<tr>
<td>$OITA$</td>
<td>-0.21133</td>
<td>-2.93$^a$</td>
</tr>
<tr>
<td>$DEPTA$</td>
<td>-0.45354</td>
<td>-2.38$^b$</td>
</tr>
<tr>
<td>$INVFATA$</td>
<td>0.08616</td>
<td>2.71$^a$</td>
</tr>
<tr>
<td>$lnS\times EC$</td>
<td>-0.00475</td>
<td>-0.71</td>
</tr>
<tr>
<td>$gTA\times EC$</td>
<td>-0.06543</td>
<td>-2.75$^a$</td>
</tr>
<tr>
<td>$OITA\times EC$</td>
<td>0.14471</td>
<td>1.49</td>
</tr>
<tr>
<td>$DEPTA\times EC$</td>
<td>-0.31013</td>
<td>-0.80</td>
</tr>
<tr>
<td>$INVFATA\times EC$</td>
<td>0.04552</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Sample size 363        262
F value 16.65        49.22
Adjusted R-square 0.4229  0.7578
Durbin-Watson D value 1.950  2.006

Notes:
1. $dDR_t = the debt ratio adjustment at year t;
   $DR_t = the debt ratio at the end of year t;
   $DR_{t-1} = the debt ratio at the end of year t-1;
   $EC = 0 for economic trough and 1 for economic peak;
   $SED$: zero for the years before 1987 and one for the years after 1987 to indicate the shift in the level of economic development,
   $FgGDP$=the future annual growth rate of the real GDP = (real GDP$_{t+1}$ – real GDP$_t$)/real GDP$_t$;
   $GOVIND_t$: the binary dummy variable with a value of 1 to indicate the industry strongly supported by government industrial policy at year t and otherwise with a value of 0;
   $IND13 = the dummy variable with a value of 1 for the plastics industry;
   $IND14 = the dummy variable with a value of 1 for the textile industry;
   $lnS = natural logarithm of net sales;
   $gTA = annual growth rate of total assets;
   $OITA = net operating income/total assets;
   $DEPTA = depreciation/total assets;
   $INVFATA = inventory plus net fixed assets/total assets;
   $lnS\times EC$, $gTA\times EC$, $OITA\times EC$, $DEPTA\times EC$ and $INVFATA\times EC$ = interactions between firm-specific variables and macroeconomic conditions.
2. $^a$, $^b$ and $^c$ indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment ($\gamma$) and the regression coefficient ($\beta$) of each independent variable except the previous actual debt ratio ($DR_{t-1}$).
4. VIF: Variance Inflation Factor
Table 8.3
Consolidated Regression Results for Actual Debt Ratio of Firms in the Case of a Negative or a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>Negative Adjustment Gap</th>
<th>Positive Adjustment Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DRt-1</td>
<td>0.85409</td>
<td>32.37⁵</td>
</tr>
<tr>
<td>EC</td>
<td>0.01492</td>
<td>1.19</td>
</tr>
<tr>
<td>SED</td>
<td>-0.04608</td>
<td>-1.85⁸</td>
</tr>
<tr>
<td>FgGDP</td>
<td>-0.23054</td>
<td>-0.44</td>
</tr>
<tr>
<td>GOVINDᵣ</td>
<td>-0.01576</td>
<td>-1.40</td>
</tr>
<tr>
<td>IND13</td>
<td>-0.01008</td>
<td>-0.73</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.02536</td>
<td>-2.19⁵</td>
</tr>
<tr>
<td>lnS</td>
<td>0.01096</td>
<td>3.21⁴</td>
</tr>
<tr>
<td>gTA</td>
<td>0.00365</td>
<td>0.25</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.21133</td>
<td>-2.93⁵</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.45354</td>
<td>-2.38⁷</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.08616</td>
<td>2.71⁴</td>
</tr>
<tr>
<td>lnS×EC</td>
<td>-0.00475</td>
<td>-0.71</td>
</tr>
<tr>
<td>gTA×EC</td>
<td>-0.06543</td>
<td>-2.75⁵</td>
</tr>
<tr>
<td>OITA×EC</td>
<td>0.14471</td>
<td>1.49</td>
</tr>
<tr>
<td>DEPTA×EC</td>
<td>-0.31013</td>
<td>-0.80</td>
</tr>
<tr>
<td>INVFATA×EC</td>
<td>0.04552</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Sample size 363 262
F value 89.17 210.38
Adjusted R-square 0.8050 0.9314
Durbin-Watson D value 1.950 2.006

Notes:
1. dDRᵣ = the debt ratio adjustment at year t;
   DRᵣ = the debt ratio at the end of year t;
   DRᵣ₋₁ = the debt ratio at the end of year t-1;
   EC = 0 for economic trough and 1 for economic peak;
   SED: zero for the years before 1987 and one for the years after 1987 to indicate the shift in the level of economic development,
   FgGDP = the future annual growth rate of the real GDP = (real GDPₜ₊₁ – real GDPₜ)/real GDPₜ;
   GOVINDᵣ: the binary dummy variable with a value of 1 to indicate the industry strongly supported by government industrial policy at year t and otherwise with a value of 0,
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   lnS = natural logarithm of net sales;
   gTA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
   lnS×EC, gTA×EC, OITA×EC, DEPTA×EC and INVFATA×EC = interactions between firm-specific variables and macroeconomic conditions.
2. a, b and c indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable except the previous actual debt ratio (DRᵣ₋₁).
4. VIF: Variance Inflation Factor
8.4.1 Impact of Macroeconomic Conditions

According to the t-value shown in the t-value column in Tables 8.2 and 8.3, the proxy for macroeconomic conditions, EC, does not have a significant effect on the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of over-leverage in the case of a negative adjustment gap between the target debt ratio and the previous actual debt ratio. However, the proxy for macroeconomic conditions, EC, has a significant positive effect on the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of under-leverage in the case of a positive adjustment gap. These results confirm the findings of the effect of macroeconomic conditions on the debt ratio adjustment and the actual debt ratios presented in Chapter 5. Firms with under-leverage in the case of a positive adjustment gap adjust their debt ratios cyclically across economic trough and peak over the business cycles. The cyclical effect of macroeconomic conditions on the capital structure of firms, however, disappears when a negative adjustment gap exists.

Further, debt ratio adjustment and actual debt ratio are influenced by the interactions between macroeconomic conditions and firm-specific variables such as growth opportunities and asset tangibility. In addition, the effect of the interactions between macroeconomic conditions and firm-specific variables varies according to where a negative or a positive adjustment gap exists. These results also confirm the findings of the effect of the interactions between macroeconomic conditions and firm-specific variables presented in Chapter 5.

In brief, macroeconomic conditions do have a significant effect on the debt ratio adjustment and the actual debt ratio. However, the effect of macroeconomic conditions varies according to whether a negative or a positive adjustment gap exists between the target debt ratio and the previous actual debt ratio.

8.4.2 Impact of Economic Development

According to the t-value shown in the t-value column in Tables 8.2 and 8.3, the proxy for the shift in the level of economic development, SED, has a significant
negative effect on the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of over-leverage in the case of a negative adjustment gap. However, the proxy for the shift in the level of economic development, SED, does not have a significant effect on the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of under-leverage in the case of a positive adjustment gap. This result is not consistent with the findings on the effect of the shift in the level of economic development that are presented in Chapter 6. The discrepancy in the effect of the shift in the level of economic development probably arises from the exclusion of the government industrial policy factor in Chapter 6. More explanation for the discrepancy is presented later when the industry effect is discussed.

Similarly, as can be seen in Tables 8.2 and 8.3, the proxy for future economic growth of economic development, FgGDP, does not affect the debt ratio adjustment and the actual debt ratio of firms with the financial constraint of over-leverage in the case of a negative adjustment gap. On the other hand, the proxy for future economic growth of economic development, FgGDP, has a significant positive effect on the debt ratio adjustment and the actual debt ratios of firms with the financial constraint of under-leverage in the case of a positive adjustment gap. These findings confirm the findings of the effect of economic development presented in Chapter 6.

In brief, economic development has both long-term and short-term impact on the debt ratio adjustment and the actual debt ratio. The impact of economic development, however, varies according to whether the financial constraint of firms is one of over-leverage or under-leverage in the case of a negative or a positive adjustment gap between the target debt ratio and the previous actual debt ratio.

**8.4.3 Impact of Government Industrial Policy**

According to the t-value shown in the t-value column in Tables 8.2 and 8.3, the proxy for government industrial policy, GOVIND, does not affect the debt ratio adjustment (see Table 8.2) and the actual debt ratios (see Table 8.3) of firms with the financial constraint of over-leverage in the case of a negative adjustment gap. It does, however, have a significant positive effect on the debt ratio adjustment and
the actual debt ratios of firms with the financial constraint of under-leverage in the case of a positive adjustment gap. The results confirm the findings of the effect of government industrial policy presented in Chapter 7.

In brief, government industrial policy does have a positive effect on the debt ratio adjustment and the level of actual debt ratios of firms with the financial constraint of under-leverage in the case of a positive adjustment gap between the target debt ratio and the previous actual debt ratio. However, the effect of government industrial policy on debt ratio adjustment and actual debt ratio does not appear to be positive for firms with the financial constraint of over-leverage in the case of a negative adjustment gap.

8.4.4 Adjustment Rate or Speed

According to the coefficient of the previous actual debt ratio shown in the Coefficient column in Table 8.2, firms with the financial constraint of over-leverage in the case of a negative adjustment gap adjust their debt ratios at a speed of 0.14591 towards the target debt ratios during the research period from 1983 to 1995. On the other hand, as can be seen in Table 8.3, the adjustment rate is 0.09011 for firms with the financial constraint of under-leverage in the case of a positive adjustment gap. The findings indicate that firms with the financial constraint of over-leverage adjust their debt ratios faster than do firms with the financial constraint of under-leverage. This is likely because, where a negative adjustment gap exists between the target debt ratio and the previous actual debt ratio, firms try to gear down their leverage ratios in order to reduce the default risk and avoid going bankrupt. The finding on the adjustment rate in the consolidated regression results confirms the findings presented in Chapters 5 to 7.

8.4.5 Effects of Control Variables

The control variables at the firm and industry levels used in the thesis research include firm-specific variables and industry types. The firm-specific effects and industry effect are discussed as follows:
8.4.5.1 Firm-Specific Effects

As shown in Tables 8.2 and 8.3, the results for the firm-specific effects on the debt ratio adjustment (see Table 8.2) and the actual debt ratio (see Table 8.3) of firms with the financial constraint of over-leverage in the case of a negative adjustment gap in Chapter 8 are similar to the findings presented in Chapters 5, 6 and 7. The results of the firm-specific effects on debt ratio adjustment and actual debt ratio of firms with the financial constraint of over-leverage found in this chapter confirm the findings presented in Chapters 5, 6 and 7.

On the other hand, the results for the firm-specific effects on the debt ratio adjustment (see Table 8.2) and the actual debt ratio (see Table 8.3) of firms with the financial constraint of under-leverage in the case of a positive adjustment gap found in this chapter are also similar to and consistent with the findings presented in Chapters 5, 6 and 7. Besides, some firm-specific effects on the debt ratio adjustment and the actual debt ratio vary according to whether a negative or a positive adjustment gap exists. The results of the firm-specific effects on debt ratio adjustment and on actual debt ratio of firms with the financial constraint of under-leverage found in this chapter confirm the findings presented in Chapters 5, 6 and 7.

On the whole, the results for the firm-specific effects on debt ratio adjustment and actual debt ratio found in this chapter confirm the findings on the firm-specific effects found in Chapters 5, 6 and 7.

8.4.5.2 Industry Effect

According to the t-value shown in the t-value column shown in Tables 8.2 and 8.3, the proxy for the textile industry, IND14, is statistically significant and negatively related to the debt ratio adjustment (see Table 8.2) and the actual debt ratio (see Table 8.3) of firms with the financial constraint of over-leverage in the case of a negative adjustment gap. This result confirms the finding in Chapter 7 but does not support the findings in Chapters 5 and 6. The exclusion of the factor of government industrial policy in Chapters 5 and 6 contributes to the discrepancy in the findings on the industry effects in Chapters 7 and 8.
Tables 8.2 and 8.3, however, reveal that the proxies for the plastics and textile industries, IND13 and IND14, are statistically significant and positively related to the debt ratio adjustment (see Table 8.2) and the actual debt ratio (see Table 8.3) of firms with the financial constraint of under-leverage in the case of a positive adjustment gap. The results found in this chapter confirm the findings in Chapter 7 but do not support the findings in Chapters 5 and 6 without the factor of government industrial policy taken into account. In particular, negative industry effects were found in Chapter 6 without the inclusion of government industrial policy. Theoretically and empirically speaking, firms with more growth in the electronics industry finance with less debt than firms with less growth in the textile and plastics industries. However, without consideration of financial supports from government industrial policy, higher debt ratios exist in the electronics industry than in the textile and plastics industries as shown in Chapter 6. The model misspecification without the inclusion of government industrial policy contributes to the results of industry effects in Chapter 6. On the whole, the results of the industry effects on debt ratio adjustment and actual debt ratio found in this chapter confirm the findings on the industry effects presented in Chapter 7. Finally, a comparative summary of regression results for debt ratio adjustment and actual debt ratio found in Chapters 5 to 7 and in this chapter is shown in Table 8.4.

