IMPLICATIONS OF TAXES ON CORPORATE FINANCIAL AND INVESTMENT POLICIES

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A Dissertation Submitted in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy Program in Quantitative Finance
Department of Banking and Finance
Faculty of Commerce and Accountancy
Chulalongkorn University
Academic Year 2016

ผลกระทบของภาษีต่อนโยบายการเงินและการลงทุนขององค์กร

นายปุณยวัจน์ ศรีสิงห์

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรดุษฎีบัณฑิต
สาขาวิชาการเงินเชิงปริมาณ ภาควิชาการธนาคารและการเงิน
คณะพาณิชยศาสตร์และการบัญชี จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2559

Thesis Title	IMPLICATIONS OF TAXES ON CORPORATE FINANCIAL AND INVESTMENT POLICIES
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Field of Study	Quantitative Finance
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ปุณยวัจน์ ศรีสิงห์ : ผลกระทบของภาษีต่อนโยบายการเงินและการลงทุนขององค์กร (IMPLICATIONS OF TAXES ON CORPORATE FINANCIAL AND INVESTMENT POLICIES) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: รศ. ดร. มนพล เอกโยคยะ, 185 หน้า.

ในปัจจุบันงานวิจัยเชิงประจักษ์ได้ประสบปัญหาในการพยายามเข้าถึงข้อสรุปถึงผลกระทบของภาษีนิติบุคคลต่อการตัดสินใจโครงสร้างเงินทุน ดังนั้นวิทยานิพนธ์ฉบับนี้จึงศึกษาถึงผลกระทบของภาษีในการตัดสินใจทางการเงินของบริษัทและนโยบายการลงทุนในเชิงประจักษ์โดยการเสนอข้อโต้แย้งใหม่ถึงความสัมพันธ์ระหว่างภาษีนิติบุคคลและต้นทุนที่คาดของความลำบากทางการเงินผ่านการเปลี่ยนแปลงในมูลค่าตลาดของบริษัท วิทยานิพนธ์ฉบับนี้แบ่งออกเป็นสามบทความหลักเพื่อศึกษาถึงผลกระทบของภาษีนิติบุคคลในทฤษฎีแลกเปลี่ยนชดเชยโครงสร้างเงินทุนทั้งแบบสถิตและพลวัตร และนโยบายการลงทุนในบริบทของความเสี่ยงขององค์กร

บทความที่หนึ่งใช้ประโยชน์จากการลดภาษีนิติบุคคลครั้งใหญ่ของประเทศไทยในปี พ.ศ. ๒๕๕๕ เพื่อศึกษาการตอบสนองของอัตราส่วนการชำระหนี้ที่มีต่อภาษีซึ่งผลวิจัยแสดงให้เห็นว่าอัตราสวนของหนี้สินของบริษัทลดลงหลังการลดภาษี อย่างไรก็ตามผลกระทบทางภาษีต่ออัตราส่วนหนี้สินคงอยู่อย่างมีนัยสำคัญเฉพาะในบริษัทที่ไม่มีข้อจำกัดทางการเงิน บทความที่สองขยายขอบเขตการวิจัยจากบทความที่หนึ่งเพื่อศึกษาผลกระทบของภาษีที่มีต่อความเร็วในการปรับโครงสร้างเงินทุนภายใต้ทฤษฎีการแลกเปลี่ยนโครงสร้างทุนแบบพลวัตและผลวิจัยแสดงให้เห็นว่าภาษีเพิ่มความเร็วของการปรับโครงสร้างเงินทุนเข้าสู่เป้าหมายโครงสร้างเงินทุน ในบทสุดท้ายบทความที่สามใช้ความสัมพันธ์ระหว่างภาษีและต้นทุนที่คาดการของความลำบากทางการเงินในการศึกษาถึงผลกระทบของภาษีนิติบุคคลที่มีต่อการตัดสินใจเพิ่มความเสี่ยงขององค์กร และผลการวิจัยแสดงให้เห็นว่าบริษัทตัดสินใจรับความเสี่ยงมากขึ้นในการลงทุนเมื่ออัตราภาษีสูง โดยสรุป หลักฐานเชิงประจักษ์ที่พบในวิทยานิพนธ์นี้แสดงให้เห็นถึงบทบาทสำคัญของภาษีในโครงสร้างเงินทุนขององค์กร รวมไปถึงโครงสร้างของการตัดสินใจลงทุนขององค์กร ซึ่งสามารถเป็นประโยชน์ต่อผู้กำหนดนโยบายเมื่อพิจารณาการเปลี่ยนแปลงของอัตราภาษี เนื่องจากจะส่งผลทั้งต่อการตัดสินใจทางการเงินและการลงทุนของบริษัท

ภาควิชา	การธนาคารและการเงิน	ลายมือชื่อนิสิต	....
สาขาวิชา	การเงินเชิงปริมาณ	ลายมือชื่อ อ.ที่ปรึกษาหลัก	....
ปีการศึกษา	2559		

5483060026 : MAJOR QUANTITATIVE FINANCE

KEYWORDS: CORPORATE INCOME TAX / CAPITAL STRUCTURE / TRADE-OFF THEORY / RISK-TAKING

POONYAWAT SREESING: IMPLICATIONS OF TAXES ON CORPORATE FINANCIAL AND INVESTMENT POLICIES. ADVISOR: ASSOC. PROF. MANAPOL EKKAYOKKAYA, Ph.D., 185 pp.

To date, the empirical literature has struggled to reach a consensus on how corporate taxes influence the capital structure decisions. This thesis, therefore, seeks to empirically explore the effect of taxes on corporate financial decisions and investment policies by proposing a new argument of the potential association between corporate taxes and expected costs of financial distress through changes in the firm's market value. This thesis is divided into three main essays in order to examine the effect of corporate taxes on both static and dynamic trade-off theory of capital structure, and investment policies in the context of corporate risk-taking.

Essay one exploits a sizeable and unique corporate tax cut enacted in Thailand in 2012 to empirically explore the tax sensitivity of leverage, shows that firms significantly reduced leverage after the tax cut, however, the tax effects of leverage only remain significant in financially unconstrained firms. Essay two further examines the effect of taxes on capital structure adjustment speeds under the dynamic trade-off theory, and the results show that taxes increase the speed of adjustment toward target capital structure. Lastly, essay three utilizes the relation between taxes and the expected distress costs in examining how corporate taxes affect corporate risk-taking decisions, and show that firms take more risk in their investment decisions when tax rates are high. Overall, the empirical evidence found in this thesis reveals an important role of taxes in corporate capital structure and structure of corporate investment decisions which can be beneficial to policy makers when considering the alteration of tax rates, as it will affect both corporate financial and investment decisions.

Department:	Banking and Finance	Student's Signature	....
Field of Study:	Quantitative Finance	Advisor's Signature	....
Academic Year:	2016		

ACKNOWLEDGEMENTS

The completion of this dissertation would not have the spirit that it has without the invaluable academic, educational, philosophy, and human support and belief in me as a writer and researcher, provided by the following scholars, friends, and family which I have to mention here as follows:

Firstly, I would like to express my sincere gratitude to my advisor, Associate Professor Dr. Manapol Ekkayokkaya, for the continuous support of my Ph.D. study and related research, for his patience, motivation, and immense knowledge. His guidance helped me in all the time of research and writing of this thesis. I could not have imagined having a better advisor and mentor for my Ph.D. study.

Besides my advisor, I would like to thank the rest of my thesis committee: Dr. Anant Chiarawongse, Assistant Professor Dr. Thaisiri Watewai, Assistant Professor Dr. Sira Suchintabandid, and Professor Dr. Christian C.P. Wolff, for their insightful comments and encouragement, but also for the hard question which incented me to widen my research from various perspectives.

My sincere thanks also goes to DBA staffs and Assumption University that provided me an opportunity to access all the research facilities, and also my colleagues in the department of business economics, especially Dr. Fred, Assistant Professor Dr. Dee, and Dr. Jerry. Without their precious support it would not be possible to conduct this research.

Last but not the least, a special thanks to my family. Words cannot express how grateful I am to my mom, dad, Nuay, and Noi for all of the sacrifices that they have made on my behalf. Your prayer for me was what sustained me thus far. I would also like to thank all of my friends, especially Jo, who supported me in writing, and incented me to strive towards my goal. At the end, I would like express appreciation to Nook who spent sleepless nights with me and was always my support in the moments when there was no one to answer my queries.

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CHAPTER 1

INTRODUCTION

How taxes affect corporate decisions is one of the most debated questions in corporate finance, and has attracted attention of economists, finance scholars, and policymakers, at least after the seminal work of Modigliani and Miller (1958) on the irrelevance theory of capital structure has been introduced. To date, the empirical literature has struggled to reach a consensus on whether and to what extent corporate taxes influence the capital structure decisions. As pointed out in Fama (2011, p. 8), "the big open challenge in corporate finance is to produce evidence on how taxes affect market values and thus optimal financing decisions."

In the study of capital structure decisions, the trade-off theory suggests that firms make a trade-off between the marginal tax shield benefit and the marginal expected distress cost in determining the optimal capital structure. In this setting, corporate taxes have been modelled as being an independent determinant of the expected bankruptcy cost and financial distress. However, the market value of a firm declines due to the rise of corporate tax rates, making a firm becomes more financially constrained so that the expected financial distress costs increase. Consequently, corporate taxation has an impact on the tax shield benefits, and as well influence the costs of debt financing through the expected financial distress costs. Though this tax effect on the cost of debt financing is intuitive, it was largely neglected.

This thesis, therefore, seeks to empirically explore the effect of taxes on corporate financial decisions and investment policies by proposing a new argument of the potential association between corporate taxes and the expected costs of financial distress. Specifically, this thesis is further divided into three main chapters to investigate the impact of corporate taxes on both static and dynamic trade-off theory of capital structure, and investment policies in the context of corporate risk-taking.

Chapter two exploits a sizeable and unique corporate tax cut enacted in Thailand in 2012 to empirically explore the tax sensitivity of leverage. While the extant literature points towards insensitivity of leverage to tax cuts, the empirical evidence holds to the contrary. Consistent with the static trade-off theory, I find that firms significantly reduced leverage after the tax cut. The leverage drop is also significant across the maturity structure. When further examining the influence of taxes on leverage across firms with different financial conditions, however, the tax effects of leverage only remain significant in financially unconstrained firms. These findings altogether lend support to the view that taxes and the costs of debt financing are correlated due to the fact that the importance of the expected financially distress cost may not be the same between financially constrained and financially unconstrained firms.

Chapter three further examines the effect of taxes on capital structure adjustment speeds under the dynamic trade-off theory. By exploiting the cross-country variation in tax rates from 31 developed and developing countries in OECD countries, the results show that taxes increase the speed of adjustment toward target capital structure. Also, the effects of taxes on adjustment speeds vary across leverage positions and financial conditions. While under-levered firms adjust their leverage toward the target more quickly when tax rates are high, the effects of taxes disappear in over-levered firms. Moreover, I find that financially constrained firms adjust less quickly when tax rates are high, suggesting that financially constrained firms, which have less ability to access the capital market, face higher adjustment costs due to higher tax rates.

On the other hand, unconstrained firms move toward their target leverage faster in high-tax countries. By accounting for both leverage deviations and financial constraints, the results also indicate that among over-levered firms, the speed of adjustment increases in the tax rate at a greater rate for financially constrained firms than those with less constraints. On other hand, the estimated adjustment speeds increase in the tax rate at a greater rate for financially unconstrained firms than for financially constrained firms when they are under-levered. This implies that the higher tax shield benefits can be substantially larger than the adjustment costs, leading to faster adjustment in under-levered firms although firms become more financially constrained and face higher adjustment costs when taxes are high. Taken together, the resulting evidence empirically confirms the relation between taxes and expected cost of distress found in chapter two even by examining in the dynamic setting.

Lastly, chapter four utilizes the relation between taxes and the expected distress costs in examining how corporate taxes affect corporate risk-taking decisions. Consistent with an implication of the Merton (1974) framework, the findings show that firms take more risk in their investment decisions when tax rates are high. This impels that the loss of equity value due to a higher tax rate gives shareholders the incentive to increase asset risk in order to minimize the would-be value loss of their claims in the firm. Moreover, the tax effects wane for firms with a relatively large borrowing opportunity and this suggests that the risk-taking incentive from tax is moderated by the reputation concern in the debt market, lending support to the Diamond (1989) reputation-building model. The empirical results also show that the tax-induced risk-taking incentive is restrained by creditor rights.

Overall, the empirical evidence found in this thesis reveals an important role of taxes in corporate capital structure decisions and structure of corporate investment decisions Results from all chapters also gives new insight into the role of taxes on the expected cost of distress, which previously assumed to be independent. This thesis makes several contributions to the long-standing unsettled literature in the trade-off theory of capital structure and corporate investment policies, especially in relation with the effects of taxes. The implications of this thesis can be beneficial to policy makers when considering the alteration of tax rates, as it will affect both corporate financial and investment decisions.

CHAPTER 2

CORPORATE TAXES AND FINANCIAL POLICIES

2.1. Introduction

After the seminal work of Modigliani and Miller (1958), corporate capital structure decisions have been one of the most important research areas in corporate finance, and have received a substantial attention from researchers and policy makers. Over the past 50 years, there is a huge volume of literature examining potential determinants of corporate capital structure. Among these factors, taxes are probably the most debated.

In the study of capital structure decisions, the benefits of corporate taxes from tax-deductibility of interest give shareholders an incentive to increase debt financing. On the other hand, the cost of debt financing generally referred as the direct bankruptcy cost (Pulvino, 1998) and the agency costs of debt financing (Jensen & Meckling, 1976; Myers, 1977; Titman, 1984).[1] The optimal capital structure can then be determined by balancing the tax-shield benefit against the expected costs of distress (Kraus & Litzenberger, 1973). This is commonly referred to as the static trade-off theory of capital structure. In this setting, therefore, it is obvious that corporate tax rates and debt financing are positively correlated, other things constant. Although recent theoretical literature (see, for example, An, 2012; Doidge & Dyck, 2015; Heider & Ljungqvist, 2015) has shown that taxes play a central role in determining the capital structure, the

[1] Within this large body of research, there are two other strands in this field that provided the groundwork for the capital structure theory which are pecking order (Myers, 1977; Myers & Majluf, 1984) and market timing theory (Baker & Wurgler, 2002; Fischer, Heinkel, & Zechner, 1989).

empirical evidence to support such a claim and of how it influences the capital structure remains inconclusive.[2]

The static trade-off theory describes that firms make a trade-off between the marginal tax-shield benefit and the marginal expected distress cost in a setting where the cost is independent of the benefit. In other words, the expected cost of financial distress is implicitly assumed to be independent of changes in corporate tax rates. Unfortunately, such an assumption may not be true. As the corporate tax rate rises, the market value of a firm declines, making it become more financially constrained. The expected financial distress costs increase. Consequently, debt financing becomes less attractive. Though this tax effect on the cost of debt financing is intuitive, it has been largely neglected in the literature.

This chapter, therefore, seeks to extend the unsettled strand of literature on the static trade-off theory of capital structure by proposing a possible correlation between corporate taxes and the costs of debt financing. Not only does corporate taxation have an impact on the tax shield benefits, but taxes also influence the costs of debt financing through the expected financial distress costs.

This study empirically explores the effects of taxes by exploiting the unique setting of Thailand's corporate tax cut in 2012 as a natural experiment. The reason to study the change in Thailand tax policy is fourfold. First, the new tax policy was enacted without concurrent policy changes. Thus, confounding events are unlikely to be of

[2] Graham (2008) and Graham and Leary (2011) provide excellent reviews on how taxes affect corporate capital structure decisions. However, they also point out that the findings on the correlation between corporate capital structure and taxes remain mixed, and investigating on whether tax effects are economically important still needed.

concern. Second, unlike relatively small tax changes analyzed in prior work, the corporate tax cut in Thailand is sizeable. Third, not only is a corporate tax cut in Thailand applied to a specific industry as in other studies (see, for example, An, 2012; Doidge & Dyck, 2015) the new tax policy was implemented on all firms in the economy. As a result, it allows us to examine the impact of taxes across different types of firms. Last and more importantly, the tax reforms in other countries occur in one step, and then last for several years, resulting in the lack of variation in tax rates to explore their effects. In contrast, the tax cut in Thailand became effective in two steps for two consecutive financial years. This multi-step tax cut in Thailand provides an interesting platform, and enough variation in tax rates to explore the tax sensitivity of leverage. As suggested by Gordon and Lee (2001, p. 195), "To test for the effects of taxes on firms' financial policy, one needs sufficient variation in tax incentives either over time or across firms."

To examine the possible relation between taxes and the expected distress cost, I compare the impact of the tax cut on leverage decisions of both financially constrained and unconstrained firms. Given that the ability to borrow varies across financial conditions, the change in tax rates may affect these two types of firms differently. Specifically, with a tax cut, debt financing becomes less attractive due to the lower tax shield benefits. In this case, both financially constrained and unconstrained firms receive less additional tax shield benefits from the additional use of debt. On the other hand, the tax cut increases the market value of a firm by leaving more cash in the firm, resulting in an improvement of its financial condition, other things being constant. An increase in profitability, and hence the market value, reduces the probability of financially distress which basically implies the lower cost of debt financing (i.e., lower expected distress cost). The simultaneous changes on the tax-shield benefit and expected distress cost imply three possible consequences on leverage adjustment. If a tax cut leads to a decline in the tax-shield benefit by a greater (smaller, the same) margin than the simultaneous decrease in the expected distress cost, the post-cut leverage should be lower (higher, the same) than before the cut.

Consistent with the static trade-off implication, I find a strong evidence that firms significantly reduce leverage following the cut enactment. The analysis further reveals that firms reduce not only their short-term debt, but also long-term debt even though the tax cut was effective only temporarily. This indicates that leverage decreases across the maturity structure when a tax cut is sizeable. The results also suggest that the post-cut leverage drops are unlikely to be driven by rises in the equity market, and hence the market value of equity, during the sample period.

However, when further examining the influence of taxes on leverage across firms with different financial conditions, the tax effects of leverage only remain significant in financially unconstrained firms. For the financially constrained firms, on the other hand, I find no evidence to support the leverage drops after the tax cut. The results are robust to the use of alternative identification of financially constrained firms, and alternative methods in estimating the effects of the tax cut. These findings altogether lend support to the view that taxes and the costs of debt financing are correlated due to the fact that the importance of the expected financially distress cost may not be the same between financially constrained and unconstrained firms.

This chapter makes several contributions to the long-standing unsettled literature in the trade-off theory of capital structure. First, in line with the static trade-off theory, I provide fresh evidence on the impact of corporate tax cut on leverage. While Heider and Ljungqvist (2015) find that leverage responds only to the tax increases and not the cuts, the evidence of leverage drop in this chapter stands in sharp contrast to the dominance of shareholders' disincentive to reduce leverage in response to small tax cuts, and is comparable in magnitude to the leverage increases reported in prior studies of a large tax increase (e.g., Doidge & Dyck, 2015). Second, the finding gives new insight into the role of taxes on the expected cost of distress, which previously assumed to be independent. In sum, the results provide a better understanding of to the long-standing puzzle of the taxes effect of leverage found previously.

The remainder of this chapter is organized as follows. In the next section, I review related literature on the static trade-off theory and corporate taxes. In section 2.3, I develop the main hypothesis. Section 2.4 describes the background of corporate tax cut in Thailand, and the data set and empirical methodology. The empirical results on the response of leverage to the tax cut are discussed in Section 2.5. Section 2.6 provides the robustness check, and Section 2.7 concludes the chapter.

2.2 Literature review

2.2.1 Related literature on the static trade-off theory

Literature has been trying to address one central issue in corporate finance, namely the determinants of the firm's optimal capital structure. In a frictionless capital market, as report in the seminal work of Modigliani and Miller (1958), capital structure is irrelevant to the value of firms. Since then, economists and finance scholars have focused on the consequences of relaxing the assumptions of a frictionless capital market. Modigliani and Miller (1963) extend the original paper in 1958, by incorporating corporate income taxes, and show that the interest on debt financing is a tax-deductible expense that served to shield earnings from taxes, so called “tax shield benefit of debt”. As a result, the firm’s capital structure is relevant to the value of firms, since the tax shield benefit adds additional value to firms when debt is employed. Kraus and Litzenberger (1973) examine bankruptcy and costs of financial distress, and proposed a leading theory of capital structure that includes both the tax shield benefit and the costs of financial distress resulting from the debt financing. The theory of capital structure in this setting is known as “static trade-off theory” of capital structure, which suggests that firms will borrow until the point where the benefit from an additional dollar from debt financing (marginal tax-shield benefit) is balanced by an increased probability of financial distress (marginal cost of debt financing), and firms are always operated at the target leverage or immediately adjust toward their optimum whenever they deviate from it since the adjustment costs are assumed to be zero. In other words, “A firm is said to follow the static trade-off theory if the firm’s leverage is determined by a single period trade-off between the tax benefits of debt and the deadweight costs of bankruptcy” (Frank & Goyal, 2008, p. 142). Miller (1977) extends the trade-off theory by introducing personal taxes into the model. He shows that the value of corporate income tax benefits can be offset by the personal tax disadvantage of debt due to the low effective rate on capital gain. DeAngelo and Masulis (1980) incorporate the impact of corporate taxes, personal taxes, and non-debt tax shields into Miller model. They argue that a firm with large non-debt tax shields is likely to employ less debt financing since non-debt tax shields can be substituted for the benefits of tax shields from using debt.

While tax-deductible interest payments encourage firms to finance themselves with debt, it has been well established in the literature that the cost of debt financing includes financial distress and direct bankruptcy cost of debt, and the agency cost of debt[3] are important for firms in order to determine their capital structure. Specifically, financial distress refers to a condition in which firms may face difficulty in repaying the interest or cannot meet their financial obligation to the creditors. If financial distress cannot be solved or mitigated over the short period of time, it can lead to bankruptcy. When firms are in financial distress, they usually associated with some costs known as the costs of financial distress. These costs may occur even firms are not filed for bankruptcy, for example, the decrease in the market value and loss of reputation from their customers (Opler & Titman, 1994).

As for the agency costs of debt, these costs are borne by the conflict of interest between the firm's shareholders and bondholders (Jensen & Meckling, 1976).[4] In general, the agency cost of debt occurs when the management has incentives to act in the best interest of the shareholders (or to act counter to the bondholders) to increase the shareholder's wealth. Managers could take on a riskier project that benefits the shareholders, and such an increase in risk in turn leads to greater default risk facing bondholders thereby weakening their fixed claims in the firm. However, in contrast with the value of a tax-shield benefit of debt, financial distress costs and agency cost are more difficult to be estimated as these costs are not observable, making it impossible

[3] However, as suggested in Jensen and Meckling (1976) and (Jensen, 1986), debt financing also can be used to alleviate the conflicts of interest between shareholders and managers through the reduction in agency costs of free cash flows.
[4] The agency costs of debt can be referred to the costs borne by shareholders and bondholders due to the differences in their interest in the firm, and also the cost on several methods that shareholders use to align the management goals with the goals of bondholder. For example, the monitoring cost, higher interest rate, and some restrictions impose on the debt contract.

to directly measure the relation between these costs of leverage and firm performance (Berger & Bonaccorsi di Patti, 2006; Graham, 2000). Overall, the static trade-off theory suggests that taxes increase benefit of debt due to the interest deductibility so that the tax shield benefit encourages firms to rely more on leverage. In the presence of capital market frictions, tax benefit of debt can be offset by the expected cost of financial distress. Therefore, an optimal capital structure under the static trade-off theory is based on the trade-off between the benefit and cost of using debt financing against equity.

2.2.2 Empirical evidence on the effects of taxes on the static trade-off theory

Although the predictive power of the trade-off theory has been long investigated both theoretically and empirically in the literature, the empirical evidence to support the prediction of the model remains debatable (Frank & Goyal, 2009).

In an early study of the trade-off theory, Miller (1977) reports that tax savings seem large and significant on the firm's financing decisions while only minor effect of the deadweight bankruptcy costs are found, suggesting that most of the firms should rely heavily upon debt financing, at least more than they really are. Moreover, if the trade-off theory is a leading theory that can explain the behavior of the corporate borrowing decisions, the previous empirical works should have found significant effect of taxes in determining corporate capital structure. Therefore, as suggested in Myers (1984), the trade-off theory may not sufficient to explain the existing evidence. Later, Mackie-Mason (1990) and Givoly, Hayn, Ofer, and Sarig (1992) exploit the Tax Reform Act of 1986 (TRA) in the United States, and find an evidence to support the prediction of the static trade-off theory by showing that tax-paying firms are more likely to finance themselves with debt. However, due to other several changes in tax rules and also the lack of the variations in tax rates across firms and time, the authors suggest that the impact of corporate tax rates on the firm leverage can be difficult to detect. Consequently, tax shield benefit may have very little effect on leverage. Huang and Ritter (2009) report that firms tend to rely more on debt financing when the corporate tax rates are higher, however, the relation is not statistically significant. The authors also suggest that corporate tax rates have only a secondary effect on firm's capital structure, which is inconsistent with the static trade-off theory that considers taxes as a major factor in financing decisions.

Recent studies have made a good progress in finding the evidence to support the trade-off theory by providing new evidence from a natural quasi-experiment. However, the extant insights mainly focus on a tax increase. For example, An (2012) shows that the China's new corporate income tax law, which removed the preferential tax treatments offered to foreign investment enterprises (FIEs), significantly increase leverage of FIEs. Doidge and Dyck (2015), by exploiting the Canadian tax fairness plan in 2006 as a shock to the market, report that the tax reform increases the benefits of debt tax shield, and therefore income trust which get affected by this policy responded by increasing their leverage. They find that, on average, the prospective tax shields increase the value of firms by 4.6%, and conclude that firm leverage could be affected by the changes in corporate tax policies. Not only focusing on a tax increase, recent literature finds that leverage responds only to the tax increases. Examining relatively small tax changes, Heider and Ljungqvist (2015) report that leverage responds only to the tax increases and not the cuts. Moreover, they also point out that "In particular, whether firms would respond to the drastic cuts in federal corporate income tax rates that some policy makers are currently debating is an open question" (Heider & Ljungqvist, 2015, p. 708).

For the cross-country analysis, Booth, Aivazian, Demirguc-Kunt, and Maksimovic (2001) examine leverage of firms in 10 developing countries, and find no evidence on the relation between debt ratios and tax rates. Antoniou, Guney, and Paudyal (2009) examine the determinants of corporate capital structure in the G-5 countries, and report that the effect of corporate tax rates on the firm's leverage is not clear and remains as puzzle. More specifically, they find an inverse relationship between tax rates and firm leverage, which is inconsistent with the prediction of the static trade-off theory. In contrast, Fan, Titman, and Twite (2011) point out that firms use more debt in a country with higher tax shield benefit. The authors also comment that the difference in results may arise because of the differences in both the sample countries and sample periods.[5]

2.2.3 Empirical challenges in examining the tax effects on leverage decisions

Although the above literature finds some evidence to support the predictions under the static trade-off theory that taxes and leverage are positively correlated, the existing evidence may not be as strong as it looks since the statistical results that are consistent with the trade-off theory can also be consistent with other theories such as the pecking order, and the market timing theory (Baker & Wurgler, 2002; Fischer et al., 1989). Thus, ability to predict and explain actual outcomes under the trade-off theory is still on debating among financial researchers.[6]

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[5] They show that taxes are significant only in the sample of developed economies and only in the later time period.

[6] For an insightful review, please see Graham (2008) and Fama (2011).

To study the relation between corporate taxes and capital structure decisions, and hence, others determinants of the trade-off theory, literature has examined both time-series and cross-sectional data by using indirect measures of tax status and the potential costs of financial distress.[7] Although the cross-sectional test seems appropriate for the study of the tax effects under the trade-off theory, one major problem found in previous literature that makes the effects of taxes are difficult to document is the insufficient variation in corporate tax rates either across firms and time. Due to the lack of tax variations, empirical results may not be economically significant, and possibly open to multiple interpretations other than the tax effects. Without a sizable and a clear-cut change in tax policy, it is also difficult to investigate the impact of taxes on the corporate policies. As suggested in Graham (2003), an unambiguous change in tax policy should offers significant potential to separate tax from nontax interpretations.

Moreover, the results from the above studies remain inconclusive and may vary due to the possible empirical issues, namely the nature of the indicator used to measure the impact of taxation, for example, effective tax rate, marginal tax rate, corporate statutory tax rate, and the Miller index.[8] Rajan and Zingales (1995) use the sample of firms in the G-7 countries to examine the explanatory power of taxation on leverage. They uncover that the result is strongly aligned with the presumptions made over the rate of the marginal investor tax rate, regardless of whether the tax rate is high or low. de Jong, Kabir, and Nguyen (2008) examine the effective tax rate (amount of tax payment over pre-tax income) instead of absolute tax rate and discover that there is no

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[7] Please see, for example, Auerbach (1985), Long and Maltiz (1985), Titman and Wessels (1988), and Fischer et al. (1989).
[8] This is an index which includes, in addition to the corporate tax rate, also the personal tax on interests and dividends.

significant relationship between the effective tax rate and the leverage among the sample firms from 42 countries. Fan et al. (2011) extend the study by including the impacts of institutional factors. The author examines firm leverage from 39 countries and concluded that taxation, if measured by using Miller Index, has a positive relationship with the leverage of the firms in developed countries, whereas this relationship does not exist in the developing countries.

Meanwhile, most of the existing empirical studies were conducted in the United States, where majority of the firms in the sample were facing the top tier of corporate tax rate. Consequently, the cross-sectional variations in the firms' tax incentives discovered by those studies were due to the variation in corporate income rather than the adjustment in tax rate. Such limitation in the sample has led to "spurious results" in their findings (Gordon, 2010).

As for the time-series evidence, while it could be used to test the importance of taxes, literature shows that it may not be sufficient to estimate the tax effects due to the lack of variation in identifying the effects of taxes on corporate capital structure decisions. As suggested in Gordon (2010), tax incentives are likely to be stable over time, especially for large firms.

Moreover, several factors that related to corporate capital structure decisions also change over time so that they could contaminate the tax effects. For example, Taggart (1985) studies the variation in the firm's capital structure in the U.S. corporations over almost 50 years between 1926 to 1979, and find that corporate debt ratios were relatively high even before the introduction of corporate taxes. This finding stands in marked contrast to the prediction under the static trade-off theory that consider only on taxes. One possible explanation is that the equity finance was much more difficult to access than it is in later years. Due to the variation in the financial markets that is likely to be difficult to control, the author suggests that it could be difficult to estimate the effects of taxes by making use of the time-series data. Recently, by using panel data, however, a few papers can identify the importance of taxes by examining the effects of changes in statutory tax rates, and conclude that taxes play a significant role on corporate use of debt (see, for example, Doidge & Dyck, 2015). Therefore, using the sizeable tax cut in Thailand as an empirical setup on testing the tax effects would overcome the problem suggested in the literature.

2.3 Institutional background and hypothesis development

2.3.1 The 2012 corporate tax reform in Thailand: An overview

To increase a country's ability in attracting foreign direct investment and in anticipation of the launch of the ASEAN Economic Community, on 14 December 2011, the Thai government enacted in two steps a country-wide corporate income tax cut of 10% in aggregate: first, a reduction from 30% to 23% for the tax year beginning on or after January 1, 2012, and second, a further reduction to 20% for tax years beginning on or after 1 January 2013 and onwards. At the enactment, it was stipulated that the tax rate would rise back to 30% after 2013. Due to the short period of policy discussion, therefore, the announcement came largely as a surprise to the market so that we can treat it as an exogenous event. However, the new tax policy was announced in November 2012 that the 20% rate was to remain effective for 2014, and in November 2014 that the rate was to remain effective for 2015. In October 2015, the government announced that the tax rate is to remain at 20% permanently from 2016 onwards.

The Thai government, at first, does not permanently cut the corporate income tax rates to 20% due to some legal restrictions according to the Thai constitution. Instead the Thai government has a three-year window of opportunity, from the period between 2012 to 2014, to reconsider the permanent reduction in the corporate income tax rates and other policies to support the transition to the AEC in 2016.

Although there is speculation that the tax rate could be risen back to 30% in 2015, when the policies that guarantees lower tax rates expires. Most people remain optimistic that the lower tax rate would be maintained as the appropriate legislation will be enacted prior to the formation of AEC.

In early 2012, the Federation of Accounting Professions (FAP) had announced that starting from accounting year 2013 and onwards, the corporate tax rate of 20% would be applied as the expected tax rate for all computations within FAP. Even though the adjustments in tax rates had not been officially confirmed, FAP had confidence that the new rate would become substantive as it would bring long-term benefits to capital and business investment in Thailand. The announcement by FAP sent a clear signal to firms and led to most of the firms expecting a permanent reduction in corporate tax rate prior to the official announcement in 2015.

2.3.2 Related literature and hypothesis development

According to the static trade-off theory, the value of a levered firm is a combination of the value of an unlevered firm, the tax shield benefit and the costs of debt financing, which can be written as follows:

$$V_L = V_U + PV\ (B(\tau_C, L)) - PV(C(L)) \tag{1}$$

where V_L is the value of a levered firm, V_U is the value of an unlevered firm, B is interest tax shield, τ_C is a corporate tax rate, L is firm leverage, C is the expected financial distress cost, and $PV(.)$ is the present value function. The second term on the right-hand side of equation (1) represents the tax shield benefit, which can be estimated as the product of corporate tax rate and the market value of debt. As in Kraus and Litzenberger (1973), the last term of equation (1) represents the expected distress cost, which is the product of probability of distress and the distress cost.[9] The value of levered firms then can be maximized by choosing the unique optimal leverage, L^*, that can be obtained by balancing the additional benefit of debt with its cost, or where

$$PV\left(\frac{\partial B(\tau_C, L^*)}{\partial L}\right) = PV\left(\frac{\partial C(L^*)}{\partial L}\right). \tag{2}$$

In other words, the static trade-off theory states that a firm would borrow up to the point where the present value of interest tax shields and the present value of costs of financial distress are equal at the margin.

[9] For example, distress costs may include the cost of filing for bankruptcy, bankruptcy proceeding fees, and other administrative costs associated with closing out a business (see, for example, Andrade & Kaplan, 1998).

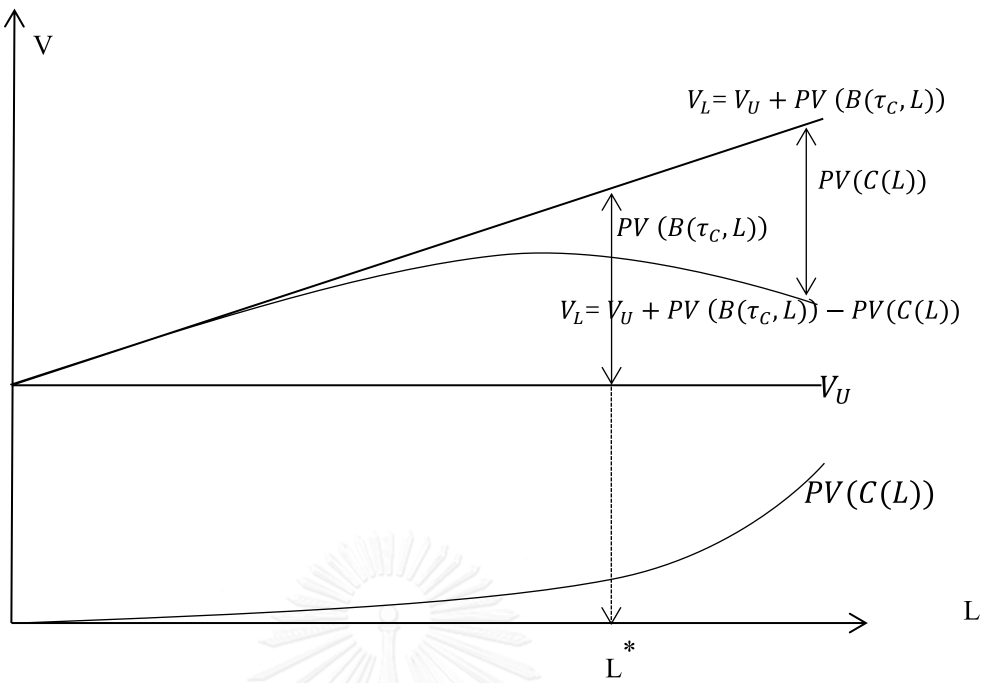

Figure 1 Trade-off theory of capital strucutre

In Figure 1, tax effects and costs of distress on the value of a levered firm are presented. The diagonal straight line describes the value of a levered firm by assuming there is no distress costs. The upside down U-shaped curve illustrates the value of a levered firm accounting the expected distress costs. This curve increases once a firm further deviate from zero leverage by using more debt financing. Here, the present value of costs of distress still relatively low due to low probability of distress. As a firm employ more debt financing, however, the present value of distress costs increases at an increasing rate (Lemmon, Liu, Mao, & Nini, 2014) as shown in the bottom line of the graph.

As shown in Figure 1, as a firm employs more and more debt financing, the increase $PV(C(L))$ from an extra debt financing will be balanced by the increase in $PV\ (B(\tau_C, L))$. Hence, the value of a firm will be maximized at this optimal level of debt financing, at L^*. Hence, costs of distress rise faster than the benefits of debt tax shield as a firm further deviate from point of L^* to the right, resulting in a reduction in firm value from employing more debt.

As can be implied from equation (1) and (2), corporate taxation is directly related to the tax shield benefit and hence to the firm's capital structure decisions. Intuitively, the tax benefit of debt financing increases with tax rates and adds value to firms, other things being equal. Accordingly, the static trade-off theory predicts that the higher the corporate tax rates, τ_C, the higher the tax shield benefit, and therefore the more debt firms employ, vice versa. The existing literature seems to support this claim by showing that the interest tax shields appear to have a significant impact on the value of firms and also on their financing decisions as shown in the previous section (An, 2012; Doidge & Dyck, 2015; Graham, 2000; Mackie-Mason, 1990). However, while the interest tax shield benefit is considered to be a major factor on corporate capital structure, how corporate taxation contributes to firm value and the firm's borrowing decisions are still inconclusive and remain open (Fama, 2011; Fama & French, 1998; Shyam-Sunder & C. Myers, 1999). Despite the substantial tax benefits on debt financing, as in equation (1), leverage seems to be the only determinant in explaining costs of financial distress. That is, the positive relation between corporate debt ratios and expected financial distress costs (through the change in the probability of financial distress) as shown in Figure 1has been accepted as a stylized fact in the previous studies (Andrade & Kaplan, 1998; Opler & Titman, 1994).[10]

[10] For example, as in Andrade and Kaplan (1998), firm leverage and its cost of distress are assumed to be closely connected. By investigating a sample of 31 companies that became distressed, they conclude that a high leverage is the primary cause of distress.

In order to determine the present value of expected financial distress, literature shows that there are three key factors that should be considered. First, the probability of financial distress, which is increasing with leverage and the firm's asset volatility. Second, the magnitude of costs after a firm is in distress. These costs vary across industry (Andrade & Kaplan, 1998; Opler & Titman, 1994).[11] Lastly, the discount rate for the distress costs which depends on the firm's market risk (Almeida & Philippon, 2007).

Among these factors, holding liquid assets is believed to be highly correlated with the probability of financial distress, especially in short-term. Liquid assets are usually considered as safe-guard against the financial distress: by holding a larger amount of liquid assets, it allows firms to reduce the cost of financing during a financial distress. For example, when facing the financial distress, firms without liquid assets must find other sources of fund which would incur much higher costs (Mikkelson & Partch, 2003); or they might be forced to sell their operating assets to cover the liabilities, which is highly unfavorable (Shleifer & Vishny, 1992).

Cash, the most liquid asset, is obviously known to be closely related to the corporate tax rates, in terms of the after-tax cash flow of firms. That is, the higher tax rates would reduce the after-tax profit of the firms, and hence, their market value, other thing constant. Consequently, the probability of distress and the expected costs of

[11] For instance, while firms in the technology sector are more likely to have high financial distress costs due to the potential loss of customers and a lack of tangible assets that can be easily liquidated, firms in the real estate sector are more likely to have low costs of financial distress since the majority of their assets can be sold relatively easily.

distress increase. This in turn implies that corporate taxes should influence the distress probability and distress cost.

Although the effects of taxes on the expected costs of distress make theoretical sense since taxes can directly affect the firm's net profit and market value, it has been previously ignored in the literature. Even if in the recent model analyzed in Lin and Flannery (2013) and the recent empirical study from Doidge and Dyck (2015) and Heider and Ljungqvist (2015), corporate taxation has been modelled as being an independent determinant (i.e., having no relation to) of the expected bankruptcy cost and financial distress.[12] This might not be the case since corporate taxes also affect these costs through the change in the firm's market value by leaving more or less cash in firms. Considering the direct effect of corporate taxes on the after-tax cash flow, it is intuitive to expect a relation between corporate taxes and expected distress cost. This chapter investigates this relation.

In this chapter, I examine the possible relation between corporate taxes and expected distress cost by allowing the effects of taxes to enter into the static trade-off model owing to the change in probability of distress due to the change in profits after taxes, as the consequences of the change in tax rates. The main purpose of this study,

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[12] Lin and Flannery (2013) show that the value of levered firms is

$$V_L = V_U + \left[1 - \frac{(1-\tau_C)(1-\tau_{PS})}{1-\tau_{PB}}\right] D - \frac{B*C\left(\frac{rD}{B}\right)}{(1-\tau_{PB})r} \qquad (3)$$

where τ_{PB} is the personal tax rate on interest income is, τ_C is the corporate tax rate, and τ_{PS} is the personal tax rate on equity income, $V_L$is the value of levered firm, $V_U$is the value of unlevered firms, $\left[1 - \frac{(1-\tau_C)(1-\tau_{PS})}{1-\tau_{PB}}\right] D$ is the present value of the firm's tax benefit of outstanding debt D (Miller, 1977), $\frac{B*C(\frac{rD}{B})}{(1-\tau_{PB})r}$ is the present value of annual cost of debt financing, r is interest rate, C is the annual cost of debt financing per unit of book assets and, B is the book value of assets.

however, is not to understand the measures the costs of financial distress or provide any estimation of the distress cost and tax shield benefits. This study seeks to examine the possible relation between taxes and the expected distress cost, and whether and how it affects the firm's capital structure decisions. Thus, instead of estimating the amount of tax effects on distress cost, this study then examines the net effect of taxes on the firm's borrowing decision, by allowing the corporate tax to affect the distress cost as well as tax benefit.

Although the change in corporate tax rates may also affect the value of unlevered firms, V_U, through the change in after-tax profits, this will not change the main analysis in this chapter that examine the effect of taxes on corporate incentive to use debt financing.[13] To be more specific, equation (1) from the static trade-off theory explains the relation between corporate taxes and debt financing by already taking into account the change in V_U due to tax rates. For example, with a higher tax rate, V_U will be lower due to the reduction in the after-tax profit. On the other hand, interest tax shield benefits (the second term in the right-hand side of the equation (1)) will also be higher. In this case, firms may find it more attractive to increase their debt financing to compensate the drop of V_L from the reduction of V_U. Hence, leverage increases due to a higher tax rate. Moreover, as can be seen in equation (2), the unique optimal leverage can be obtained by balancing the additional benefit of debt with its cost without V_U. Hence, the change in V_U due to taxes will not affect the prediction of the positive relation between corporate taxes and debt financing under the static trade-off theory.

[13] As suggested in Modigliani and Miller (1958), the value of unlevered firms can be written as $V_U = \frac{E(EBIT)(1-\tau_C)}{\rho}$, where $E(EBIT)$ is the expected perpetual earnings before interest and taxes, and ρ is the discount rate for an all-equity firm of equivalent risk.

However, the change in after-tax profits, and hence V_U, will be resulted in the expected financial distress cost that may vary across firm types (which will be explained in the next section). Therefore, there is an intuitive reason to believe that the changes in leverage may not be the same between firms due to the difference in effects of taxes on the expected distress costs, not because of the change in V_U.

To this extent, corporate taxation is expected to have a positive relation with the expected financial distress costs. That is, a higher tax rate would reduce the after-tax profit of firms, and hence increase the distress probability and expected distress costs. Therefore, corporate taxes may not only have a positive effect on the tax shield benefit as predicted in the trade-off theory, but it would also result in the expected distress costs as well. Consequently, any change in the tax advantage of debt financing can be occurred with a simultaneous change in probability of distress and also expected distress costs of firms. As a result, firms may need to incorporate the opposing effects of tax benefit when considering on their borrowing decisions.

2.3.3 The 2012 corporate tax reform in Thailand and capital structure decisions: Evidence from listed companies in Thailand

To examine the effects of corporate taxes on the corporate capital structure decisions, this study exploits the 2012 corporate tax cut in Thailand as a natural experimental lab, due to its advantage characteristics as mentioned in earlier.

The corporate tax cut reduces the tax shield benefit due to less interest deductions. Debt financing now becomes less attractive, and firms should be better off relying more on equity financing. Accordingly, the static trade-off theory predicts that firms should employ less debt financing (borrow less) after the tax cut. However, with a tax cut, firms also pay less taxes so that their net profit increases, other thing being constant. Consequently, firms may find it easier to pay interest payments on debt, and reinvest in profitable projects that would otherwise be foregone. In other words, an increasing of the after-tax cash flow from the tax cut would provide more financial flexibility in firms, increase their borrowing capacity and hence the market value since the creditors will consider them as in a better financial position. Thus, the distress probability and distress cost are expected to be lower after the tax cut.

Assuming that firms are rational, they would borrow more, once their borrowing capacity has been enhanced. To this extent, firms may not respond to the tax cut by lowering their leverage as predicted from the static trade-off theory. However, the leverage after the tax cut can be the same or even higher than before the new policy became effective. If this proves to be the case, this argument can be viewed as a plausible explanation to the capital structure puzzle that has been found in the literature.

More importantly, although larger cash holdings (due to tax cut) should reduce default probability of firms over the short horizon (Acharya, Davydenko, & Strebulaev, 2012), the net effect on leverage behavior would be different across firm types. Unlike the tax changes studied in the previous literature, the corporate tax cut in Thailand affects the entire universe of listed companies in an economy. This unique feature allows me to test for importance of corporate taxes on leverage decisions across different firm types, namely financially constrained and unconstrained firms.

According to (Acharya, Almeida, & Campello, 2007), cash can be more than just a negative debt for a financially constrained firm. That is, as suggested in (Acharya et al., 2007, p. 517), “because cash balances transfer resources into low cash flow states, a financially constrained firm will prefer saving cash (as opposed to reducing debt) if investment opportunities tend to arrive in low cash flow states." Therefore, there should exist a positive relation between cash flows and debt financing in financially constrained, especially constrained firms with high hedging needs since constrained firms are more likely to have better borrowing capacity with higher cash flows. Consequently, financially constrained firms can borrow more and be able to use extra cash balances in the next period. However, this relation may not hold in the unconstrained firms. Thus, the net benefit of corporate tax cut would be significantly different between firm types due to their financial conditions since the value of cash is higher in the constrained firms.

Specifically, according to Opler and Titman (1994), financial distress can be defined as the situation where companies face severe difficulties with the financial commitments to creditors or when companies can no longer meet the financial obligations to their creditors. Wruck (1990) and Andrade and Kaplan (1998) also explain situation of financial distress as when earnings before interests, taxes, and amortizations (EBITDA) are smaller than financial expenses.

Although the cost of distress affects the value of firms according to equation (1), however, these costs are not easy to be estimated. As such, literature has differentiated financial distress costs into direct and indirect costs (Kim, 1978). The direct costs of financial distress are defined as the fees that firms pay to their financial advisors and lawyers, filing fees, and transactional costs in general. According to the previous studies, the direct costs are estimated to be 2% to 6% of firm value.[14]

In contrast with the direct costs, indirect financial distress costs are generally considered as opportunity costs because these costs (e.g., loss of market share and inefficient asset sales) cannot be directly observed from the market (Warner, 1977). However, indirect costs have been shown to be significant or at least dominate the direct costs. For example, Andrade and Kaplan (1998) report that indirect costs, which can be estimate by the losses in value of the order, are around 10% to 23% of firm value at the time of distress. However, the authors also suggest that distress costs are probably small from an ex-ante perspective, especially in comparison to the potential tax benefits of debt.[15]

While a large number of literature has been devoted on examining the nature of distress costs, whether and to what extent these costs are large enough to affect capital structure decisions remain debatable. In other words, there is another strand of literature trying to examine whether distress costs are generally large enough to make the tradeoff theory works (Jensen & Meckling, 1976; Myers, 1977). Thus, the importance of financial distress costs in explaining the trade-off theory has often been criticized in the capital structure puzzle (Bradley, Jarrell, & Kim, 1984; Myers, 1984), and hence the empirical research on financial distress remains disconnected from its theory.

[14] For example, Warner (1977) reports that the direct costs of financial distress are estimated to be 5.7% of the firm's market value. van Binsbergen, Graham, and Yang (2010) also examine the direct financial distress costs, and report that these costs are around 2% to 4% of the firm's value.
[15] See, for example, Opler and Titman (1994) and Andrade and Kaplan (1998) for more details on empirical evidence of financial distress costs.

Campbell, Hilscher, and Szilagyi (2011) also examine the failure of corporations by utilizing the measures from market and balance sheet of firms to estimate the corporate possibility of financial distress. Their study shows an improvement in the predicting power against previous literature (Altman, 1968; Bharath & Shumway, 2008). They show that the firm’s cash holding is significantly and negatively relate to probability of financial distress. Moreover, a higher cash (liquid assets) in hand can be used to invest in the positive NPV projects and improve the quality of the collaterals, resulting in a lower marginal cost of debt financing (van Binsbergen et al., 2010).

Furthermore, cash, which can be considered as the most liquid asset, is obviously known to be closely related to the corporate tax rate, in term of the after-tax cash flow of firms. To be more specific, the after-tax cash flow from operations is the money that a company generates from its core business operations after paying all of its operating expenses and income taxes. If the firm can ensure their creditors that those assets will be retained, higher cash should also increase debt capacity and hence the target debt ratio (Morellec, 2001; Myers & Rajan, 1998; Shleifer & Vishny, 1992). Thus, it is not surprising, and also well established in the above literature that liquid assets, such as cash, would have a negative impact on probability of distress and distress cost.

In addition, it would be more difficult for financially constrained firms to access the capital market to raise external funds than unconstrained firms, due to the limited ability to borrow. Consequently, some profitable investment opportunities would be foregone. With a tax cut, the benefit of an increase in cash holdings is greater for constrained firms as the resulting reduction in the probability of distress is larger. On the other hand, unconstrained firms would gain less net benefit from cash. Although the probability of distress for an unconstrained firm would also be lower, the magnitude of change is less than in the case of constrained firms. In other words, a one-dollar increase of cash for financially constrained firms would be more valuable than for unconstrained firms. With more cash in hand, constrained firms could be able to invest in the forgone profitable projects, and survive a period of tight constraints. Thus, the net benefit of corporate tax cut should vary between these firms due to their financial conditions.

Therefore, by taking into account the firm's financial conditions, I can examine the effects of taxes on the firm's borrowing decisions through the different in the importance cash across different types of firms. More specifically, the reduction in the probability of distress would be comparatively higher in the constrained firm, which receives comparatively higher benefit from the tax cut (due to higher profits). In other words, this study analyzes the impact of corporate taxes on the financially constrained and unconstrained firms, in order to understand how corporate taxation contributes to the cost of financial distress, and thus the firm's financing decisions.

In sum, other things being constant, the tax cut may affect both of the marginal benefit (through the tax-shields) and marginal cost of debt financing (through the expected distress costs). I examine the net effect of taxes on the firm's borrowing capacity after the new policy became effective. If the tax benefit decreases by a larger margin than the drop in distress cost, the firm's borrowing capacity should be lower (less incentive to borrow) after the tax cut. On the other hand, if the reduction in distress cost is large enough to dominate the drop in benefit from tax shields, the firm's borrowing capacity should be higher (more incentive to borrow) after the tax cut. By assuming that firms operate at their optimal and assuming constant marginal tax rate (non-progressive), it implies possible directions of the firm's leverage adjustment as can be shown as in the Figure 2 below.

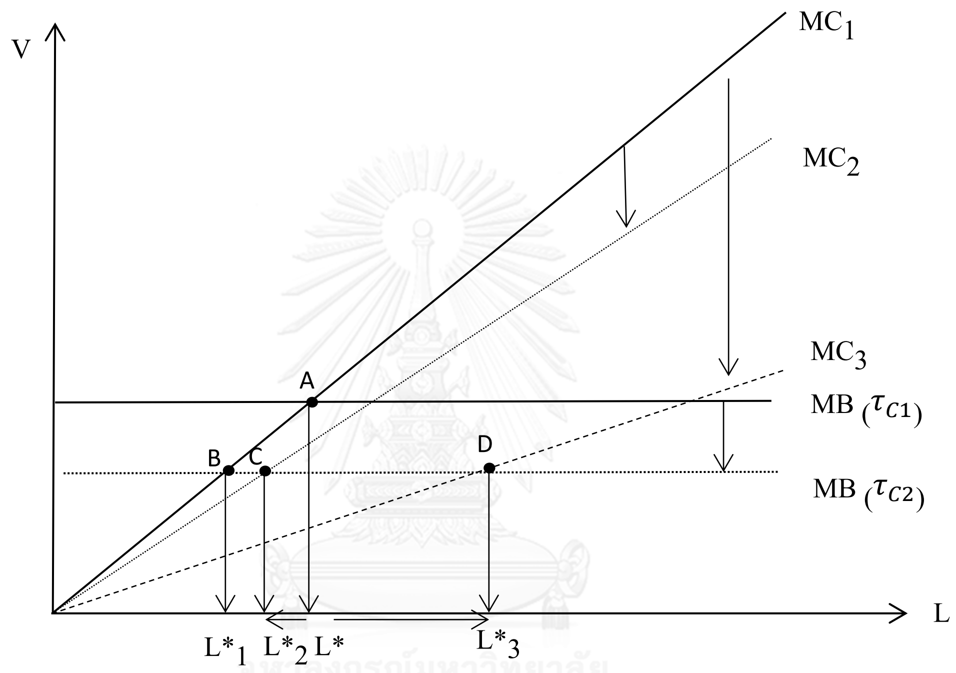

Figure 2 Changes in firm leverage

According to the static trade-off theory, the corporate tax cut from τ_{C1} to τ_{C2} lowers the marginal benefit of debt (tax shield) from MB (τ_{C1}) to MB (τ_{C2}), by holding marginal cost of debt financing constant, since it is independent to taxes. Firms would respond to a tax cut by lowering leverage to L_1* (firms operate at L* before tax cut). However, by allowing the expected distress cost to be endogenous to tax rates, the marginal cost of debt financing (MC) would be simultaneously lower as already discussed. If the negative change in marginal benefit of debt (MB (τ_{C2})) is relatively larger than (dominates) the negative change in cost (MC_2), then firms would respond to the tax cut by lowering the leverage to L_2*, which is similar to the traditional static trade-off prediction since L_2* is less than L* (but still, higher than L_1*). Lastly, if the negative change in expected distress cost (MC_3), is relatively higher than (dominates) the negative change in benefit (MB (τ_{C2})), then firms would respond to the tax cut by increasing the leverage to L_3*, which is higher than L*.

Taken together, under the static trade-off theory that assume the independence between taxes and expected cost of distress, leverage should be lower after the tax cut. However, if corporate taxes affect the expected financial distress cost, therefore, the tax cut reduces both the benefit of debt financing and the expected costs of distress so that the new optimal leverage can be determined by the relative changes in the benefit and cost of debt financing. As for unconstrained firms which has a better capital market access, the loss of the tax shield benefit should be large enough to dominate the reduction in distress cost. Consequently, I hypothesize that *unconstrained firms lower their leverage after the tax cut.* On the other hand, as for constrained firms, the benefit of the reduction in distress cost should be large enough to dominate its effect on the tax shield benefit. Therefore, I hypothesize that *constrained firms increase their leverage after the tax cut.*

2.4 Empirical design

In this section, I present the empirical design and sample used in testing the proposition.

2.4.1 Data and Sample

To examine the impact of the corporate tax cut in Thailand on corporate borrowing decisions, I explore all listed companies in the Stock Exchange of Thailand

(SET) and the Market for Alternative Investment (MAI) during the period beginning in 2007 (five years before the cut came into effect) and ending in 2015.[16] The initial sample shows in total 613 firms. The information of market data and accounting data from the balance sheet are drawn from Thomson Reuters Datastream. Firms with no trading activity or without the reported financial statements during the sample periods are dropped. Also, firms under financial and utility sectors are excluded. In the final sample, 433 unique firms with 3,353 firm-year observations meet these requirements. Lastly, to control for outliers, all firm-level variables are winsorized at the 1% and 99% level.

2.4.2 Leverage, control variables, and descriptive statistics

To study the corporate borrowing decisions, this chapter examines the effects of taxes on the firm leverage as the main dependent variable. Following Rajan and Zingales (1995), I adopt two alternative measures of leverage: first, book debt divided by capital (book debt plus market value of equity); second, book debt divided by the market value of assets (book assets minus book equity plus market value of equity).

In the presence of asymmetric information, moreover, the default risk premium becomes material for long-maturity debt (e.g., Flannery, 1986), implying material tax shields for long-term, rather than short-term, debt. Thus, a tax cut may have a meaningful impact, if any, more on long-term debt. Therefore, I examine the effect of

[16] According to the Stock Exchange of Thailand, "SET provides a market for large companies with more than THB 300 million in paid-up capital after IPO to raise long- term funds. MAI, on the other hand, is a source of funding for small and medium-sized enterprises, having over THB 200 million in paid-up capital after IPO. However, from the viewpoint of firms applying to the Securities Exchange Commission (SEC) for an IPO, there are no regulatory differences." For more details, please see https://www.set.or.th/en/faqs/listing_p1.html#1

taxes across the maturity structure: the short-term debt (debt due within one year to market assets), and also long-term debt (debt due after one year to market assets) ratios.

As reported in Panel A of Table 1, the average total debt to capital ratio significantly drops from 26.96% during the pre-cut period (2007-2011) to 20.46% during the post-cut period (2012-2015). When looking across the maturity structure, the post-cut decline is significant not only for the short-term debt (debt due within one year to market assets), but also long-term debt (debt due after one year to market assets) ratios. As shown in Panel B, the debt to market assets ratios also persistently exhibit a significant post-cut decline. The median results are similar to the results based on mean leverage. The median total debt to capital ratio significantly drops from 21.72% during the pre-cut period (2007-2011) to 14.28% during the post-cut period (2012-2015). The reduction pattern in median also exhibits across maturity structure.

To investigate robustness of the leverage drops observed in Table 1, I employ the following regression framework:

$$Lev_{i,t} = \alpha + \beta Tax_t + \delta Z_{i,t} + \eta_i + \gamma_t + \epsilon_{i,t}. \quad (4)$$

$Lev_{i,t}$ is a leverage ratio for firm i in year t, and Tax is the top country statutory corporate tax rates. According to the static trade-off theory, firms should reduce their leverage following the tax cut, predicting a positive coefficient for Tax. Z is a vector of control variables. Following Faccio and Xu (2015), I include firm fixed effects, η_i, and year fixed effects, γ_t, to eliminate the cross-sectional correlation between taxes and leverage (Flannery & Rangan, 2006; Lemmon, Roberts, & Zender, 2008), and to remove spurious correlation from unobservable variables over time. In all regressions, standard errors are clustered at the firm level (Petersen, 2009).

In this study, the control variables used in the analysis are guided by the extant literature which shows that the choice of corporate capital structure can be influenced by firm and market characteristics. Also, these control variables are known to affect corporate capital structure with the basic similar pattern across countries (Doidge & Dyck, 2015; Faccio & Xu, 2015; Öztekin & Flannery, 2012).

First, I include firm size, which is measured by the natural logarithm of total assets. Firm size is known to increase the leverage of firms since larger firms face lower costs of financial distress as they are typically more diversified, more stable or less volatile cash flows, and hence less likely to go bankrupt (Rajan & Zingales, 1995; Titman & Wessels, 1988). I also control for tangibility measured by the ratio of net fixed assets (net property, plant, and equipment) to total assets. A number of empirical evidence also suggests that the type of the assets that a firm has determines the leverage level, and also affect the cost of debt due to collateral (Klapper, 2008; Rajan & Zingales, 1995). Moreover, the pecking order theory suggests that firms with higher profitability prefer using retained earnings to external finance due to asymmetric information (Myers & Majluf, 1984). Therefore, I control the firm profitability, measured by the ratio of return on assets which is earnings before interest, tax, and depreciation (EBITD), divided by total assets.

As shown in van Binsbergen et al. (2010), market-to-book ratio have an impact on debt financing due to higher demand of borrowing, especially for firms with poor cash flows and liquidity. Hence, I control for that market-to-book ratio. Lastly, I include industry leverage (average of firm leverage in the same Datastream Level-3 industry), and $Lev_{i,t-1}$ (Doidge & Dyck, 2015).

Table 1 Descriptive statistics

This table presents the descriptive statistics of all variable used in the analysis during the period between 2007-2015. The pre-tax cut and post-tax cut are periods during 2007-2011 and 2012-2015 respectively. All variables are defined as in section 2.4. The last column reports the difference in means between the pre- and post-tax cut. Significance of measures is computed using the independent-sample t-test allowing for unequal variances. The Difference in means that are statistically different from pre-tax cut at the 1%, 5%, and 10% significance level are denoted by ***, **, *, respectively.

	Entire period (1)			Before tax cut (2)			After tax cut (3)			(2) vs. (3) (mean)	(2) vs. (3) (median)
	Mean	Median	N	Mean	Median	N	Mean	Median	N		
Panel A											
Panel A1: Debt to capital											
Total debt (%)	23.84	17.41	3,353	26.96	21.72	1,743	20.46	14.28	1,610	-6.50***	-7.44***
Short-term debt (%)	15.24	7.91	3,353	17.40	9.66	1,743	12.89	6.46	1,610	-4.51***	-3.20***
Long-term debt (%)	8.60	1.90	3,353	9.56	2.04	1,743	7.57	1.79	1,610	-1.99***	-0.25
Panel A2: Debt to market assets											
Total debt (%)	20.57	15.13	3,353	22.77	17.47	1,743	18.19	12.85	1,610	-4.58***	-4.62***
Short-term debt (%)	13.04	6.77	3,353	14.48	8.02	1,743	11.49	5.67	1,610	-2.99***	-2.35***
Long-term debt (%)	7.53	1.57	3,353	8.29	1.57	1,743	6.70	1.54	1,610	-1.59***	-0.03
Panel B											
Tax (%)	25.90	30.00	3,353	30.00	30.00	1,743	20.80	20.00	1,610	-9.20***	-10.00***
ln(asset)	14.87	14.63	3,353	14.70	14.49	1,743	15.06	14.81	1,610	0.36***	0.32***
Tangibility	0.36	0.35	3,353	0.37	0.36	1,743	0.35	0.34	1,610	-0.02***	-0.02**
Profitability	0.05	0.05	3,353	0.06	0.06	1,743	0.05	0.05	1,610	-0.01*	-0.01*
Market-to-book	1.76	1.21	3,353	1.40	0.98	1,743	2.15	1.46	1,610	0.75***	0.48***
Industry leverage (%)	23.25	23.73	3,353	23.76	23.86	1,743	22.62	22.76	1,610	-1.13***	-1.11***

Panel B of Table 1 presents distributions of the final sample, and the comparative statistics of means and medians before and after the tax reform for control variables used in the analysis. As noted in Table 1, the variables used in the regression analysis change significantly after the tax cut. Interestingly, in line with Panel A, the mean industry leverage significantly drops around 1.11% after the tax cut. Overall, Table 1 provide an early evidence that corporate taxes and firm leverage are positively correlated supporting the static trade-off theory, and also the tax cut policy plays an important role in leverage adjustment.