8.5 Robustness Tests

A number of robustness tests are made to confirm the conclusions from the consolidated empirical results and the analysis on the impact of macroeconomic conditions, economic development and government industrial policy on capital structure decisions. The empirical results without adjustment gaps taken into account in the application of the partial adjustment model are presented and discussed as follows:

8.5.1 Alternative Proxy for Economic Development

The future annual growth rate of real per capita GDP, FgPCGDP, is used as an alternative proxy for economic development for the robustness test. The regression results with this alternative proxy shown in Tables 8.5 and 8.6 are similar to those
shown in Tables 8.2 and 8.3. In spite of some differences, the results do not change the conclusions about the significant impact of macroeconomic conditions, economic development and government industrial policy on the determination of debt ratio adjustment and actual debt ratio and the variation in their impact according to whether firms are over-leveraged or under-leveraged.

### Table 8.4
Comparative Summary of Regression Results for Debt Ratio Decisions in Chapters 5 to 7 and Chapter 8

<table>
<thead>
<tr>
<th>Variables</th>
<th>Negative Adjustment Gap</th>
<th>Positive Adjustment Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chapters 5 to 7</td>
<td>Chapter 8</td>
</tr>
<tr>
<td></td>
<td>Chapters 5 to 7</td>
<td>Chapter 8</td>
</tr>
<tr>
<td>(Average) adjustment rate</td>
<td>(15.2%)</td>
<td>14.6%</td>
</tr>
<tr>
<td>(Average) adj. R-square for dDR</td>
<td>(0.4709)</td>
<td>0.4229</td>
</tr>
<tr>
<td>(Average) adj. R-square for DR</td>
<td>(0.7953)</td>
<td>0.8050</td>
</tr>
<tr>
<td>Macroeconomic conditions</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Macroeconomic conditions’ interaction with:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firm size</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Growth opportunities</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Profitability</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Non-debt tax shields</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Asset tangibility</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Shift in business cycles or in the level of economic development</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Economic development</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Government industrial policy</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Plastics industry</td>
<td>-,-,+</td>
<td>+</td>
</tr>
<tr>
<td>Textile industry</td>
<td>-,-,+</td>
<td>+</td>
</tr>
<tr>
<td>Firm size</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Growth opportunities</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Profitability</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Non-debt tax shields</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Asset tangibility</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Macroeconomic conditions’ interaction with:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firm size</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Growth opportunities</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Profitability</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Non-debt tax shields</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Asset tangibility</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>(Average) adj. R-square for dDR</td>
<td>(0.7237)</td>
<td>0.7578</td>
</tr>
<tr>
<td>(Average) adj. R-square for DR</td>
<td>(0.9240)</td>
<td>0.9314</td>
</tr>
</tbody>
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230
Table 8.5
Consolidated Regression Results for Debt Ratio Adjustment of Firms in the Case of a Negative or a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>Negative Adjustment Gap</th>
<th>Positive Adjustment Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DR&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>-0.14210</td>
<td>-5.36&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>EC</td>
<td>0.02203</td>
<td>1.71&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>SED</td>
<td>-0.05514</td>
<td>-2.35&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>FgPCGDP</td>
<td>-0.50074</td>
<td>-0.87</td>
</tr>
<tr>
<td>GOVIND&lt;sub&gt;t&lt;/sub&gt;</td>
<td>-0.01952</td>
<td>-2.04&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>IND13</td>
<td>-0.01289</td>
<td>-0.98</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.02919</td>
<td>-2.91&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>lnS</td>
<td>0.01071</td>
<td>3.12&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>gTA</td>
<td>0.00650</td>
<td>0.44</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.20024</td>
<td>-2.68&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.33675</td>
<td>-1.70&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.07874</td>
<td>2.44&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>lnS×EC</td>
<td>-0.00496</td>
<td>-0.74</td>
</tr>
<tr>
<td>gTA×EC</td>
<td>-0.07115</td>
<td>-3.04&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>OITA×EC</td>
<td>0.11765</td>
<td>1.17</td>
</tr>
<tr>
<td>DEPTA×EC</td>
<td>-0.34386</td>
<td>-0.89</td>
</tr>
<tr>
<td>INVFATA×EC</td>
<td>0.03873</td>
<td>0.67</td>
</tr>
</tbody>
</table>

Sample size: 363  262
F value: 16.59  53.27
Adjusted R-square: 0.4220  0.7723
Durbin-Watson D value: 1.945  1.977

Notes:
1. dDR<sub>t</sub> = the debt ratio adjustment at year t;
2. DR<sub>t-1</sub> = the debt ratio at the end of year t-1;
3. EC = 0 for economic trough and 1 for economic peak;
4. SED: 0 for the years before 1987 and 1 for the years after 1987 to indicate the shift in the level of economic development,
5. FgPCGDP = the future annual growth rate of the real per capita GDP = (real PCGDP<sub>t+1</sub> – real PCGDP<sub>t</sub>) / real PCGDP<sub>t</sub>;
6. GOVIND<sub>t</sub>: the binary dummy variable with a value of 1 to indicate the industry strongly supported by government industrial policy at year t and otherwise with a value of 0,
7. IND13 = the dummy variable with a value of 1 for the plastics industry;
8. IND14 = the dummy variable with a value of 1 for the textile industry;
9. lnS = natural logarithm of net sales;
10. gTA = annual growth rate of total assets;
11. OITA = net operating income/total assets;
12. DEPTA = depreciation/total assets;
13. INVFATA = inventory plus net fixed assets/total assets;
14. lnS×EC, gTA×EC, OITA×EC, DEPTA×EC and INVFATA×EC = interactions between firm-specific variables and macroeconomic conditions.

2. <sup>a</sup>, <sup>b</sup> and <sup>c</sup> indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable except the previous actual debt ratio (DR<sub>t-1</sub>).
4. VIF: Variance Inflation Factor
Table 8.6
Consolidated Regression Results for Actual Debt Ratio of Firms in the Case of a Negative or a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>Negative Adjustment Gap</th>
<th>Positive Adjustment Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DR$_{t-1}$</td>
<td>0.85790</td>
<td>32.35$^a$</td>
</tr>
<tr>
<td>EC</td>
<td>0.02203</td>
<td>1.71$^c$</td>
</tr>
<tr>
<td>SED</td>
<td>-0.05514</td>
<td>-2.35$^b$</td>
</tr>
<tr>
<td>FgPCGDP</td>
<td>-0.50074</td>
<td>-0.87</td>
</tr>
<tr>
<td>GOVIND$_t$</td>
<td>-0.01952</td>
<td>-2.04$^b$</td>
</tr>
<tr>
<td>IND13</td>
<td>-0.01289</td>
<td>-0.98</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.02919</td>
<td>-2.91$^a$</td>
</tr>
<tr>
<td>lnS</td>
<td>0.01071</td>
<td>3.12$^a$</td>
</tr>
<tr>
<td>gTA</td>
<td>0.00650</td>
<td>0.44</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.20024</td>
<td>-2.68$^a$</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.33675</td>
<td>-1.70$^c$</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.07874</td>
<td>2.44$^b$</td>
</tr>
<tr>
<td>lnS×EC</td>
<td>-0.00496</td>
<td>-0.74</td>
</tr>
<tr>
<td>gTA×EC</td>
<td>-0.07115</td>
<td>-3.04$^a$</td>
</tr>
<tr>
<td>OITA×EC</td>
<td>0.11765</td>
<td>1.17</td>
</tr>
<tr>
<td>DEPTA×EC</td>
<td>-0.34386</td>
<td>-0.89</td>
</tr>
<tr>
<td>INVFATA×EC</td>
<td>0.03873</td>
<td>0.67</td>
</tr>
</tbody>
</table>

Sample size     | 363         | 262
F value         | 89.00       | 224.66
Adjusted R-square | 0.8047   | 0.9355
Durbin-Watson D value | 1.945    | 1.977

Notes:
1. dDR$_t$ = the debt ratio adjustment at year t; DR$_t$ = the debt ratio at the end of year t; DR$_{t-1}$ = the debt ratio at the end of year t-1; EC = 0 for economic trough and 1 for economic peak; SED: 0 for the years before 1987 and 1 for the years after 1987 to indicate the shift in the level of economic development, FgPCGDP=the future annual growth rate of the real per capita GDP = (real PCGDP$_{t+1}$ – real PCGDP$_t$)/real PCGDP$_t$; GOVIND$_t$: the binary dummy variable with a value of 1 to indicate the industry strongly supported by government industrial policy at year t and otherwise with a value of 0, IND13 = the dummy variable with a value of 1 for the plastics industry; IND14 = the dummy variable with a value of 1 for the textile industry; lnS = natural logarithm of net sales; gTA = annual growth rate of total assets; OITA = net operating income/total assets; DEPTA = depreciation/total assets; INVFATA = inventory plus net fixed assets/total assets; lnS×EC, gTA×EC, OITA×EC, DEPTA×EC and INVFATA×EC = interactions between firm-specific variables and macroeconomic conditions.
2. $^a$, $^b$ and $^c$ indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment ($\gamma$) and the regression coefficient ($\beta$) of each independent variable except the previous actual debt ratio (DR$_{t-1}$).
4. VIF: Variance Inflation Factor
8.5.2 Alternative Proxies for Government Industrial Policy

An alternative proxy for government industrial policy is used to capture the post-policy effect of government industrial policy on the determination of debt ratio adjustment and actual debt ratio. The binary dummy variable, GOVIND_{t-1}, with a value of 1 or 0 indicates whether an industry is supported by government industrial policy in the previous year or not. The empirical results with this alternative proxy shown in Tables 8.7 and 8.8 are similar to those shown in Tables 8.2 and 8.3. In addition, the R-square and the estimated adjustment rate for firms with over-leverage or under-leverage in the case of a negative or a positive adjustment gap in Tables 8.7 and 8.8 are similar to those in Tables 8.2 and 8.3.

Another alternative proxy for government industrial policy is used to capture the expected pre-policy effect of government industrial policy on the determination of debt ratio adjustment and actual debt ratio. The binary dummy variable, GOVIND_{t+1}, indicates whether or not an industry is supported by government industrial policy in the following year. The empirical results with this alternative proxy shown in Tables 8.9 and 8.10 are similar to those shown in Tables 8.2 and 8.3. In addition, the R-square and the estimated adjustment rate for firms with over-leverage or under-leverage in Tables 8.9 and 8.10 are similar to those in Tables 8.2 and 8.3. In brief, in spite of some differences, the results with alternative proxies do not change the conclusions about the significant impact of macroeconomic conditions, economic development and government industrial policy on the determination of debt ratio adjustment and actual debt ratio and the variation in their impact according to whether firms are over-leveraged or under-leveraged.

Further, the empirical results without adjustment gaps taken into account are shown in Table 8.11. The results shown in Tables 8.2 and 8.3 with adjustment gaps taken into account are much better in terms of adjusted R-squares and Durbin-Watson D values than those in Table 8.11. In addition, the adjustment rate (0.24253) shown in Table 8.11 is overestimated and much higher than those (0.14591 and 0.09011) shown in Table 8.2 with adjustment gaps taken into account. This reflects a more accurate estimation in the thesis research when adjustment gaps are taken into account in the application of the partial adjustment model.
Table 8.7
Consolidated Regression Results for Debt Ratio Adjustment of Firms in the Case of a Negative or a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>Negative Adjustment Gap</th>
<th>Positive Adjustment Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DR$_{t-1}$</td>
<td>-0.14307</td>
<td>-5.40$^a$</td>
</tr>
<tr>
<td>EC</td>
<td>0.04041</td>
<td>2.27$^b$</td>
</tr>
<tr>
<td>SED</td>
<td>-0.04705</td>
<td>-1.90$^c$</td>
</tr>
<tr>
<td>FgGDP</td>
<td>-0.23238</td>
<td>-0.44</td>
</tr>
<tr>
<td>GOVIND$_{t-1}$</td>
<td>-0.01683</td>
<td>-1.73$^c$</td>
</tr>
<tr>
<td>IND13</td>
<td>-0.01197</td>
<td>-0.98</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.02650</td>
<td>-2.80$^a$</td>
</tr>
<tr>
<td>lnS</td>
<td>0.01081</td>
<td>3.16$^a$</td>
</tr>
<tr>
<td>gTA</td>
<td>0.00828</td>
<td>0.56</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.20205</td>
<td>-2.75$^a$</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.08158</td>
<td>-0.31</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.07835</td>
<td>2.43$^b$</td>
</tr>
<tr>
<td>lnS×EC</td>
<td>-0.00464</td>
<td>-0.69</td>
</tr>
<tr>
<td>gTA×EC</td>
<td>-0.07273</td>
<td>-3.16$^a$</td>
</tr>
<tr>
<td>OITA×EC</td>
<td>0.12337</td>
<td>1.24</td>
</tr>
<tr>
<td>DEPTA×EC</td>
<td>-0.52144</td>
<td>-1.46</td>
</tr>
<tr>
<td>INVFATA×EC</td>
<td>0.05006</td>
<td>0.88</td>
</tr>
</tbody>
</table>

Sample size | 363 | 262 |
F value | 16.67 | 50.39 |
Adjusted R-square | 0.4233 | 0.7622 |
Durbin-Watson D value | 1.936 | 1.972 |

Notes:
1. dDR$_t$ = the debt ratio adjustment at year $t$;
   DR$_t$ = the debt ratio at the end of year $t$;
   DR$_{t-1}$ = the debt ratio at the end of year $t-1$;
   EC = 0 for economic trough and 1 for economic peak;
   SED: 0 for the years before 1987 and 1 for the years after 1987 to indicate the shift in the level of economic development,
   FgGDP = the future annual growth rate of the real GDP
   $= \frac{\text{real GDP}_{t+1} - \text{real GDP}_t}{\text{real GDP}_t}$;
   GOVIND$_{t-1}$: the binary dummy variable with a value of 1 to indicate the industry strongly supported by government industrial policy at year $t-1$ and otherwise with a value of 0,
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   lnS = natural logarithm of net sales;
   gTA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
   lnS×EC, gTA×EC, OITA×EC, DEPTA×EC and INVFATA×EC = interactions between firm-specific variables and macroeconomic conditions.
2. $^a$, $^b$ and $^c$ indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment ($\gamma$) and the regression coefficient ($\beta$) of each independent variable except the previous actual debt ratio (DR$_{t-1}$).
4. VIF: Variance Inflation Factor
Table 8.8
Consolidated Regression Results for Actual Debt Ratio of Firms in the Case of
a Negative or a Positive Adjustment Gap at the Years of Economic Peak and
Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>t Value</th>
<th>VIF$^4$</th>
<th>Coefficient</th>
<th>t Value</th>
<th>VIF$^4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{DR}_{t-1}$</td>
<td>0.85693</td>
<td>32.35$^a$</td>
<td>1.36776</td>
<td>0.90444</td>
<td>44.37$^a$</td>
<td>1.76926</td>
</tr>
<tr>
<td>$\text{EC}$</td>
<td>0.04041</td>
<td>2.27$^b$</td>
<td>5.23288</td>
<td>-0.00033</td>
<td>-0.03</td>
<td>5.55042</td>
</tr>
<tr>
<td>$\text{SED}$</td>
<td>-0.04705</td>
<td>-1.90$^c$</td>
<td>4.61022</td>
<td>0.02082</td>
<td>1.08</td>
<td>5.09640</td>
</tr>
<tr>
<td>$\text{FgGDP}$</td>
<td>-0.23238</td>
<td>-0.44</td>
<td>4.89160</td>
<td>1.03172</td>
<td>2.55$^b$</td>
<td>5.61986</td>
</tr>
<tr>
<td>$\text{GOVIND}_{t-1}$</td>
<td>-0.01683</td>
<td>-1.73$^c$</td>
<td>3.01576</td>
<td>0.07636</td>
<td>10.61$^a$</td>
<td>3.05015</td>
</tr>
<tr>
<td>$\text{IND13}$</td>
<td>-0.01197</td>
<td>-0.98</td>
<td>1.36607</td>
<td>0.04993</td>
<td>5.66$^b$</td>
<td>1.56648</td>
</tr>
<tr>
<td>$\text{IND14}$</td>
<td>-0.02650</td>
<td>-2.80$^a$</td>
<td>2.37567</td>
<td>0.06173</td>
<td>9.13$^b$</td>
<td>2.13205</td>
</tr>
<tr>
<td>$\ln\text{S}$</td>
<td>0.01081</td>
<td>3.16$^a$</td>
<td>1.13745</td>
<td>0.00014</td>
<td>0.05</td>
<td>1.51207</td>
</tr>
<tr>
<td>$\text{gTATA}$</td>
<td>0.00828</td>
<td>0.56</td>
<td>3.29351</td>
<td>0.03490</td>
<td>4.02$^b$</td>
<td>4.32074</td>
</tr>
<tr>
<td>$\text{OITA}$</td>
<td>-0.20205</td>
<td>-2.75$^a$</td>
<td>5.84495</td>
<td>-0.14759</td>
<td>-2.49$^b$</td>
<td>4.32569</td>
</tr>
<tr>
<td>$\text{DEPTA}$</td>
<td>-0.08158</td>
<td>-0.31</td>
<td>2.76849</td>
<td>-0.68817</td>
<td>-3.11$^a$</td>
<td>3.21663</td>
</tr>
<tr>
<td>$\text{INVATA}$</td>
<td>0.07835</td>
<td>2.43$^b$</td>
<td>1.99660</td>
<td>0.05310</td>
<td>2.3$^b$</td>
<td>2.05661</td>
</tr>
<tr>
<td>$\ln\text{S} \times \text{EC}$</td>
<td>-0.00464</td>
<td>-0.69</td>
<td>1.08318</td>
<td>-0.00352</td>
<td>-0.68</td>
<td>1.31455</td>
</tr>
<tr>
<td>$\text{gTATA} \times \text{EC}$</td>
<td>-0.07273</td>
<td>-3.16$^a$</td>
<td>3.18259</td>
<td>-0.02605</td>
<td>-2.23$^b$</td>
<td>4.35207</td>
</tr>
<tr>
<td>$\text{OITA} \times \text{EC}$</td>
<td>0.12337</td>
<td>1.24</td>
<td>5.78857</td>
<td>0.05080</td>
<td>0.62</td>
<td>4.42847</td>
</tr>
<tr>
<td>$\text{DEPTA} \times \text{EC}$</td>
<td>-0.52144</td>
<td>-1.46</td>
<td>8.01542</td>
<td>0.28808</td>
<td>1.01</td>
<td>8.45473</td>
</tr>
<tr>
<td>$\text{INVATA} \times \text{EC}$</td>
<td>0.05006</td>
<td>0.88</td>
<td>1.55987</td>
<td>0.06240</td>
<td>1.55</td>
<td>1.57697</td>
</tr>
</tbody>
</table>

Sample size: 363  262
F value: 89.25  214.51
Adjusted R-square: 0.8052  0.9327
Durbin-Watson D value: 1.936  1.972

Notes:
1. $\text{dDR}_t$ = the debt ratio adjustment at year $t$;
   $\text{DR}_t$ = the debt ratio at the end of year $t$;
   $\text{DR}_{t-1}$ = the debt ratio at the end of year $t-1$;
   EC = 0 for economic trough and 1 for economic peak;
   SED: 0 for the years before 1987 and 1 for the years after 1987 to indicate the shift in the level of
   economic development;
   FgGDP = the future annual growth rate of the real GDP
   $=(\text{real GDP}_{t+1} - \text{real GDP}_t)/\text{real GDP}_t$;
   GOVIND$_{t-1}$: the binary dummy variable with a value of 1 to indicate the industry strongly
   supported
   by government industrial policy at year $t-1$ and otherwise with a value of 0,
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   $\ln\text{S}$ = natural logarithm of net sales;
   gTATA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVATA = inventory plus net fixed assets/total assets;
   $\ln\text{S} \times \text{EC}$, gTATA$\times$EC, OITA$\times$EC, DEPTA$\times$EC and INVATA$\times$EC = interactions between firm-
   specific
   variables and macroeconomic conditions.
2. $^a$, $^b$ and $^c$ indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment ($\gamma$) and the regression
   coefficient ($\beta$) of each independent variable except the previous actual debt ratio ($\text{DR}_{t-1}$).
4. VIF: Variance Inflation Factor
Table 8.9
Consolidated Regression Results for Debt Ratio Adjustment of Firms in the Case of a Negative or a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>Negative Adjustment Gap</th>
<th>Positive Adjustment Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DR$_{t-1}$</td>
<td>-0.14014</td>
<td>-5.29a</td>
</tr>
<tr>
<td>EC</td>
<td>0.01851</td>
<td>1.43</td>
</tr>
<tr>
<td>SED</td>
<td>-0.04772</td>
<td>-1.91b</td>
</tr>
<tr>
<td>FgPDP</td>
<td>-0.24524</td>
<td>-0.47</td>
</tr>
<tr>
<td>GOVIND$_{t+1}$</td>
<td>-0.03518</td>
<td>-3.30a</td>
</tr>
<tr>
<td>IND13</td>
<td>-0.02893</td>
<td>-2.21b</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.04405</td>
<td>-4.43a</td>
</tr>
<tr>
<td>lnS</td>
<td>0.01079</td>
<td>3.15a</td>
</tr>
<tr>
<td>gTA</td>
<td>0.00579</td>
<td>0.39</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.19937</td>
<td>-2.67a</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.35318</td>
<td>-1.79c</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.07707</td>
<td>2.40b</td>
</tr>
<tr>
<td>lnS×EC</td>
<td>-0.00349</td>
<td>-0.52</td>
</tr>
<tr>
<td>gTA×EC</td>
<td>-0.07135</td>
<td>-3.00a</td>
</tr>
<tr>
<td>OITA×EC</td>
<td>0.13348</td>
<td>1.35</td>
</tr>
<tr>
<td>DEPTA×EC</td>
<td>-0.28980</td>
<td>-0.75</td>
</tr>
<tr>
<td>INVFATA×EC</td>
<td>0.03986</td>
<td>0.69</td>
</tr>
</tbody>
</table>

Sample size 363 262
F value 16.63 55.27
Adjusted R-square 0.4226 0.7788
Durbin-Watson D value 1.954 2.037

Notes:
1. dDR$_t$ = the debt ratio adjustment at year $t$; DR$_t$ = the debt ratio at the end of year $t$; DR$_{t-1}$ = the debt ratio at the end of year $t-1$; EC = 0 for economic trough and 1 for economic peak; SED: 0 for the years before 1987 and 1 for the years after 1987 to indicate the shift in the level of economic development, FgGDP = the future annual growth rate of the real GDP = (real GDP$_{t+1}$ – real GDP$_t$)/real GDP$_t$; GOVIND$_{t+1}$: the binary dummy variable with a value of 1 to indicate the industry strongly supported by government industrial policy at year $t+1$ and otherwise with a value of 0, IND13 = the dummy variable with a value of 1 for the plastics industry; IND14 = the dummy variable with a value of 1 for the textile industry; lnS = natural logarithm of net sales; gTA = annual growth rate of total assets; OITA = net operating income/total assets; DEPTA = depreciation/total assets; INVFATA = inventory plus net fixed assets/total assets; lnS×EC, gTA×EC, OITA×EC, DEPTA×EC and INVFATA×EC = interactions between firm-specific variables and macroeconomic conditions.
2. a, b and c indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment ($\gamma$) and the regression coefficient ($\beta$) of each independent variable except the previous actual debt ratio (DR$_{t-1}$).
4. VIF: Variance Inflation Factor
Table 8.10
Consolidated Regression Results for Actual Debt Ratio of Firms in the Case of a Negative or a Positive Adjustment Gap at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>Negative Adjustment Gap</th>
<th>Positive Adjustment Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
</tr>
<tr>
<td>DR&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>0.85986</td>
<td>32.45&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>EC</td>
<td>0.01851</td>
<td>1.43</td>
</tr>
<tr>
<td>SED</td>
<td>-0.04772</td>
<td>-1.91&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>FgGDP</td>
<td>-0.24524</td>
<td>-0.47</td>
</tr>
<tr>
<td>GOVIND&lt;sub&gt;t+1&lt;/sub&gt;</td>
<td>-0.03518</td>
<td>-3.30&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>IND13</td>
<td>-0.02893</td>
<td>-2.21&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>IND14</td>
<td>-0.04405</td>
<td>-4.43&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>lnS</td>
<td>0.01079</td>
<td>3.15&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>gTA</td>
<td>0.00579</td>
<td>0.39</td>
</tr>
<tr>
<td>OITA</td>
<td>-0.19937</td>
<td>-2.67&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>DEPTA</td>
<td>-0.35318</td>
<td>-1.79&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>INVFATA</td>
<td>0.07707</td>
<td>2.40&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>lnS×EC</td>
<td>-0.00349</td>
<td>-0.52</td>
</tr>
<tr>
<td>gTA×EC</td>
<td>-0.07135</td>
<td>-3.00&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>OITA×EC</td>
<td>0.13348</td>
<td>1.35</td>
</tr>
<tr>
<td>DEPTA×EC</td>
<td>-0.28980</td>
<td>-0.75</td>
</tr>
<tr>
<td>INVFATA×EC</td>
<td>0.03986</td>
<td>0.69</td>
</tr>
</tbody>
</table>

Sample size 363 262
F value 89.12 231.74
Adjusted R-square 0.8049 0.9374
Durbin-Watson D value 1.954 2.037