2.4.3 Financially constrained firms, financially unconstrained firms, and taxes

To examine the main hypothesis of this study, whether taxes and the expected cost of debt financing are correlated, this study analyzes the impact of corporate taxes on the financially constrained and unconstrained firms. As mentioned in Section 2.3, these two types of firms may respond differently to the changes in tax rate, therefore, I divide the sample into two groups: financially constrained and financially unconstrained firms.

As pointed out by Lamont, Polk, and Saaá-Requejo (2001), financial constraints limit firms from funding investment opportunities due to constraints in credit access, the limited ability to issue equity financing, or illiquidity of assets. The words "financial constraints", however, have to be interpreted carefully since they can be closely related with financial distress and bankruptcy risk. Specifically, when firms are in "a financially constraint" position, they incur an additional cost of debt, namely the debt servicing costs, which arise from the cash drain associated with interest payments under the trade-off theory (Lamont et al., 2001).

Theoretically, financial constraints firms are not directly observable. To identify whether firms are financially constrained, the empirical literature therefore relies on indirect proxies and indices constructed from linear combinations of observable firm characteristics (e.g., Fazzari, Hubbard, & Petersen, 2000; Kaplan & Zingales, 2000; Lamont et al., 2001). Among several measures of financial constraints, the Whited-Wu (WW) developed by Whited and Wu (2006) is probably one of the most recent and popular in the literature (Farre-Mensa & Ljungqvist, 2016).

The WW index is a relative measurement of reliance on external financing, which is based on the coefficients obtained from a structural model. With a large international data set through structural estimations, the WW index has been shown to be a better measure of financial constraints over the investment-cash flow sensitivities or the Kaplan-Zingales index (Kaplan & Zingales, 2000), due to advantages of less serious sample selection and measurement-error problems (Whited & Wu, 2006). As in Whited and Wu (2006), the WW index can be estimated from the linear combinations between several firm characteristics such as cash flow to assets, a dummy capturing whether the firm pays a dividend (negative), long-term debt to total assets, size, sales growth, and industry sales growth.[17]

Following Whited and Wu (2006), the WW index can be obtained from the following equation:

$$WW\ Index\ =\ -0.091INC - 0.062DIV + 0.021TLD - 0.044TA + 0.102ASG - 0.035SG, \qquad (5)$$

[17] Please see Whited and Wu (2006) for more details on the WW index.

where *INC* is the sum of income before extraordinary items and depreciation to total book assets, *DIV* is the dummy variable set to one if dividend is positive, and zero otherwise, *TLD* is long-term debt to total book assets, *TA* is the natural logarithm of total assets, *ASG* is the average industry *SG* for each Datastream Level-3 industry each year, and *SG* is the annual percentage increase in sales.

Accordingly, I divided the final sample into financially constrained and unconstrained firms based on the estimated WW index. Firms with a higher WW index scores are more likely to experience difficulties in accessing the capital market or external finance. Specifically, the sample is divided into three sub-groups, where I classified firms according to their WW index, namely the lowest 30%, the middle 40%, and the highest 30% estimated WW index before the tax cut (in year 2011). The firms with the lowest 30% and the highest 30% of the WW index will be classified as financially unconstrained and financially constrained firms respectively.

Table 2 reports the final sample based on the sub-sample of the WW index in 2011 (one year prior to the tax cut). Panel A and Panel B report mean and median leverage of financially constrained and unconstrained firms respectively. As shown in Table 2, both mean and median leverage of financially constrained firms are significantly lower than unconstrained firms across two leverage measures, and in every period. This finding is consistent with Whited and Wu (2006) and Farre-Mensa and Ljungqvist (2016) that reported the higher leverage in less constrained firms, suggesting a better ability to use debt as a form of financing. Notably, although the short-term debt ratio is not in the estimation of the WW index as in equation (5), the results in Table 2 also indicate the lower average short-term debt ratio in financially constrained firms.

This finding is also in line with Farre-Mensa and Ljungqvist (2016), suggesting that the WW index is appropriate for using with Thai data. In Panel A1 of Table 2, the average (median) total debt to capital is 9.13% (0.74%) on the entire period of the sample (2007-2015). After the tax cut, the average (median) debt to capital ratio increases from 8.93% (0.62%) before the tax cut to 9.36% (0.79%). However, the difference in mean (median) of 0.43% (0.17%) is not statistically significant. When looking across maturity, the average (median) short-term debt declines after the tax cut with statistically insignificant difference in mean (median) while only the average long-term debt ratio increases with statistically significant difference in mean at the 10% level. As observed in Panel A2, the debt to market assets ratios also persistently exhibits the insignificant post-cut change in average debt ratios.

The financially unconstrained firms are reported in Panel B1. The average (median) total debt to capital is 40.83% (42.32%) in the whole sample period. After the tax cut, the average total debt ratio significantly drops from 46.03% (49.46%) during the pre-cut period to 34.49% (35.47%) during the post-cut period. The post-cut decline is significant not only for the short-term debt but also long-term debt ratios. Consistent with Panel B1, A decreasing pattern of average (median) leverage also can be observed in Panel B2, where leverage is measured as debt to market assets.

Table 2 Summary statistics: Financially constrained and unconstrained firms

This table presents the average measures of leverage between financially constrained and unconstrained firms for the periods before (2007-2011) and after (2012-2015) the tax cut. The differences in leverage between before and after the tax cut are also reported. The debt ratios are defined as in Section 2.4. Significance of measures is computed using the independent-sample t-test allowing for unequal variances and the he Mann–Whitney *U* test. All firm-level variables are winsorized at the 1% and 99% level. The Differences in means and medians that are statistically different from pre-tax cut at the 1%, 5%, and 10% significance level are denoted by ***, **, *, respectively.

	Entire period (1)			Before tax cut (2)			After tax cut (3)			(2) vs. (3) (mean)	(2) vs. (3) (median)
Panel A: Financially constrained firms											
Panel A1: Debt to capital	Mean	Median	N	Mean	Median	N	Mean	Median	N		
Total debt (%)	9.13	0.74	779	8.93	0.62	419	9.36	0.79	360	0.43	0.17
Short-term debt (%)	5.35	0.30	779	5.70	0.27	419	4.94	0.34	360	-0.76	0.07
Long-term debt (%)	3.78	0.02	779	3.23	0.00	419	4.42	0.07	360	1.19*	0.07
Panel A2: Debt to market assets											
Total debt (%)	8.66	0.72	779	8.46	0.52	419	8.89	0.84	360	0.43	0.32
Short-term debt (%)	5.01	0.26	779	5.33	0.22	419	4.64	0.29	360	-0.69	0.07
Long-term debt (%)	3.65	0.02	779	3.13	0.00	419	4.25	0.05	360	1.12*	0.05
Panel B: Financially unconstrained firms											
Panel B1: Debt to capital	Mean	Median	N	Mean	Median	N	Mean	Median	N		
Total debt (%)	40.83	42.32	800	46.03	49.46	440	34.49	35.47	360	-11.54***	-13.99***
Short-term debt (%)	24.57	21.18	800	27.21	24.05	440	21.35	16.90	360	-5.86***	-7.15***
Long-term debt (%)	16.26	10.83	800	18.81	14.63	440	13.14	7.99	360	-5.67***	-6.64***
Panel B2: Debt to market assets											
Total debt (%)	34.15	35.01	800	37.40	38.08	440	30.18	30.69	360	-7.22***	-7.39***
Short-term debt (%)	20.43	16.38	800	21.77	17.83	440	18.8	14.62	360	-2.97***	-3.21***
Long-term debt (%)	13.72	8.81	800	15.63	11.12	440	11.39	7.07	360	-4.24***	-4.05***

To this extent, the results in Table 2 provide an early evidence of the associations between corporate taxes and leverage. These findings, in general, suggest that leverage is sensitive to tax rates. However, the effect of taxes may vary across the firm's financial conditions. On the one hand, the taxes effect of leverage seems to be weaker in financially constrained firms. On the other hand, the post-cut leverage reduction for unconstrained firms are broadly in line with Table 2, confirming the effect of the tax cut on leverage. To investigate robustness of the change in leverage between financially constrained and unconstrained firms observed in Table 2, I rerun equation (4) by dividing the sample based on the financial conditions.

2.5. Empirical results

In this section, I present the estimation results of the impact of the taxes on firm leverage using the corporate tax reform in Thailand as a natural experiment. Also, I investigate how the impact varies according to the firm's financial conditions.

2.5.1 Regression analyses of taxes and leverage

To examine the effect of taxes on leverage, firstly, I examine the effect of taxes based on equation (1), and the regression results are reported in Table 3. In models (1) through (3), leverage is defined as the debt capital ratio. In model (1), where debt is the total debt ratio, *Tax* has a significantly positive coefficient. The coefficient is also significantly positive in models (2) and (3), where the debt ratio is the short-term debt ratio and long-term debt ratio, respectively. In models (4), (5) and (6), leverage is defined as the debt to market assets ratio, and the debt ratio is the total debt ratio, short-term debt ratio and long-term debt ratio, respectively. Across these three models, the coefficient of *Tax* is also significantly positive.

Since the SET index is relatively low during the early part and relatively high during the later part of the sample period, it is possible that the positive relation between taxes and leverage or the leverage drops observed in Table 3 and models (1) through (6), despite controlling for the year fixed effects, are driven by rising market valuation of equity. To address this possibility, I repeat the regression analysis using book leverage (book debt divided book total assets). As shown in models (7) through (9), the coefficient of *Tax* remains significantly positive across three models. Thus, the rising market valuation of equity is unlikely to explain the positive coefficient of taxes or the post-cut leverage reduction.

Overall, consistent with the static trade-off model, the regression results in Table 3 support the hypothesis that corporate taxes and leverage are positively correlated, that is, firms reduce leverage following the tax cut. Moreover, firms reduce not only short-maturity debt, but also long-maturity debt even though the tax cut was to be effective only temporarily. Intuitively, the estimates from models (1) through (6), i.e., measures of market leverage, imply that the reduction in total debt ranges between 6% and 9.6%, or 60 and 96 basis points per 1% cut in the tax rate. Also, short-term debt appears more sensitive to the tax cut than long-term debt. The short-term debt reduction varies between 40 and 66 basis points per 1% cut in the tax rate, while it varies between 20 and 29 basis points for long-term debt.

Moreover, the results in Table 2 suggest that the decrease in tax shields due to a tax cut from 30% down to 20% is large enough to dominate shareholders' disincentive to reduce leverage, i.e., the premium price required to induce debtholders to sell their claims back to the firm. The findings also suggest that a sizeable tax cut has an impact on both short-term and long-term debts even though firms may generally enjoy material tax shields only from long-term debt.[18]

For both market leverage and book leverage, the results for control variables are in line with prior studies examining the tax effects on leverage (e.g., Doidge & Dyck, 2015; Faccio & Xu, 2015; Öztekin, 2015). That is, I find that leverage can be determined by, beside corporate tax rates, firm size, tangibility, profitability, market to book equity, and industry leverage. To be more specific, first, the leverage in all models are positively related to firm size. Consistent with the static trade-off theory, this finding

[18] Interestingly, the results from models (2) and (3) indicate a larger drop in short-term debt than in long-term debt. One plausible reason for such a larger impact on short-term debt is the notably greater use of short-term debt by our sample firms (see Table 1).

suggests that larger firms have a better ability to access the capital market and are less likely to go bankrupt, therefore, relying more on debt financing. Also, the positive significant coefficient of tangibility implies that firms with more tangible assets tend to use more debt. This finding supports the trade-off theory and the viewed of debtholders according to the agency theory (agency costs of debt), implying that firms with more tangible assets are likely to have more collateral to secure the credit, and also lower default risk so that they can borrow more.

Furthermore, the negative coefficient of profitability and market to book equity (growth opportunities) are in line with majority of prior empirical evidence, supporting the viewed of the pecking-order theory. To minimize the costs of adverse selection, the pecking-order theory suggests that firms are more likely to issue internal funds before debt and equity, implying that firms with higher internal funds and less investment opportunities should issue less debt, and use more funds that can be generated from internally. Hence, firms with higher profits and less growth opportunities are less likely to rely on debt financing. Lastly, consistent with Öztekin (2015), leverage is positively and significantly related to industry leverage and lagged leverage.

Though supportive the static trade-off theory, the results reported above should be viewed as early evidence since the market might have anticipated the tax cut before the policy came into effect. Therefore, firms may start adjusting their leverage in anticipation of potential changes in tax rates before 2012, making it more difficult to evaluate the tax effects of leverage. To address this possibility, I investigate robustness of the leverage drops observed in Table 2 and Table 3 by employing the following regression framework:

$$Lev_{i,t} = \alpha + \beta X_{i,t} + \gamma Z_{i,t} + \eta_i + \epsilon_{i,t}, \tag{6}$$

where X is a vector of year dummy variables taking the value 1(0) for 2007 through 2010 and 2012 through 2015 (otherwise). The hypothesis that taxes and leverage are positively correlated so that firms should reduce their leverage following the tax cut implies a negative coefficient for the year dummy variables for 2012 through 2015.

Table 4 reports regression results based on equation (6). In model (1), the dependent variable is the total debt to assets ratio. The coefficient of the dummy variable 2012 is significantly negative, suggesting that leverage falls in 2012 (the first year for which the tax cut became effective) from the level in 2011 (the year preceding the cut). The coefficients of the dummy variables 2013 through 2015 are all negative and significant, indicating that the reduction in 2012 did not reverse in subsequent years. Furthermore, the leverage reduction becomes larger in subsequent years and is significantly largest in 2015. These results, the positive relation between taxes and leverage, are consistent with Table 1 and Table 2 showing that firms reduce their leverage as the tax-shield benefit of debt financing becomes smaller.

Table 3 Regression analysis of corporate taxes and leverage

Results based on equation (4) are reported. In all models, the dependent variable is leverage. In model (1) through (3), debt is defined as total debt, as short-term debt in model (4) through (6), and as long-term debt in model (7) through (9). Leverage is measured as debt to capital in model (1), (4), and (7), and debt to market assets in model (2), (5), and (8), and debt to book assets in model (3), (6), and (9). All other variables are defined as in Section 2.4. In parentheses is *p*-value based on the White standard errors that are robust to clustering at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Tax	0.96***	0.66***	0.29***	0.60***	0.40***	0.20***	0.48***	0.36***	0.12***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln(total assets)	0.09***	0.04***	0.05***	0.07***	0.03***	0.04***	0.07***	0.03***	0.05***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Tangibility	0.12***	0.04	0.08***	0.08**	0.02	0.06***	0.14***	0.04	0.10***
	(0.00)	(0.18)	(0.00)	(0.01)	(0.46)	(0.00)	(0.00)	(0.13)	(0.00)
Profitability	-0.34***	-0.25***	-0.09**	-0.20***	-0.14***	-0.05*	-0.26***	-0.22***	-0.05*
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.06)	(0.00)	(0.00)	(0.09)
Market-to-book equity	-0.01***	-0.01***	-0.01***	-0.02***	-0.01***	-0.01***	0.01***	0.01***	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.27)
Industry leverage	0.15**	0.10	0.06	0.19***	0.11**	0.08	0.18***	0.10**	0.09**
	(0.04)	(0.13)	(0.29)	(0.00)	(0.03)	(0.13)	(0.00)	(0.06)	(0.02)
$Lev_{i,t-1}$	0.61***	0.34***	0.27***	0.55***	0.30***	0.25***	0.53***	0.28***	0.25***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-1.55***	-0.75***	-0.71***	-1.12***	-0.46***	-0.66***	-1.22***	-0.46***	-0.77***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Adjusted R^2 (%)	83.48	76.47	65.49	79.30	74.10	65.49	85.71	78.50	72.83
Number of observations	3,353	3,353	3,353	3,353	3,353	3,353	3,353	3,353	3,353

Moreover, none of the dummy variables representing years 2007 through 2010 has a negative coefficient, confirming that the lower leverage in years 2012 through 2015 relative to the level in 2011 is unlikely to arise from the leverage in 2011 being coincidentally high. That is, the leverage drop after the tax cut enactment is unlikely to be a chance result. The coefficients of dummy variables 2012 through 2015 are also significantly negative in models (2) and (3), where the debt ratio is the short-term debt ratio and long-term debt ratio, respectively.[19]

[19] Notably, since the SET index is relatively low during the early part of the sample period resulting from the subprime crisis Kalemli-Ozcan, Sorensen, and Yesiltas (2012), the positive and significant coefficient of year dummy variables 2008 and 2009 in model (1) to model (6), where leverage is defined as market

Models (4) through (6) and model (7) through (9) are models (1) through (3) rerun with leverage defined as the debt to market assets ratio and the book leverage, respectively. As shown in model (4) through (6), with an exception of the dummy variable 2012, all of the post-cut year dummy variables (2013 to 2015) are significantly negative. Furthermore, consistent with model (1), the dummy variables 2012 through 2015 are all significantly negative in model (7). The short-term debt reduction is also monotonically larger over the post-cut years, and becomes significantly largest in 2015 in model (8). Notably, all of the pre-cut year dummy variables have a small and insignificant coefficient. In model (9) where the dependent variable is the long-term debt ratio, in contrast, the dummy variables 2012 and 2014 both have an insignificant coefficient.

Interestingly, however, the dummy variables 2015 in model (9) is significantly negative. Long-term debt financing significantly falls in 2015. Since it was officially announced late (i.e., October) in 2015 that the tax cut would remain effective permanently, it is plausible that the government's plan to maintain the cut permanently had been leaked out earlier in the year, and firms responded by reducing their long-term debt financing. Lastly, the results for control variables are broadly in line with Table 3. Taken together, the findings support the view that corporate taxes and leverage are positively related. In other words, leverage is sensitive to a tax cut, supporting our first hypothesis and the prediction according to the static-trade-off theory.

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leverage, can be explained by the declining market valuation of equity. However, when examining book leverage in model (7) to model (9), the coefficient of year dummy variables 2008 and 2009 become insignificant, confirming that the relatively low SET index during 2008 and 2009 is likely to explain the positive and significant coefficient of year dummies of the pre-cut leverage increase.

Table 4 Regression analysis of corporate taxes and leverage across maturity structure

Results based on equation (4) are reported. In all models, the dependent variable is leverage. In models (1) through (3) leverage is defined as the debt to capital ratio. In models (4) through (6) leverage is defined as the debt to market assets ratio, and as the debt to book assets ratio in models (7) through (9). All other variables are defined as in Section 2.4. In parentheses is *p*-value based on the White standard errors that are robust to clustering at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2007	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	(0.16)	(0.33)	(0.71)	(0.33)	(0.05)	(0.76)	(0.41)	(0.69)	(0.78)
2008	0.03***	0.02***	0.01	0.02***	0.02**	0.00	0.01**	0.01	0.00
	(0.00)	(0.00)	(0.37)	(0.00)	(0.02)	(0.56)	(0.04)	(0.12)	(0.80)
2009	0.04***	0.02**	0.02***	0.05***	0.02***	0.03***	0.00	-0.01	0.01
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.99)	(0.21)	(0.13)
2010	0.01	0.01	0.01	0.02***	0.01	0.01***	0.00	-0.01	0.01**
	(0.27)	(0.88)	(0.14)	(0.00)	(0.13)	(0.00)	(0.78)	(0.21)	(0.04)
2012	-0.03***	-0.02***	-0.01**	-0.01	-0.01	0.00	-0.01**	-0.01	0.00
	(0.00)	(0.00)	(0.03)	(0.55)	(0.60)	(0.84)	(0.04)	(0.14)	(0.38)
2013	-0.06***	-0.03***	-0.02***	-0.03***	-0.02***	-0.02***	-0.03***	-0.02***	-0.01**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)
2014	-0.06***	-0.04***	-0.02***	-0.03***	-0.02***	-0.01**	-0.02***	-0.02***	-0.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.29)
2015	-0.09***	-0.06***	-0.03***	-0.05***	-0.04***	-0.02***	-0.04***	-0.03***	-0.01**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.04)
Ln(total assets)	0.09***	0.04***	0.05***	0.07***	0.03***	0.04***	0.07***	0.03***	0.05***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Tangibility	0.12***	0.04	0.08***	0.08**	0.02	0.06***	0.14***	0.04	0.10***
	(0.00)	(0.18)	(0.00)	(0.01)	(0.46)	(0.00)	(0.00)	(0.12)	(0.00)
Profitability	-0.34***	-0.25***	-0.09**	-0.20***	-0.14***	-0.05*	-0.27***	-0.22***	-0.05*
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.06)	(0.00)	(0.00)	(0.08)
Market-to-book equity	-0.01***	-0.01***	-0.01***	-0.01***	0.01***	-0.01***	0.01**	0.01***	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.16)
Industry leverage	0.15**	0.10	0.06	0.19***	0.11**	0.08	0.18***	0.10*	0.08*
	(0.04)	(0.13)	(0.30)	(0.00)	(0.03)	(0.13)	(0.00)	(0.06)	(0.07)
$Lev_{i,t-1}$	0.61***	0.34***	0.27***	0.55***	0.30***	0.25***	0.53***	0.28***	0.25***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-1.28***	-0.56***	-0.71***	-0.94***	-0.34***	-0.60***	-1.09***	-0.35***	-0.73***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Adjusted R^2 (%)	83.48	76.47	68.80	81.83	74.41	66.59	85.88	78.71	73.18
Number of observations	3,353	3,353	3,353	3,353	3,353	3,353	3,353	3,353	3,353

2.5.2 Regression analyses of taxes and leverage: financially constrained and unconstrained firms

The results from the previous section reveal that taxes and leverage are positively related, confirming the static trade-off theory. However, as mentioned in Section 2.3, when allowing for the effects of corporate taxes to enter into the static trade-off model through the change in financially costs of distress, this cost can be significant and possibly can offset the change in tax shield benefits of debt. Consequently, firms may or may not adjust their leverage following the prediction of the static trade-off theory. In other words, corporate taxes can be positively related, negatively related or not related to leverage. The new optimal leverage should depend on whether which effect of taxes (change in tax shield benefits or change in financially costs of distress) is dominated. This section, therefore, further examines the main hypothesis of this study, that is, whether taxes and the expected costs of financially distress are correlated. To test this hypothesis, I rerun equation (1) in financial condition subsample. The sample is then divided into two sub-groups, financially constrained and unconstrained firms, based on the value of WW index explained in Section 2.3.

Table 5 reports the regressions results of the taxes effect based on equation (4) between financially constrained and unconstrained firms. The dependent variable is debt to capital in models (1) and (4), debt to market assets in models (2) and (5), and book leverage in models (3) and (6).[20] For financially constrained firms, *Tax* has a positive coefficient in model (1) through model (3). In model (1), the coefficient of *Tax*

[20] As previously shown in the Table 1 through Table 4, the effects of taxes on both measures of market leverage are similar. Therefore, from this point onwards, in order to make the table looks clearer and easier to understand, I will only report the leverage defined as the debt to capital ratio and the debt to book assets ratio. Unreported tables show that the results are robust to the debt to market assets ratio.

(0.23) shows that taxes and debt ratio are positively and significantly correlated at 10% level. Although weakly significant, this finding is in line with the result from Table 3 that reports the significantly positive coefficient of *Tax*, indicating a weaker positive correlation between taxes and debt ratio on constrained firms. Model (2), where leverage is defined as debt to market assets, shows that the coefficient of *Tax* remains positive (0.19), however, with statistically insignificant estimate. The coefficient of *Tax* remains positive in model (3), and become significant at 5% level. The results from model (1) through (3), in general, do not seem to support the prediction according to the static trade-off theory and the empirical results reported in Table 3. That is, although the coefficient of *Tax* is positive in model (1) through (3), corporate taxes and leverage are weakly correlated, especially in financially constrained firms with the market leverage measures.

Table 5 Regression analysis of corporate taxes and leverage between financially constrained and unconstrained firms

Results based on equation (4) are reported. In all models, the dependent variable is leverage defined as the total debt. Debt is debt to capital in models (1) and (4), debt to market assets in models (2) and (5), and book leverage in models (3) and (6). Financially constrained and unconstrained firms, and all other variables are defined as in Section 2.4. In parentheses is *p*-value based on the White standard errors that are robust to clustering at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Constrained firms			Unconstrained firms		
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)
Tax	0.23*	0.19	0.26**	1.69***	0.99***	0.72***
	(0.08)	(0.15)	(0.05)	(0.00)	(0.00)	(0.00)
Ln(total assets)	0.11***	0.09***	0.11***	0.07***	0.04***	0.05***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Tangibility	0.11	0.09	0.20**	0.24***	0.17*	0.27***
	(0.24)	(0.28)	(0.04)	(0.00)	(0.08)	(0.00)
Profitability	-0.20**	-0.18**	-0.24**	-0.11	-0.02	-0.02
	(0.03)	(0.03)	(0.02)	(0.45)	(0.83)	(0.90)
Market-to-book equity	-0.01	-0.01*	0.00	-0.01	-0.01*	0.02**
	(0.12)	(0.05)	(0.54)	(0.31)	(0.08)	(0.02)
Industry leverage	-0.02	-0.05	-0.02	-0.07	0.12	0.15
	(0.90)	(0.75)	(0.91)	(0.75)	(0.63)	(0.59)
$Lev_{i,t-1}$	0.26***	0.24***	0.40***	0.37***	0.32***	0.34***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-0.02*	-0.02	-0.03**	-0.17***	-0.10***	-0.07***
	(0.08)	(0.15)	(0.05)	(0.00)	(0.00)	(0.00)
Adjusted R^2 (%)	76.01	74.21	80.94	78.01	73.80	75.77
Number of observations	451	451	451	451	451	451

Model (4) through (6) rerun model (1) through (3) in unconstrained firms. The coefficient of *Tax* is positive in all models. However, in contrast with the results in constrained firms shown in model (1) through (3), all coefficients of *Tax* are significantly positive at 1% level in unconstrained firms. Not only does the coefficient of *Tax* is positive, the magnitude of *Tax* coefficient is also significantly larger than those reported in model (1) through (3) for constrained firms. Overall, in line with the static trade-off theory and results in Table 3, this finding shows that leverage is positively related with corporate taxes in unconstrained, consequently, financially unconstrained firms reduce leverage after the tax cut.[21]

To examine whether the taxes effect of leverage reported in Table 5 is consistent across the maturity structure, I rerun the regression analysis of Table 5 using short-term and long-term ratio as the dependent variable. In model (1) through (3) of Table 6, debt is defined as short-term debt, and as long-term debt ratio in model (4) through (6). Leverage is measured as debt to capital in model (1) and (4), debt to market assets in model (2) and (5), and debt to book assets in model (3) and (6).

As for financially constrained firms, model (1) through (6) show that *Tax* has the positive coefficient. This finding is consistent with Table 5 that reported the positive coefficients of *Tax* for constrained firms. However, not only does the coefficient of *Tax* is positive in model (1) through (3) where the dependent variable is short-term debt, the estimates also insignificant. This implies that, for constrained firms, corporate taxes have no impact on leverage, or in other words, the short-term debt is not sensitive to the tax cut. This result supports our main hypothesis.

[21] Interestingly, apart from the coefficients of *Tax* reported in Table 5, the coefficient of *Tangibility* and *Profitability* is also different between financially constrained and unconstrained firms. Specifically, while the sign of the coefficient of *Tangibility* and *Profitability* is the same between financially constrained and unconstrained firms, the coefficient of *Tangibility* is significant only in unconstrained firms, and *Profitability* is significant only in constrained firms. To test the difference in the coefficients of *Tangibility* and *Profitability* between two subsamples, I use a stacked regression analysis. I interact the dummy variable for financial constraints with a constant and all of the independent variable. Then I estimate regression with the year and firm fixed effects. As suggested in Pinkowitz, Stulz, and Williamson (2006), this method is appropriate in using to test whether the mean of the differences in the coefficients is zero. In an unreported result, I find that the coefficient of *Tangibility* and *Profitability* significantly differ between two subsamples with *p*-value of difference at 0.00 on both variables, suggesting that the effects of *Tangibility* and *Profitability* are different between financially constrained and unconstrained firms.

When looking across the maturity structure, the coefficient of *Tax* in model (4) through (6), where debt is the long-term debt, remains positive. However, the estimates become significant. This finding suggests that the tax cut may have an impact only on the long-term debt since the decrease in tax shield benefits as a result of the tax cut can be relatively larger on the long-term than short-term debt financing. Hence, the reduction in tax shield benefits on long-term debt probably large enough to offset the reduction in expected distress costs, especially in constrained firms. Unlike the use of long-term debt, the reduction in tax shield benefits on short-term debt is relatively less in constrained firms.

Table 6 Regression analysis of corporate taxes and leverage between financially constrained and unconstrained firms across maturity structure

Results based on equation (4) are reported. In all models, the dependent variable is leverage. In model (1) through (3) and model (7) through (9), debt is defined as short-term debt, and as long-term debt ratio in model (4) through (6) and model (10) through (12). Leverage is measured as debt to capital in model (1), (4), (7), and (9), and debt to market assets in model (2), (5), (8), and (11), and debt to book assets in model (3), (6), (9), and (12). Financially constrained and unconstrained firms, and all other variables are defined as in Section 2.4. In parentheses is *p*-value based on the White standard errors that are robust to clustering at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Constrained firms						Unconstrained firms					
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Tax	0.05	0.03	0.09	0.18**	0.15*	0.17**	1.02***	0.54***	0.45**	0.67***	0.45***	0.27**
	(0.56)	(0.66)	(0.41)	(0.03)	(0.07)	(0.03)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.03)
Ln(total assets)	0.03***	0.03***	0.04***	0.07***	0.06***	0.07***	0.02	0.00	0.00	0.04***	0.04***	0.05**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.31)	(0.87)	(0.91)	(0.00)	(0.00)	(0.01)
Tangibility	0.03	0.03	0.08*	0.07	0.06	0.13*	0.23**	0.17**	0.22***	0.01	0.00	0.05
	(0.32)	(0.33)	(0.08)	(0.26)	(0.32)	(0.07)	(0.02)	(0.05)	(0.01)	(0.78)	(0.96)	(0.31)
Profitability	-0.10**	-0.09***	-0.14**	-0.10	-0.09	-0.10	-0.02	0.05	0.01	-0.09	-0.07	-0.03
	(0.00)	(0.00)	(0.01)	(0.14)	(0.14)	(0.13)	(0.89)	(0.65)	(0.97)	(0.16)	(0.20)	(0.64)
Market-to-book equity	-0.01*	-0.01**	0.00	0.00	0.00	0.00	-0.01	-0.01	0.01*	0.00	0.00	0.01***
	(0.09)	(0.04)	(0.86)	(0.25)	(0.15)	(0.17)	(0.29)	(0.12)	(0.10)	(0.84)	(0.44)	(0.00)
Industry leverage	-0.09	-0.10	-0.09	0.07	0.05	0.08	0.22	0.34	0.30	-0.29*	-0.22	-0.15
	(0.32)	(0.23)	(0.24)	(0.49)	(0.60)	(0.49)	(0.36)	(0.15)	(0.28)	(0.06)	(0.11)	(0.25)
$Lev_{i,t-1}$	0.13***	0.12***	0.18***	0.13*	0.11*	0.21***	0.21***	0.18***	0.19***	0.16***	0.14***	0.14***
	(0.00)	(0.00)	(0.00)	(0.06)	(0.07)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-0.42**	-0.35**	-0.50**	-1.07***	-0.94***	-1.11**	-0.29	-0.03	-0.06	-0.50**	-0.44**	-0.62**
	(0.01)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.43)	(0.92)	(0.86)	(0.04)	(0.02)	(0.02)
Adjusted R^2 (%)	78.43	77.68	75.86	73.74	71.43	75.06	70.99	70.07	67.98	72.01	70.28	70.35
Number of observations	451	451	451	451	451	451	451	451	451	451	451	451

This reduction in tax shield benefit is then dominated by the loss of expect distress costs, therefore, financially constrained firms reduced only the long-term debt, leaving the short-term debt unchanged after the tax cut.