Notes:
1. dDR<sub>t</sub> = the debt ratio adjustment at year t;
   DR<sub>t</sub> = the debt ratio at the end of year t;
   DR<sub>t-1</sub> = the debt ratio at the end of year t-1;
   EC = 0 for economic trough and 1 for economic peak;
   SED: 0 for the years before 1987 and 1 for the years after 1987 to indicate the shift in the level of economic development,
   FgGDP = the future annual growth rate of the real GDP
   = (real GDP<sub>t+1</sub> – real GDP<sub>t</sub>)/real GDP<sub>t</sub>;
   GOVIND<sub>t+1</sub>: the binary dummy variable with a value of 1 to indicate the industry strongly supported by government industrial policy at year t+1 and otherwise with a value of 0,
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   lnS = natural logarithm of net sales;
   gTA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
   lnS×EC, gTA×EC, OITA×EC, DEPTA×EC and INVFATA×EC = interactions between firm-specific variables and macroeconomic conditions.
2. <sup>a</sup>, <sup>b</sup> and <sup>c</sup> indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable except the previous actual debt ratio (DR<sub>t-1</sub>).
4. VIF: Variance Inflation Factor
Table 8.11
Regression Results for Debt Ratio Adjustment and Actual Debt Ratio of Firms without Adjustment Gaps Taken into Account at the Years of Economic Peak and Trough in the Period from 1983 to 1995

<table>
<thead>
<tr>
<th>Variables</th>
<th>Negative Adjustment Gap</th>
<th>Positive Adjustment Gap</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t Value</td>
<td>VIF&lt;sup&gt;4&lt;/sup&gt;</td>
<td>Coefficient</td>
</tr>
<tr>
<td>DR&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>-0.24253</td>
<td>-11.13&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.32157</td>
<td>0.75747</td>
</tr>
<tr>
<td>EC</td>
<td>0.02534</td>
<td>2.50&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.28700</td>
<td>0.02534</td>
</tr>
<tr>
<td>SED</td>
<td>-0.02868</td>
<td>-1.33</td>
<td>4.61031</td>
<td>-0.02868</td>
</tr>
<tr>
<td>FgGDP</td>
<td>0.36326</td>
<td>0.80</td>
<td>4.96258</td>
<td>0.36326</td>
</tr>
<tr>
<td>GOVIND&lt;sub&gt;t&lt;/sub&gt;</td>
<td>0.03103</td>
<td>3.23&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.92627</td>
<td>0.03103</td>
</tr>
<tr>
<td>IND13</td>
<td>0.01234</td>
<td>1.07</td>
<td>1.75008</td>
<td>0.01234</td>
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<tr>
<td>IND14</td>
<td>0.00953</td>
<td>0.99</td>
<td>3.17231</td>
<td>0.00953</td>
</tr>
<tr>
<td>lnS</td>
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<td>3.09&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.22409</td>
<td>0.00939</td>
</tr>
<tr>
<td>gTA</td>
<td>0.04303</td>
<td>3.84&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.61012</td>
<td>0.04303</td>
</tr>
<tr>
<td>OITA</td>
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<td>-5.83&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.80856</td>
<td>0.02985</td>
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<td>lnS×EC</td>
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<td>-1.49</td>
<td>1.15413</td>
<td>0.07419</td>
</tr>
<tr>
<td>gTA×EC</td>
<td>-0.02985</td>
<td>-1.86&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3.69360</td>
<td>0.07419</td>
</tr>
<tr>
<td>OITA×EC</td>
<td>0.04303</td>
<td>3.84&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.61012</td>
<td>0.07419</td>
</tr>
<tr>
<td>DEPTA&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>-0.41484</td>
<td>-2.46&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.83712</td>
<td>-0.41484</td>
</tr>
<tr>
<td>DEPTA×EC</td>
<td>0.07419</td>
<td>0.87</td>
<td>4.74671</td>
<td>0.07419</td>
</tr>
<tr>
<td>INVFATA&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>0.009964</td>
<td>2.09&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.52211</td>
<td>0.09964</td>
</tr>
<tr>
<td>Sample size</td>
<td>625</td>
<td></td>
<td></td>
<td>625</td>
</tr>
<tr>
<td>F value</td>
<td>12.40</td>
<td></td>
<td></td>
<td>117.74</td>
</tr>
<tr>
<td>Adjusted R-square</td>
<td>0.2367</td>
<td></td>
<td></td>
<td>0.7605</td>
</tr>
<tr>
<td>Durbin-Watson D value</td>
<td>1.212</td>
<td></td>
<td></td>
<td>1.212</td>
</tr>
</tbody>
</table>

Notes:
1. dDR<sub>t</sub> = the debt ratio adjustment at year t;
   DR<sub>t</sub> = the debt ratio at the end of year t;
   DR<sub>t-1</sub> = the debt ratio at the end of year t-1;
   EC = 0 for economic trough and 1 for economic peak;
   SED: zero for the years before 1987 and one for the years after 1987 to indicate the shift in the level of economic development,
   FgGDP = the future annual growth rate of the real GDP
   = (real GDP<sub>t+1</sub> – real GDP<sub>t</sub>)/real GDP<sub>t</sub>;
   GOVIND<sub>t</sub>: the binary dummy variable with a value of 1 to indicate the industry strongly supported by government industrial policy at year t and otherwise with a value of 0,
   IND13 = the dummy variable with a value of 1 for the plastics industry;
   IND14 = the dummy variable with a value of 1 for the textile industry;
   lnS = natural logarithm of net sales;
   gTA = annual growth rate of total assets;
   OITA = net operating income/total assets;
   DEPTA = depreciation/total assets;
   INVFATA = inventory plus net fixed assets/total assets;
   lnS×EC, gTA×EC, OITA×EC, DEPTA×EC and INVFATA×EC = interactions between firm-specific variables and macroeconomic conditions.
2. <sup>a</sup>, <sup>b</sup> and <sup>c</sup> indicate the significance level of 1%, 5% and 10%, respectively.
3. The value of the coefficient is the product of the rate of adjustment (γ) and the regression coefficient (β) of each independent variable except the previous actual debt ratio (DR<sub>t-1</sub>.
4. VIF: Variance Inflation Factor
8.6 Conclusion

Based on the research framework described in Section 2.4, the test variables found to have a significant effect on the determination of debt ratio adjustment and actual debt ratio in Chapters 5, 6 and 7 are included together in the empirical model for further confirmation of the final conclusions. This allows model misspecification to be avoided and robustness for the final conclusions to be checked. Therefore, consolidated theoretical and empirical models of capital structure adjustment are constructed with the financial constraint of over-leverage or under-leverage taken into account based on the reformulated partial adjustment model described in Chapter 4.

The consolidated empirical results show that macroeconomic conditions, economic development and government industrial policy affect the determination of debt ratio adjustment and actual debt ratio. However, their impact on capital structure decisions varies according to whether the financial constraint of over-leverage or under-leverage occurs. Similar empirical results with alternative proxies for economic development and government industrial policy are obtained and confirmed to be robust for the conclusions of the consolidated analysis. In addition, the regression results without adjustment gaps taken into account shows lower explanatory power of adjusted R-square and a serious residual autocorrelation problem according to the Durbin-Watson D value that is almost 1. The adjustment rate estimated without adjustment gaps taken into account is much higher than those estimated with adjustment gaps taken into account. The findings reflect a more accurate estimation in the application of the partial adjustment model if adjustment gaps are taken into account.
Chapter 9

Conclusion

9.1 Summary

The thesis investigates the impact of macro-level factors, namely macroeconomic conditions, economic development and government industrial policy, on the adjustment behavior of capital structure decisions. These factors have either been neglected or never been investigated by prior studies. Unlike previous studies, the thesis investigates macroeconomic conditions, economic development and government industrial policy based on investment and growth opportunities guided by the agency theory of capital structure. The thesis research fills the research gap and provides further evidence on the impact of macroeconomic conditions and economic development and, in addition, new evidence on the impact of government industrial policy on capital structure decisions.

A number of studies (Myers and Majluf, 1984, Narayanan, 1988) and several surveys (Allen, 1991, Graham and Harvey, 2001, Pinegar and Wilbracht, 1989) point out the importance of financial flexibility or spare debt capacity in capital structure decisions. In addition, a number of recent studies (Flannery and Rangan, 2006, Hovakimian et al., 2001, Taggart, 1977, Marsh, 1982, Jalilvand and Harris, 1984) argue that firms may deviate away from their target capital structure in the short run but adjust towards the target capital structure in the long run. The consideration of spare debt capacity reserved for future investment and growth opportunities reflects the nature of the adjustment behavior of capital structure decisions in the real world, i.e. the deviation away from the target capital structure in the short run. On the other hand, the partial adjustment model allows the actual level to deviate away from its equilibrium, which is consistent with the adjustment behavior of capital structure decisions. The adjustment from the previous level to the current actual level is a proportion of the gap between the target level and the previous level. The adjustment rate is assumed to be greater than 0. The faster the
speed of the adjustment, the greater is the adjustment. If the adjustment is complete or the adjustment rate is equal to 1, then the actual level is equal to the target. If the adjustment is incomplete or the adjustment rate is not equal to 1, then the deviation away from the target capital structure occurs. Therefore, following recent prior studies (Flannery and Rangan, 2006, Fama and French, 2002), the thesis utilizes the partial adjustment model (Koyck, 1954, Nerlove, 1958) as an analytical tool to investigate the impact of macroeconomic conditions, economic development and government industrial policy on the adjustment behavior of capital structure decisions. The thesis, however, does not intend to test the efficiency or the superiority of any of the theories that explain capital structure decisions of firms.

Further, the thesis considers two important situations of financial constraint, i.e. over-leverage and under-leverage, which have not been addressed by previous studies based on the partial adjustment model, i.e., when firms, relative to their target capital structure, are either over-leveraged or under-leveraged. With the financial constraint of over-leverage or under-leverage taken into account, the biased estimation that occurs in the application of the partial adjustment model in the related prior studies is avoided in the thesis research. To the best of this writer’s knowledge, no other studies in capital structure decisions have taken financial constraints into account when applying the partial adjustment model. In addition, with regard to the estimation of the unobservable target debt ratios, model misspecification due to the lack of inclusion of the macro-factors also results in the biased estimation in the application of the partial adjustment model in prior studies.

In only a few decades, Taiwan has made a stunning economic transition. The textile, plastics and electronics industries were financially supported by government industrial policy and played an important role in contributing to this economic development, particularly during the periods of the 1960s, the 1970s to the mid-1980s, and the mid-1980s to the mid-1990s. The thesis research, therefore, is conducted during the period from 1983 to 1995 in the context of Taiwan. In contrast, most prior studies have been conducted in developed countries, in particular the USA, rather than in developing or less-developed countries or even in countries in transition. The findings of the thesis research provide a new perspective on the determination of capital structure decisions in three relatively different
characteristics industries, i.e. the labor-intensive textile, the capital-intensive plastics and the technology-intensive electronics industries. The findings should help practitioners in corporate finance to have a better understanding of the determination of capital structure decisions and policy-makers in developing countries to formulate their industrial and economic development policy. In addition, the findings should provide a new direction for corporate finance researchers interested in the adjustment behavior of capital structure decisions.

The major findings in the thesis research are as follows:

Firstly, during the research period from 1983 to 1995, macroeconomic conditions have a significant effect on capital structure decisions for the listed firms in the textile, plastics and electronics industries at the years of economic peak and trough in Taiwan. In addition, the effect of macroeconomic conditions on the debt ratio adjustment and on the level of actual debt ratio varies upon whether firms are over-leveraged or under-leveraged relative to their target debt ratios. Macroeconomic conditions have a cyclical positive effect on the debt ratio adjustment and the actual debt ratio for firms with under-leverage relative to their target debt ratios. This finding suggests that firms with under-leverage tend to finance with more debt at the years of economic peak than at the years of economic trough with future investment and growth opportunities taken into account, consistent with the agency theory of capital structure. However, the positive effect of macroeconomic conditions does not appear for firms with the financial constraint of over-leverage relative to their target debt ratios.

Secondly, economic development affects the determination of the debt ratio adjustment and the actual debt ratio. However, the impact of economic development including future economic growth and the shift in the level of economic development varies with firms having the financial constraint of over-leverage or under-leverage relative to their target debt ratios. The proxy for future economic growth has a significant positive effect on the debt ratio adjustment and the actual debt ratio for firms with under-leverage relative to their target debt ratios but not for those with the financial constraint of over-leverage relative to the target debt ratios. This finding provides additional evidence with regard to the differing effects of
economic development on capital structure decisions among countries as found by the recent empirical study of Chen (2004b). On the other hand, the proxy for the shift in the level of economic development has a significant negative effect on the debt ratio adjustment and the actual debt ratio for firms that are over-leveraged relative to their target debt ratios but not for firms that are under-leveraged. This finding on a negative effect of the shift in the level of economic development on the debt ratio adjustment and the actual debt ratio is consistent with the conclusion of Boyd and Smith (1996): that the aggregate ratio of debt to equity will generally decline as an economy develops.