On the other hand, as for unconstrained firms, model (7) through (12) show that the coefficient of *Tax* is significantly positive across all models. This finding is consistent with the results reported in Table 5, confirming the positive correlation between taxes and leverage. Unlike the tax effect of leverage on constrained firms that only affect the long-term debt, unconstrained firms reduce both short-term and long-term debt after the tax cut. While we can observe the positive relation between taxes and leverage in unconstrained firms, the positive relation becomes weaker in constrained firms. These results suggest that, although firms have incentive to lower leverage when tax rates are lower, only unconstrained firms may do so. Financially constrained firms, on the other hand, only reduce the long-term debt while leaving the total and short-term debt unchanged.

As reported above, there is no evidence of the tax effect of leverage on constrained firms. However, these firms might have anticipated the tax cut before it came into effect so that firms start making the leverage adjustment earlier. To address this possibility, in Table 7 and 8, I rerun the regression analysis of Table 5 and 6 by using year dummy variables as explain in equation (6). As in Table 7, the coefficient of all year dummy variables before the tax cut (2007 through 2010) are positive across the three measures of leverage in constrained firms in model (1) through (3).

Table 7 Regression analysis of corporate taxes and leverage between financially constrained and unconstrained firms

Results based on equation (6) are reported. In all models, the dependent variable is leverage defined as the total debt. Debt is debt to capital in models (1) and (4), debt to market assets in models (2) and (5), and book leverage in models (3) and (6). Financially constrained and unconstrained firms, and all other variables are defined as in Section 2.4. In parentheses is *p*-value based on the White standard errors that are robust to clustering at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Constrained firms			Unconstrained firms		
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)
2007	0.03***	0.02**	0.01	-0.04**	-0.02	-0.02
	(0.00)	(0.01)	(0.13)	(0.02)	(0.15)	(0.18)
2008	0.04***	0.03***	0.03**	-0.01	0.00	-0.01
	(0.00)	(0.00)	(0.01)	(0.81)	(0.89)	(0.39)
2009	0.02**	0.03**	0.00	0.05***	0.08***	0.00
	(0.02)	(0.01)	(0.93)	(0.00)	(0.00)	(0.71)
2010	0.01	0.01	0.01	-0.01	0.04***	-0.01
	(0.18)	(0.11)	(0.38)	(0.32)	(0.00)	(0.16)
2012	0.00	0.01	0.00	-0.05***	0.01	-0.02
	(0.74)	(0.22)	(0.62)	(0.00)	(0.35)	(0.12)
2013	-0.01	-0.01	-0.01	-0.14***	-0.08***	-0.06***
	(0.23)	(0.52)	(0.26)	(0.00)	(0.00)	(0.00)
2014	-0.01	-0.01	-0.01	-0.13***	-0.05***	-0.05***
	(0.20)	(0.55)	(0.36)	(0.00)	(0.00)	(0.00)
2015	-0.03*	-0.02	-0.03**	-0.16***	-0.09***	-0.07***
	(0.07)	(0.16)	(0.05)	(0.00)	(0.00)	(0.00)
Ln(total assets)	0.09***	0.07***	0.10***	0.09***	0.06***	0.06***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Tangibility	0.08	0.08	0.13**	0.12	0.06	0.13***
	(0.12)	(0.12)	(0.02)	(0.12)	(0.37)	(0.00)
Profitability	-0.18***	-0.14**	-0.21***	-0.27**	-0.16**	-0.18**
	(0.00)	(0.02)	(0.00)	(0.01)	(0.04)	(0.03)
Market-to-book equity	0.00**	-0.01**	0.00	-0.02***	-0.02***	0.02***
	(0.05)	(0.01)	(0.12)	(0.00)	(0.00)	(0.00)
Industry leverage	-0.02	0.03	0.01	0.03	0.24	0.11
	(0.86)	(0.84)	(0.96)	(0.88)	(0.16)	(0.49)
$Lev_{i,t-1}$	0.48***	0.45***	0.55***	0.62***	0.51***	0.50***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-1.26***	-1.04***	-1.48***	-1.18***	-0.84***	-0.76***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Adjusted R^2 (%)	70.85	65.87	76.88	73.35	69.22	77.84
Number of observations	779	779	779	800	800	800

Table 8 Regression analysis of corporate taxes and leverage between financially constrained and unconstrained firms across maturity structure

Results based on equation (6) are reported. In all models, the dependent variable is leverage. In model (1) through (3) and model (7) through (9), debt is defined as short-term debt, and as long-term debt ratio in model (4) through (6) and model (10) through (12). Leverage is measured as debt to capital in model (1), (4), (7), and (9), and debt to market assets in model (2), (5), (8), and (11), and debt to book assets in model (3), (6), (9), and (12). Financially constrained and unconstrained firms, and all other variables are defined as in Section 2.4. In parentheses is p-value based on the White standard errors that are robust to clustering at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Constrained firms						Unconstrained firms					
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
2007	0.02***	0.02***	0.02**	0.00	0.00	0.00	-0.07***	-0.05***	-0.04**	0.02	0.03*	0.02*
	(0.00)	(0.00)	(0.04)	(0.63)	(0.81)	(0.61)	(0.0017)	(0.00)	(0.01)	(0.22)	(0.10)	(0.08)
2008	0.03***	0.03***	0.03***	0.01	0.01	0.00	-0.03	-0.02	-0.03*	0.02	0.02	0.02
	(0.00)	(0.00)	(0.00)	(0.19)	(0.43)	(0.95)	(0.21)	(0.15)	(0.07)	(0.27)	(0.16)	(0.29)
2009	0.02**	0.02**	0.00	0.01	0.01	0.00	0.00	0.02	-0.03**	0.05***	0.07***	0.03**
	(0.02)	(0.01)	(0.99)	(0.41)	(0.22)	(0.91)	(0.88)	(0.27)	(0.02)	(0.00)	(0.00)	(0.04)
2010	0.01	0.01	0.00	0.00	0.00	0.01	-0.03**	0.00	-0.03***	0.02*	0.04***	0.02*
	(0.21)	(0.12)	(0.77)	(0.59)	(0.61)	(0.32)	(0.02)	(0.92)	(0.01)	(0.09)	(0.00)	(0.07)
2012	0.00	0.01	0.00	0.00	0.01	0.00	-0.04**	0.00	-0.01	-0.02	0.01	-0.01
	(0.92)	(0.24)	(0.59)	(0.72)	(0.47)	(0.87)	(0.04)	(0.79)	(0.34)	(0.17)	(0.35)	(0.61)
2013	-0.01	-0.01	-0.01	0.00	0.00	0.00	-0.09***	-0.05***	-0.04***	-0.05***	-0.03**	-0.02*
	(0.12)	(0.25)	(0.19)	(0.71)	(0.99)	(0.96)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.08)
2014	-0.01	-0.01	-0.02*	0.00	0.00	0.01	-0.08***	-0.02	-0.03**	-0.05***	-0.03**	-0.02*
	(0.11)	(0.31)	(0.05)	(0.78)	(0.90)	(0.49)	(0.00)	(0.18)	(0.04)	(0.00)	(0.01)	(0.09)
2015	-0.01	-0.01	-0.02*	-0.01	-0.01	-0.01	-0.10***	-0.05***	-0.04**	-0.06***	-0.04***	-0.02*
	(0.17)	(0.34)	(0.09)	(0.13)	(0.24)	(0.25)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.07)
Ln(total assets)	0.03***	0.02**	0.04***	0.06***	0.05***	0.06***	0.03**	0.01	0.01	0.06***	0.05***	0.05***
	(0.00)	(0.03)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.31)	(0.65)	(0.00)	(0.00)	(0.00)
Tangibility	0.03	0.03	0.04	0.06	0.05	0.09**	0.09	0.06	0.07	0.02	0.00	0.06
	(0.47)	(0.46)	(0.29)	(0.13)	(0.13)	(0.02)	(0.10)	(0.17)	(0.16)	(0.66)	(0.95)	(0.12)
Profitability	-0.12***	-0.09**	-0.13***	-0.06	-0.05	-0.07	-0.19**	-0.12*	-0.18**	-0.08	-0.04	0.00
	(0.00)	(0.01)	(0.00)	(0.14)	(0.17)	(0.12)	(0.04)	(0.09)	(0.01)	(0.17)	(0.42)	(0.94)
Market-to-book equity	0.00	0.00	0.00	0.00**	0.00**	0.00	-0.01***	-0.01***	0.01	-0.01	0.00	0.01*
	(0.35)	(0.22)	(0.29)	(0.05)	(0.03)	(0.31)	(0.01)	(0.00)	(0.10)	(0.19)	(0.29)	(0.09)
Industry leverage	-0.13	-0.08	-0.10	0.11	0.10	0.11	0.11	0.24	0.17	-0.08	-0.01	-0.06
	(0.20)	(0.40)	(0.16)	(0.14)	(0.15)	(0.17)	(0.53)	(0.13)	(0.34)	(0.58)	(0.96)	(0.62)
$Lev_{i,t-1}$	0.25***	0.23***	0.27***	0.23***	0.22***	0.29***	0.33***	0.28***	0.27***	0.29***	0.23***	0.23***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-0.40**	-0.31**	-0.59***	-0.86***	-0.73***	-0.89***	-0.36*	-0.10	-0.02	-0.82***	-0.74***	-0.74***
	(0.01)	(0.04)	(0.00)	(0.00)	(0.00)	(0.00)	(0.08)	(0.52)	(0.89)	(0.00)	(0.00)	(0.00)
Adjusted R^2 (%)	67.80	62.31	69.60	64.81	62.54	69.67	64.74	64.79	66.54	65.82	63.62	68.39
Number of observations	779	779	779	779	779	779	800	800	800	800	800	800

The coefficients of year dummy variables before the tax cut (2007 through 2009) are also significant in model (1) and model (2) where leverage is defined as the total debt to capital and total debt to market assets, respectively. However, when looking at the year dummy variables after the tax cut (2012 through 2015), with a trivial exception in 2015, none of the coefficient of year dummy variables is significant. These findings altogether suggest that the tax cut has no significant impact on constrained firms, and the reason that I find no evidence of the relation between taxes and leverage in constrained firms is not driven by the anticipation of the tax cut, confirming the results in Table 4. Model (4) through (6) report the effects of the tax cut using year dummy variables on unconstrained firms. In contrast with model (1) through (3), all the post-cut year dummy variables are negative and significant when examining in unconstrained firms. This finding is consistent with the result reported in Table 5 that only unconstrained firms reduce their leverage after the tax cut.

Table 8 reports the regression analysis of equation (6) across the maturity structure, where debt is short-term debt in model (1) through (3) and model (7) through (9), and long-term debt in model (4) through (6) and model (10) through (12). For constrained firms, as reported in model (1) through (6), the coefficients of all post-cut year dummy variables are insignificant with one trivial exception of the coefficients of year dummy variables 2015 in model (3). This finding is in line with the result in Table 6, suggesting that although the tax cut has no impact on short-term debt, constrained firms may have incentive to reduce the long-term debt after the tax cut. In model (7) through (12), the post-cut year dummy variables are negatively and significantly correlated with both short-term and long-term debt. In contrast with constrained firms, this finding suggests that unconstrained firms significantly reduce both short-term and long-term debt after the tax cut.

Taken together, the positive relation between corporate taxes and leverage reported above support the static trade-off theory. Exploiting a sizeable corporate tax cut as a lab, I find that firms significantly reduced leverage. This finding stands in sharp contrast to the recent insights derived from small tax cuts. Moreover, when dividing the sample based on their financial conditions, I find that the taxes effect of leverage disappears in financially constrained firms. Though financially constrained firms are supposed to increase their leverage according the main hypothesis as in Section 2.3, I find no evidence to support such claim. One plausible explanation of this finding is that constrained firms may not increase their leverage after the tax cut because of their constraints. While the 10% cut is large enough to cause leverage adjustment among unconstrained firms, it is not large enough to affect constrained firms. It is plausible that the fixed adjustment cost, such as lending fees (Leary & Roberts, 2005), is much larger for constrained firms, thereby causing leverage hysteresis in these firms. Specifically, the empirical results in turn imply that the loss of tax shield benefits from a tax cut can be dominated by the reduction in the expected costs of distress. Therefore, firms may not adjust their leverage according to the prediction of the static trade-off theory, especially in constrained firms.

Overall, there is a strong evidence of the correlation between taxes and the cost of debt financing. When making the leverage adjustment, firms consider both the change in tax shield benefits and the change in expected costs of distress due to the alteration of tax rates.

2.6. Robustness check

Though the empirical evidence seems to support the main hypothesis, that is, the positive correlation between corporate taxes and the expected costs of distress, the conclusions in the previous section are based on the specifications reported in Tables 5 to 8. In this section, I present one check to assess the robustness of the main results by using the alternative measure of financial constraints to examine the tax effect of leverage.

2.6.1 Using different measure of financially constrained and unconstrained firms

In the previous section, financially constrained and unconstrained firms are defined based on the WW index. Although the WW index is one of the most common and rather recent index used to quantify the financially constrained firms, it has been criticized for the reliability of the measurement as there are also other ways to identify whether firms have financial constraints. Therefore, it is not clear whether the results shown in Section 2.4 are driven by the selection biased or the measurement error.

To address the possibility of this measurement error, in this section, I use the alternative method to identify the financially constrained firms. Without using the index estimated from the regression analysis or the structural model, I defined firms with the financial constraints using dividend. This method has been adopted by several studies (Farre-Mensa & Ljungqvist, 2016; Fazzari et al., 2000; Kaplan & Zingales, 2000; Lamont et al., 2001).

In general, financially constrained firms should retain net income for investment, and hence, are more likely to pay no or relatively less dividends. The empirical evidence that support this argument was found in literature. For example, according to Lamont et al. (2001), most of the constrained firms are more likely to repurchase their securities than the firms classified as less or unconstrained, thereby paying less dividend (Hadlock & Pierce, 2010; Kaplan & Zingales, 2000).

In order to use dividends as a measure to define whether firms are financially constrained firms, firstly, I calculate the average dividends before 2011 for each firm in the final sample. Then, I calculate the difference between the average dividends before 2011 and the dividend paid in 2011. Accordingly, I divide the sample into three sub-groups namely the lowest 30%, the middle 40%, and the highest 30% estimated difference in dividends between these two periods. The firms with the lowest 30% and the highest 30% of the difference in dividends will be classified as financially unconstrained and financially constrained firms respectively.

Table 9 Regression analysis of corporate taxes and leverage between low-dividend and high-dividend firms

Results based on equation (4) are reported. In all models, the dependent variable is leverage defined as the total debt. Debt is debt to capital in models (1) and (4), debt to market assets in models (2) and (5), and book leverage in models (3) and (6). Financially constrained (low-dividend firms) and unconstrained firms (high-dividend firms), and all other variables are defined as in Section 2.4. In parentheses is *p*-value based on the White standard errors that are robust to clustering at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Low-dividend firms			High-dividend firms		
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)
Tax	0.72***	0.53***	0.49***	0.65***	0.35***	0.35**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)
Ln(total assets)	0.11***	0.11***	0.14***	0.04	0.03	0.06**
	(0.00)	(0.00)	(0.00)	(0.12)	(0.14)	(0.03)
Tangibility	0.04	0.03	0.17**	-0.06	-0.05	0.07
	(0.63)	(0.74)	(0.04)	(0.58)	(0.60)	(0.53)
Profitability	-0.30***	-0.20***	-0.25***	-0.41**	-0.24*	-0.34**
	(0.00)	(0.01)	(0.00)	(0.01)	(0.06)	(0.02)
Market-to-book equity	-0.02***	-0.02***	0.01	0.00	-0.01	0.01*
	(0.12)	(0.00)	(0.12)	(0.87)	(0.21)	(0.09)
Industry leverage	0.25*	0.11	0.23	-0.11	0.03	-0.11
	(0.09)	(0.43)	(0.11)	(0.56)	(0.89)	(0.59)
$Lev_{i,t-1}$	0.36***	0.30***	0.32***	0.38***	0.35***	0.46***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-1.69***	-1.60***	-2.25***	-0.59	-0.48	-0.96**
	(0.00)	(0.00)	(0.00)	(0.15)	(0.19)	(0.04)
Adjusted R^2 (%)	87.79	83.95	87.58	87.57	84.98	88.29
Number of observations	424	424	424	424	424	424

Table 9 is the Table 5 rerun with financially constrained and unconstrained firms based on dividends. In model (1), where leverage is defined as the total debt to capital, the coefficient of *Tax* is positive and significant. This finding, however, does not support the positive insignificant coefficient of *Tax* reported in Table 5. In line with model (1), model (2) and (3) show that the coefficient of *Tax* is significantly positive. This finding suggest that, in general, corporate taxes and leverage are positively related, and constrained firms reduce their leverage after the tax cut.

Model (4) through (6) report the regression analysis of the taxes effect of leverage on unconstrained firms. The results show that *Tax* has a significantly positive coefficient across the three models, supporting the evidence reported in Table 5. When viewed together, model (1) through (6) show that corporate taxes and leverage are positively related in both low-dividend and high-dividend firms. Therefore, these two types of firms reduce their leverage after the tax cut. In contrast with the results in Section 2.4, the tax effects of leverage on financially constrained firms as defined as a low-dividend firms do not seem to support the argument that taxes and the expected distress cost are positively correlated.

To examine whether the taxes effect of leverage reported in Table 9 is consistent across the maturity structure, I rerun the regression analysis of Table 5 using short-term and long-term ratio as the dependent variable. In model (1) through (3) of Table 6, debt is defined as short-term debt, and as long-term debt ratio in model (4) through (6). Leverage is measured as debt to capital in model (1) and (4), debt to market assets in model (2) and (5), and debt to book assets in model (3) and (6).

When looking across the maturity structure, Table 10, which is Table 6 rerun with the low-dividend and high-dividend firms, shows that the coefficient of *Tax* remains positive and significant in model (1). Although the coefficient of *Tax* remains positive in all models, it becomes insignificant as shown in model (2) and (3) where debt is the short-term debt (short-term debt to capital ratio). This finding is line with the insignificant coefficient of *Tax* in Table 5, suggesting that the corporate taxes and the tax cut has no impact on the leverage adjustment in constrained firms. In model (4), the coefficient of *Tax* for the long-term debt is significantly positive, albeit less statistically significant than the result shown in Table 6, and become insignificant in model (5) and (6). These findings altogether imply that the corporate taxes effect of leverage disappears in the constrained firms, confirming the evidence found in Section

2.4, and support the view that taxes and the expected costs of distress are related. As for unconstrained firms defined as a high-dividend firms, all coefficients of *Tax* are significantly positive in model (7) through (12). This finding is in line with the positive and significant coefficients of *Tax* reported in model (7) through (12) in Table 5, supporting the static trade-off prediction in unconstrained firms.

Overall, Table 10 shows that the result in Section 2.4 is robust, even after using the different method to quantify whether a firm has financial constraints. Consequently, our previous findings, the disassociation between taxes and leverage in financially constrained firms are not driven by the selection biased of the index using to identify financially constrained firms.

2.6.2 Using the different estimation approach to examine the tax effect of leverage

As mentioned in Section 3, this study examines the taxes effect of leverage by exploiting the two steps a country-wide corporate income tax cut in Thailand that provide a large variation in tax rates within the short period. This unique feature gives advantage over the previous studies which suffering from the lack of tax variation overtime, especially with the time-series evidence. Consequently, without the variation in tax rates, literature examines the effects of taxes on capital structure by using the several measure of taxes namely the effective tax rate. However, the effective tax rates, which can be measured by the firm's taxable income, have often been criticized for the potential endogeneity (see, for example, Graham, 2003). To overcome these problems, the generalized method of moments (GMM) estimation method has been utilized in the literature to alleviate biases.

Therefore, in this section, I provide further robustness for the results by using the GMM estimator to address the potential endogeneity problem in our analysis. Specially, the GMM estimator controls for omitted invariant variables and corrects for endogeneity by using internal instruments. This estimator technique is commonly employed in dynamic model which is controlling for omitted variable problem and potential endogeneity issue. More importantly, this analysis approach is appropriate for our unique dataset which has the characteristics of large cross-section and short time series (Arellano & Bond, 1991; Holtz-Eakin, Newey, & Rosen, 1988).

Table 11 is Table 3 rerun with the dynamic GMM estimation technique. Consistent with results reported in Table 3, the coefficient of *Tax* estimated from the dynamic GMM estimation in model (1) through (3) where debt is the total debt ratio are all positive and significant. The coefficient of *Tax* is also comparable in magnitude to the results in Table 3. Moreover, when looking across the maturity structure, the coefficient of *Tax* remains positive and significant in both model (3) through (6) where debt is the short-term debt ratio and in model (7) through (9) where debt is the long-term debt ratio. This finding supports the static trade-off theory in which corporate taxes and are positively related with leverage.

To check for the robustness of the effect of taxes on leverage between financially constrained and unconstrained firms, I re-examine the regression analysis in Table 5 by using the dynamic GMM estimation model, and the results are reported in Table 12. In model (1) through (3), as for financially constrained firms, the coefficient of *Tax* is positive and insignificant in all models. This finding is in line with the positive and weakly statistically significant coefficient of *Tax* reported in Table 5. When examining the effect of taxes in financially unconstrained firms model (4) through (6), the coefficient of *Tax* remains positive, however, becomes significant at 1% level in all models, suggesting the post-cut reduction of leverage. Overall, the estimates form the dynamic system GMM are consistent with the results reported in Table 5, confirming the positive correlation between taxes and leverage in financially unconstrained firms.

Table 10 Regression analysis of corporate taxes and leverage between low-dividend and high-dividend firms

Results based on equation (4) are reported. In all models, the dependent variable is leverage. In model (1) through (3) and model (7) through (9), debt is defined as short-term debt, and as long-term debt ratio in model (4) through (6) and model (10) through (12). Leverage is measured as debt to capital in model (1), (4), (7), and (9), and debt to market assets in model (2), (5), (8), and (11), and debt to book assets in model (3), (6), (9), and (12). Financially constrained (low-dividend firms) and unconstrained firms (high-dividend firms), and all other variables are defined as in Section 2.4. In parentheses is *p*-value based on the White standard errors that are robust to clustering at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Constrained firms						Unconstrained firms					
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Tax	0.45***	0.25*	0.23	0.20*	0.10	0.12	0.49***	0.34***	0.39***	0.23**	0.19*	0.09**
	(0.01)	(0.08)	(0.19)	(0.07)	(0.32)	(0.25)	(0.00)	(0.00)	(0.00)	(0.05)	(0.06)	(0.34)
Ln(total assets)	0.02	0.01	0.02	0.02*	0.02*	0.04***	0.05***	0.05***	0.07***	0.05***	0.06***	0.07***
	(0.42)	(0.49)	(0.33)	(0.08)	(0.08)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Tangibility	-0.09	-0.09	-0.05	0.03	0.04	0.11	-0.04	-0.02	0.02	0.08	0.05	0.15***
	(0.22)	(0.20)	(0.54)	(0.61)	(0.52)	(0.14)	(0.43)	(0.69)	(0.76)	(0.21)	(0.52)	(0.00)
Profitability	-0.28*	-0.17	-0.25*	-0.13**	-0.06	-0.10	-0.17***	-0.08	-0.18***	-0.13***	-0.11**	-0.08**
	(0.06)	(0.14)	(0.06)	(0.05)	(0.31)	(0.19)	(0.00)	(0.13)	(0.00)	(0.00)	(0.03)	(0.04)
Market-to-book equity	0.00	0.00	0.01*	0.00	0.00**	0.00	-0.01***	-0.01***	0.01	-0.01***	-0.01***	0.00
	(0.53)	(0.63)	(0.09)	(0.27)	(0.05)	(0.33)	(0.00)	(0.00)	(0.17)	(0.00)	(0.00)	(0.42)
Industry leverage	-0.13	-0.02	-0.17	0.02	0.05	0.06	0.11	0.04	0.07	0.15	0.07	0.16*
	(0.45)	(0.91)	(0.38)	(0.78)	(0.55)	(0.51)	(0.41)	(0.72)	(0.63)	(0.16)	(0.45)	(0.09)
$Lev_{i,t-1}$	0.20***	0.18***	0.23***	0.19***	0.18***	0.23***	0.06	0.05	-0.04	0.30***	0.25***	0.37***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.36)	(0.42)	(0.59)	(0.00)	(0.00)	(0.00)
Constant												
Adjusted R^2 (%)	84.04	82.12	82.59	78.08	75.39	80.30	88.15	87.83	86.12	81.83	76.85	84.41
Number of observations	424	424	424	424	424	424	424	424	424	424	424	424

Table 11 Regression analysis of corporate taxes and leverage

Results based on equation (4) using the Blundell and Bond's system generalized method of moments (GMM) estimation method are reported. In all models, the dependent variable is leverage. In model (1) through (3), debt is defined as total debt, as short-term debt in model (4) through (6), and as long-term debt in model (7) through (9). Leverage is measured as debt to capital in model (1), (4), and (7), and debt to market assets in model (2), (5), and (8), and debt to book assets in model (3), (6), and (9). All other variables are defined as in Section 2.4. In parentheses is *p*-value based on the White standard errors that are robust to clustering at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Tax	0.52***	0.41***	0.29***	0.70***	0.39***	0.33***	0.38***	0.32***	0.20***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln(total assets)	0.13***	0.08***	0.05***	0.09***	0.04***	0.04***	0.10***	0.05***	0.05***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Tangibility	0.08**	-0.03	0.12***	0.13***	0.00	0.14***	0.07**	-0.02	0.13***
	(0.03)	(0.46)	(0.00)	(0.00)	(0.93)	(0.00)	(0.03)	(0.44)	(0.00)
Profitability	-0.29***	-0.17***	-0.12***	-0.13***	-0.08**	-0.05*	-0.20***	-0.12***	-0.08***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.09)	(0.00)	(0.00)	(0.00)
Market-to-book equity	0.00	0.00	0.00	-0.01***	-0.01***	-0.01***	0.01***	0.01***	0.00
	(0.83)	(0.53)	(0.11)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.36)
Industry leverage	0.21**	0.15*	0.07	0.52***	0.37***	0.183***	0.25***	0.19***	0.10*
	(0.01)	(0.07)	(0.33)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.06)
Constant	-1.55***	-1.12***	-1.22***	-0.75***	-0.46***	-0.46***	-0.71***	-0.66***	-0.77***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Number of observations	2,494	2,494	2,494	2,494	2,494	2,494	2,494	2,494	2,494

Lastly, to examine the effect of taxes across the maturity structure, I rerun the analysis in Table 6 with the dynamic system GMM estimation, and results are reported in Table 13. As report in model (1) through (6) where firms are financially constrained firms, the coefficient of *Tax* are all positive and insignificant with one trivial exception in model (2). Though Table 5 reports the positive and significant coefficient of *Tax* on the long-term debt ratio, I find no evidence of the tax effect of leverage on both maturity structure. However, when looking across the maturity structure in financially unconstrained firms, the coefficient of *Tax* is remaining positive, however, becomes significant in model (7) through (12). This finding is in line with Table 6, suggesting the positive correlation between taxes and leverage in financially constrained firms.

While the empirical evidence shows that the effect of taxes is significant in financially unconstrained firms, the relation between taxes and leverage disappears in financially constrained firms. These findings are consistent with the results reported in Section 2.5, lending support to the hypothesis that corporate taxes and the expected financially distress costs are positively related. Overall, accounting for possible endogeneity problem by using the different estimation method does not change the main results.

Table 12 Regression analysis of corporate taxes and leverage between financially constrained and unconstrained firms

Results based on equation (4) using the Blundell and Bond's system generalized method of moments (GMM) estimation method are reported. In all models, the dependent variable is leverage defined as the total debt. Debt is debt to capital in models (1) and (4), debt to market assets in models (2) and (5), and book leverage in models (3) and (6). Financially constrained and unconstrained firms, and all other variables are defined as in Section 2.3 and 2.4. In parentheses is *p*-value based on the White standard errors that are robust to clustering at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Constrained firms			Unconstrained firms		
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)
Tax	0.15	0.13	0.14	0.88***	1.00***	0.77***
	(0.18)	(0.21)	(0.16)	(0.00)	(0.00)	(0.00)
Ln(total assets)	0.17***	0.14***	0.14***	0.10***	0.07***	0.06***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Tangibility	-0.02	-0.03	0.06	0.14	0.16*	0.20*
	(0.81)	(0.72)	(0.52)	(0.11)	(0.05)	(0.08)
Profitability	-0.17***	-0.15**	-0.27***	-0.18**	0.11	-0.08
	(0.00)	(0.03)	(0.00)	(0.05)	(0.18)	(0.52)
Market-to-book equity	0.00	-0.01*	-0.01	0.00	-0.01*	0.01***
	(0.89)	(0.06)	(0.16)	(0.69)	(0.05)	(0.01)
Industry leverage	0.05	0.05	0.04	0.26	0.91***	0.17
	(0.61)	(0.56)	(0.71)	(0.22)	(0.00)	(0.27)
$Lev_{i,t-1}$	-0.73***	-0.35**	-1.03	-0.64***	0.25**	-0.38**
	(0.00)	(0.02)	(0.25)	(0.00)	(0.02)	(0.04)
Constant	-2.45***	-1.98***	-2.06***	-1.49***	-1.28***	-0.93**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Number of observations	438	438	438	447	447	447

Table 13 Regression analysis of corporate taxes and leverage between financially constrained and unconstrained firms

Results based on equation (4) using the Blundell and Bond's system generalized method of moments (GMM) estimation method are reported. In all models, the dependent variable is leverage. In model (1) through (3) and model (7) through (9), debt is defined as short-term debt, and as long-term debt ratio in model (4) through (6) and model (10) through (12). Leverage is measured as debt to capital in model (1), (4), (7), and (9), and debt to market assets in model (2), (5), (8), and (11), and debt to book assets in model (3), (6), (9), and (12). Financially constrained and unconstrained firms, and all other variables are defined as in Section 2.3 and 2.4. In parentheses is *p*-value based on the White standard errors that are robust to clustering at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Constrained firms						Unconstrained firms					
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Tax	0.08	0.09**	0.11	0.09	0.011	0.13	0.75***	0.53***	0.55***	0.33**	0.19*	0.23*
	(0.16)	(0.05)	(0.16)	(0.35)	(0.90)	(0.14)	(0.00)	(0.00)	(0.00)	(0.01)	(0.09)	(0.05)
Ln(total assets)	0.06***	0.05***	0.05***	0.10***	0.08***	0.11***	0.06**	0.02	0.02	0.03*	0.02	0.03
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.03)	(0.22)	(0.33)	(0.07)	(0.16)	(0.12)
Tangibility	-0.05	-0.05	-0.01	0.07	0.04	0.11**	0.08	0.05	0.11	0.06	0.07	0.07
	(0.31)	(0.32)	(0.87)	(0.23)	(0.51)	(0.05)	(0.47)	(0.59)	(0.34)	(0.50)	(0.32)	(0.31)
Profitability	-0.09***	-0.06*	-0.12**	-0.09*	-0.10*	-0.15***	0.04	0.12	0.15	-0.17**	-0.03	-0.05
	(0.01)	(0.06)	(0.01)	(0.06)	(0.06)	(0.00)	(0.69)	(0.15)	(0.28)	(0.02)	(0.62)	(0.40)
Market-to-book equity	0.00	0.00	0.00	0.00	-0.01*	0.00	0.00	-0.01*	0.01	0.00	0.00	0.01**
	(0.39)	(0.12)	(0.55)	(0.87)	(0.08)	(0.74)	(0.78)	(0.09)	(0.12)	(0.68)	(0.23)	(0.03)
Industry leverage	-0.02	-0.01	-0.01	0.05	0.05	0.04	0.31	0.82***	0.36*	-0.04	0.24	0.01
	(0.64)	(0.82)	(0.85)	(0.39)	(0.47)	(0.47)	(0.16)	(0.00)	(0.08)	(0.82)	(0.11)	(0.98)
$Lev_{i,t-1}$	-0.11	-0.04	-0.06	-0.26***	-0.24***	-0.07	-0.34***	0.07	-0.45***	-0.02	0.07	-0.01
	(0.12)	(0.47)	(0.52)	(0.00)	(0.01)	(0.47)	(0.00)	(0.41)	(0.00)	(0.73)	(0.17)	(0.90)
Constant	-0.80***	-0.64***	-0.70**	-1.49***	-1.20***	-1.61***	-0.96**	-0.51	-0.42	-0.44*	-0.43	-0.42
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.03)	(0.12)	(0.25)	(0.08)	(0.10)	(0.12)
Number of observations	438	438	438	438	438	438	447	447	447	447	447	447

2.7. Conclusion

Though literature examines the relation between corporate taxes and leverage, existing evidence remains mixed. This chapter investigates the effects of taxes on leverage by proposing the new argument that corporate taxation may not only affect the tax shield benefits, taxes have an impact on the cost of debt financing through the expected cost of financial distress as well.

Using a natural experiment of the unique corporate tax cut in Thailand in 2012, I find that firms, in general, reduce both short-maturity and long-maturity debts following the cut enactment,

lending support to the tax sensitivity of leverage, and accordingly, the static trade-off model. This finding stands in sharp contrast to the recent insights derived from small tax cuts. When a tax cut is sizeable, the decrease in available tax shields dominates shareholders' disincentive to reduce leverage.

When looking across the firm's financial conditions, the significant effect of taxes on leverage remains valid only in unconstrained firms. On the other hand, the correlation between corporate taxes and leverage is disappearing in constrained firms. These findings are also robust to the alternative specification dealing with the identification of the financial constraints, and to the different method used in testing the effect of taxes.

The empirical results give support to the main hypothesis that corporate taxes and the costs of debt financing are positively correlated. Holding other thing being constant, corporate taxes lower the firm's after-tax profit and market value so that the expected cost of distress increases. Hence, a higher tax rate may induce firms to rely more on the debt financing because of the higher tax shield benefits. However, due to the higher expected cost of financial distress, firms may be more aware of raising more debt financing, leaving leverage unchanged.

Overall, the results in this chapter mainly contribute to the ongoing debate and discussion on the relation between tax rates on the firm leverage. While the static trade-off theory may fail to explain the role of taxes on the corporate capital structure in some empirical evidence found in the previous studies, it may not be the case when considering the costs of debt financing as a function of taxes. The main finding on the positive relation between taxes and leverage, therefore, helps to understand the puzzle of the mixed evidence found in the previous studies. Future work may explore the threshold at which the marginal change in tax shields exceeds the marginal change in costs of debt financing and whether firms further adjust their leverage once the cut is permanent.

CHAPTER 3

CORPORATE TAXES AND SPEED OF ADJUSTMENT TOWARD TARGET CAPITAL STRUCTURE: CROSS-COUNTRY EVIDENCE

3.1. Introduction

In the study of capital structure decisions, literature has been devoting much of its attention to explore the static trade-off model as previously mentioned in chapter two. However, less is known about the dynamic trade-off theory especially with the cross-country evidence. Prior studies have been attempted to theoretically and empirically explore the dynamic trade-off theory of capital structure, mainly in the context of the speed of adjustment. Although several determinants have been found to explain the speed of adjustment toward the target leverage (see, for example, Antoniou et al., 2009; Byoun, 2008; Cook & Tang, 2010), current evidence remains limited and deserve further investigation. As suggested in Huang and Ritter (2009, p. 239) that "This [speed with which firms adjust toward target leverage] is perhaps the most important issue in capital structure research today".

In a frictionless world, the trade-off theory of capital structure suggests that firms respond to any leverage shocks by quickly moving toward their target leverage (Flannery & Rangan, 2006; Jalilvand & Harris, 1984). However, with the presence of frictions such as adjustment costs, firms have incentive to maintain the deviations or slowly converge to their target leverage. Hence, firms adjust their leverage to target only when benefits of adjusting exceed the adjustment costs (Fischer et al., 1989), making firms adjust their leverage infrequently over time. This theory is referred to as the "dynamic trade-off theory of capital structure".

In the dynamic setting, corporate taxes have an effect on adjustment speeds through debt financing due to the tax shield benefits (Graham, 1996). However, the previous chapter has examined the effect of corporate taxes on capital structure decisions in the static trade-off model, and results reveal the possibility of the relation between taxes and the expected costs of distress. If there exists such a relationship between taxes and costs of debt financing as obtained from the static setting, this relation should remain valid independently of the model selection. Specifically, as taxes rise, firms become more financially constrained due to the reduction in market value. Hence, firms may find it more difficult to access the capital market, resulting in an increase in adjustment costs. Consequently, the speed of rebalancing becomes slower. When view together, taxes should have an impact on both benefits of adjusting and adjustment costs, and should be considered as one important factor in determining when and how fast a firm adjusts towards optimal leverage. Among the potential determinants of firm adjustment speeds, to date, there is only little evidence on how taxes affect the speed of adjustment.

Accordingly, this chapter seeks to explore the effects of taxes on capital structure adjustment speeds, and further empirically confirm the relation between corporate taxes and cost of debt financing by applying the finding in chapter two, the positive relation between taxes and expected cost of distress, in a context of the dynamic trade-off theory. In other words, this chapter extend the arguments from the previous chapter to a more general setting by asking “how tax affects the speed of adjustment towards target leverage?”.

To examine the effect of corporate taxes on capital structure decisions, this study avoids basing conclusions from the previous chapter that utilized the single tax reform which may result in obtaining the unique effect on corporate debt policy by exploiting the cross-country variation in tax rates along with other determinants from 31 developed and developing countries in OECD countries between 1995 to 2015.

This chapter contributes to the literature on the dynamic trade-off theory of capital structure and mainly differs from the existing empirical evidence which related to the speed of adjustment in the following ways. First, previous studies examine the effect of taxes only as one component of the adjustment benefits through the advantage of tax shields. However, not only taxes can affect tax shield benefits, corporate taxes also play an important role in the expected distress costs as shown in chapter two. With a higher tax rate, the market value of a firm declines, making it becomes more financially constrained. Consequently, the adjustment costs increase. Accordingly, both the costs and benefits of adjusting, which determine the speed of adjustment, should be related with corporate taxes.

Second, in order to examine the importance of corporate taxes on the speed of adjustment, I take into account the relation between taxes and cost of debt financing together with the asymmetry in speed of adjustment across firm types. Literature shows that firms adjust their leverage toward the target with heterogeneous speeds. Specifically, over-levered firms adjust their leverage toward the optimal faster than under-levered firms due to the higher cost of deviation (Byoun, 2008; Faulkender, Flannery, Hankins, & Smith, 2012). With the higher tax rate, under-levered firms gain additional benefit of reaching the target leverage, and therefore, should converge toward their optimal faster due to the higher debt tax shield. On the other hand, according to the possible relation between taxes and expected cost of distress, higher tax rates worsen the firm's financial conditions, and thus, increase the adjustment costs. An increase in expected distress costs for over-levered firms, however, would be relatively larger than under-levered firms. Therefore, the costs of deviations from target leverage in over-levered firms would be large enough to dominate the tax shield benefits so that they have less incentive to make adjustment to target leverage. On the other hand, under-leverage firms are considered to be in a safer position. An increase in the expected distress cost can be dominated by the larger benefit from the tax shields. Therefore, under-levered firms with financial constraints should still have incentive to adjust their leverage toward the optimal although with less speed of adjustment.

I utilize the cross-country analysis to empirically explore the effects of taxes in the context of dynamic trade-off theory. By using the system GMM estimator in dynamic panel data models to estimate the partial adjustment model of leverage, I find that over-levered and under-levered firms move toward their target leverage with different speeds. Specifically, consistent with Byoun (2008) and Faulkender et al. (2012), I find that over-levered firms adjust their leverage toward the optimal faster than under-levered firms. However, with the effect of taxes, results indicate only under-levered firms adjust toward the target more quickly when tax rates are high. This finding suggests that the tax advantages of leverage increases the benefit of adjusting upward to the target leverage in under-levered firms(Öztekin & Flannery, 2012). On the other hand, the effects of taxes are weaker in over-levered firms.

To understand the relation between taxes and cost of debt financing in the dynamic trade-off theory, I further examine the effect of taxes in four subsamples based on a combination between leverage positions (over- and under-levered firms) and the financial conditions (financially constrained and unconstrained firms). The result shows that corporate taxes are positively and significantly related with leverage in under-levered firms regardless of the financial conditions. However, the speed of adjustment to target leverage is lower in under-levered firms with financial constraints, suggesting the higher adjustment costs as taxes rise. When looking at the speed of adjustment in over-levered firms, the effect of taxes on leverage remains significant in over-levered and financially unconstrained firms, while I find a weaker evidence of taxes effect of speed of adjustment in over-levered firms with financial constraints. Overall, the results suggest that corporate taxes and the speed of adjustment toward optimal leverage are correlated, and the relation between taxes and expected cost of distress remains valid in the dynamic trade-off theory.

This chapter helps to fulfill the limited evidence of the relation between corporate taxes and the speed of adjustment by being the first to empirically examine the link between corporate taxes and adjustment speed with cross-country analysis, and by incorporating the effects of taxes with leverage positions and financial conditions. Also, this chapter provides a further understanding of the relation between taxes and expected cost of distress in another strand of the capital structure decisions.

The remainder of this chapter is organized as follows. In the next section, I review the related theories for the speed of adjustment toward target leverage and also the heterogeneous adjustment speed. Section 3.3 develops the main hypothesis of the relation between taxes and speed of adjustment. Section 3.4 describes the data set and empirical methodology. The empirical results are discussed in Section 3.5, and Section 3.6 concludes the chapter.

3.2 Literature review

3.2.1 The dynamic trade-off theory of capital structure

The previous chapter examines the effects of corporate taxation on the firm's capital structure decisions under the prediction of the static trade-off theory. More specifically, chapter two studies the effects of corporate tax cut on the capital decisions, by assuming that firms use debt financing until the interest tax shield benefits from additional debt financing are just balanced by additional costs from a higher risk of financial distress.

However, by including adjustment costs into the static trade-off theory of capital structure, Fischer et al. (1989) suggest that adjustment costs may prevent firms from continuously rebalancing to the target leverage. This implies that firms may not always be at their optimal as predicted by the static trade-off theory, and they will adjust their leverage toward the target only when the benefits of adjusting outweigh the costs of doing so.

This theory is known as the "dynamic trade-off theory of capital structure". In contrast to the static trade-off theory, the dynamic trade-off models relax the zero adjustment cost assumption in the frictionless world so that issuing and repurchasing debt would be costly for firms. Consequently, firms may have an optimal leverage range, instead of one static level as suggested in the static trade-off model. However, this target leverage is not directly observable, and vary across time and firms due to the changes in the firm's characteristic and market conditions. Moreover, Fischer et al. (1989) find that the types of adjustment cost also determine how much firms will adjust their capital structure. The authors suggest that even with small transaction costs probably produce large variations in observed leverage ratios while producing a relatively small effect on optimal capital structure, compared to taxes and distress costs. As a result, firms whose leverage ratios do not coincide with their targets would be reluctant to rebalance their leverage to the target, and they would only adjust their capital structure when the benefits of doing so outweigh the costs of adjustment.

For the empirical evidence on the dynamic trade-off theory Hovakimian, Hovakimian, and Tehranian (2004) report that a firm is more likely to issue debt or repurchase shares when its debt ratios below target, and the probability of a debt issue is also higher for more profitable firms, and for firms with low market-to-book ratios.[22] For those which operate above-target, they are more likely to retire debt. Hence, they conclude that, in general, management acts to move leverage towards a target debt ratio, and the target can be determined by the characteristics of firms.

Although the above studies suggest that adjustment of leverage towards the target can be costly and these costs may prevent firms from adjusting leverage towards target, making adjustment is still required because the deviations from target debt ratio also costly for firms as well. As suggested in the literature, the costs of deviation vary across firms due to their leverage positions and significantly affect the firm's capital structure policy (Byoun, 2008; Faulkender et al., 2012; Korajczyk & Levy, 2003). More

[22] As in Hovakimian et al. (2004), profitability is taken as a measure of debt servicing capacity and market-to-book ratio measures the importance of growth opportunities.

details on deviation costs due to the firm's leverage positions will be discussed in the next section.

Specifically, literature shows that the speed of adjustment depends on two main factors, the costs of deviating from the target leverage and the costs of adjusting toward the target. On the one hand, Faulkender et al. (2012) show that financial conditions of a firm, such as the degree of the financing deficit and the magnitude of target deviation, are likely to have a significant effect on the adjustment speed. On the other hand, the firm's institutional and financial environment also affect costs of deviating from the target leverage and the adjustment costs (see, for example, Antoniou et al., 2009; Cook & Tang, 2010; Öztekin & Flannery, 2012).

Hence, due to the difference in adjustment costs and costs of deviation regarding to the firm's characteristic and market environment, a firm would employ different financing policy in order to rebalance its leverage towards the target. This in turn implies that firms should have different incentives of leverage adjustment, and therefore it determines how fast they will move back to the target, namely the speed of adjustment toward target leverage. In other words, the reversal path towards the target occurs at a speed that depends on the interplay between rebalancing costs and benefits.

In an early study of the adjustment speed, by using a partial adjustment model (which will be discussed in the methodology), Jalilvand and Harris (1984) find that firms move toward the target capital structure rather quickly by approximately 56% per year. Later, Flannery and Rangan (2006), by estimating the corporate target leverage using an instrumental variable approach, report that that approximately 33.33% of the gap between actual and target leverage will be closed each year. They argue that the variation in adjustment speed found in the previous study is due to estimation method of the target leverage that may contain noise. Antoniou et al. (2008) examine the adjustment speed in the G-5 countries, and report a similar coefficient for the U.S. companies (32.2% per year).[23]

In a more recent study, Öztekin and Flannery (2012) use a larger international sample and analyze whether institutional cross-country differences explain the variance in the speed of adjustment. The authors show that firms in countries with the common law legal origin rebalance their leverage toward the target with an average rate of 9% to 14% per year (depending upon the econometric methodology employed) faster than civil law originated countries, since the market based economies generally involved with lower market frictions. Moreover, macroeconomic conditions also affect the firm's time-varying abilities to move their leverage back to the target (Cook & Tang, 2010; Halling, Yu, & Zechner, 2016). By exploiting an international sample, Cook and Tang (2010) report that adjustment dynamics vary over the business cycle, and the speed of adjustment is lower during recessions than during expansions periods.

Although recent evidence suggests that the speed of adjustment varies across firms and countries, there is still no clear consensus in the empirical literature on the determinants related with the adjustment speeds. Intuitively, the heterogeneity of the estimated speeds of adjustment between these empirical tests has different implications for the determinants of capital structure. A slow adjustment speed suggests that the current leverage possibly depend on past financing activities. This suggests that firms may not have a target capital structure or the benefits of reaching the target is

[23] They find that the speed of adjustment is the fastest in France (39.4% per year) and slowest in Japan (11.1% per year).

insignificant. On the other hand, quick adjustment implies that history play no role and that the trade-offs between the costs and benefits associated with financial policies will determine the optimal capital structure (Flannery & Rangan, 2006).

However, besides the extensive research in the context of the dynamic trade-off theory, there has been little evidence on the impact of taxes on the adjustment behavior in different countries and under different financial conditions. As will be discussed in the next section, this chapter would extend an argument of the relation between taxes and distress cost as in the previous essay in a context of the dynamics trade-off theory, which is a more general setting of the trade-off theory. Although a number of studies examine the speed of adjustment in the context of dynamic trade-off theory and show that firms slowly adjust their leverage toward the target due to adjustment costs, results from the existing literature remain mixed and inconclusive, as suggested in Frank and Goyal (2008).

3.2.2 Taxes and symmetric speed of adjustment towards target leverage, assuming the independence between taxes and expected distress costs

The dynamic trade-off theory of capital structure indicates that firms usually consider the cost of adjustment toward a target capital structure over time. Hence, the adjustment would be instantons only if the cost of adjustment is zero, otherwise the adjustment would gradually take place over time. In reality, due to imperfect market, such as “asymmetric information and financial costs” are not likely to be zero, and hence, firms may deviate some times from their desired level of leverage, especially during the process of capital structure adjustment. These occurrences have been examined and observed by several empirical studies such as Fischer et al (1989) and

Leary and Roberts (2005), with consensus that firms tend to move back to a target leverage ratio but the speed at which firms rebalance their capital structure is still undetermined.

As for the effect of taxes, the static trade-off theory predicts that the tax advantages of debt are a primary benefit of debt financing (Modigliani & Miller, 1963). Thus, firms in countries with relatively high corporate tax rates will tend to carry higher debt ratios, in order to maximize the tax benefits of debt financing. In the dynamic setting, however, the evidence for the effects of debt tax shied benefits remain scarce.

According to the dynamic tradeoff theory, the speed at which managers will reverse the deviations from their target leverage varies due to the benefits and cost of adjustment. As for the benefit of adjustment towards target leverage, Graham (1996) shows that the tax shield benefits of debt play an important role in the adjustment to target capital structure. He suggests that the tax advantages of debt financing increase the benefit of rebalancing and maintaining at the target leverage, especially for those firms that operate below the target.

As for the adjustment costs, Fischer et al (1989) suggests that a small cost of adjustment can create a large fluctuation in capital structure. Leary and Roberts (2005), by incorporating costly adjustment, report that firms would be reluctant to or slowly move towards the target, and management allows leverage to deviate from the target until the gain in market value from rebalancing outweighs the cost. Consistent with the importance of adjustment costs on financing decisions, Faulkender et al. (2012) suggest that adjustment speeds vary across firms due to their financial conditions, and hence, financially constrained firms move more slowly toward its target leverage when they are under-levered. However, taxes are assumed to be independent to these costs in the previous studies.

A number of studies have examined the determinants that can be related to the speed of adjustment as I have mentioned in the previous section.[24] However, little attention has been devoted to the effect of corporate tax on speed of adjustment towards target leverage. Among the existing empirical evidences in this context, Antoniou et al. (2008) show that a country's economic background, tax systems, institutions and governance practices can explain the variation in speed of adjustment across countries. However, inconsistent with the static trade-off theory, they find that taxes and leverage are inversely related and "why the firms do not adjust their leverage to minimize their tax burden remains a puzzle" (Antoniou et al., 2008, p. 73). Huang and Ritter (2009) examine the relation between statutory corporate taxes and the speed of adjustment. They show that corporate tax rates and the speed of adjustment are negatively correlated but insignificantly so. Cook and Tang (2010) report that firms adjust their leverage toward target more quickly in good macroeconomic conditions, and suggest that the variation in target leverage possibly can be determined by changes in macroeconomic conditions. However, they do not examine the impact of taxes. Recently, Öztekin and Flannery (2012) conduct a cross-country analysis and show that the adjustment speeds can be explained by the institutional differences. They find that adjustment speeds are related with adjustment benefits and taxes play an important role in these benefits. By

[24] Jalilvand and Harris (1984) show that size of firms affects the speed of adjustment. Drobetz and Wanzenried (2006) show that the macroeconomic factors influence adjustment speed. Byoun (2008) suggests that the financial deficit of firms significantly determine the speed of adjustment. Faulkender et al. (2012) find that large cash flow realizations allow firms to adjust faster due to the lower leverage adjustment costs.

using variation of effective tax rates across countries to examine the correlation between corporate taxes and the speed of adjustment, they find that the benefits of adjustment are positively related to effective tax rate. The results show that a country with higher effective tax rate adjusts faster due to a higher tax shield benefit, but with very weak effect.

To this extent, it has been documented in the literature that taxes affect adjustment benefits due to tax advantages of debt financing. However, whether and to what extent the tax shield benefits affect the adjustment cost to target capital structure is still inconclusive.

3.2.3 Taxes and asymmetric speed of adjustment towards target leverage, assuming the independence between taxes and expected distress cost

Regarding to the empirical evidence for the impact of taxes on the speed of adjustment toward the target capital structure as mentioned in the previous section, however, it is very important to recognize that they do not allow for asymmetric adjustment costs and leverage adjustment. In other words, the previous literature implicitly assumes that all firms adjust their leverage toward the target at the same rate due to the symmetry in costs and benefits of rebalancing. However, these costs and benefits need not be symmetric depending on whether firms are over or under-levered, and also their financial conditions. This is an important limitation of their analysis, and it may lead to a bias estimation in the speed of adjustment (Chang & Dasgupta, 2009).

Thus, a recent strand of the literature takes explicitly into account the asymmetries both on the relative amount of leverage and costs of adjustment when firms adjust toward their target debt ratio. The bottom line of these new studies is that the adjustment speed depends on firm characteristics, especially on leverage positions, and any future research on the speed of adjustment should be conditioned on these characteristics to increase the statistical power of the tests (Byoun, 2008; Faulkender et al., 2012).

There are a few possible reasons that may explain the relative faster speed of adjustment for over-levered firms than under-levered firms. First, over-levered firms concern more about their leverage position due relative higher costs of financial distress from the excessively use of debt financing. On the other hand, under-levered firms should have lower costs of deviations from leverage target (Flannery & Rangan, 2006). Consequently, the adjustment toward the target leverage becomes more pronounce for over-levered firms, either for external financing or financial flexibility, making over-levered firms to rebalance their leverage toward the target more quickly (Byoun, 2008). In other words, making adjustment towards the target leverage by reducing debt ratios is more necessary for over-levered firms.

In addition, apart from the difference in cost of deviations from target leverage due to the firms leverage positions that cause the asymmetric speed of leverage adjustment, literature also reports another important source of this asymmetry, which is the difference in the costs of adjustment facing firms due to different characteristics and positions relative to target leverage (Fischer et al., 1989). However, Leary and Roberts (2005) show that, in fact, adjustment costs contain fixed costs plus weakly convex variable costs. According to the weakly convex variable costs, it implies that the curve of adjustment costs is flatter than the curve of adjustment benefit.[25] Thus, as

[25] For more details on the derivation, please see Leary and Roberts (2005).

the adjustment costs increase at a slower rate than the costs of deviations (costs of not adjusting), the net benefit from rebalancing would then broaden with the size of deviation from the target leverage. Consequently, the greater the deviation from target, the more the incentive that firms would rebalance and the higher the speed. This in turn implies that the size of adjustment costs relative to the adjustment benefit would determine when and how fast a firm adjusts.

The intuition behind the asymmetric speed of adjustment is that the present value of financial distress costs increase exponentially as firms further deviates above the target leverage. However, firms under the target may find it relatively less necessary to adjust their leverage upward to the target although they also benefit from an increase in leverage. Roberts (2002) reports that the current leverage position relative to the target play an important role in determining adjustment speeds. By dividing the sample into four adjustment quartiles, he empirically confirms that over-levered firms adjust more quickly than under-levered firms. Moreover, with fixed and weakly convex adjustment costs, Leary and Roberts (2005) and Elsas and Florysiak (2011) report that adjustment becomes relatively cheaper with increasing deviations. As a result, firms which further move away from their target debt ratio are more likely to adjust faster than firms near or at their target.

The empirical evidence on the asymmetry in speed of adjustment towards target leverage seems to support the above argument, Hovakimian, Opler, and Titman (2001) report that over-levered firms in the United States make faster adjustments than under-levered firms, by employing debt reductions. Drobetz and Wanzenried (2006) report that firms which grow faster or further deviate from their target debt ratio make faster adjustment. Flannery and Rangan (2006) argue that highly leveraged firms face higher cost of deviations from target, and find that the most over-levered firms or firms with relatively high debt ratios reduce their debt ratios back to the target with higher speed than firms with lower debt ratios. On the other hand, among under-levered firms, firms increase their leverage more rapidly when absolute leverage is the lowest. Byoun (2008) extend Flannery and Rangan (2006) by incorporating the financing-needs-induced models (financial deficit/surplus) with the firm leverage positions (over or under-levered firms).[26] The results show that over-levered firms use all of financial surpluses to pay off debt while under-levered firms finance their deficits with more debt. Therefore, over-levered firms with a financing surplus have faster adjustment speed than those with a financing deficit. Faulkender et al. (2012) also argue that the deviations from the target leverage may not explain all the incentives that firms make adjustment. By accounting for the potential association between cash flow and leverage deviations, Faulkender et al. (2012) report that when firms with greater operating cash flow and leverage deviations adjust faster than firms with lower cash flow realizations. Thus, by allowing the adjustment speeds to vary depending upon whether the firm is over or under its target leverage, literature finds that over-levered firms adjust more quickly than under-levered firms.

To this extent, the above studies do not explicitly address the effect of corporate taxes that may have a significant effect on an asymmetric adjustment speed that empirically found previously. Although firms face differential tax rates may have

[26] For the derivation of financial deficit, please see an equation (4) in Byoun (2008).

varying speed of adjustment, the evidence of the tax effects conditioned on the asymmetric speed remains limited.

In a dynamic setting, the trade-off theory predicts that adjustment speeds should be positively related to the adjustment benefits (the benefit from not deviating from the target). As suggested by Faulkender et al. (2012), there is no theoretical reason to expect symmetry adjustment between under- and over-leveraged firms. In particular, under-levered firms forgo the debt tax shield benefits and still have rooms for debt financing. They may also have little concerns with financial distress costs due to the lower debt ratios. In contrast, financial distress costs can be more excessive for over-leveraged firms.

More specifically, among the existing evidence, Clark, Francis, and Hasan (2009) suggest that firms with relatively large untapped tax benefits of debt financing are expected to adjust toward their respective targets faster than firms who have less benefits from increasing their leverage ratios. The authors report that the adjustment speed of the subsample of firms with untapped tax benefits of debt financing is increasing with corporate tax rates. However, they do not directly examine the effects of taxes on the firm's leverage positions, whether they are over or under the target leverage. Öztekin and Flannery (2012) find evidence to support this argument by suggesting that the advantages of debt financing from taxes should increase the benefits of moving towards the target capital structure for under-levered firms due to higher incentives to shield taxes.

As for the under-levered firms, the deviation from their target generates higher costs of deviation due to the loss of tax shield benefits. This in turn implies that the under-levered firms should have more incentive to adjust their leverage toward target level when tax rates are high due to a higher benefit of adjustment from tax benefits of leverage. However, as for the over-levered firms, the effects of corporate tax on the speed of adjustment remains inconclusive. Specifically, literature provides no evidence on the relation between the adjustment speed and corporate tax for firms operate over their target leverage. This issue has been ignored in prior studies.

In sum, according to the above literature, as a firm further deviates from its target leverage downward (upward), the foregone tax savings (bankruptcy costs) rise at an increasing rate while bankruptcy cost declines at a decreasing rate. This phenomenon explains the asymmetric speed of adjustment as an increasing function of the costs of deviation from the target.

3.3 Hypothesis development

3.3.1 Taxes and asymmetric speed of adjustment towards target leverage, allowing taxes to affect expected distress costs

As for the effect of taxes on the asymmetric speed of leverage adjustment, it is well established in the literature that corporate tax positively affects the speed of capital structure adjustment only for under-levered firms, through the adjustment benefits from debt tax shields (Graham, 2000; Öztekin & Flannery, 2012). This is because the adjusting benefits are higher due to higher incentives to shield taxes in institutional settings imposing higher corporate tax rates, thereby causing higher speed of adjustment to target leverage. More specifically, while under-levered firms rebalance their leverage to target with faster speed under the higher tax environment, there appears to be no prior study to investigate the relation between taxes and speed of adjustment on over-levered firms.

Further, as in the context of static-trade off theory, an argument in chapter two indicates that corporate tax can also affect distress costs through the probability of distress. To be more specific, with a higher (lower) tax rate, firms would have less (more) after-tax profits so that the probability of distress will be higher (lower), and therefore increase (decrease) the distress costs. Hence, if there exists a positive association between corporate tax rates and the costs of distress, as already examined under the static trade-off theory in essay one, this relation possibly exist in the dynamic setting as well.

This chapter builds on the relation between corporate tax and distress costs demonstrated in chapter two, by specifically examining the effect of taxes on the adjustment speeds. In other words, this chapter examines an argument from the previous chapter, by allowing taxes to affect expected distress costs, in another context of the trade-off theory, namely the dynamic trade-off theory, which is generally known as a more general setting than the static trade-off theory as in chapter two (tax cut). In particular, corporate tax can be higher, lower, or remains unchanged overtime.

In order to examine the linkage between taxes and distress costs in the context of dynamic trade-off theory, this chapter investigates the effects of corporate tax rates (across countries) on the asymmetric speed of leverage adjustment resulting from the deviation from the target leverage ratio and the degree of financial constraints. To be more specific, this chapter examines the effects of corporate taxation on speed of capital structure adjustment across different leverage positions (over-levered or under-levered) and alternative financially constrained or unconstrained conditions to take into account differential impacts of taxes on adjustment costs and benefits. The relationship between taxes and distress costs should affect these two types of firms differently.

In particular, without the progressive tax rates, the expected tax shield is a concave function in debt (Graham, 2000). In other words, this benefit is increasing at a decelerating rate, and possibly turns negative as the amount of using the tax shield offered by debt diminishes with leverage. In contrast, the bankruptcy costs are generally known as increasing at an increasing rate as more debt is employed (Myers, 1984). Thus, when firms are over (under) the target leverage, the bankruptcy costs rise (decline) at a faster (slower) speed than the tax benefits as the leverage further deviates. Hence, the benefit from leverage adjustment and the cost of deviations increase with deviation, and the firms will have more incentives to move the leverage toward the target if they further deviate from the target, at least for over-levered firms.

Therefore, regardless of other firm characteristics (such as financial conditions), as under-levered firms further move away from the target leverage by employing less debt financing, the costs of deviations from the target rise mainly due to the loss of tax shield benefits. Hence, the incentive to adjust toward the target would be higher when under-levered firms forgo more of the tax shield benefits. In other words, the adjustment benefits (due to the tax shields) would be higher as they move back towards the target, by raising debt financing. Accordingly, with a lower tax rate, the benefit of debt financing decreases so that the forgone benefit of tax shield (the adjustment benefit) also decreases. On the other hand, firms would pay less taxes so that after-tax profits increase. As shown in chapter two, by allowing taxes to affect costs of distress, the probability of distress and also financial distress costs of firms would be lower due to a lower tax rate as well.

Although the costs of distress will also be lower in under-levered firms, they already had less concern with the costs of distress due to the relatively lower of debt usage in the first place. Thus, a reduction in distress costs would have trivial benefits for them. Moreover, under-levered firms can obtain more tax shield benefits when they move the leverage upward to target while costs of distress would also increase with relatively slower rate. For these reasons, a lower corporate tax rate would reduce tax shield benefit so that incentive of under-levered firms to make adjustment becomes less. In sum, the reduction in distress costs and the lower in tax shield benefit due to a lower tax rate would lower the firm's incentive to rebalance leverage, thereby reducing the speed of adjustment to target leverage for under-leverage firms.

On the other hand, unlike under-levered firms, the main source of the deviation costs in over-levered firms is the cost that borne by financial distress, since they have excessively relied on debt financing and already extracted the relatively large amount of tax shield benefits. Due to a higher distress probability and distress costs, over-levered firms may find it relatively more difficult (or even impossible) to access and borrow from the capital market. This implies that over-levered firms should have more concern on the leverage positions due to relatively higher cost of deviations from the target. Hence, with less distress costs due to lower corporate tax rates, over-levered firms can obtain benefits from the lowering in the costs of deviations, and possibly also a better ability to access the capital market. Thus, the benefits from a reduction in distress costs would be relatively larger than under-levered firms since over-levered firms have more concern about costs of distress. As a result, the incentive to make leverage adjustment for over-levered would be lower when taxes are low due to the decrease in the costs of deviations.

Furthermore, as for the benefit of tax shields, over-levered firms will have less incentive to use debt financing due to lower tax shield benefits from a lower tax rate. Therefore, the two opposing changes in incentive to adjust toward target leverage, slower adjustment speed due to the lower in costs of deviation from the reduction in expected distress costs and faster adjustment due to the lower benefits of debt from a lower tax rate could be offset, and hence, corporate taxes may have little or no effect on the adjustment speed for over-levered firm. This possibly explains why the literature finds no evidence on the relation between taxes and the adjustment speed toward the target in over-levered firms.