Finally, government industrial policy affects the determination of the debt ratio adjustment and the actual debt ratio; however, the effect of government industrial policy on debt ratio choices varies for firms with the financial constraint of over-leverage or under-leverage relative to their target debt ratios. Government industrial policy has a significant positive effect on the debt ratio adjustment and the actual debt ratio for firms with under-leverage relative to their target debt ratios. Firms with under-leverage maximize the value of government industrial policy through capital structure decisions and extract this value to increase the value of their firms. This finding is consistent with the conclusion of Appelbaum (1993). However, government industrial policy does not significantly affect the debt ratio adjustment and the actual debt ratio for firms with over-leverage relative to their target debt ratios. This finding suggests that firms, with the financial constraint of over-leverage, tend to gear down their over-leveraged ratios in order to reduce the default and bankruptcy risks rather than to finance with more debt when government industrial policy provides them with cheaper debt. If these over-leveraged firms go into bankruptcy, then these firms have no chance at all of extracting the value of government industrial policy to increase the value of their firms.

9.2 Conclusions and Suggestions for Future Research

Firstly, the findings in the thesis research show that macroeconomic conditions affect the adjustment behavior of debt ratio decisions for the listed firms in three industries of different characteristics in Taiwan during the research period from 1983 to 1995. The effect of macroeconomic conditions, however, varies according
to whether firms are over-leveraged or under-leveraged relative to their target debt ratios. Firms with under-leverage relative to their target debt ratios finance with more debt at the years of economic peak than at the years of economic trough. This implies that, as suggested by the agency theory of capital structure, firms should finance with more debt in a period of good macroeconomic conditions, in particular at economic peak, with limited future investment and growth opportunities but with less debt in a period of bad macroeconomic conditions, in particular at economic trough, with more future investment and growth opportunities. On the other hand, the positive effect of macroeconomic conditions does not appear for firms with the financial constraint of over-leverage relative to their target debt ratios. The finding suggests that firms with the financial constraint of over-leverage do not tend to finance with more debt in a period of good macroeconomic conditions, in particular at economic peak, with limited future investment and growth opportunities. This implies that firms, with the financial constraint of over-leverage relative to the target debt ratios, tend to relieve their over-leveraged problem in order to reduce the default risk rather than finance with more debt in a period of good macroeconomic conditions. In addition, this also implies that, in a period of good macroeconomic conditions, the agency problem between managers and shareholders seems to be less serious for firms with over-leverage than for those with under-leverage. Future research may provide further evidence on the issue. Further, future research may address the adjustment behavior of capital structure decisions across countries, in particular in developed and developing or less developed countries, to provide further evidence on the effect of macroeconomic conditions. Future research might even address the issue in industries of lagging and leading characteristics over business cycles for a better understanding of the difference in the adjustment behavior of capital structure decisions across developed and developing countries.

Secondly, the effect of economic development includes the short-term effect of future economic growth and the long-term effect of the shift in the level of economic development. The shift in the level of economic development has a significant negative effect on the debt ratio adjustment and on the level of actual debt ratio for firms with the financial constraint of over-leverage relative to their target debt ratios. This finding is consistent with the conclusion of Boyd and Smith (1996) - that the aggregate debt-to-equity ratio generally declines as the economy
develops further. The long-term effect arising from the shift in the level of economic development, however, disappears for firms with under-leverage relative to the target debt ratios during the research period from 1983 to 1995. These mixed findings suggest that the long-term effect of economic development varies according to whether firms are over-leveraged or under-leveraged relative to the target debt ratios. On the other hand, the future economic growth of economic development has a positive effect on the debt ratio adjustment and on the level of actual debt ratio for firms with under-leverage relative to their target debt ratios. The short-term positive effect of future growth in the course of economic development is similar to the positive effect of macroeconomic conditions on the debt ratio adjustment and the level of actual debt ratio for firms with under-leverage relative to the target debt ratios. This finding supports Stulz (1990) who argues that the optimal face value of debt increases with an increase in the probability that a firm will have free cash flow. This latter increase might result in this short-term positive effect of economic development on capital structure decisions. The short-term positive effect of economic development, however, disappears for firms with the financial constraint of over-leverage relative to the target debt ratios. These mixed findings suggest that the short-term effect of economic development varies according to whether firms are over-leveraged or under-leveraged relative to their target debt ratios. In brief, economic development has a significant effect on the adjustment behavior of debt ratio decisions of firms in the textile, plastics and electronics industries of Taiwan. However, the short-term effect of future economic growth and the long-term effect of the shift in the level of economic development on the debt ratio adjustment and on the level of actual debt ratio vary upon the financial constraint of over-leverage or under-leverage relative to the target debt ratios of firms. Future research may provide further evidence on the conflicting long-term and short-term effects of economic development to allow a better understanding of the adjustment behavior of capital structure decisions. If the data of future growth for each industry in terms of annual future growth rate of real GDP were available, future research might use annual future growth rate of real GDP in each industry to indicate the future growth of economic development.

Thirdly, government industrial policy has a significant positive effect on the adjustment behavior of debt ratio choices but the effect varies according to whether
firms are over-leveraged or under-leveraged relative to their target debt ratios. Firms with under-leverage relative to their target debt ratios finance with more debt due to cheaper credit and supporting measures from government industrial policy. Firms take advantage of the measures provided by government industrial policy to maximize the value of the government intervention measures in order to extract this value to increase the value of their firms. However, the positive effect of government industrial policy disappears when firms are over-leveraged relative to their target debt ratios. Firms with the financial constraint of over-leverage relative to the target debt ratios tend to gear down their debt ratios to decrease the default risk so that they avoid going bankrupt and losing benefits from government industrial policy. In other words, government industrial policy itself encourages firms to finance with more debt to take advantage of government policy measures to increase the value of their firms. Policy-makers might need to impose some financial requirements on firms under the financial constraint of over-leverage in order to prevent the catastrophe of a financial system failure. Proper design and planning of government industrial policy can also avoid imbalanced development, inefficient credit allocation among industries and possible increased instability of the economy. Indeed, critics claim that the government is not really good at “picking winners”. The findings on the impact of government industrial policy in the thesis research also suggest that the agency problem between managers and shareholders might become less serious for firms with over-leverage than for those with under-leverage because of the variation in the significance of the impact of government industrial policy on debt ratio adjustment and on the level of actual debt ratio. The benefits from government industrial policy create more free cash flow and might well increase the conflicts of interest between managers and shareholders. Based on the agency theory of capital structure, firms should finance with more debt in order to avoid the over-investment problem. The increase in cash flow arising from government industrial policy forces firms, with under-leverage relative to the target debt ratios, to finance with more debt to mitigate the conflicts of interest between managers and shareholders. Future research may provide further evidence on the agency problem arising from government industrial policy. Moreover, in response to global climate change, future research might explore evidence on the impact of government environmental policy on capital structure decisions, in particular for firms with high carbon emissions.
The thesis research also finds that the adjustment rate does not remain constant over time and varies upon whether firms are over-leveraged or under-leveraged relative to their target debt ratios. The findings in the thesis research show a faster rate of adjustment for firms with over-leverage than for firms with under-leverage relative to their target debt ratios. In addition, firms with the financial constraint of over-leverage adjust faster towards the target debt ratios to gear down their leverage ratios in order to reduce the default risk and hence avoid financial distress at years of economic trough rather than at years of economic peak. Based on these findings in the thesis research, further evidence on the variation in the adjustment rate of capital structure decisions is left for future researchers. In addition, the findings in the study show that the rate of adjustment towards the target debt ratios in the range between 6% and 15% is much lower than 34.3% found by Flannery and Rangan (2006). The findings on the adjustment rate in the thesis research seem to support the view that firms in the textile, plastic and electronics industries in Taiwan behave as if they have a target debt ratio. The empirical results show that the capital structures of firms in the sample do adjust towards their target debt ratios, but the rate at which they adjust towards their target debt ratios is relatively slower than the level of 0.343, as found by Flannery and Rangan (2006). This is consistent with the static trade-off theory of capital structure. However, this does not imply that firms do not behave in a pecking order manner in their financing decisions. The focus of the thesis is mainly on investigating the impact of macroeconomic conditions, economic development and government industrial policy on capital structure decisions. Therefore, additional evidence for the pecking order hypothesis awaits future research.

Moreover, due to the time limitation of the thesis research, further work on the mathematical modeling for the impact of government industrial policy on capital structure decisions based on the agency theory is left for future research. In addition to the macro-factors included in the thesis, future research may also address other macro-level factors - such as monetary and fiscal policies and the foreign exchange policy of the central banks - to investigate their impact on the adjustment behavior of capital structure decisions. Future research may also gather evidence on the adjustment behavior of capital structure decisions in developed countries and compare developed and developing or less-developed countries as well as countries
with different cultural backgrounds or judicial systems. In the application of the partial adjustment model, the adjustment rate is assumed to be greater than 0. Therefore, the model could not explain correctly the zero adjustment of capital structure decisions. Zero adjustment might be caused by the zero rate of adjustment or the situation in which the target capital structure is equal to the previous actual capital structure. However, no case of zero adjustment was found in the sample of the thesis research. Future research, however, should take this limitation into account. Further, the fuzzy regression model allows a range of fluctuation in the estimation of the dependent variable in the regression. The fuzzy regression model matches well with the adjustment behavior of the deviation away from the target capital structure found in both prior studies and in the thesis research. Evidence on the efficiency of the fuzzy regression model that explains the adjustment behavior of capital structure decisions is left for future research.

Finally, in brief, the findings in the thesis research show that macroeconomic conditions, economic development and government industrial policy affect the adjustment behavior of debt ratio choices but the effects of these factors on the debt ratio adjustment and on the level of actual debt ratio vary upon the financial constraint of firms with over-leverage or under-leverage relative to the target debt ratios. These findings suggest that, in order to maximize the value of their firms, firms with financial constraint of over-leverage or under-leverage should have a well-constructed financial plan for future investment and growth opportunities across both the shift in macroeconomic conditions over business cycles and the shift in government industrial policy in the course of economic development. In addition, the thesis provides new perspectives and further evidence on the impact of macroeconomic conditions, economic development and government industrial policy on capital structure decisions within the context of a newly industrialized nation such as Taiwan. In general, the findings in the thesis research should be a helpful reference for practitioners of corporate finance, for policy-makers in Taiwan, in developing and less-developed countries or in economies in transition and for researchers in capital structure.
## Appendix 1