More importantly, as for the firm characteristics influence adjustment costs and speed of adjustment, literature also reports that financial conditions on the firm-level, namely whether firms are financially constrained or unconstrained, can be considered as another source for cross-sectional variation in adjustment speeds. Since financial constraints should affect the costs and benefits of rebalancing firm capital structure, highly financially constrained and less financially constrained firms therefore should have different speed of adjustment.

By definition as in the previous chapter, financially constrained firms will find it relatively more difficult to access the capital market, making the adjustment towards their target debt ratios by issuing equity or raising debt financing seem to be impossible (Lamont et al., 2001). Specifically, evidence indicates that firms facing potentially less financial flexibility and more financial constraints undertake slower leverage adjustment towards target leverage.[27] Thus, this argument potentially implies a slower adjustment speeds for financial constrained firms due to the relatively higher adjustment costs (Öztekin & Flannery, 2012).

However, Drobetz, Schilling, and Schröder (2015) report that the adjustment speeds are higher for financially constrained firms across all leverage quintiles. The authors suggest that, presumably, the high adjustment costs of constrained firms can be outweighed by the high costs of deviating from the target capital structure. In particular, constrained firms should have more concern over the financial conditions, thereby having to maintain the degree of financial flexibility and avoid being shut off from the capital markets. In order to do that, they have to be at their target leverage ratio and attempt to adjust rapidly subsequent to any leverage shock.[28] Consequently, the costs of deviation from the target capital structure for financially constrained firms should be relatively higher than those for unconstrained firms so that and they may even adjust faster toward the target. Elsas and Florysiak (2011) find evidence to support this argument, by examining the importance of a firm's rating on capital structure adjustment, they report that the CCC+ to D-rated U.S. firms, which are more likely to suffer from financial constraints, have the fastest adjustment speeds.

Thus, by taking into account for the firm's financial conditions together with its leverage position, the lower corporate taxation may not only reduce the costs of

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[27] These firms are in this condition, for example, due to a large dividend payments or investment (Korajczyk & Levy, 2003). More details on the categorization on constrained firms will be discussed in the next section (data and methodology).

[28] For example, Graham and Harvey (2001), based on surveys from 392 CFOs in the Fortune 500 list, show that maintain financial flexibility is one of the primary goal of a firm, especially for a financially constrained firm.

deviations from the target capital structure, but also the costs of adjustment. This is because firms can be in a better financial condition and may find it easier to access the capital market because of the marginal amount of cash left in the firm from lower taxes, which can reduce a firm's concern about excessive leverage, especially in constrained firms. More importantly, this argument is also consistent with the study in the previous chapter, by investigating the effects of taxes on distress costs, and specifically looking at the firm's financial positions.

Although the firm's financial positions can affect speed of capital structure adjustment, however, these two types of firms (constrained over- and under-levered firms) may have greatly different concern over costs of adjustment and costs of deviations due to the costs and benefits of adjustment would vary with the leverage positions and financial conditions.

On the one hand, although under-levered firms face with the significant costs of deviations from target leverage due to reduction in tax shield benefits, these costs have been shown to be relatively less important than the costs of deviations in over-levered firms from the high distress costs (Leary & Roberts, 2005).[29] Moreover, when firms deviated from the target capital structure, they have two adjustment options to rebalance their leverage toward the target, namely debt and equity financing. While over-levered firms can either retire debt or issue equity, those which are under-levered can repurchase shares or issue debt. Since over-levered firms are likely to adjust towards their target capital structure by retiring debt, this in turn implies that over-levered firms

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[29] As reported in Korteweg (2010), when a firm is under the target capital structure, a further reduction in a firm leverage generally reduces the value of a firm with constant rate. However, when the firm is above the target, the value of a firm reduces at increasing rate as leverage further increases.

could potentially encounter with relatively less costs of adjustment than under-levered firms (Hovakimian et al., 2001; Leary and Roberts, 2005).[30] On the other hand, the cost of adjustment are higher in under-levered firms than over-levered firms. This is because of increasing in debt financing are relatively more expensive than reducing it. Hence, facing with potentially higher costs of adjustment, under-levered firms tend to adjust toward the target debt ratio less quickly than over-levered firms do. This implies that the adjustment costs for the under-levered firms (from issuing debt) can be relatively higher and more important for the firm's adjustment decision than the costs of deviations, especially when they are in the financially constrained position, which entering the capital market seems to be very costly.

Thus, among under-levered firms, the financially constrained condition may lower the firm's incentive to make a leverage adjustment due to the high adjustment costs so that the benefits of moving closer to target capital structure (from tax shields) could be offset by the associated adjustment costs. On the other hand, over-levered firms should have more incentive to rebalance the leverage toward target, especially when they are in the financially constrained condition. Furthermore, as already discussed in the previous section, over-levered firms tend to have relatively higher costs of deviations from target capital structure. Therefore, with the high costs of deviations from target due to the leverage position and financial conditions, among over-levered firms, constrained above the target leverage would have relatively higher costs of deviations from the target than those over-levered firms with unconstrained condition.[31]

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[30] Hovakimian et al. (2001) show that over- leveraged firms on the US make faster adjustments with debt reductions.

[31] Dang, Kim, and Shin (2012) also report that over-levered firms can potentially face borrowing constraints and suffer from greater costs of bankruptcy.

Taken together, the firm's financial conditions, whether they are financially constrained or unconstrained, should have an impact on adjustment speeds in an asymmetrical way, and along with the leverage positions. As in Faulkender et al. (2012), financially constrained firms converge to their target leverage less quickly in under-levered firms, but faster in over-levered firms. These findings indicate that constrained under-levered firms focus more on the adjustment costs due to the relatively higher costs of accessing external capital markets, but have relatively less concerned on the costs of deviation due to loss of tax shield benefits. In contrast, constrained over-levered firms pay more attention to the costs of deviations than costs of adjustment, and therefore making faster adjustment. However, Faulkender et al. (2012) have not incorporate the effect of taxes into the estimations of the speed of adjustment.

Overall, this chapter examines the effect of corporate taxation on speed of capital structure adjustment across different leverage positions (over-levered or under-levered) and alternative financially constrained or unconstrained conditions to take into account the differential impacts of taxes on adjustment costs and benefits of adjustment with cross-country data. Thus, independently of being financially constrained or unconstrained, over-levered firms seem to move more quickly back to their target than under-levered firms. Although corporate taxes affect under-levered firms by having a positive relation with the adjustment speeds, there is still no evidence of taxes effect on speed of adjustment in over-levered firms. However, if taxes affect the costs of distress as found in the previous chapter, this relation also can be used to examine the asymmetry in speed of leverage adjustment according to the above discussions. By assessing on over-levered firms with financially constrained condition, we would expect a quicker speed of leverage adjustment, and corporate taxes should have an effect on the incentive to adjust toward the target level.

To this extent, I argue that there is a correlation between corporate taxes (across countries) and corporate adjustment speeds toward target leverage. This relation, however, also depend on the leverage positions relative to the target and the financial conditions. With a lower tax rate, the benefits of adjusting should be lower from a loss of tax shield. However, if corporate taxation also affects the expected cost of distress, costs of deviations would also be lower. According to these arguments, firms would have less incentive to alter the adjustment speed in a lower tax environment, especially for over-levered firms. Therefore, if corporate taxes significantly affect benefit of tax shields and expected distress costs as in the second chapter, over and under-levered firms should adjust to their target leverage with different speeds. However, the evidence on this link is still insufficient and inconclusive, especially in over-levered firms. The objective of this chapter is to cover partly this gap by identifying cross-sectional variations in the speed of adjustment, by exploiting whether such corporate tax rates, also to be either above-target or below-target leverage, and whether firms are financially constrained or unconstrained, are correlated with the speed of adjustment toward target leverage.

Accordingly, with a higher tax rate, under-levered firms tend to adjust their leverage toward the target with faster speed. However, when these firms are in the financially constrained position, the higher tax rates would also increase the expected distress costs, worsening the financial condition. Hence, adjusting leverage back to the target by issuing debt would be more costly. Thus, among under-levered firms, a higher tax rate will lead to a slower speed of adjustment for the constrained ones. Therefore, I hypothesize that *among under-levered firms, the speed of adjustment increases in the tax rate at a greater rate for financially unconstrained firms than for financially constrained firms.*

As for over-levered firms, tax rates may have no effect on the firm's incentive to adjust its leverage toward target. This is because the higher costs of deviations from target leverage can be offset by the higher tax shield benefits from maintaining the current leverage ratio. However, when consider over-levered firms with financial constraints, the higher tax rates possibly have a stronger effect compare to those which are unconstrained. That is, although the cost of deviations for over-levered firms increases with the higher tax rate, the increase in cost of deviations should be more pronounced in constrained firms. Consequently, the cost of deviations from the target may dominate the incentive to maintain higher leverage due to higher tax shield benefits. Accordingly, I hypothesize that *corporate tax rates have no effect on the speed of leverage adjustment in over-levered firms, however, among over-levered firms, the speed of adjustment increases in the tax rate at a greater rate for financially constrained firms than for financially unconstrained firms.*

This study sheds light on the implication of corporate taxes, apart from the optimal capital structure as in chapter two, which is the difference between over- and under-levered firms. Moreover, this study reflects the importance of frictions to the firm's capital structure decision, which is one major aspect in the trade-off theory. More importantly, by doing so, this chapter further confirm the association between corporate taxes and costs of distress, and providing supporting evidence to results found in the previous chapter, as in the dynamic setting of the trade-off theory.

3.4 Empirical design

3.4.1 Data and sample

To examine the effect of taxes on the dynamic trade-off theory, I explore listed companies in 31 OECD countries, which provide enough variation in policy tax rates (Faccio & Xu, 2015). In the final sample, I exclude 4 countries in the OECD (Estonia, Iceland, Latvia, and Luxembourg) as I could not find data on creditor rights index. Due to the availability of the information on corporate tax rates on the OECD database (see https://data.oecd.org/), the sample are drawn from the period between 1995 and 2015. The country-level data are obtained from the World Development Indicators Database of the World Bank and Thomson Reuters Datastream. The firm-level information of market data and accounting data from the balance sheet are drawn from Thomson Reuters Datastream. Firms with no trading activity or with the missing reported financial statements during the sample periods are dropped. Also, firms under financial and utility sectors are excluded. In the final sample, 31 countries and 16,244 unique firms with 146,684 firm-year observations meet these requirements. Lastly, to control for outliers, all country-level and firm-level variables are winsorized at the 1% and 99% level.

3.4.2 Leverage, control variables, and descriptive statistics

Following Rajan and Zingales (1995), leverage is measured in both market and value terms. The market and book leverage are defined, respectively as, book debt divided by the market value of assets (book assets minus book equity plus market value of equity) and book debt divided book total assets. These two alternative leverage measures also have been adopted in chapter two.

Corporate tax rates and control variables included in the analysis (will be discussed in the next section) are in line with chapter two. Specifically, corporate taxes are measured as the top statutory corporate income tax rates in each year. As for the firm-level control variables, I include firm size (the natural logarithm of total assets), tangibility (the ratio of net fixed assets (net property, plant, and equipment) to total assets), profitability (the ratio of return on assets which is earnings before interest, tax, and depreciation (EBITD), divided by total assets), the market-to-book equity ratio, industry leverage (average of firm leverage in the same Datastream Level-3 industry), and and $Lev_{i,t-1}$ (please see Section 2.4.2 in chapter two).

Moreover, as this chapter examines the capital structure decisions based on the cross-country analysis, I also include the country-level control variables follow from the extant capital structure literature which shows that the choice of corporate capital structure can be influenced by firm, market, and country characteristics (Faccio & Xu, 2015; Öztekin, 2015; Öztekin & Flannery, 2012). To control for unobserved country-specific macroeconomic variables that vary over time, I follow Oztekin and Flannery (2012) by including the nominal gross domestic product (GDP) annual growth. Also, I control for inflation using annual growth in consumer price index as it has been shown to significantly affect the cost of debt issuance and equity value (Ritter & Warr, 2002). Moreover, Rajan and Zingales (1995) and Öztekin (2015) suggests that creditors in countries with stronger creditor protection could mitigate bankruptcy costs due to a better control of firms so that creditor can easily force repayment. Hence, I control for the creditor protection using the creditor rights index as in La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998). The index ranges between 0 (the weakest creditor protections) to 4 (the strongest creditor protections). Table 14 presents the sample distribution of the final sample by country, and descriptive statistic of all variables used in the analysis.

In Table 14, the sample distribution and descriptive statistics of country-variables are reported Panel A. In line with Faccio and Xu (2015), Panel A shows that corporate taxes vary across the 31 OECD countries with the highest and the lowest average top statutory corporate income tax rates of 38.20% and 14.00% in the United States and Ireland, respectively. Panel B reports the descriptive statistics of firm variables. While the mean market leverage of the final sample is 26.31%, the mean book leverage is slightly lower at 24.64%. These estimates leverage are comparable with Öztekin and Flannery (2012) that examine the corporate capital structure adjustments across countries.

Table 14 Sample distributions and descriptive statistics

This table presents distributions of the final sample and descriptive statistics. Panel A reports distributions of the sample and descriptive statistics of all macroeconomic variable by country from 31 OECD countries through the period between 1995 and 2015. Panel B reports descriptive statistics of firm variables during the sample period. All firm-level variables are winsorized at the 1% and 99% level.

Panel A
Sample distribution by country and descriptive statistics of macroeconomic variables

Country	Number of firms	Tax (%)	GDP growth	Inflation	Creditor rights
Australia	1,121	30.27	0.03	0.03	1
Austria	88	28.00	0.02	0.02	3
Belgium	121	35.23	0.02	0.02	2
Canada	2,032	20.93	0.02	0.02	1
Chile	129	17.43	0.04	0.04	2
Czech Republic	29	24.13	0.03	0.04	3
Denmark	155	27.17	0.02	0.02	3
Finland	131	26.40	0.02	0.02	1
France	581	35.02	0.02	0.01	0
Germany	513	22.61	0.01	0.02	3
Greece	143	28.97	0.01	0.03	1
Hungary	31	18.42	0.02	0.08	1
Ireland	46	14.00	0.06	0.02	1
Israel	173	30.10	0.04	0.03	4
Italy	252	31.17	0.01	0.02	2
Japan	2,891	29.74	0.01	0.00	2
Korea	612	24.60	0.05	0.03	3
Mexico	122	31.00	0.03	0.09	0
Netherlands	211	29.11	0.02	0.02	3
New Zealand	87	31.07	0.03	0.02	4
Norway	103	27.65	0.02	0.02	2
Poland	192	21.47	0.04	0.06	1
Portugal	59	27.73	0.01	0.02	1
Slovak Republic	20	21.60	0.04	0.05	2
Slovenia	36	22.20	0.03	0.05	3
Spain	228	32.50	0.02	0.03	2
Sweden	146	26.75	0.03	0.01	1
Switzerland	201	20.16	0.02	0.01	1
Turkey	132	24.80	0.04	0.32	2
United Kingdom	1,868	27.87	0.02	0.02	4
United States	3,791	38.20	0.03	0.02	1
Sample mean	524	26.65	0.03	0.04	2
Sample median	146	27.65	0.02	0.02	2

Table 14 – *continued*

Panel B
Descriptive statistics of firm variables

	Number of observations	Mean	Median	Min	Max
Market leverage (%)	146,684	26.31	22.56	0.00	1.86
Book leverage (%)	146,684	24.64	23.51	0.00	1.67
Ln(size)	146,684	13.21	11.35	2.1	23.65
Tangibility	146,684	0.28	0.26	0.03	0.87
Profitability	146,684	0.08	0.06	0.00	0.71
Market-to-book	146,684	1.65	0.89	0.00	3.44

3.4.3 The speed of adjustment towards target leverage: The partial adjustment model

To estimate the speed of adjust toward target leverage, I employ the standard partial adjustment model of capital structure as in Fama and French (2002), Flannery and Rangan (2006), Huang and Ritter (2009), and Öztekin and Flannery (2012). The adjustment speed can be estimated by the following model:

$$Lev_{ij,t} - Lev_{ij,t-1} = \gamma_j\left(Lev^*{}_{ij,t} - Lev_{ij,t-1}\right) + \epsilon_{ij,t}. \quad (2)$$

$Lev_{ij,t}$ is a leverage ratio for firm *i* in year *t* and in country *j*, $Lev^*{}_{ij,t}$ is the target capital structure, and γ_j measures the proportional speed of adjustment during one year for firms in country *j*. Hence, firms in country *j* are assumed to adjust uniformly at the constant rate γ_j, and accordingly, equation can be written as

$$Lev_{ij,t} = \left(1 - \gamma_j\right)Lev_{ij,t-1} + \gamma_j Lev^*{}_{ij,t} + \epsilon_{ij,t}. \quad (3)$$

In general, the target leverage is unobservable and hence, usually can be calculated from the estimated value from a regression of observed leverage based on known determinants of target capital structure (Fama & French 2002; Flannery & Rangan

2006). Thus, in order to determine the optimal leverage ratio, ${Lev^*}_{ij,t}$, I employ the regression model as follows:

$$ {Lev^*}_{ij,t} = \beta_j Z_{ij,t-1} + \eta_i + \nu_t. \tag{4} $$

Z is a vector of control variables for firm- and country-level. The control variables used in the analysis are described as in Section 3.4.2. These control variables are also known to affect corporate capital structure with the basic similar pattern across countries (e.g., Faccio & Xu, 2015; Öztekin & Flannery, 2012). As in the previous chapter, I also include the firm fixed effects, η_i, and year fixed effects, ν_t, as to control for unobserved variables across firms and time. In all regressions, standard errors are clustered at the firm level (Petersen, 2009).

Lastly, by substituting the ${Lev^*}_{ij,t}$ from equation (4) into the standard partial adjustment model as in equation (3), we can obtain the estimable specification as follows:

$$ Lev_{ij,t} = (1-\gamma_j)Lev_{ij,t-1} + \gamma_j\beta_j Z_{ij,t-1} + \upsilon_{ij}\eta_i + \rho_t\nu_t + \epsilon_{ij,t} \tag{5} $$

The adjustment speed towards target capital structure can be estimated by γ_j, which is the coefficient of $Lev_{ij,t-1}$, by subtracting it from 1. Notably, after replacing the target leverage, ${Lev^*}_{ij,t}$, from equation (4) into equation (3), the target leverage disappears from the model. As suggested in Öztekin and Flannery (2012), the estimations of equation (5) include no information on the firm's institutional environments that possibly affects the estimated adjustment speed $\gamma_j$and target capital ratios β_j. As suggested in Öztekin and Flannery (2012, p. 90), the general model in estimating the speed of adjustment as in equation (5), therefore, "accounts for the potentially dynamic nature of the firm's capital structure and its unobserved heterogeneity." That is, equation (5) controls for the changes in target leverage (causing by changes in other determinants) that may affect the estimated adjustment speeds.

The dynamic trade-off theory, therefore, suggests that γ is strictly ranged between 0 and 1 For example, the coefficient of $Lev_{ij,t-1}$ of 0.75 implies that the speed of adjustment is 0.25, meaning that on average, 25% of the gap between the actual and the optimal leverage will be closed within one year. Alternatively, following Huang and Ritter (2009), it takes approximately 2.5 years for half the gap between actual and optimal leverage to be closed.

3.4.4 Over- and under-levered firms, and financially constrained and unconstrained firms

For the study on the variation in the speed of adjustment towards target leverage between over- and under- levered firms, I conduct a separate test on these two groups of firms. To define whether a firm is over- or under-levered, I firstly calculate the target leverage ratio using equation (4). Then, I calculate the distance between the actual (observed) leverage and the estimated target leverage from equation (4). Accordingly, a will be defined as over-levered (under-levered) if the actual leverage is 10% above (below) the calculated target leverage. The same calculation was also adopted by Öztekin and Flannery (2012).

As for financially constrained and unconstrained firms, I use the WW index as in chapter two (see Whited & Wu, 2006). That is, the firms with the lowest 30% and the highest 30% of the WW index will be classified as financially unconstrained and financially constrained firms respectively (please see Section 2.4.3 in chapter two for the calculation).

3.5 Empirical results

3.5.1 Taxes and leverage: Evidence from 31 OECD countries

To investigate the effect of taxes on leverage, firstly, I evaluate known determinants of capital structure with the cross-country analysis by employing the following regression framework:

$$Lev_{ij,t} = \alpha + \beta Tax_{ij,t} + \delta Z_{ij,t} + \eta_i + \gamma_t + \epsilon_{ij,t}. \tag{6}$$

Tax is the top country statutory corporate tax rates. Z is a vector of control variables for firm- and country-level described as in Section 3.4.2.

Table 15 reports the regression results from equation (5). In model (1), where the leverage ratio is defined as the market leverage, the coefficient of *Tax* is positive (0.42) and significant at 1% level. The positive and significant coefficient of *Tax* is in line with the result in Table 3 of chapter two that examine the effect of taxes on leverage using the corporate tax cut in Thailand. Also, the coefficient of *Tax* is comparable in magnitude with Faccio and Xu (2015) that examine the tax effect of leverage across 31 OECD countries.

Table 15 Regression analysis of corporate taxes and leverage across 31 OECD countries
Results based on equation (6) are reported. In all models, the dependent variable is leverage. In model (1), leverage is measured as market leverage, and as book leverage in model (2). All other variables are defined as in Section 3.4. In parentheses is *p*-value based on the White standard errors that are robust to clustering at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Explanatory variables	(1)	(2)
Tax	0.42***	0.33***
	(0.00)	(0.00)
Ln(total assets)	0.05***	0.07***
	(0.00)	(0.00)
Tangibility	0.16***	0.21***
	(0.00)	(0.00)
Profitability	-0.22***	-0.16***
	(0.00)	(0.00)
Market-to-book equity	0.00	-0.01***
	(0.32)	(0.00)
Industry leverage	0.21***	0.18***
	(0.00)	(0.00)
$Lev_{ij,t-1}$	0.71***	0.53***
	(0.00)	(0.00)
GDP_growth	-0.35***	-0.41***
	(0.00)	(0.00)
Inflation	0.33	0.14
	(0.76)	(0.89)
Creditor rights	0.11	0.08
	(0.21)	(0.45)
Constant	-1.21***	-1.82***
	(0.00)	(0.00)
Adjusted R^2 (%)	72.48	70.71
Number of observations	146,684	146,684

In line with model (1), model (2) reports the positive and significant coefficient of *Tax* (0.33), where the leverage ratio is defined as book leverage. Taken together, the positive and significant coefficient of *Tax* in model (1) and (2) lends support the prediction of the trade-off theory.

As for the control variables, the results are mainly in line with those reported in chapter two and recent empirical studies that exploit the cross-country analysis (Faccio & Xu, 2015; Öztekin, 2015). Specifically, Table 15 shows that leverage is significantly and positively related with size of firms, tangibility, industry leverage, and $Lev_{i,t-1}$, while significantly and negatively related with profitability and GPD growth. Overall, these findings empirically confirm the evidence of taxes effect of leverage documented in chapter two, although using the cross-country analysis.

3.5.2 Speed of adjustment toward target leverage

To estimate the speed of adjustment, I employ the Blundell and Bond (1998) system Generalized Method of Moments (GMM) estimation method in the dynamic panel model as in equation (5). This estimation method has been adopted in the majority of studies which empirically investigated the dynamic trade-off theory of capital structure (see, Huang & Ritter, 2009; Öztekin, 2015). Among several estimation techniques that have been previously used in prior studies, the dynamic system GMM estimation method is widely accepted as the fair estimates in the presence of the potential problem of the endogeneity in equation (5) by using transformed lagged-dependent variable (Flannery & Hankins, 2013).

Table 16 Adjustment speeds

Results based on equation (5) using the Blundell and Bond's system generalized method of moments (GMM) are reported. In model (1), leverage is measured as market leverage, and as book leverage in model (2). All other variables are defined as in Section 3.4. The adjustment speeds, γ as in equation (5), can be estimated by subtracting the coefficient of $Lev_{ii,t-1}$ from 1. The p-values are reported in parentheses below the coefficient estimates. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Explanatory variables	(1)	(2)
$Lev_{ii,t-1}$	0.76***	0.79***
	(0.00)	(0.00)
Tax	0.11***	0.09***
	(0.00)	(0.00)
Ln(total assets)	0.03***	0.05***
	(0.00)	(0.00)
Tangibility	0.11***	0.18***
	(0.00)	(0.00)
Profitability	-0.32***	-0.21***
	(0.00)	(0.00)
Market-to-book equity	-0.01	0.0
	(0.87)	(0.45)
Industry leverage	0.44***	0.35***
	(0.00)	(0.00)
GDP_growth	-0.28***	-0.33***
	(0.00)	(0.00)
Inflation	0.61	0.56
	(0.65)	(0.46)
Creditor rights	0.21	-0.08
	(0.76)	(0.25)
Constant	-1.81***	-1.98***
	(0.00)	(0.00)
Number of observations	112,424	112,424

Table 16 reports the estimation results from equation (5) by using the dynamic system GMM method as in Blundell and Bond (1998). Leverage is defined as market and book leverage in model (1) and model (2), respectively. In model (1), the coefficient of $Lev_{ij,t-1}$ of 0.76 is positive and significant at 1% level. This implies that the speed of adjustment toward target, on average, in OECD countries is 24.21% for the market leverage. The coefficient of $Lev_{ij,t-1}$ remains positive and significant in model (2), however, with the larger size of coefficient of 0.79, suggesting that the slower speed of adjustment (21.77%) when looking at book leverage. The estimated adjustment speed of 24.21% in market leverage is lower than the mean adjustment speed of 26.29% reported in Öztekin and Flannery (2012) that examine the speed of adjustment from 37 counties around the world. Notably, the slower speed of adjustment in book leverage than market leverage is consistent with Öztekin and Flannery (2012). Overall, consistent with prior studies (see, for example, Flannery & Rangan, 2006; Strebulaev, 2007), the positive and significant coefficient of $Lev_{ij,t-1}$ in Table 15 indicates the existence of target leverage, and firms have incentive to move toward its target leverage.

As mentioned in Section 3.2.3, firms may have different speed of adjustment regarding to their leverage positions. Specifically, over-levered firms should have stronger incentive to rebalance their leverage due to the higher cost of deviation. Table 17 reports the estimation results from equation (5) by dividing the final sample into subsamples of over- and under-levered firms to reflect the heterogeneity in adjustment speeds toward target leverage. Over- and under-levered firms are defined as in Section 3.4. In model (1) and (3), leverage is defined as market leverage, and as book leverage in model (2) and (4).

The coefficient of $Lev_{ij,t-1}$ for over-levered firms is positive and significant as reported in model (1) and model (2). However, the size of the coefficient of $Lev_{ij,t-1}$ is smaller than the estimates reported in Table 16, implying the faster speed of adjustment in over-levered than average of all firms in the final sample. Specifically, the estimated speed of adjustment in over-levered firms is 34.51% in market leverage, and 29.22% in the book leverage, while it only ranged from 21.77% to 24.21% in the whole sample.

Table 17 Adjustment speeds: over- and under-levered firms

Results based on equation (5) using the Blundell and Bond's system generalized method of moments (GMM), and by partitioning the sample into two sub-groups based on leverage positions before adjustment are reported. Over- and under-levered firms are defined as in Section 3.4. In model (1) and (3), leverage is measured as market leverage, and as book leverage in model (2) and (4). All other variables are defined as in Section 3.4. The adjustment speeds, γ as in equation (5), can be estimated by subtracting the coefficient of $Lev_{ii,t-1}$ from 1. The p-values are reported in parentheses below the coefficient estimates. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Over-levered firms		Under-levered firms	
Explanatory variables	(1)	(2)	(3)	(4)
$Lev_{ii,t-1}$	0.65***	0.71***	0.74***	0.75***
	(0.00)	(0.00)	(0.00)	(0.00)
Tax	0.04	0.10	0.22***	0.29***
	(0.33)	(0.51)	(0.00)	(0.00)
Ln(total assets)	0.06***	0.04***	0.05***	0.02***
	(0.00)	(0.00)	(0.00)	(0.00)
Tangibility	0.17***	0.21***	0.18***	0.23***
	(0.00)	(0.00)	(0.00)	(0.00)
Profitability	-0.37***	-0.24***	-0.44***	-0.28***
	(0.00)	(0.00)	(0.00)	(0.00)
Market-to-book equity	0.0	-0.01	0.00	0.00
	(0.88)	(0.42)	(0.50)	(0.49)
Industry leverage	0.35***	0.51***	0.62***	0.53***
	(0.00)	(0.00)	(0.00)	(0.00)
GDP_growth	-0.24***	-0.16***	-0.11***	-0.13***
	(0.00)	(0.00)	(0.00)	(0.00)
Inflation	0.24	0.41	0.31	0.09
	(0.44)	(0.48)	(0.30)	(0.64)
Creditor rights	0.56	0.31	0.18	-0.08
	(0.52)	(0.19)	(0.46)	(0.27)
Constant	-0.89***	-1.12***	-1.99***	-1.72***
	(0.00)	(0.00)	(0.00)	(0.00)
Number of observations	40,548	40,548	51,336	51,336

In model (3) and model (4), the estimation results of under-levered firms are reported. In line with model (1) and model (2), the coefficient of $Lev_{ij,t-1}$ remains positive and significant although with the smaller size. The estimated adjustment speeds in under-levered firms are 26.24% and 24.98% in market and book leverage, respectively. These findings indicate that the speed of adjustment in under-levered firms, on average, is faster than the average speed of adjustment obtained from the whole sample as in Table 16. However, when looking across model (1) through (4), results show that the estimated adjustment speeds are significantly different. That is, over-levered firms rebalance their leverage downward to their target faster than under-levered firms by approximately 8.27% (34.51% vs 26.24%) per year. This finding is in line with prior literature that suggested the faster speed of adjustment in over-levered firms due to higher benefits or less adjustment costs toward the target, so that deviating upward from the target seems to be more costly than moving downward the target (Byoun, 2008; Hovakimian et al., 2004).

The other strand of literature also posits that the speed of adjustment may varies across the firm’s financial conditions, that is, whether they are financially constrained or unconstrained firms (Faulkender et al., 2012). Specifically, financially constrained may find it more difficult to access the capital market, resulting in the higher access costs than less constrained firms. Accordingly, financially constrained firms are more likely to adjust toward their target with the slower speeds. Therefore, to evaluate the robustness of the relation between financial constraints and the speed of adjustment found in the literature with the cross-country analysis, I divide the final sample into subsamples financially constrained and unconstrained firms as defined in Section 3.4.4, and regression results are reported in Table 18.

The estimation results from financially constrained firms are reported in model (1) and model (2), and from unconstrained firms in model (3) and (4), as market leverage in model (1) and (3) and book leverage in model (2) and (4), respectively. In model (1), the estimated speed of adjustment in financially constrained firms is positive and significant at 1% level. The coefficient of $Lev_{ij,t-1}$ remains positive and significant in model (2). Model (3) and (4) also report the positive and significant coefficient of $Lev_{ij,t-1}$. The size of the coefficient of $Lev_{ij,t-1}$ is larger in model (1) and (2) than in model (3) and (4), suggesting that financially constrained firms adjust their leverage to target less quickly than unconstrained firms.