### Recent Empirical Results in Testing the Theory of Capital Structure

<table>
<thead>
<tr>
<th>Author(s) &amp; (Year)</th>
<th>Data and Period of Study</th>
<th>Empirical Results</th>
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</thead>
<tbody>
<tr>
<td>Beattie, Goodacre and Thomson (2006)</td>
<td>A comprehensive survey of corporate financing decision-making in UK listed companies</td>
<td>About half of the firms seek to maintain a target debt level, consistent with the trade-off theory. On the other hand, 60% of the firms claim to follow a financing hierarchy, consistent with the pecking order theory.</td>
</tr>
<tr>
<td>Beck, Demirgüç-Kunt and Maksimovic et al. (2008)</td>
<td>48 countries in the developed, emerging and less developed countries.</td>
<td>The empirical results suggest that the pecking order theory holds across countries.</td>
</tr>
<tr>
<td>Brounen, De Jong and Koedijk (2006)</td>
<td>the UK, the Netherlands, Germany, and France</td>
<td>On the whole, the trade-off theory is supported in each of the four European countries.</td>
</tr>
<tr>
<td>Cassar and Holmes (2003)</td>
<td>1. A survey study on 1,555 Australian small-and-medium sized enterprises 2. final sample of 1,555 firms was available for analysis 3. Chinese-listed companies</td>
<td>On the whole, the empirical results support static trade-off and pecking order arguments proposed by theoretical models.</td>
</tr>
<tr>
<td>Chen (2004a)</td>
<td>Chinese-listed companies</td>
<td>Neither the trade-off model nor the Pecking order hypothesis provides complete explanations for the capital choices of the Chinese firms.</td>
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<tr>
<td>Author(s) &amp; (Year)</td>
<td>Data and Period of Study</td>
<td>Empirical Results</td>
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<tr>
<td>De Bie and De Haan (2007)</td>
<td>a sample of Dutch listed firms and a sub-sample of Dutch initial public offering (IPO) firms</td>
<td>The empirical results support market timing theory. However, no persistent effects of market timing on capital structures of Dutch firms are found.</td>
</tr>
<tr>
<td>Delcoure (2007)</td>
<td>Emerging Central and Eastern European countries</td>
<td>Neither the trade-off, pecking order, nor agency theories explain the choices of capital structure.</td>
</tr>
<tr>
<td>Eldomiaty and Ismail (2008)</td>
<td>The sample firms were selected according to two criteria. First, the non-financial firms amongst the 100 actively trading firms in Egypt stock market. Second, those non-financial firms amongst the 100 firms with the highest market value.</td>
<td>The empirical results show that corporate financing is influenced by the trade-off theory relatively.</td>
</tr>
<tr>
<td>Elliott, Koeter-Kant and Warr (2008)</td>
<td>all non-financial, US firms that issued public seasoned equity, and all non-convertible debt (both public and private), during the period 1980–1999</td>
<td>Equity market mispricing plays a significant, if not dominant, role in the security choice decision.</td>
</tr>
<tr>
<td>Fan and So (2004)</td>
<td>Two surveys from Hong Kong managers in 1994 and 1999</td>
<td>The pecking order principle is found to be preferred to maintaining a target financing mix. Managers consider the current market conditions in making financing decisions.</td>
</tr>
<tr>
<td>Author(s) &amp; (Year)</td>
<td>Data and Period of Study</td>
<td>Empirical Results</td>
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<tr>
<td>Flannery and Rangan (2006)</td>
<td>All firms included in the Compustat Industrial Annual tapes between the years 1965 and 2001</td>
<td>The results suggest that firms do have target capital structures and adjust towards the target over time, consistent with the trade-off theory.</td>
</tr>
<tr>
<td>Frank and Goyal (2003)</td>
<td>publicly traded American firms for 1971 to 1998</td>
<td>Net equity issues track the financing deficit more closely than do net debt issues. The finding does not support the pecking order theory.</td>
</tr>
<tr>
<td>Hogan and Hutson (2005)</td>
<td>117 Irish software companies</td>
<td>The results show that the use of debt is rare and equity financing is the prime source of external finance. The finding of Hogan and Huston does not support the pecking order theory.</td>
</tr>
</tbody>
</table>
| Hovakimian, Hovakimian and Tehranian (2004) | Following MacKie-Mason (1990) and Hovakimian et al. (2001), security issues are identified using annual firm level data from the Compustat Industrial, Full Coverage, and Research files | 1. Consistent with dynamic trade-off theories, dual issuers offset the deviation from the target resulting from accumulation of earnings and losses.  
2. Consistent with market timing, high stock returns increase the probability of equity issuance but have no effect on target leverage. |
<p>| Kayhan and Titman (2007) | firms listed in the Compustat Industrial Annual Files at any point between 1960 and 2003. | The results indicate that although firms' histories strongly influence their capital structures, over time their capital structures tend to move towards target debt ratios that are consistent with the tradeoff theories of capital structure. |</p>
<table>
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<th>Author(s) &amp; (Year)</th>
<th>Data and Period of Study</th>
<th>Empirical Results</th>
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<tbody>
<tr>
<td>Leary and Roberts (2005)</td>
<td>The data are taken from the combined quarterly research, full coverage, and industrial COMPSTAT files for the years 1984 to 2001.26 We also extract return data from the Center for Research in Security Prices (CRSP) monthly stock price file. All regulated (SICs 4900–4999) and financial firms (SICs 6000–6999) are removed from the sample to avoid financial policy governed by regulatory.</td>
<td>The results show that firms actively rebalance their leverage to stay within an optimal range, consistent with the trade-off theory. The persistent effect of shocks on leverage observed in previous studies is more likely due to adjustment costs than indifference toward capital structure.</td>
</tr>
<tr>
<td>López-Gracia and Sogorb-Mira (2008)</td>
<td>3,569 Spanish SMEs over a 10-year period dating from 1995 to 2004</td>
<td>1. Results suggest that both theoretical models help to explain SME capital structure. 2. SMEs follow a funding source hierarchy (pecking order model). 3. The results reveal that greater trust is placed in SMEs that aim to reach target or optimum leverage (trade-off model).</td>
</tr>
<tr>
<td>Mahajan and Tartaroğlu (2008)</td>
<td>major industrialized (G-7) countries</td>
<td>The empirical results are inconsistent with the prediction of the equity market timing hypothesis and more in line with dynamic trade-off model.</td>
</tr>
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</table>
Table A1 (continued)

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<th>Author(s) &amp; (Year)</th>
<th>Data and Period of Study</th>
<th>Empirical Results</th>
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<tbody>
<tr>
<td>Mazur (2007)</td>
<td>Polish companies traded on the Warsaw Stock Exchange</td>
<td>The evidence generally suggests the relevance of the pecking order hypothesis in explaining the financing choices of Polish firms.</td>
</tr>
<tr>
<td>Mehrotra, Mikellson and Partch (2003)</td>
<td>98 spin-offs occurred in the period 1979-1997</td>
<td>1. The positive relation between profitability and the use of financial leverage, in a setting that is free of pecking order effects. &lt;br&gt;2. The ability to cover debt payments and default-related costs are important determinants of the use of financial leverage, as implied by the trade-off theory of capital structure.</td>
</tr>
<tr>
<td>Nivorozhkin (2004)</td>
<td>Two transition economies, the Czech Republic and Bulgaria</td>
<td>1. The Bulgarian corporate credit markets were less supply-constrained than those of the Czech Republic during the sample period. &lt;br&gt;2. Bulgarian companies adjusted much faster to the target leverage than Czech firms. &lt;br&gt;3. The conservative policies of Czech banks and the exposure control were likely responsible for the slower adjustment among the larger companies.</td>
</tr>
<tr>
<td>Sánchez-Vidal and Martín-Ugedo (2005)</td>
<td>1,566 Spanish firms over 1994–2000</td>
<td>The results show that the pecking order theory holds for most subsamples analyzed, particularly for the small and medium-sized enterprises and for the high-growth and highly leveraged companies.</td>
</tr>
<tr>
<td>Author(s) &amp; (Year)</td>
<td>Data and Period of Study</td>
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</table>
| Seifert and Gonenc (2008) | USA, UK, Germany and Japan        | 1. The evidence finds little overall support the pecking order hypothesis for American, British, and German firms.  
                                |                                   | 2. The evidence supports the pecking order hypothesis for Japanese firms especially during the 1980s and early 1990s |
| Tong and Green (2005)     | the largest Chinese listed companies | These results broadly support the pecking order hypothesis over the trade-off theory. |
Appendix 2

Political and Economic Status of Taiwan: An Overview

In order to facilitate a basic understanding of Taiwan, the appendix provides an overview of the international political and economic history of Taiwan. The first part of this appendix discusses the geographical and international political status of Taiwan. The second part of this appendix discusses the international economic status of Taiwan.

A2.1 Geographical and Political Status of Taiwan

Taiwan has an area of 35,801 square kilometers and a population of about 23 million. Taiwan, also known as Formosa (derived from the Portuguese word for “beautiful”), is bound to the east by the Pacific Ocean, to the west by the Taiwan Strait, to the south by the Luzon Strait and to the north by the East China Sea. Before the end of the Second World War, Taiwan had been colonized and governed by the Japanese government for about fifty years. On 25th October 1945 after the end of the Second World War, the Republic of China’s troops representing the Allied Forces led by the USA accepted the surrender of the Japanese military forces in Taiwan.\(^\text{14}\)

In 1949, the Kuomintang, i.e. the KMT Party led by Chiang Kai-shek, retreated from mainland China to Taiwan. In addition, the government of the Republic of China moved from Nanjing to Taipei and claimed its sovereignty over the whole of China and Outer Mongolia despite the People’s Republic of China and the Mongolian People’s Republic having declared their independence and sovereignty in 1949 and in 1924, respectively.\(^\text{15}\) Today, Taiwan is the name commonly used to refer to the territory governed by the Republic of China and is often referred to internationally as Chinese Taipei.

\(^\text{14}\) Please refer to http://en.wikipedia.org/wiki/Taiwan.

\(^\text{15}\) The People’s Republic of China and the Mongolian People’s Republic became a member of the United Nations in 1971 and 1961, respectively.
However, at the 1976th plenary meeting of the United Nations in 1971, the General Assembly passed Resolution 2758 by which the United Nations recognized that the representatives of the government of the People’s Republic of China are the only lawful representatives of China to the United Nations and that the People’s Republic of China is one of the five permanent members of the Security Council. Moreover, the United Nations decided to restore all rights to the People’s Republic of China and to expel the representatives of Chiang Kai-shek from the place which they unlawfully occupied at the United Nations and in all the organizations related to it. Coincidentally, Resolution 2758 of the United Nations was passed on 25th October 1971 - exactly twenty-six years after troops of the Republic of China took over the control of Taiwan from Japan.

Nevertheless, in order to help maintain peace, security and stability in the western Pacific and to promote the foreign policy of the United States, the Taiwan Relations Act was enacted in the American Congress on 1st January 1979. One of the purposes of the Act is to make clear that American diplomatic relations with the People’s Republic of China rest upon the expectation that the future of Taiwan will be determined by peaceful means. This has resulted in both the political dispute between Taiwan and China and the dilemma where Taiwan cannot be a member nation of any organization related to the United Nations.

A2.2 International Economic Status of Taiwan

Despite its difficult and uncertain political status, Taiwan has successfully transformed itself within just a few decades. In 2007, Taiwan was ranked as the 19th highest in the list of countries sorted by gross domestic product, i.e. GDP, calculated on a purchasing power parity basis by the International Monetary Fund. In contrast, for the same year, the ranks of China, Japan, Singapore and South Korea were 2nd, 3rd, 44th and 14th, respectively. In addition, the ranks of Taiwan, China, Japan, Singapore and South Korea were 28th, 99th, 24th, 6th, and 35th in the list of countries sorted by the GDP per capita calculated on a purchasing power parity basis.

parity basis by the IMF for the year of 2007.18

Foreign trade is critical to Taiwan’s economic growth and development. However, due to the “One China” policy, Taiwan has formal diplomatic relations with fewer than thirty countries in the international community. To offset the lack of diplomatic relations with its trading partners, Taiwan sets up cultural and trade offices in these countries. Fortunately, since January 2002, Taiwan has been a member of the World Trade Organization under the name of The Separate Customs Territory of Taiwan, Penghu, Kinmen and Matsu, i.e. Chinese Taipei. Taiwan received U.S. aid during the 1950s and the early 1960s; today, Taiwan is an aid donor and one of the major foreign investors in the world.19

Taiwan enjoyed a spectacular economic performance from the 1960s through to the 1990s (see the Real GDP column in Table A2.1 and Figure A2.1). The real GDP of Taiwan increased more than 24 times, from NT$441,611 million dollars in 1962 to NT$10,726,908 million Taiwan dollars in 2004. A similar economic performance was achieved by its competitors in the “Asian Four Tigers”, Hong Kong, Singapore and South Korea, all culturally influenced by China (see columns 2 to 5 of Table A2.2 and Figure A2.2). The per capita GDP of the “Asian Four Tigers” increased about three to five times from 1986 to 2004. As argued by Kahn (1979), cultural advantages are the critical factor of economic success in East Asia. However, as can be seen in the gGDP column in Table A2.1 and Figure A2.3, the double-digit growth rate of GDP disappeared after 1987, the turning point of economic development in Taiwan, as stated by Chiang (2004).

In addition, according to the official data of the Directorate-General of Budget, Accounting and Statistics, Executive Yuan of Taiwan, the per capita GDP of Taiwan increased dramatically from 1951. By 1987 it had increased by 111 times the 1951 level and by 2006 it had increased by 348 times.20 Such rapid economic growth also can be seen in Figure A2.1. However, a decrease in GDP and GDP growth rate of Taiwan occurred in 1998 and 2001. The decrease in 1998 and 2001

occurred due to the Asian Financial Crisis and the shift in the ruling party of the Taiwanese government (see the gGDP column in Table A2.1 and Figures A2.1 and A2.3).

### Table A2.1

**Economic Performance of Taiwan since the 1960s**

<table>
<thead>
<tr>
<th>Year</th>
<th>Business Cycle</th>
<th>Real GDP (million NT$)</th>
<th>gGDP</th>
<th>Percent of Real GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Agricultural</td>
</tr>
<tr>
<td>1962</td>
<td>2</td>
<td>441,611</td>
<td>7.90%</td>
<td>20.29%</td>
</tr>
<tr>
<td>1966</td>
<td>3</td>
<td>655,834</td>
<td>8.91%</td>
<td>17.84%</td>
</tr>
<tr>
<td>1967</td>
<td>3</td>
<td>726,082</td>
<td>10.71%</td>
<td>17.04%</td>
</tr>
<tr>
<td>1969</td>
<td>4</td>
<td>863,600</td>
<td>8.95%</td>
<td>14.67%</td>
</tr>
<tr>
<td>1975</td>
<td>5</td>
<td>1,473,672</td>
<td>4.93%</td>
<td>9.70%</td>
</tr>
<tr>
<td>1983</td>
<td>6</td>
<td>2,906,311</td>
<td>8.45%</td>
<td>5.92%</td>
</tr>
<tr>
<td>1985</td>
<td>6</td>
<td>3,373,562</td>
<td>4.95%</td>
<td>5.31%</td>
</tr>
<tr>
<td>1986</td>
<td>7</td>
<td>3,766,144</td>
<td>11.64%</td>
<td>4.76%</td>
</tr>
<tr>
<td>1987</td>
<td>7</td>
<td>4,246,134</td>
<td>12.74%</td>
<td>4.49%</td>
</tr>
<tr>
<td>1988</td>
<td>7</td>
<td>4,579,049</td>
<td>7.84%</td>
<td>4.19%</td>
</tr>
<tr>
<td>1989</td>
<td>7</td>
<td>4,956,018</td>
<td>8.23%</td>
<td>3.84%</td>
</tr>
<tr>
<td>1990</td>
<td>7</td>
<td>5,223,394</td>
<td>5.39%</td>
<td>3.71%</td>
</tr>
<tr>
<td>1991</td>
<td>8</td>
<td>5,617,967</td>
<td>7.55%</td>
<td>3.51%</td>
</tr>
<tr>
<td>1994</td>
<td>8</td>
<td>6,921,479</td>
<td>7.11%</td>
<td>2.79%</td>
</tr>
<tr>
<td>1995</td>
<td>8</td>
<td>7,366,118</td>
<td>6.42%</td>
<td>2.69%</td>
</tr>
<tr>
<td>1996</td>
<td>8</td>
<td>7,815,617</td>
<td>6.10%</td>
<td>2.53%</td>
</tr>
<tr>
<td>1997</td>
<td>9</td>
<td>8,313,215</td>
<td>6.37%</td>
<td>2.34%</td>
</tr>
<tr>
<td>1998</td>
<td>9</td>
<td>8,673,131</td>
<td>4.33%</td>
<td>2.10%</td>
</tr>
<tr>
<td>1999</td>
<td>10</td>
<td>9,134,467</td>
<td>5.32%</td>
<td>2.05%</td>
</tr>
<tr>
<td>2000</td>
<td>10</td>
<td>9,662,544</td>
<td>5.78%</td>
<td>1.95%</td>
</tr>
<tr>
<td>2001</td>
<td>10</td>
<td>9,447,649</td>
<td>-2.22%</td>
<td>1.96%</td>
</tr>
<tr>
<td>2002</td>
<td>NA</td>
<td>9,820,311</td>
<td>3.94%</td>
<td>1.97%</td>
</tr>
<tr>
<td>2003</td>
<td>NA</td>
<td>10,147,817</td>
<td>3.33%</td>
<td>1.91%</td>
</tr>
<tr>
<td>2004</td>
<td>NA</td>
<td>10,726,908</td>
<td>5.71%</td>
<td>1.68%</td>
</tr>
</tbody>
</table>