Table 18 Adjustment speeds: financially constrained and unconstrained firms

Results based on equation (5) using the Blundell and Bond's system generalized method of moments (GMM), and by partitioning the sample into two sub-groups based on financial conditions are reported. Financially constrained and unconstrained firms are defined as in Section 3.4. In model (1) and (3), leverage is measured as market leverage, and as book leverage in model (2) and (4). All other variables are defined as in Section 3.4. The adjustment speeds, γ as in equation (5), can be estimated by subtracting the coefficient of $Lev_{ii,t-1}$ from 1. The p-values are reported in parentheses below the coefficient estimates. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Constrained firms		Unconstrained firms	
Explanatory variables	(1)	(2)	(3)	(4)
$Lev_{ii,t-1}$	0.81***	0.78***	0.72***	0.75***
	(0.00)	(0.00)	(0.00)	(0.00)
Tax	0.24	0.34	0.12	0.19
	(0.49)	(0.38)	(0.19)	(0.23)
Ln(total assets)	0.23***	0.18***	0.08***	0.15***
	(0.00)	(0.00)	(0.00)	(0.00)
Tangibility	0.16***	0.22***	0.19***	0.14***
	(0.00)	(0.00)	(0.00)	(0.00)
Profitability	-0.25***	-0.17***	-0.23***	-0.29***
	(0.00)	(0.00)	(0.00)	(0.00)
Market-to-book equity	-0.01	0.00	0.00	0.00
	(0.43)	(0.37)	(0.80)	(0.75)
Industry leverage	0.25***	0.20***	0.34***	0.22***
	(0.00)	(0.00)	(0.00)	(0.00)
GDP_growth	-0.28***	-0.19***	-0.20***	-0.38***
	(0.00)	(0.00)	(0.00)	(0.00)
Inflation	0.29	0.16	0.21	0.33
	(0.35)	(0.59)	(0.68)	(0.66)
Creditor rights	0.42	0.31	0.11	-0.02
	(0.67)	(0.36)	(0.56)	(0.87)
Constant	-0.51***	-0.77***	-1.33***	-1.72***
	(0.00)	(0.00)	(0.00)	(0.00)
Number of observations	38,604	38,604	37,028	37,028

Although results in Table 18 suggests that financially constrained firms are likely to adjust their leverage less quickly, the adjustment speed also differ among financially constrained firms regarding to the leverage positions. As reported in Faulkender et al. (2012), when examining the effect of financial constraints on the adjustment speed by incorporating the leverage positions (over- and under-levered firms), financially constrained firms adjust less quickly than unconstrained firms when they are below the target leverage, however, when they are above the target, financially constrained firms adjust more quickly. Thus, I rerun Table 18 by taking into account the leverage positions defined as in Section 3.4.4.

Table 19 present the regression results from equation (5) accounting for both financial conditions and leverage positions. From this point onwards, I will only report the results from book leverage as can be seen in Table 15 through Table 18 that market and book leverage measures yields similar results.[32] Regression results from over-levered are reported in model (1) and model (2). In model (1), where firms are also classified as financially constrained firms, the estimated speed of adjustment is 37.28% while it is only 32.54% in unconstrained firms as reported in model (2). This finding suggests that, among over-levered firms, the adjustment speeds become faster with financial constraints. Model (3) and (4) report the speed of adjustment in under-levered firms. The adjustment speeds in model (3) indicate that under-levered firms with financial constraints rebalance their leverage toward target by approximately 25.16% per year. On the other hand, under-levered firms adjust toward target more quickly without financial constraints as reported in model (4) with the estimated adjustment speeds of 30.77%. These findings are consistent with Faulkender et al. (2012), which show that financial constraints increase the adjustment speeds in over-levered firms, while decrease in when firms are under-levered.

[32] Several prior studies examine the determinants of speed of adjustment only on book leverage, and suggest that by substituting market leverage for book leverage measures gives consistent results (see, for example, Faulkender et al., 2012; Öztekin, 2015; Öztekin & Flannery, 2012).

Table 19 Adjustment speeds: leverage positions and financial conditions

Results based on equation (5) using the Blundell and Bond's system generalized method of moments (GMM), and by partitioning the sample into four sub-groups based on leverage positions and financial conditions are reported. Over- and under-leverage, and financially constrained and unconstrained firms are defined as in Section 3.4. In all model leverage is measured as book leverage. All other variables are defined as in Section 3.4. The adjustment speeds, γ as in equation (5), can be estimated by subtracting the coefficient of $Lev_{ii,t-1}$ from 1. The p-values are reported in parentheses below the coefficient estimates. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Over-levered firms		Under-levered firms	
	Constrained firms	Unconstrained firms	Constrained firms	Unconstrained firms
Explanatory variables	(1)	(2)	(3)	(4)
$Lev_{ii,t-1}$	0.63***	0.67***	0.75***	0.69***
	(0.00)	(0.00)	(0.00)	(0.00)
Tax	0.32	0.12	0.11*	0.15
	(0.46)	(0.19)	(0.09)	(0.37)
Ln(total assets)	0.10***	0.04***	0.12***	0.07***
	(0.00)	(0.00)	(0.00)	(0.00)
Tangibility	0.22***	0.10***	0.19***	0.08***
	(0.00)	(0.00)	(0.00)	(0.00)
Profitability	-0.27***	-0.19***	-0.25***	-0.20***
	(0.00)	(0.00)	(0.00)	(0.00)
Market-to-book equity	-0.01	0.00	-0.01	0.00
	(0.30)	(0.63)	(0.33)	(0.49)
Industry leverage	0.35***	0.52***	0.59***	0.45***
	(0.00)	(0.00)	(0.00)	(0.00)
GDP_growth	0.08	-0.21	-0.23	-0.24*
	(0.62)	(0.40)	(0.39)	(0.08)
Inflation	-0.04	0.21	0.19	0.22
	(0.34)	(0.22)	(0.47)	(0.40)
Creditor rights	0.11	0.51	0.01	0.21
	(0.67)	(0.47)	(0.98)	(0.53)
Constant	-1.44***	-1.10***	-1.78***	-1.81***
	(0.00)	(0.00)	(0.00)	(0.00)
Number of observations	14,102	14,102	19,280	19,280

In sum, results from Table 4 through Table 19 indicate the importance of both financial conditions and leverage positions in determining the capital structure decisions in the context of the speed of adjustment toward target leverage. Although using the cross-country analysis, these results provide robustness to prior studies that examine the potential determinant of adjust speeds in the dynamic trade-off setting.

3.5.3 Taxes and speed of adjustment toward target leverage

The previous section reveals the evidence of the existence of the target leverage, and hence, firms have incentive to move toward the target. However, the missing link between corporate taxes and the adjustment speed toward target leverage has not been yet examined. Thus, this section empirically explores the association between taxes and speed of adjustment, and also incorporate with the known determinants that are previously shown to affect the speed of adjustment: leverage positions and financial conditions.

To examine the effect of taxes on the speed in which a firm converges to its target, firstly, I estimate the speed of adjustment from equation (5) in the subsample of taxes. Specifically, the sample is divided into three sub-groups, where I classified countries according to the top marginal statutory corporate income tax rates, namely the lowest 30%, the middle 40%, and the highest 30% average tax rates, and the estimated regression results are reported in Table 7.

As shown in Table 20, when examining the speed of adjustment in the subsample of tax rates, the mean adjustment speeds in high-tax countries is 24.13% as in model (1) while it is 22.66% in low-tax countries as in model (2). Following Öztekin and Flannery (2012), I estimate equation (5) separately for each country. Then, I calculate average values of adjustment speeds for countries that are in the same group according to tax rates, and use t-tests to examine whether the speed of adjustment differ between the groups. The result show that the mean difference between two groups is statistically significantly different to zero. This implies that, on average, firms in countries with higher tax rates rebalance their capital structure toward target at higher speeds than in countries with low taxes by approximately 1.50%. This finding of the faster adjustment speeds in countries with higher taxes, is in line with Öztekin and Flannery (2012).

Table 20 Taxes and adjustment speeds

The adjustment speed estimates based on equation (5) using the Blundell and Bond's system generalized method of moments (GMM), and by partitioning the sample into two sub-groups based on the top marginal statutory corporate income tax rates are reported. Leverage is measured as book leverage in estimating equation (5). Following Öztekin and Flannery (2012), equation (5) is separately estimated for each country. Mean speed of adjustment is then calculated from average values of adjustment speeds for countries that are in the same group according to tax rates. Significance of measures is computed using the independent-sample t-test allowing for unequal variances. The Differences in means and medians that are statistically different from pre-tax cut at the 1%, 5%, and 10% significance level are denoted by ***, **, *, respectively.

	High-tax (1)			Low-tax (2)			(1) vs. (2) (mean)
	Mean	Median	N	Mean	Median	N	
% Estimated adjustment speeds (γ)	24.13	20.74	44,438	22.66	20.12	32,882	1.47***

The effect of taxes, however, may different in leverage positions and financial conditions as explained earlier in Section 3.3. Hence, I further examine the relation between taxes and speed of adjustment by incorporating whether firms are over- or under-levered before making the adjustment, and whether they are considered as financially constrained or unconstrained firms. The estimated adjustment speeds between firms in high- and low-tax countries, and by accounting for leverage positions, are reported in Table 21.

Model (1) and model (2) report the speed of adjustment in high-tax countries, and in low-tax countries in model (3) and model (4). In model (1), the estimated adjustment speeds of over-levered firms in high-tax countries is 36.55%, and becomes slightly faster in low-countries at 37.21% as reported in model (3) with insignificant mean difference. Model (2) reports that under-levered firms in high-tax countries close their leverage gaps by 27.61% while only 23.16% in low-tax countries with significantly mean difference in model (4). Specifically, while it seems that taxes have no effect on speed of adjustment in over-levered, under-levered firms in adjust their capital structure approximately 4.5% faster when tax rates are high, lending support the hypothesis that tax benefits of leverage increase the value of moving upward to target for underleveraged firm.

As in chapter two, the evidence reveals the potential correlation between taxes and expected cost of distress. That is, a higher tax rate reduces firm market values, making firms become more financially constrained. Since it has been found in the previous section that financial conditions play a role in determining speed of adjustment, accordingly, taxes may as well have a different effect on adjustment speed due to the financial conditions.

Table 22 reports the estimated speed of adjustment between high- and low-tax counties in subsamples of financially constrained and unconstrained firms. In model (1), the estimated speed of adjustment of firms in high-tax counties is 26.45% for financially constrained firms, and 29.15% when taxes rates are low as reported in model (3). This finding indicates that, when taxes rate are high, financially constrained firms adjust their leverage less quickly. One possible explanation is that the adjustment costs may be higher due to high tax rates (since firms become more financially constrained), resulting in slower adjustment speeds. As for unconstrained firms, model (2) shows that the estimated speed of adjustment is 27.44% in high-tax countries, and 25.76% in low-tax countries as in model (4). The faster speed of adjustment for financially unconstrained firms in high-tax countries suggests that although taxes make a firm becomes more financial constraints with higher adjustment costs, this effect could be trivial in unconstrained firms. Consequently, the effect of taxes on financial conditions as in chapter two can be dominated by the higher tax shield benefits, making unconstrained firms adjust toward their target leverage with faster speeds when tax rates are high. To this extent, Table 21 and Table 22 show that taxes play an important role in determining speed of adjustment. However, the effects of taxes vary across leverage positions and financial conditions

Lastly and more importantly, I examine the main hypothesis on how taxes affect the adjustment speeds, and further empirically explore the relation between by incorporating both leverage positions and financial conditions. Table 23 reports the estimated adjustment speeds from high- and low-tax countries in subsample of leverage positions and financial conditions. Model (1) through model (4) reports estimated adjustment speeds in high-tax counties, and in low-tax countries in model (5) through (8). In model (1), the estimated speed of adjustment of over-levered firms with financial constraints is 38.46%. This estimate is slightly higher than the speed of adjustment in over-levered firms with financial constraints reported in Table 19, and also higher than when tax rates are low as shown in model (5) at 35.13%. Specifically, over-levered firms with financial constraints adjust approximately 3% per year significantly faster in high-tax counties.

In model (2) and (6), results show that over-levered firms with less financial constraints (financially unconstrained) adjust their leverage to target faster when tax rates are low, however, with less difference in mean size between high-tax and low-tax countries than with financially constraints. Taken together, results suggest that among over-levered firms, the effect of taxes on speed of adjustment is more pronounced with financial constraints. In other words, among over-levered firms, the speed of adjustment increases in the tax rate at a greater rate for financially constrained firms than for financially unconstrained firms. This finding lends support to the possible relation between taxes and expected distress costs found in chapter two. That is, with a higher tax rate, firms become more financially constrained due to lower market value, resulting in a higher cost of deviations. Consequently, over-levered firms have stronger incentive to rebalance their leverage to target, especially when they are also considered as financially constrained firms.

As for under-levered firms, model (3) shows that the estimated speed of adjustment is 26.65% with financial constraints in high-tax countries, and becomes slower when tax rates are low as shown in model (7) at 24.86%. However, in high-tax countries, under-levered firms with less financial constraints adjust their leverage significantly faster than in low-tax countries by approximately 6% as reported in model (4) and (8). This implies that among under-levered firms, the speed of adjustment increases in the tax rate at a greater rate for financially unconstrained firms than for financially constrained firms. Although a higher tax rate makes firms become more financially constrained as in chapter two, under-levered firms may find it better to move toward their target due to higher adjustment benefits from tax shields, and especially when firms are financially unconstrained.

Table 21 Taxes and adjustment speeds: over- and under-levered firms

The adjustment speed estimates based on equation (5) using the Blundell and Bond’s system generalized method of moments (GMM), and by partitioning the sample into four sub-groups based on the top marginal statutory corporate income tax rates and leverage positions are reported. Leverage is measured as book leverage in estimating equation (5). Over- and under-leverage firms are defined as in Section 3.4. Following Öztekin and Flannery (2012), equation (5) is separately estimated for each country. Mean speed of adjustment is then calculated from average values of adjustment speeds for countries that are in the same group according to tax rates. Significance of measures is computed using the independent-sample t-test allowing for unequal variances. The Differences in means and medians that are statistically different from pre-tax cut at the 1%, 5%, and 10% significance level are denoted by ***, **, *, respectively.

	High-tax				Low-tax				(1) vs. (3) (Mean)	(2) vs. (4) (Mean)
	Over-levered firms (1)		Under-levered firms (2)		Over-levered firms (3)		Under-levered firms (4)			
	Mean	Median	Mean	Median	Mean	Median	Mean	Median		
% Estimated adjustment speeds (γ)	36.55	32.12	27.61	29.07	37.21	34.41	23.16	23.29	-0.57	4.45^{***}
N	14,148	14,148	19,208	19,208	9,280	9,280	13, 582	13,582		

Table 22 Taxes and adjustment speeds: financially constrained and unconstrained firms

The adjustment speed estimates based on equation (5) using the Blundell and Bond’s system generalized method of moments (GMM), and by partitioning the sample into four sub-groups based on the top marginal statutory corporate income tax rates and financial conditions are reported. Leverage is measured as book leverage in estimating equation (5). Financially constrained and unconstrained firms are defined as in Section 3.4. Following Öztekin and Flannery (2012), equation (5) is separately estimated for each country. Mean speed of adjustment is then calculated from average values of adjustment speeds for countries that are in the same group according to tax rates. Significance of measures is computed using the independent-sample t-test allowing for unequal variances. The Differences in means and medians that are statistically different from pre-tax cut at the 1%, 5%, and 10% significance level are denoted by ***, **, *, respectively.

	High-tax				Low-tax				(1) vs. (3) (Mean)	(2) vs. (4) (Mean)
	Constrained firms (1)		Unconstrained firms (2)		Constrained firms (3)		Unconstrained firms (4)			
	Mean	Median	Mean	Median	Mean	Median	Mean	Median		
% Estimated adjustment speeds (γ)	26.45	24.67	27.44	26.12	29.15	28.45	25.76	24.72	-2.70^{***}	1.68^{***}
N	13,445	13,445	12,986	12,986	9,402	9,402	8,930	8,930		

Table 23 Taxes and adjustment speeds: leverage positions and financial conditions

The adjustment speed estimates based on equation (5) using the Blundell and Bond's system generalized method of moments (GMM), and by partitioning the sample into eight sub-groups based on the top marginal statutory corporate income tax rates, leverage positions, and financial conditions are reported. Leverage is measured as book leverage in estimating equation (5). Over- and under-levered, and financially constrained and unconstrained firms are defined as in Section 3.4. Following Öztekin and Flannery (2012), equation (5) is separately estimated for each country. Mean speed of adjustment is then calculated from average values of adjustment speeds for countries that are in the same group according to tax rates. Significance of measures is computed using the independent-sample t-test allowing for unequal variances. The Differences in means and medians that are statistically different from pre-tax cut at the 1%, 5%, and 10% significance level are denoted by ***, **, *, respectively.

	High-tax				Low-tax			
	Over-levered firms		Under-levered firms		Over-levered firms		Under-levered firms	
	Constrained (1)	Unconstrained (2)	Constrained (3)	Unconstrained (4)	Constrained (5)	Unconstrained (6)	Constrained (7)	Unconstrained (8)
% Estimated adjustment speeds (γ)	38.46	32.15	26.65	28.62	35.13	30.88	24.86	23.10
N	5,042	4,802	7,610	6,820	3,958	3,618	5,448	4,832
Difference in mean (1) vs. (5)	3.33^{***}(9)							
Difference in mean (2) vs. (6)		1.27^{***}(10)						
Difference in mean (3) vs. (7)			1.79^{***}(11)					
Difference in mean (4) vs. (8)				5.52^{***}(12)				
Difference in mean (9) vs. (10)		2.06^{***}						
Difference in mean (11) vs. (12)				-3.73^{***}				

3.6 Conclusion

Though literature has documented a number of robust determinants in determining the speed of adjustment that firms move toward target capital structure, the link between corporate taxes and adjustment speed remains empirically unexplored, especially by incorporating with leverage positions and financial conditions. This chapter seeks to bridge the gap in literature by asking how taxes affect the capital structure adjustments in the dynamic setting. Also, this chapter further empirically examines the possible relation between taxes and cost of debt financing found in chapter in another context of the trade-off theory.

By applying the standard partial adjustment model of leverage to estimate the adjustment speeds toward target for the firms in 31 OECD countries during the period between 1995-2015, I find that taxes play an important role in explaining adjustment speeds. The effects of taxes also vary across leverage positions before the adjustment and financial conditions. Specifically, I find that under-levered firms rebalance their leverage faster when tax rates are high. Consistent with the trade-off theory of capital structure, this finding suggests that corporate tax increase the value of adjusting upward to target leverage, leading to faster adjustment for underleveraged firms. However, I find only weak evidence that taxes significantly affect over-levered firms.

When examining the effect of taxes with financial conditions, results indicate that financially constrained firms adjust slower when tax rates are high. This implies that financially constrained firms, which have less ability to access the capital market, face higher adjustment costs due to higher tax rates. On the other hand, unconstrained firms move toward their target leverage faster in high-tax countries, suggesting that the grater benefit of tax shields may dominate the higher cost of adjustment in financially unconstrained firms which have a better ability to access the external market.

Moreover, results also support the finding from chapter one that taxes and expected cost of distress are possibly related. By accounting for both leverage gaps and financial constraints, I find that, when firms are over-levered, the speed of adjustment increases in the tax rate at a greater rate for financially constrained firms than for financially unconstrained firms. This implies that the cost of deviations increases in tax rates, however, relatively faster in financially constrained firms. On the other hand, the estimated speed of adjustment increases in the tax rate at a greater rate for financially unconstrained firms than for financially constrained firms when they are under-levered. This finding suggests that although firms become more financially constrained and face with higher adjustment costs when taxes are high, the higher tax shield benefits can be substantially larger, leading to faster adjustment in under-levered firms. Taken together, the resulting evidence empirically confirms the relation between taxes and expected cost of distress found in chapter two even examining in the dynamic setting.

Overall, this chapter, in line with the trade-off theory of capital structure, shows that firms have target debt ratios. Also, firms have incentive to adjust to target with heterogeneous speeds, depending on different benefits and costs of adjustment. I show that corporate taxes may not only affect the adjustment benefits through tax shields, but may also affect the adjustment costs through the relation between taxes and expected distress costs. Hence, taxes significantly affect the speed of adjustment to target leverage. To the best of my knowledge, this chapter is the first to examine the relation between taxes and speed of adjustment by incorporating leverage positions and financial conditions, and in cross-country analysis.

CHAPTER 4

CORPORATE TAXES AND RISK-TAKING BEHAVIOR: EVIDENCE FROM MERGERS AND ACQUISITIONS IN THE G7 NATIONS

4.1 Introduction

The previous two chapters examine the impact of corporate taxes on capital structure decisions in both static and dynamic settings by taking into account the positive relation between taxes and expected financial distress costs. To better understand the implication of the effect of taxes on cost of debt financing, this chapter further investigates the importance of corporate taxes in another aspect of corporate finance study, namely the corporate investment policies.

Not only does a corporate taxation have effects on a firm's leverage due to tax shield benefits as shown in chapter two and chapter three, but it may also influence firm risk-taking. However, the direction and the extent of the impact of corporate taxation on risk-taking are unclear as there are two different mechanisms at work. On the one hand, under the Merton (1974) framework, equity is a call option on a levered firm's assets. The loss of equity value due to a higher tax rate gives shareholders the incentive to increase asset risk in order to minimize the would-be value loss of their claims in the firm. Hence, taxes and risk-taking are positively correlated. On the other hand, the reputation-building model proposed by Diamond (1989) predicts that corporate tax deters risk-taking as shareholders have incentives to secure future borrowings when the expected future tax-shield benefit is large due to a high tax rate. One common way to do so is to maintain a good record with creditors by investing in less risky projects. Consequently, taxes and risk-taking behavior are negatively correlated.

Yet, the role played by corporate taxation in firm risk-taking remains largely unexplored empirically. This chapter, therefore, seeks to bridge the gap in the literature by empirically examining how firm risk-taking decision is influenced by corporate taxation. I examine corporate risk-taking by analyzing how a firm's asset risk changes following an acquisition. Corporate acquisitions typically involve significant investment outlays, and as a result, are likely to affect the asset risk of acquiring firms. To measure the asset risk of a firm, I utilize the option pricing framework in Merton (1974), which yields a forward-looking measure of asset volatility. As Vassalou and Xing (2004) point out, a proxy for asset risk based on accounting data, including ROA (i.e., volatility of ROA), which is employed in several prior studies, is not forward looking.

I constructed a dataset which contains all acquisitions made by publicly traded firms in the G7 countries, which had different policy tax rates, during the period between 1990 and 2012. The empirical analysis shows that an increase in asset risk following an acquisition is significantly larger for acquirers in countries with a higher policy tax rate. This tax effect remains significant after taking account the known determinants of asset risk, and regardless of whether tax rates are policy tax rates or estimated as effective firm-specific tax rates. The positive relation between corporate taxes and the change in asset volatility is consistent with the Merton framework, where shareholders invest in a riskier project in order to alleviate the anticipated drop in the value of their claims.

To further understand the role of corporate tax on risk-taking, this study also examines to what extent the effects of corporate taxes vary across levels of leverage. While taxes generally produce the risk-taking incentive as predicted by the Merton framework, expectation of a tax-shield benefit may, as implied by the reputation-building model, encourage the firm to minimize its risk-taking in order to secure future borrowings. When viewed together, the Merton framework and reputation-building model jointly raise the possibility that the tax effect on risk-taking has two sides. As tax rise, shareholders may have stronger incentive to increase asset risk to compensate the loss of equity value, however, taxes may as well become a disincentive for risk-taking when firms expect a material tax-shield benefit (i.e., for firms with a large borrowing opportunity and the resulting expected tax-shield benefit). This issue has not been empirically explored yet.

Consistent with this implication, the positive relation between taxes and risk-taking is weaker for acquirers with relatively low leverage (i.e., larger expected tax-shield benefit) than for acquirers with relatively high leverage. Together with the positive relation between taxes and risk-taking in the baseline result due to the loss of equity value, such a weaker incentive among low leverage firms due the reputation concern lends support to the possibility that corporate taxation can produce both the incentivizing and disincentivizing effects on risk-taking, depending on the expected tax-shield benefit.

Furthermore, to the extent that creditor protection serves to safeguard the quality of collateral held by debt-holders (La Porta et al., 1998), the risk-taking effect of taxes should be weaker in countries with strong creditor rights (Acharya, Sundaram, & John, 2011).[33] The results show that the positive relation between taxes and risk-taking exists only in countries with low creditor rights. Despite the importance of tax as a risk-taking incentive, its effect appears to be restrained by the legal rights enjoyed by debt-holders.

My study is closely related to two prior studies—Langenmayr and Lester (2016) and Ljungqvist, Zhang, and Zuo (2017). They analyze how the changes in the statutory tax loss offset rules and in corporate income tax rates affect corporate risk-taking measured as the volatility of ROA. My work, however, provides further insights by exploiting the event study of corporate acquisitions across countries as a testing ground, which provide an opportunity to observe an impact of a major corporate investment on risk-taking. As suggest in Acharya et al. (2011, p.151), "corporate investment in the form of mergers and acquisitions is not tainted by the cross-country differences in reporting practices that affect other measures of investment (such as capital expenditures and research and development (R&D) expenses)." To the best of my knowledge, this chapter is the first to examine the implication of creditor rights on the tax effects of risk-taking. Results in this chapter offer crucial evidence that tax can produce two-sided effects on risk-taking that had previously been ignored even in the recent literature. In addition, a measure of asset volatility in my study is directly obtained from the theoretical option pricing framework which yields a forward-looking measure of asset volatility.

The remainder of this paper is organized as follows. In the next section, I review the related theories on taxes and the risk-taking. Section 4.3 discuss the hypotheses on the incentive and disincentive to shift risk due to corporate taxes. Section 4.4 describes

[33] Acharya et al. (2011) report that firms in countries with strong creditor rights reduce risk by undertaking diversifying acquisitions.

the data set and empirical methodology. Empirical results are reported in Section 4.5 and Section 4.6 concludes the chapter.

4.2 Literature review

4.2.1 Related literature on risk-taking

Risk-taking, also known as asset substitution, was first introduced by Jensen and Meckling (1976). It is a situation in which shareholders of levered firms have more incentive to undertake risky investment. This is because if the project becomes successful, shareholders will receive all of the project's upside potential, whereas if it fails, there is a chance of firm value decreasing, and debt holders will absorb the downside. In other words, the successful outcomes of high risk investment from excessive risk-taking only benefit equity holders while debt holders will get no extra rewards since debt has no potential upside (fixed claim). On the other hand, if the project fails, both debtholders and shareholders also lose their benefits, however, the key difference is therefore the limited upside for debtholders and unlimited upside for shareholders.

The difference in payoffs between these two agents, the gains of shareholders and losses of debt holders, give equity holders incentives to take on risky projects that maximize their own benefit at the expense of debt holders. This argument of increasing in the firm's asset risk, by substituting safe assets with riskier assets in order to raise the upside potential of equity through their investment policies is referred as risk-taking or asset substitution (Jensen & Meckling, 1976).[34]

[34] Risk-taking also mentioned in Galai and Masulis (1976, p. 57), by showing that $\frac{\partial S}{\partial \sigma^2} > 0$, where S is the value of equity and σ is asset volatility, implying that the value of equity increases with volatility.

In the context of risk-taking, prior studies have pointed out that the value of the firm's equity can be viewed as the value of a call option on the firm's total assets (Black & Scholes, 1973; Leland, 1994; Merton, 1974). Simply put, according to the basic balance sheet identity[35], the shareholder's equity is the remaining on assets after all limited liabilities have been returned. The limited liability nature of equity suggests that equity-holders have the ability to pay off the debt-holders and own the residual assets of a firm. Consequently, the holders of other liabilities of the firm remain as an owner until the liabilities are repaid in full by the equity holders. These arguments have the same properties as a call option on the underlying assets.

To be more specific, the option holder will not exercise the option if the value of the assets is insufficient to meet the liabilities of the firm, therfore leaving the firm to their creditors. Thus, once a debt is in place (when firms are indebted), equity can be viewed as a call option on the firm's assets with the book value of the firm's liabilities as a strike price.[36] Hence, any investments that potentially increase the asset risk from the higher cash flow volatility would also increase call option value on the firm's assets, and hence reducing the value of debt. As suggest in Allen and Gale (2000), the limited liability on the part of debt issuers leads to over-investment in risky assets.

According to the option nature of equity mentioned above, the asset risk (or asset volatility) then becomes an important determinant regarding the corporate investment policies that should be considered by both shareholders and bondholders.

[35] Total assets = Total liabilities + Total (shareholders) equities

[36] However, Leland (1994) argues that this does not reflect the risk shifting incentive of equity holders. He extends Merton (1974) to address the impact of limited liability on optimal capital structure. By examining a call option in the context of the American option framework, Leland (1994) suggests that equity holders can endogenously choose the optimal timing of bankruptcy and therefore better reflect the shareholder's risk shifting incentives.

On the one hand, a higher volatility of assets would increase the probabilities of higher value of assets, and hence, greater payouts for the equity with unlimited potential upside. On the other hand, since volatility works both ways, it possibly increases the probabilities of lower asset values as well. This is undesirable to the company's bondholder as it increases the possibility of default without any extra rewards due to a fixed interest rate of bonds (the bondholders require only a fixed return). However, due to the limited liability, this will affect the equity value with the limited downside. Specifically, when value of the firm' assets becomes lower than the strike, the payout to the shareholder (equity value) remains constant at zero.[37] This is because the equity holders will receive nothing at bankruptcy, and are not obligated to pay anything to debt holders from their own pockets. Therefore, the equity holders of levered firms would have the incentive to transfer wealth from debtholders by increasing asset volatility in ex-post.

4.2.2 Empirical evidence on the existence of risk-taking

As for the evidence of the existence of risk-taking, it has long been debated in the existing empirical literature. In the beginning, risk-taking incentive could not be observed in the empirical studies. An early paper, by Andrade and Kaplan (1998), studies 31 firms in financial distress, and reports no evidence that financially distressed firms made large or unusually risky investments or acquisitions. Parrino and Weisbach (1999), by using a Monte Carlo simulation to examine the importance of conflicts of interest between debtholders and equity holders, report that risk-taking is also not a primary factor of optimal capital structure decisions. De Jong and Van Dijk (2007)

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[37] Crosbie and Bohn (2003, pp. 11-12) provides a basic example of this argument.

examine the shareholder's incentive to increase the firm's risk from listed companies in Netherlands by using questionnaires sent to 102 chief financial officers of listed companies on the Amsterdam Stock Exchange, and report that risk-shifting dose not exist. Furthermore, survey evidence of 302 chief financial officers in U.S. and Canadian firms from Graham and Harvey (2001) suggests that risk-taking concerns are the least important factor for chief financial officers in determining the maturity of debt a firm issue as well as whether a firm issues convertible bonds. Thus, there appears to be only limited empirical evidence on whether and to what extent shareholders engage in risk-taking.[38]

Later, Fang and Zhong (2004), and Larsen (2006) report an evidence of risk-taking in the industrial firms. By measuring the firm's risk from the ratio of the firm's asset volatility to the previous year's asset volatility, they conclude that, on average, asset volatility is relatively high and risk-taking only exists for firms near or at distress. Until Eisdorfer (2008), by examining a large sample evidence of the US firms, the author investigates risk-shifting hypothesis within the context of a real options framework[39], and reports that the asset volatility increases risky investment by distressed firms. He argues that the risk-shifting incentive is stronger when firms move closer to financial distress, since financially weak firms have little to lose but all to gain

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[38] In the beginning, there is no evidence of risk-shifting except in the financial sector. For example, Esty (1997) and Basak, Pavlova, and Shapiro (2007) report an evidence of risk-shifting in the financial sector. Recently, Landier, Sraer, and Thesmar (2015) find evidence of risk-shifting incentives of banking sector during the S&L crises and more recently in the sub-prime crisis in 2008. However, as suggested in Almeida, Campello, and Weisbach (2011), it is unclear whether these findings would be applicable to industrial firms due to the special government role in financial institutions.

[39] The real options approach suggests that firms usually consider a trade-off between postponing their investment by waiting for more information related to the project, and immediately invest in a project so that firms can generate cash flows earlier. By delaying the investment, firms are able to increase the value of their projects according to the higher degree of cash flows uncertainty. For more details on the theoretical can empirical study of the real options framework, please see Eisdorfer (2008).

by taking large gambles. This is because the shareholders can possibly delay filing for bankruptcy by raising the asset volatility that increases opportunities of the asset value to rebound or in order to generate sufficient temporary cash flow in avoiding bankruptcy. However, this action is at the expense of debt holders since it also increases a likelihood of default. Moreover, the longer equity holders can delay for the bankruptcy filing, the less value of assets debt holders will receive at distress if the firm continues to worsen.