Sources:

Notes:
1. GDP: gross domestic product
2. gGDP: annual growth rate of real GDP
4. Manufacturing is a subsector of Industrial Sector of Taiwan.
Figure A2.1 Real GDP of Taiwan from 1962 to 2004
<table>
<thead>
<tr>
<th>Year</th>
<th>Taiwan</th>
<th>Hong Kong</th>
<th>S. Korea</th>
<th>Singapore</th>
<th>Philippines</th>
<th>Thailand</th>
<th>Indonesia</th>
<th>Malaysia</th>
<th>Japan</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>2,348</td>
<td>5,672</td>
<td>1,632</td>
<td>4,853</td>
<td>675</td>
<td>698</td>
<td>483</td>
<td>1,779</td>
<td>9,184</td>
<td>304</td>
</tr>
<tr>
<td>1985</td>
<td>3,243</td>
<td>6,420</td>
<td>2,290</td>
<td>6,532</td>
<td>566</td>
<td>769</td>
<td>533</td>
<td>1,992</td>
<td>11,303</td>
<td>280</td>
</tr>
<tr>
<td>1986</td>
<td>3,897</td>
<td>7,305</td>
<td>2,609</td>
<td>6,517</td>
<td>537</td>
<td>838</td>
<td>510</td>
<td>1,724</td>
<td>16,656</td>
<td>270</td>
</tr>
<tr>
<td>1987</td>
<td>5,192</td>
<td>8,923</td>
<td>3,244</td>
<td>7,226</td>
<td>583</td>
<td>967</td>
<td>454</td>
<td>1,949</td>
<td>20,157</td>
<td>287</td>
</tr>
<tr>
<td>1988</td>
<td>6,223</td>
<td>10,472</td>
<td>4,293</td>
<td>8,744</td>
<td>650</td>
<td>1,162</td>
<td>505</td>
<td>2,082</td>
<td>24,290</td>
<td>352</td>
</tr>
<tr>
<td>1989</td>
<td>7,455</td>
<td>11,977</td>
<td>5,198</td>
<td>10,131</td>
<td>713</td>
<td>1,342</td>
<td>569</td>
<td>2,235</td>
<td>24,123</td>
<td>384</td>
</tr>
<tr>
<td>1990</td>
<td>7,918</td>
<td>13,224</td>
<td>5,893</td>
<td>12,234</td>
<td>725</td>
<td>1,562</td>
<td>631</td>
<td>2,467</td>
<td>24,606</td>
<td>332</td>
</tr>
<tr>
<td>1991</td>
<td>8,769</td>
<td>15,068</td>
<td>6,820</td>
<td>13,952</td>
<td>726</td>
<td>1,773</td>
<td>695</td>
<td>2,681</td>
<td>28,039</td>
<td>342</td>
</tr>
<tr>
<td>1992</td>
<td>10,274</td>
<td>17,394</td>
<td>7,198</td>
<td>15,671</td>
<td>828</td>
<td>1,984</td>
<td>743</td>
<td>3,143</td>
<td>30,503</td>
<td>396</td>
</tr>
<tr>
<td>1993</td>
<td>10,757</td>
<td>19,732</td>
<td>8,200</td>
<td>17,820</td>
<td>831</td>
<td>2,196</td>
<td>831</td>
<td>3,462</td>
<td>34,906</td>
<td>501</td>
</tr>
<tr>
<td>1994</td>
<td>11,613</td>
<td>21,896</td>
<td>9,496</td>
<td>20,929</td>
<td>958</td>
<td>2,504</td>
<td>917</td>
<td>3,754</td>
<td>38,316</td>
<td>449</td>
</tr>
<tr>
<td>1995</td>
<td>12,488</td>
<td>22,907</td>
<td>11,490</td>
<td>24,132</td>
<td>1,084</td>
<td>2,880</td>
<td>1,033</td>
<td>4,363</td>
<td>42,105</td>
<td>575</td>
</tr>
<tr>
<td>1996</td>
<td>13,527</td>
<td>24,921</td>
<td>12,281</td>
<td>25,381</td>
<td>1,186</td>
<td>3,084</td>
<td>1,146</td>
<td>4,827</td>
<td>37,264</td>
<td>668</td>
</tr>
<tr>
<td>1997</td>
<td>13,904</td>
<td>27,242</td>
<td>11,275</td>
<td>25,759</td>
<td>1,154</td>
<td>2,530</td>
<td>1,073</td>
<td>4,675</td>
<td>34,133</td>
<td>727</td>
</tr>
<tr>
<td>1998</td>
<td>12,769</td>
<td>25,563</td>
<td>7,485</td>
<td>21,498</td>
<td>895</td>
<td>1,857</td>
<td>468</td>
<td>3,287</td>
<td>31,103</td>
<td>761</td>
</tr>
<tr>
<td>1999</td>
<td>13,609</td>
<td>24,520</td>
<td>9,582</td>
<td>21,037</td>
<td>1,025</td>
<td>2,015</td>
<td>678</td>
<td>3,520</td>
<td>35,149</td>
<td>790</td>
</tr>
<tr>
<td>2000</td>
<td>14,519</td>
<td>25,426</td>
<td>10,938</td>
<td>23,079</td>
<td>1,002</td>
<td>1,998</td>
<td>789</td>
<td>3,927</td>
<td>36,602</td>
<td>847</td>
</tr>
<tr>
<td>2001</td>
<td>13,093</td>
<td>24,778</td>
<td>10,244</td>
<td>20,897</td>
<td>922</td>
<td>1,863</td>
<td>775</td>
<td>3,746</td>
<td>32,113</td>
<td>928</td>
</tr>
<tr>
<td>2002</td>
<td>13,163</td>
<td>24,063</td>
<td>11,572</td>
<td>21,251</td>
<td>976</td>
<td>2,027</td>
<td>932</td>
<td>3,974</td>
<td>30,620</td>
<td>1,009</td>
</tr>
<tr>
<td>2003</td>
<td>13,587</td>
<td>23,021</td>
<td>12,813</td>
<td>21,974</td>
<td>993</td>
<td>2,263</td>
<td>1,092</td>
<td>4,254</td>
<td>33,125</td>
<td>1,131</td>
</tr>
</tbody>
</table>

Figure A2.2 Comparison in Per Capita GDP - Taiwan versus Other Asian Countries
Figure A2.3 Real GDP Growth of Taiwan
Further, as can be seen in Table A2.2 and Figure A2.2, the per capita GDP of Taiwan has grown faster and is more stable than that of other Asian countries except Japan, Hong Kong and Singapore. As well, as can be seen in Table A2.2 and Figure A2.2, the Asian financial crisis also resulted in the decrease in per capita GDP of other Asian countries such as the Philippines, Thailand, Indonesia, Malaysia, Japan, South Korea, Singapore and Hong Kong. It took several years for these countries to recover to the same level of per capita GDP as they had before the financial crisis. In terms of the decrease in per capita GDP among the Asian Four Tigers, Taiwan suffered least from the impact of the Asian Financial Crisis and South Korea suffered most. On the other hand, as can be seen in Table A2.2, the impact of the financial crisis seems to have lasted longest in Hong Kong in terms of the recovery of per capita GDP. However, in terms of the increase in per capita GDP, the economy of China seems not to have been affected by the Asian Financial Crisis of 1997.

Moreover, in Table A2.1, the second column of Business Cycle and the fourth column of gGDP reveal that the annual growth rates of real GDP vary over the business cycles. In particular, the annual growth rate of real GDP appears higher at the years of economic peak, i.e. 1983, 1988 and 1994, than at the years of economic trough, i.e. 1985, 1990 and 1995, over Business Cycles 6 to 8. These years are selected for the thesis research according to the reference dates of economic peak and trough over the business cycles published by the top economic planning authority of Taiwan, the Council for Economic Planning and Development. The detail for the reference dates of the business cycles and the duration of expansion and contraction in each business cycle in Taiwan are shown in Figure A2.4.
## The Reference Dates of Business Cycles in Taiwan

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Trough</th>
<th>Peak</th>
<th>Trough</th>
<th>Duration (Month)</th>
<th>Expansion</th>
<th>Contraction</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Nov. 1954</td>
<td>Nov. 1955</td>
<td>Sept. 1956</td>
<td>12</td>
<td>10</td>
<td>22</td>
<td></td>
</tr>
</tbody>
</table>

Source:

---

**Figure A2.4 Business Cycles of Taiwan**

264
A2.3 Economic and Industrial Development of Taiwan

Taiwan started its economic development planning in 1953. This planning was formulated by a commission that was reorganized or renamed by the government over the stages of Taiwan’s economic development. As pointed out by Sun (2001), the first four-year term economic plan covering the period from 1953 to 1956 was only a summary plan of the projects for agricultural and industrial production and traffic construction rather than an across-the-board economic plan. Since 1977, the Council for Economic Planning and Development (CEPD) appointed by the government has been in charge of the economic development planning of Taiwan.21

Since the first Four-Year Plan in 1953, Taiwan has implemented fourteen economic plans for its economic development.22 The industrial policy adopted by the government of Taiwan in the stages of economic development shifted from labor-intensive industries in the 1960s, to heavy and petro-chemical industries in the 1970s, and then to high-tech and knowledge-intensive industries in the 1980s and 1990s (Wang, 1999). Certainly, the economic development of Taiwan can be described in different ways according to research purposes (Wang, 1997). After the retreat of the Kuomintang Party led by Chiang Kai-shek from mainland China to Taiwan in 1949 and, taking into account changes in economic plan and industrial policy in the process of economic development, the economic development of Taiwan can be classified in six stages (Sun, 2001, The Council for the Economic Planning and Development, 2003, Chiang, 2004, Li, 1988). The economic development plans implemented by the Taiwanese Government from 1953 to 2008 are listed in Table A2.3.

A2.3.1 Import-Substitution Period

The first stage of Taiwan’s economic development was from 1953 to 1960. During this stage, the country encountered problems of supply shortage in the market and a

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21 This is referred to “The Evolution of Economic Development Planning of Taiwan” reported by the Council for the Economic Planning and Development of Executive Yuan, Taiwan.

22 Refer to Taiwan Yearbook 2005 by the Government Information Office of Taiwan and the Historical Review of National Economic Plans by the Council for Economic Planning and Development.
lack of foreign reserve. Assisted by U.S. foreign aid, the Taiwanese government implemented its first four-year economic plan formulated by the Council for Economic Stabilization, i.e. the former body of the Council for the Economic Planning and Development of Executive Yuan.

<table>
<thead>
<tr>
<th>Economic Plan No.</th>
<th>Name of Economic Plan</th>
<th>Period</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Four-Year Economic Plan</td>
<td>1953 - 1956</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Four-Year Economic Plan</td>
<td>1957 - 1960</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Four-Year Economic Plan</td>
<td>1961 - 1964</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Four-Year Economic Plan</td>
<td>1965 - 1968</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Four-Year Economic Plan</td>
<td>1969 - 1972</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Four-Year Economic Plan</td>
<td>1973 - 1976</td>
<td>Implemented for only three years due to the oil crisis</td>
</tr>
<tr>
<td>8</td>
<td>Four-Year Economic Plan</td>
<td>1982 - 1985</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Four-Year Economic Plan</td>
<td>1990 - 1993</td>
<td>Implemented for only one year</td>
</tr>
</tbody>
</table>


266
At this stage of economic development, the government of Taiwan regulated importing by means of foreign exchange control, tariff barriers and import limits in order to protect and promote the development of domestic industries. Industries protected by government industrial policy included those connected to fertilizers, cement, glass, textiles, plastics, and electronics in which represented industries producing for domestic needs (Sun, 2001). This period is referred to as the Import Substitution Stage of economic development in Taiwan.

The agricultural sector dominated this stage of economic development in Taiwan. In 1953, about 34.45% of total nominal GDP was contributed by the agricultural sector and 19.39% by the industrial sector; however, in 1961, only 28.54% of total nominal GDP was contributed by the agricultural sector but 26.87% by the industrial sector (DGBAS of Executive Yuan, 2005). In addition, the trade deficit remained a fundamental problem although it became smaller year after year. The major export market for Taiwan was Japan and the major import market was the U.S.A. The major export items ranked in order of dollar value were sugar, rice, tea, bananas, and textile products. In 1957, sugar comprised 62.37% of Taiwan’s total exports and so played an important role in the import-substitution stage of economic development in Taiwan.

It is worth noting that the import-substitution strategy taken by the government at this stage emphasised equally economic growth and economic stability. People were encouraged to save and were provided with incentives for their investment in the markets, thus fostering the growth of the industrial sector over the agricultural sector. According to the former chief of the Council of Economic Planning and Development, the government clarified two principles of industrial development: first, to help the import substitution industries to develop; and, second, to promote private enterprise development (Chiang, 2004).

A2.3.2 Export-Expansion Period

During the late 1950s, several economic issues challenged the government policy.

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23 Refer to the documents related to economic development of Taiwan provided by the Council for the Economic Planning and Development of Executive Yuan, Taiwan.
adopted in the 1950s. The economic growth in the import-substitution industries declined and industries serving the small domestic market could not create enough jobs to solve the unemployment problem in the rural areas of Taiwan. In addition, the capital expenditure and the import of raw material for import-substitution increased dramatically. Considering future economic development both domestically and overseas, the government decided to implement the second four-year economic development plan and to replace the import-substitution policy by an export-expansion policy in labor-intensive industries (Chiang, 2004).

In addition, due to the negative marginal production of the agricultural sector, the government of Taiwan set up several processing export zones and offered various investment incentives to promote exports (Chou and Wu, 1990b, Industrial Development Bureau of the Ministry of Economic Affairs, 2004, Chiang, 2004). For example, three processing export zones in Kaohsiung, Tangzu, and Nangzu were established successfully (Chiang, 2004). Both the Statute of Nineteen Fiscal and Economic Reforms approved in December 1959 and the Statute for Encouragement of Investment enacted in 1960 offered investment incentives and were helpful for economic growth (Sun, 2001, Chiang, 2004). Moreover, the Industrial Development Bureau under the Ministry of Economic Affairs was set up on 25th February 1970 with the important mission and objectives such as to formulate industrial policies, to devise strategies and measures for industrial development, to promote industrial upgrading, to develop and manage industrial parks, and to formulate financial and tax measures for industrial development (Industrial Development Bureau of the Ministry of Economic Affairs, 2004).

Further, labour costs were quite low during the export-expansion stage of economic development and this attracted much foreign direct investment in Taiwan. Consequently, with such government industrial policy initiatives, the new manufacturing industries absorbed the oversupply of labour in the agricultural sector. Since 1967, the percentage contributed by the manufacturing subsector of the industrial sector to the gross domestic product has been higher than that contributed by the agricultural sector (see Figure A2.5 and the Agricultural and Manufacturing columns in Table A2.1). Chiang (2004) considers this to be the first turning point of economic development in Taiwan.
Figure A2.5 Changes in Industrial Structure of Taiwan
In brief, during the period from the 1960s to the early 1970s, the government switched from import-substitution to export-expansion in its industrial policy for labour-intensive industries and this resulted in export-driven economic growth. The textile industry was strategically promoted by the government industrial policy at this stage of economic development (Chu, 2003).

**A2.3.3 Second Import-Substitution Period**

As pointed out by Sun (2001), government policy measures implemented in the 1960s resulted in a rapid increase in export and economic growth in the mid 1960s and 1970s. However, the infrastructure, including transportation and electricity, was expanded relatively too slowly to cope with the rapid economic growth. In addition, spare parts and raw materials were highly dependent on imports due to the large quantity of critical raw materials needed to develop domestic industries.

Consequently, the government decided to develop heavy and petro-chemical industries to produce fundamental raw materials needed in mid-stream and lower-stream domestic industries (Chiang, 2004). During this period from the early 1970s to the early 1980s, the government continued to promote exports and accelerated initiatives to develop capital-intensive and technology-intensive industries in order to improve Taiwan’s industrial structure and its competitiveness in the global market.

The push for industrial and economic development adopted by the government of Taiwan at this stage is referred to as “Backward Linkage” or “Backward Integration” (Sun, 2001). In the process of economic development, if lower-stream labour-intensive industries develop to an extent that can provide enough markets for their middle-stream and upper-stream capital-intensive industries, then it is suitable for a country to develop its capital-intensive industries in order to improve its industrial structure and to foster national economic self-reliance in the process of economic development (Sun, 2001, Sun, 2003). However, this approach to economic development is suitable only for a country with the comparative advantage of developing its own capital-intensive industries (Sun, 2001).
At this stage of economic development, the Industrial Development Bureau of MOEA, Taiwan, introduced several plans to promote industrial development in the machinery and petrochemical industries. At the same time, the government also carried out the Ten National Great Construction Projects and the Twelve National Construction Projects to improve infrastructure and to expand domestic demand in response to the energy crisis. In addition, in order to meet the increasing demand for private land acquisitions, the government systematically developed several industrial parks to solve the problem of high land costs in the private sector. In brief, heavy and petrochemical industries such as steel and plastics industries were emphasized strategically in this stage of economic development in Taiwan (Sun, 2001, Chiang, 2004, Chu, 2003).

A2.3.4 Financial Liberalization and Technology-Intensive Development

According to Chiang (2004), the former chief of the Council of Economic Planning and Development of Taiwan, an inappropriate system and the regulation of an economy are the obstacles to economic growth. The economic structure of Taiwan changed dramatically during the 1980s. At the same time, Taiwanese social and political structure and, in addition, the relationship between Taiwan and China also changed dramatically. Moreover, at this stage of economic development, the Taiwanese government promoted the privatization of state-owned enterprises and the deregulation and liberalization of the financial markets.

From the late 1970s to the early 1980s, the Taiwanese government implemented economic and financial liberalization measures which were strongly suggested and recommended by several Taiwanese economists and by well-known foreign economists such as Friedrich A. Hayek and Milton Friedman (Sun, 2003). Controls on interest rates and foreign exchange were deregulated and the tariff on imported goods was decreased significantly (Sun, 2001, Sun, 2003, Chiang, 2004). During the fourth stage of economic development in Taiwan, the Taiwan dollar appreciated against the U.S. dollar from NT$37.85 in 1986 to NT$26.89 in 1990. In the late 1980s, the Taiwanese government accelerated its economic and financial deregulation, hoping to help Taiwan maintain its economic growth in a reasonable
path through the late 1990s into the early 2000s.

However, as discussed above, inappropriate economic and financial regulations contributed to an enormous trade surplus in Taiwan during the 1980s. Subsequently, the Taiwan dollar appreciated rapidly in the late 1980s, thus frustrating Taiwan’s economic growth in the 1990s. As can be seen in Table A2.1 and Figure A2.3, the annual growth rate of real GDP declined dramatically from 12.74% in 1987 to 7.84% in 1988 and then plateaued at the lower level through the 1990s and the early 2000s. Probably due to understanding the real source of economic growth based on the past experience of economic development, the Prime Minister of Taiwan announced in a report to Parliament in June 1984 principles for a policy of economic liberalization, internationalization and systemization (Sun, 2003). Indeed, Taiwan’s performance in economic development might have been much better if the government of Taiwan had boldly implemented liberalization of the economic and financial system in the 1970s and the early 1980s (Sun, 2003). On the whole, over the past fifty years, the Taiwanese government continuously adopted and implemented industrial and economic policy in response to economic issues and bottlenecks in the various stages of economic development. Its actions and measures, however, have been criticized by some Taiwanese economists as “too late and too big” (Sun, 2003).

The electronics industry was strategically promoted by the government industrial policy at this stage of economic development from the early 1980s to the mid-1990s (Industrial Development Bureau of the Ministry of Economic Affairs, 2004, Sun, 2001, Chu, 2003). The Hsin-Chu Science-Based Industrial Park was established in 1981 in accordance with the government industrial development plan (Industrial Development Bureau of the Ministry of Economic Affairs, 2004). The original factory of the well-known Taiwan Semiconductor Manufacturing Company, i.e. TSMC, was built at this industrial park. It is worth noting that, the real GDP contribution from the industrial sector accounted for nearly 40% of Taiwan's GDP in 1986 but it continued to drop to nearly 30% of the GDP in the early 2000s (see the Industrial column in Table A2.1 and Figure A2.5). As pointed out by Chiang (2004), this is the second milestone of economic development in Taiwan.
A2.3.5 Industrial Upgrading Development

From the late 1980s, the economy of Taiwan changed dramatically. Due to the accumulated trade surplus and the enormous amount of capital inflows, the Taiwan dollar appreciated rapidly in the 1980s (Sun, 2001). During this time, an unfortunate result was that the competitiveness of Taiwan-made products decreased significantly in the international market and undermined the continuous growth of the Taiwanese economy. Many low-productivity and labor-intensive industries were transferred to mainland China and to some Southeast Asian countries.

Consequently, during the period from the mid-1990s to 2000, the government of Taiwan introduced initiatives to encourage industrial upgrading. The Statute for Upgrading Industries was enacted in 1991. In addition, other measures for boosting economic development were announced in 1993 in order to implement provisions of the Strategies and Measures for Development of Ten Emerging Industries (Industrial Development Bureau of the Ministry of Economic Affairs, 2004). Moreover, an industrial promotion task force was designated for three key industries namely information technology, precision machinery and biotechnology and pharmaceutical industries (Industrial Development Bureau of the Ministry of Economic Affairs, 2004).

As can be seen in the Industrial column in Table A2.1 and Figure A2.5, the contribution to GDP by the industrial sector in Taiwan decreased from 41.93% in 1986 to 31.17% in 2001. At the same time, the structure of export products also changed dramatically due to the increase in industrial upgrading. Export products from high-tech industries increased from 18.4% in 1986 to 39.9% of Taiwan’s total exports in 1996 (Sun, 2001). Export products with 50% or more market share in the world market in 1996 included lap-top scanners - 95%, main boards - 74.2%, computer mouses - 65%, keyboards - 61% and PC power adaptors - 55.3% (Sun, 2001, Chiang, 2004). This expansion of Taiwan’s industrial base reflects the efficacy of government industrial policy.
A2.3.6 New Era of Taiwan’s Economy After 2000

Since 2000, Taiwan has faced increased challenges from liberalization and competition in domestic and international markets due to both its accession to the World Trade Organization on the 1st January of 2002 and the impact of mainland China’s economic boom. In response, as the primary goals of future economic development, the government vowed to adhere to both the industrial policy of seeking superiority in global competitiveness and the policy of encouraging the development of creative and innovative industries (Industrial Development Bureau of the Ministry of Economic Affairs, 2004).

As well, the Taiwanese government pledged to take into account quality of life in addition to economic growth when initiating future industrial and economic development planning. It was the government’s intention to transform Taiwan into “a green silicon island” during the first decade of the new century (The Council for the Economic Planning and Development, 2003). To put it succinctly, strong market potential, high interrelation between industries, high value addition, advanced technology, low pollution and low reliance on energy are the six principles of the policy for future economic and industrial development in Taiwan. The Statute for Upgrading Industries was amended on 30 January 2001 in order to facilitate economic development, to promote investments in emerging industries, to introduce advanced technology and to solve the problem of acquiring land for industrial use (Industrial Development Bureau of the Ministry of Economic Affairs, 2004).

Furthermore, the National Development Plan for the New Century from 2001 to 2004, the Plan to Develop a Knowledge-Based Economy, and the Global Logistics Development Plan became the first-priority missions for Taiwan’s economic development in the early 2000s (The Council for the Economic Planning and Development, 2003). The government also implemented the new National Development Plan, Challenge 2008, designed to strengthen global competitiveness, upgrade the quality of life, and promote the sustainable development of Taiwan’s economy. Core industries promoted by the government policy for future economic development in Taiwan included digital content, semi-conductors, image displays and biotechnology (Industrial Development Bureau of the Ministry of Economic Affairs, 2004).
As can be seen in the Industrial column in Table A2.1 and Figure A2.5, the contribution to GDP by the industrial sector in Taiwan increased from 31.17% in 2001 to 32.91% in 2004. At the same time, the contribution to GDP by the manufacturing subsector within the industrial sector increased from 25.60% in 2001 to 28.01% in 2004 as can be seen in the Manufacturing column in Table A2.1. This shows the efficacy of the economic development policy implemented in the Industrial Upgrading Period from the mid-1990s to 2000 and the National Development Plan for the New Century from 2001 to 2004.
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