Although Eisdorfer (2008) finds that the firms have stronger incentive to increase risk, especially when they are in financially distressed condition, several studies in specific industries show the contradictory results. For example, Rauh (2009) examines risk-shifting behavior in corporate pension funds, and finds that firms allocate their pension fund assets more on safer assets when becoming financially distressed. Rampini, Sufi, and Viswanathan (2014) provide evidence that reduced hedging activity by airlines when entering distress is driven by collateral constraints and liquidity considerations, not risk-shifting incentives. These findings imply that risk-shifting might not be a primary reason of high-risk investment in some industries.

However, not only does the shareholders of distressed firms would have stronger incentive to shift risk, shareholders of firms which are not in financial distress condition should also have incentive to increase risk as well (although with relatively less magnitude) as pointed out by Leland (1998). Recently, Danielova, Sarkar, and Hong (2013) has empirically confirmed Leland (1998) by examining the firm's operational risk of 1,983 debt issues made between 1972 and 2009, and report that operating risk significantly increases after debt issue for all samples.

4.2.3 The determinants of risk-taking incentive

The related literature also sought to identify the relation between costs of risk-shifting and several characteristics of firms and bonds. For example, a large number of studies examine the effect of bond covenants and convertible debt on risk-taking, and find that the problem of risk-taking can be reduced through secured debt and investment restrictions (Barclay & Smith, 1995; Danielova et al., 2013; Friend & Lang, 1988; Green, 1984; Nini, Smith, & Sufi, 2009; Smith & Warner, 1979; Titman & Wessels, 1988).

Barnea, Haugen, and Senbet (1980) examine the relation between risk-shifting problem and the maturity of debt, and find that short-term debt financing can be used to mitigated the shareholder’s risk-shifting incentive. The is because of the value of short-term debt is relatively less volatile to the changes in asset risk than the value of long-term debt. Consistent with the finding in Barnea et al. (1980), Barclay and Smith (1995) and Guedes and Opler (1996) suggest that the underinvestment problem (due to mismatching between asset and debt maturities) and risk-taking increase as firms have more growth opportunities because of the greater conflict of interest between shareholders and debtholders. That is, firms with high growth opportunities can easily switch to higher risk projects, and hence, use more short-term debt while large and regulated firms tend to use more long-term debt financing.

(Diamond, 1989, 1991) examine the effects of reputation concern on the ability to mitigate the conflict of interest between borrows and lenders over time. The author suggests that, without reputation concerns, borrowers have greater incentives choose high-risk projects since these projects can only benefit the shareholders due to the unlimited potential upside. However, over the long-time horizon, a borrower can achieve a good reputation through a good track record with creditors by investing in a less risky project and repayment without a default. As a result, the interest rate falls so that the present value of rents in the future from a good reputation rises.

Nini et al. (2009) have confirmed the above arguments of the reputation concerns proposed by Diamond (1989) by showing that lenders normally impose explicit restrictions on capital expenditure after a fall in the borrower's credit quality or increased in the borrower's credit risk, and these capital expenditure restrictions constrain firm investment. They report that, most of the time, the financial covenant violations are followed by the decreased of investment spending, the reduction in net debt issuance, reduction in capital structure, and reduction in shareholder payouts. This result implies that the restriction on the shareholder's potential risk-shifting investments becomes more significant as the riskiness of debt increases[40], and can be an important reason that motivates firms to reduce their risk-shifting behaviors.

Later, Almeida and Philippon (2007) also suggest that these concerns about reputations could directly impact the ability of a firm to fund the future projects. They report that these concerns on future financing constraints possibly large enough for firms to reduce their overall risk from investment so that positive NPV projects can be funded in the future. Therefore, the above literature that use the multi-period setting to examine the risk-shifting problem have agreed that the reputation building concerns are important in capital markets, and possibly explains for why risk-shifting cannot be observed previously in the empirical studies.

[40] It is also consistent with Aghion and Bolton (1992), in which creditors can mitigate the conflicts with equity-holders by limiting investment after negative firm performance but before payment default.

Further, by using a dynamic model, Leland (1998) finds that the tax benefits of debt financing are significantly larger than the costs of the risk-shifting problem. Therefore, risk-shifting problem is not expected to significantly affect the firm's capital structure. However, Ericsson (2000) reports the negative and significant effect of risk-shifting problem on firm leverage.[41]

4.2.4 Taxes and corporate risk-taking

Risk-shifting is basically the problem of wealth transfer from debtholders to shareholder, or in other words, shareholder is stealing wealth from debtholders by increasing the firm's asset risk. Therefore, a factor that can affect this problem should be the important issue to be studied further in the context of risk-shifting hypothesis. As discussed above, it is well established from the existing literature that several determinants can be related with risk-taking.

There is a large number of studies examine the effects of taxes on corporate investment. For example, Devereux, Keen, and Schiantarelli (1994) study how the asymmetric tax treatment of profits and losses affects the size of firm investment. They find that such asymmetries made bonus depreciation tax incentives at most 4% less effective than if all firms had been taxable. Dreßler and Overesch (2013), by using a sample of multinational subsidiaries of German multinationals, study how the host country tax loss rules affect the level of investment (measured with fixed assets). They find no relation between a country's loss carryback rules and the level of investment. The literature also examines the relation between taxes and firm hedging. Graham and

[41] There is also other growing literature that examines other possible determinants of risk-taking. For example, corporate governance (John, Litov, & Yeung, 2008), creditor rights (Acharya et al., 2011), shareholder diversification (Faccio, Marchica, & Mura, 2011), and inside debt (Choy, Lin, & Officer, 2014) have been recently found to be important determinants of corporate risk-taking.

Smith (1999) show in a simulation analysis that tax-function (due primarily to tax loss rules) provides an incentive to hedge for 50% of firms. Graham and Rogers (2002) empirically test this prediction and find no evidence that taxes motivate firms to hedge. They show, however, that firms hedge to for a higher debt capacity, which also provides more tax advantages.

While many studies have been conducted to examine the effects of taxes on capital structure and financing policies, there is still very little known about the effects on the firm's investment policy, especially from a major corporate investment, which is a central issue to the risk-taking problem. That is, the relation between risk-taking and corporate taxation, which is a factor that directly related to the benefits and costs of debt financing so that firms use to determine their capital structure, has been ignored in the previous literature.

As for the evidence of the effects of taxes on the firm's risk-shifting incentive, Asea and Turnovsky (1998) consider the effect of taxes on risk-taking for individual portfolio choice and entrepreneurial risk-taking. They find that higher taxes make it less likely that individuals hold risky assets. Cullen and Gordon (2007) show that corporate tax has no (or very small) impact in entrepreneurial risk-shifting incentive. However, they only examine in small firms, or "start-up" firms.

As I mentioned above, while most studies have examined the effects of taxation on the firm's investment policy by focusing on the level of capital invested[42], none of them study its relation with the firm's asset risk from the option pricing framework, which is a direct measure of risk-shifting. However, until recently, two studies by

[42] Hassett and Hubbard (2002) survey the theoretical and empirical literature on this topic.

Langenmayr and Lester (2016), and Ljungqvist et al. (2016) examine the effects of taxes on corporate risk-taking, which are closely related to this study. Both papers examine the possible relation between taxes and corporate risk-taking, and find that taxes affect corporate risk-taking decisions. Langenmayr and Lester (2016) conduct a cross-country analysis to study the effects of corporate tax on corporate risk-taking, and conclude that firms view tax rates and tax rules as important determinant when choosing the riskiness of firm investment, as suggested in their study (Langenmayr & Lester, 2016, p. 30) that "the level of future corporate risk-shifting is related to the available loss offset period, and this relation is stronger, the higher the home country's statutory rate". They suggest that a firm who can fully offset losses (measured by more favorable loss carryback/carryforward periods) tend to increase risk with higher tax rates. On the other hand, a firm who expects to regain smaller loss incurred will reduce risk. However, the periods of loss carryback/carryforward are hardly changed overtime for most of the countries. Also, the tax loss offset rules are rather a special case than reflective of normal business conditions. That is, under normal business conditions, firms just simply make profits and pay tax. Therefore, their empirical model may not be applicable in general practice. Thus, without considering loss carryback/carryforward periods, and according to the above arguments, this study addresses the importance of corporate taxation on risk-taking by arguing that corporate tax rates can affect risk-shifting problem that can be explained through the option nature of equity according to the Merton (1974) model. Ljungqvist et al. (2016) find a consistent result that taxes significantly affect corporate risk-taking. By using the changes in corporate income tax rates across U.S. states, the authors find that a higher corporate income tax rate reduces corporate risk-taking. However, there is no evidence that firms increase risk-taking in response to corporate income tax cuts.

Although Langenmayr and Lester (2016), and Ljungqvist et al. (2016) provide an evidence on the link between corporate taxation and risk-taking, my study is significantly different from theirs in several ways. First, instead of using information from firm's financial statements, such as volatility on return on assets (ROA), as a proxy of corporate-risk taking previously shown in Langenmayr and Lester (2016), and Ljungqvist et al. (2016), this study investigates corporate risk-shifting through the change in asset risk estimated directly from the theoretical framework by the Merton (1974) model. In the past, one major challenge for the study in the context of risk-shifting is that the market value of firms is unobservable, which makes it impossible to directly measure asset volatility. Therefore, the previous literature estimates the risk of the firm's asset by using realized cash flow volatility or return on assets which can be obtained directly from a firm's accounting data. However, the future cash flow uncertainty and asset value may not be captured by these proxies, and also require a long horizon to measure accurately.[43]

Furthermore, as suggested in Vassalou and Xing (2004), one important disadvantage of estimating the asset volatility from a firm's accounting annual reports is due to a backward-looking nature of information. Basically, the data that obtained from a firm's financial statements is based on a firm's past performance, rather than its future prospects. On the other hand, the asset volatility that directly estimate from the option pricing model of Merton (1974) takes in to account the market value of a firm's

[43] For example, Fama and French (2002) proxy it by firm size. However, firm size is related to many other factors potentially relevant for financial policy, such as the ease of access to capital markets.

equity. That is, the model uses market prices of equity to reflect investor's expectations on a firm's future performance when backing out the asset risk. That is, while Merton model includes data from a market in estimating a firm's asset risk, which is a forward-looking information, the asset risk from firm's accounting report is still based on a firm's past performance, which is a backward-looking data.

Thus, the measurements used in the previous literature could suffer from the measurement error that may generate the biased results or easily misinterpretation. In other words, a measure of the firm's asset risk (or the risk of firm's business operation) should be directly related with the firm's asset value. It should contain information on the uncertainty of future cash flow generate by firm's asset. Therefore, whether or not a firm engage in risk-shifting should be examined by a changed in volatility of the firm's asset value directly from an option pricing (Crosbie & Bohn, 2003; Fang & Zhong, 2004; Levine & Wu, 2017).[44]

According to the possibility of a measurement error that mentioned earlier, this study is trying to mitigate this concern by using the asset risk, as a proxy of risk-taking, that directly estimate from the Merton model. The asset risk from the Merton's model provides the advantage over the asset volatility of return on assets because the model takes into account the increase in debt volatility that occurs as leverage increases. Based on the observable data from the market such as, the market value and volatility of equity, the risk-free rate, and the face value of debt, it is straightforward to use this option pricing model to estimate the implied asset volatility. In other words, as suggest

[44] Fang and Zhong (2004) claim to be the first to use a contingent-claims approach (the Merton model) to directly explain the risk-shifting behavior of industrial firms, without the need to proxy asset volatility with variables such as industry class or firm size. They find that firms tend to increase asset volatility when facing a high default probability, which is the basic proposition from a Black and Scholes (1973) or Merton (1974) approach to equity.

Levine and Wu (2017), using the Merton's model to estimate the firm's asset volatility could avoid the bias that comes from ignoring the volatility of the firm's debt.

Moreover, this chapter exploits the effects of taxes on corporate risk-taking by using the mergers and acquisitions as an experimental lab of a corporate investment. In the previous literature, the problem of corporate risk-taking has been studied through the change in the firm's asset volatility pattern over a period of time. For example, Fang and Zhong (2004) and Larsen (2006) examine corporate risk-taking behavior in all industries by looking at the pattern of change in the firm's asset volatility from the ratio of asset volatility to the previous year's asset volatility, after adjusting for the industry effects. If the ratio is, on average, higher than 1 or exhibit an increasing pattern, it implies that firms are likely to increase their asset risk. Langenmayr and Lester (2016), and Ljungqvist et al. (2016) measure risk-taking by using difference between the standard deviation of returns on assets (ROA) over a period of time. If the changes in the volatility of ROA is higher, a firm has more risk-shifting incentive.

However, unlike the previous studies that examine risk-taking problem from the change in risk pattern over a period of time, my study looks at the change in firm's asset volatility through the investment decisions. Risk-shifting should be about the change in the firm's asset volatility that arise from the high-risk investment. That is, this problem should occur after the investment decision has been made and become successful. Therefore, if the shareholders decide to undertake risky projects that may increase the firm's asset risk, the degree of risk-taking should be captured by the change in the firm's asset risk between pre- and post-investment instead of the change in risk pattern or change in asset volatility over a period of time.

In order to estimate the change in asset risk from firm's investment decisions, this study focuses on mergers and acquisitions events. Specifically, I estimate corporate risk-taking incentive from the difference of asset risk before and after acquisitions. Why using acquisitions are a good lab? Firstly, mergers and acquisitions are considered as major corporate investment, and have been shown to significantly affect firm's risk. For example, Amihud and Lev (1981) find that a conglomerate merger lower risk of the combined entity, through the diversification effect. Furfine and Rosen (2011) examine the effects of mergers and acquisitions on the firm's default risk, and report that, on average, a merger increases the default risk of the acquiring firm. Also, as suggested in Acharya et al. (2011), mergers and acquisitions provide a good opportunity to observe the effects of corporate investment on the firm's overall risk.

Also, one important benefit of using mergers and acquisitions to examine the risk-taking is that we can identify the characteristics and types of investments. For example, an acquisition could affect the firm's risk since it can be either a risk-reduction investment by diversifying across industries or focusing within-industry. More importantly, we can easily identify the period before and after the investment decision has been made. That is, we can calculate the firm's asset volatility of an acquirer, and compare its asset risk between pre-announcement date and after deal become effective. Further, it is also possible to identify other characteristic of acquisitions that also have an effect on firm's risk such as, types of payments, types of targets, and locations (domestic and cross-border). Lastly, unlike other information shown in corporate annual reports, "corporate investment in the form of mergers and acquisitions decisions is not tainted by the cross-country differences in reporting practices that affect other measures of investment such as capital expenditures and research and development

(R&D) expenses" (Acharya et al., 2011, pp. 151). That is, using merger events as a proxy of corporate investment require less assumptions on other control variables in the study that can affect the measure of investment although operating in different countries. Therefore, by using mergers and acquisitions to examine the effects of taxes on corporate risk-taking, there are several advantages over looking at other investment or without considering the pre- and post-investment decisions. Hence, we can directly access the change in firm's asset risk or risk-taking incentive through a corporate investment.

4.3 Hypothesis development

The focus of this study is to examine whether and how corporate income tax affects corporate risk-taking. In this section, two different channels through which tax can influence risk-taking are discussed. The discussion also raises the possibility that the tax effect on risk-taking can have two sides.

4.3.1 A positive relation between corporate tax rate and risk-taking

In the framework of Merton (1974), equity is a call option on a firm's asset and its value depends on factors including asset volatility. The model implies that the presence of debt gives shareholders the incentive to increase asset risk. This is because the probability of higher asset value and the odds of higher payouts for an equity-holder with unlimited potential equity upside increase in the volatility of asset value (i.e., asset risk). Other things equal, the value of a firm's equity therefore increases in its asset volatility, and vice versa.

In the presence of corporate taxes, a tax increase reduces the expected cash flows available to shareholders. Thus, the value of equity decreases in the tax rate. With this tax effect, the Merton framework implies that shareholders can make up for such a tax-induced value loss of their claims by increasing their firm's asset volatility.[45] In this setting, taxes therefore give shareholders an incentive to invest in a project that increases their firm's asset risk, leading to the hypothesis that *the likelihood of corporate risk-taking increases in tax rates*. Although shareholders can maximize the value of their call option (equity) by increasing asset volatility even without taxes, this chapter, however, proposes that taxes only give shareholders an additional incentive to shift risk.

The effect of a tax change on the expected cash flows to shareholders and equity value may vary across firms depending on their financial conditions. Firms that are financially weak or close to being distressed are likely to be more susceptible to a tax increase than those that are financially healthy. For a given increase in tax rate, the reduction in equity value is greater for financially weak firms than their healthy counterparts (Eisdorfer, 2008). In this setting, financially weak firms have a stronger incentive to engage in a risk-taking activity, such as committing to risky investment projects, than financially strong firms do. As pointed out by Jensen and Meckling (1976), financially weak firms have little to lose but all to gain by taking large gambles.[46] Given the above analysis, I hypothesize that *the risk-taking effect of tax is larger for firms with high leverage than for firms with low leverage*.

[45] However, even without transactions costs, taxes, or problems with indivisibilities of assets in the model, Merton (1974, p.460) notes the following: "If, for example, due to bankruptcy costs or corporate taxes, the MM theorem does not obtain and the value of the firm does depend on the debt-equity ratio, then the formal analysis of the paper is still valid."

[46] Shareholders can possibly delay filing for bankruptcy by raising the asset volatility that increases opportunities of the asset value to rebound or by generating sufficient temporary cash flow to avoid bankruptcy.

4.3.2 A negative relation between corporate tax rates and risk-taking

The single-period framework of the Merton (1974) model implicitly assumes that shareholders make a risk-taking decision without regards to their future financing opportunity.[47] In a multi-period setting, debt-holders rationally expect opportunistic behavior of shareholders, and, as compensation, impose either a higher interest rate or strict covenants, or both. In this setting, firms with a good borrowing record will receive more favorable lending terms. As demonstrated by Diamond (1989, 1991), such a benefit increases overtime as the firm accumulates its reputation, thereby giving it an incentive to invest in less risky projects.

When corporate tax rates are high, debt financing becomes more attractive due to a larger tax-shield benefit. To enjoy a larger tax-shield benefit, the Diamond (1989) model implies that shareholders are likely to build a good reputation by maintaining a relatively low asset risk so that debt financing remains accessible to the firm with favorable terms. Accordingly, in the multi-period setting, corporate taxes (through the tax-shield benefit) gives shareholders an incentive to invest in low-risk projects, leading to the hypothesis that *the likelihood of corporate risk-taking decreases in tax rates.*

In this reputation-building model, the effects of corporate taxes on risk-taking may differ between firms with high and low leverage. Firms with low leverage and hence the opportunity to raise further borrowings are likely to have a relatively large expected tax-shield benefit. For low-levered firms, reputation should therefore be of great concern, implying the tendency to minimize risk-taking in their investment decisions to a minimum when tax rates are high. On the other hand, the expected tax-

[47] Earlier literature that studies corporate risk-taking mainly applied in the single period framework (see, for example, Black & Scholes, 1973; Jensen & Meckling, 1976; Merton, 1974).

shield benefit from further borrowings is likely to be small for firms with high leverage. To this extent, the net gain from reputation-building (net of the benefit from risk-taking) may well be smaller to shareholders in high-leverage firms. With a trivial concern about reputation, the risk-taking effect of tax is likely to be pronounced among high-leverage firms. In this analysis, I hypothesize that *the risk-taking effect of taxes is weaker for firms with low leverage than for firms with high leverage*.

When viewed together with the single-period framework of the Merton (1974) model, the multi-period reputation-building model also implies that that the effect of corporate tax on corporate risk-taking varies with leverage.

4.4 Empirical design

4.4.1 Measuring the corporate risk-taking

As a measure of the amount of risk-taking associated with an acquisition, we calculate for each deal the difference between the acquirer's asset risk six months following the completion date $\sigma_{A_{c+6}}$ and its asset risk one month prior to the bid announcement date $\sigma_{A_{a-1}}$. Then, the risk-taking measure is defined as

$$\Delta\sigma_A = \sigma_{A_{c+6}} - \sigma_{A_{a-1}}. \qquad (1)$$

A public announcement of the firm's decision can lead investors to revise their expectations about the firm's prospects (Mitchell, Pulvino, & Stafford, 2004). Accordingly, $\sigma_{A_{a-1}}$ is estimated during the 120-trading day period ending one month before the announcement date in order to mitigate the impact of information leakage (if any) on the acquirer's stock price, and hence, the estimation of asset volatility. Since the estimation of asset risk in Merton (1974) also requires information on book value of debt (see below), $\sigma_{A_{c+6}}$ is estimated during the 120-trading day period beginning six months after the completion date. This is to ensure that the publicly observable balance sheet information on the acquirer reflects the merged firm. The practice of estimating asset risk during the period ending one prior the bid announcement and period beginning six months after the bid completion has been adopted in Furfine and Rosen (2011).

The economic importance of a given amount of risk-taking may vary across firms, depending on the firm's initial asset volatility before making an acquisition. This suggests an alternative way to look at risk changes would be to examine the percentage change in risk. Specifically, the same absolute amount of $\Delta\sigma_{\mathrm{A}}$ in equation (1) can be economically more significant for firms with inherently low-risk assets than those with inherently high-risk assets. To address this issue, we scale $\Delta\sigma_{\mathrm{A}}$ in equation (1) by $\sigma_{\mathrm{A_{a-1}}}$ to obtain $\%\Delta\sigma_{\mathrm{A}}$:

$$\%\Delta\sigma_{\mathrm{A}} = \frac{\sigma_{\mathrm{A_{c+6}}} - \sigma_{\mathrm{A_{a-1}}}}{\sigma_{\mathrm{A_{a-1}}}}. \tag{2}$$

Since $\%\Delta\sigma_{\mathrm{A}}$ controls for the differences in the inherent riskiness of acquirers, this study focuses on it throughout the empirical analysis of the study.

I estimate asset risk (σ_{A}) in the Merton (1974) framework, in which the firm's underlying assets follows a geometric Brownian motion (GBM) of as follows:

$$dV_A = \mu V_A dt + \sigma_A V_A dW, \tag{3}$$

where V_A is the value of a firm's assets, μ an instantaneous drift, σ_A an instantaneous volatility of a firm's assets, and W the standard Wiener process. The market value of equity, V_E, is then given by a closed-form solution of the Black and Scholes (1973) model for call options:

$$V_E = V_A N(d_1) - Xe^{-rT} N(d_2), \tag{4}$$

where r is the instantaneous risk-free rate, T is time to maturity of debt, and X is the book value of the firm's debt. $N(.)$ is the cumulative standard normal distribution function, with d_1 and d_2 defined as: $d_1 = \frac{\ln\left(\frac{V_A}{X}\right)+\left(r+\frac{\sigma_A^2}{2}\right)T}{\sigma_A\sqrt{T}}$; and $d_2 = d_1 - \sigma_A\sqrt{T}$.

Following Vassalou and Xing (2004), I employ an iterative procedure to back out σ_A from equation (4). To estimate the asset volatility before an acquisition takes place, $\sigma_{A_{a-1}}$, I first estimate the volatility of equity using daily stock returns from the past 120 trading days ending one month before the announcement date, which will be used as an initial value for the estimation of σ_A. Next, by using equation (4), and for each trading day of the past 120 days, I compute V_A by using V_E as the market value of equity of that day to obtain daily values for V_A. Then, I calculate the standard deviation of those V_A's, which is used as the value of σ_A, for the next iteration. This procedure is repeated until the values of σ_A from two consecutive iterations converge.[48] The asset volatility after the completion of acquisition, $\sigma_{A_{c+6}}$, can be estimated by repeating the same procedure from the 120-trading day period beginning six months after the completion date.[49]

4.4.2 Data and sample selection

To examine the effects of taxes on risk-taking through the corporate investment policy, this study explores all completed mergers and acquisitions (M&As) carried out by publicly listed companies in the G7 nations. I include acquisitions of domestic and

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[48] The tolerance level for convergence I used is 10E-4.

[49] For more detail on the calculation of asset volatility using iterative procedure, please see Löeffler and Posch (2010).

cross-border (both from the G7 and non-G7) targets, and of both publicly quoted and privately held targets. Mergers and acquisitions provide a good measure of whether firms take risks to invest because these transactions typically involve large capital outlays, which by structure affect the firm's asset risk (Eckbo & Thorburn, 2009).

The reason to study the G7 countries is fourfold. First, as they are all developed industrial countries, their capital markets are of a similar structure. Second, the information about acquisitions is not only more reliable but also more transparent (Acharya et al., 2011). Third, M&A activities are more prevalent in these countries and M&A activities from the G7 countries represents more than the 63% of net global wealth ($241 trillions), according to Credit Suisse Global Wealth Report September 2013. Lastly, the corporate tax rates of these seven countries provide enough variation to study the impact of taxes on investment decision (Rajan & Zingales, 1995)

The sample acquisitions are drawn from the Thomson Financial SDC Mergers Database. The collected acquisitions were those with the initial bid announced during the period between January 1, 1989 and December 31, 2012. To ensure that the gathered sample consists of deals in which the acquirer was involved in a substantial asset risk, I only include acquisitions where an acquirer did not hold shares of the target above 50% before the bid announcement, and the total transaction amount was more than 5% of the acquirer's market value. Also, transactions that lasted for more than once year from the time the M&A was announced to the time of completion are dropped. This eliminates some certain numbers of investments that possibly affect the acquirer's asset risk other than acquisitions. Acquisitions by acquirers under financial and utility sectors are dropped.

The information from both market and accounting data from the balance sheet are obtained from Thomson Reuters Datastream. I eliminate observations with either missing total assets or where total assets are negative. Acquirers from SDC for which we could not obtain data from Thomson Reuters Datastream are dropped. Finally, from the initial sample of 91,014 acquisitions, a total final sample of 21,252 acquisitions and 9,510 unique acquirers survive the above sample criteria.

Table 24 reports distributions of the final sample. As shown in Panel A, the number of deals from the G7 nations fluctuates over the period between 1988-2012. Acquisitions in the final sample come in wave peaking in the late 1990s and 2000s, and dropping after 2008. Among 21,252 deals in the final sample, the majority of deals in the sample, 55% (11,705 deals), are from acquirers located in the United States. Even without including acquisitions from the United states, merger waves from the remaining sample have followed the similar pattern. This pattern is also in line with the evidence from previous literature that examine waves of mergers and acquisitions overtime (Alexandridis, Fuller, Terhaar, & Travlos, 2013; Goel & Thakor, 2010; Harford, 2005).

Panel B presents the statutory corporate tax rates and the average percentage changes in asset volatility from 1989 through 2012. As shown in Panel B, the statutory tax rates vary across years, and have declined over time from the highest average of 45% in 1997 to the lowest of 31.56% in 2012.

Table 24 Sample distributions

This table presents distributions of the final sample. Panel A reports distributions of the sample acquisitions from the G7 nations through the period between 1989 and 2012. Panel B reports statutory tax rates from the G7 nations during the sample period, and the percent changes in asset volatility.

Panel A: Distributions of sample acquisitions across sample period

	Number of acquisitions							
Year	G7 nations	Canada	France	Germany	Italy	Japan	UK	USA
All	21,252	2,588	490	279	231	1,479	4,480	11,705
1989	40	3	6	2	0	1	4	24
1990	406	17	17	6	8	11	195	152
1991	347	12	13	4	5	7	150	156
1992	404	23	9	2	5	4	155	206
1993	475	22	10	7	4	4	172	256
1994	605	24	9	10	3	2	208	349
1995	780	30	14	2	2	5	200	527
1996	966	48	11	12	1	9	191	694
1997	1,223	52	31	7	6	3	257	867
1998	1,418	74	15	11	9	24	286	999
1999	1,384	61	45	23	21	56	282	896
2000	1,332	106	45	22	22	86	291	760
2001	1,043	105	32	15	13	59	242	577
2002	938	126	19	11	13	68	165	536
2003	901	99	16	11	17	82	166	510
2004	1,101	141	13	10	5	104	208	620
2005	1,180	160	26	15	14	125	247	593
2006	1,248	186	30	23	17	130	270	592
2007	1,330	246	40	26	16	159	262	581
2008	1,012	220	21	15	16	149	152	439
2009	940	300	30	11	11	138	99	351
2010	945	271	18	14	13	106	129	394
2011	836	193	18	15	10	110	110	380
2012	398	69	2	5	0	37	39	246

Among the G7 nations, Germany has the highest average corporate tax rate of 45.42%, while the United Kingdom has the lowest average statutory corporate tax rates of 30.54%. Throughout the sample period, there are several corporate tax changes from the G7 nations, suggesting that our sample periods provide enough variation in tax rates for examining its effects on risk-taking.

Table 24 – *continued*

Panel B: Statutory tax rates and percentage changes in asset volatility across sample period

	Statutory corporate tax rate (%)								$\%\Delta\sigma_A$
Year	G7 nations	Canada	France	Germany	Italy	Japan	UK	USA	G7 Nations
All	39.00	37.74	36.66	45.42	39.35	44.02	30.54	39.26	13.15
1989	44.77	41.34	42.00	60.00	46.40	49.98	35.00	38.65	1.72
1990	43.86	41.45	42.00	54.55	46.40	49.98	34.00	38.65	-5.16
1991	44.24	41.81	42.00	56.25	47.80	49.98	33.00	38.85	-0.62
1992	44.10	42.52	34.00	58.15	52.20	49.98	33.00	38.86	13.84
1993	43.91	42.56	33.33	56.52	52.20	49.98	33.00	39.75	2.98
1994	43.42	42.58	33.33	52.17	53.20	49.98	33.00	39.69	16.52
1995	44.35	42.86	36.66	55.11	53.20	49.98	33.00	39.61	21.80
1996	44.46	42.94	36.66	55.88	53.20	49.98	33.00	39.53	1.22
1997	45.00	42.94	41.66	56.80	53.20	49.98	31.00	39.45	6.76
1998	42.06	42.94	41.66	56.05	37.00	46.36	31.00	39.44	11.62
1999	40.31	42.87	40.00	52.03	37.00	40.87	30.00	39.39	24.22
2000	39.92	42.43	37.76	52.03	37.00	40.87	30.00	39.34	2.01
2001	37.42	40.48	36.43	38.90	36.00	40.87	30.00	39.26	-2.47
2002	36.93	38.02	35.43	38.90	36.00	40.87	30.00	39.30	5.94
2003	36.53	35.87	35.43	40.22	34.00	40.87	30.00	39.33	12.63
2004	35.79	34.38	35.43	38.90	33.00	39.54	30.00	39.31	7.37
2005	35.69	34.18	34.95	38.90	33.00	39.54	30.00	39.28	21.37
2006	35.59	33.93	34.43	38.90	33.00	39.54	30.00	39.30	10.23
2007	35.58	33.95	34.43	38.90	33.00	39.54	30.00	39.26	29.14
2008	32.90	31.43	34.43	30.18	27.50	39.54	28.00	39.25	41.96
2009	32.82	31.02	34.43	30.18	27.50	39.54	28.00	39.10	-5.62
2010	32.60	29.36	34.43	30.18	27.50	39.54	28.00	39.21	21.64
2011	32.07	27.64	34.43	30.18	27.50	39.54	26.00	39.19	33.16
2012	31.56	26.14	34.43	30.18	27.50	39.54	24.00	39.13	2.69

Also reported in Panel B, the means change in asset volatility fluctuate over the sample period. We observe the negative percentage changes in asset volatility during 1990-1991, in 2001, and in 2009. These findings are consistent with Langenmayr and Lester (2016), which reported the negative ROA during the major economic crises.

4.4.3 Control variables and descriptive statistics

This chapter uses acquisitions as a lab to examine corporate risk-taking decisions, therefore, I incorporate the known determinants of the acquirer's asset risk. The choice of independent variables is guided by the extant literature which suggests that risk-taking can be influenced by firm and market characteristics. Summary statistics for both our dependent and independent variables are given in Table 25. All firm-level variables are winsorized at the 1% and 99% level to control for outliers.

To begin with our firm-level variables, I include a firm's size (John et al., 2008) and the relative size of deal to the acquirer market value (Asquith, Bruner, & Mullins, 1983). Acquiring firms in the sample report average values of deals to be 68% of acquirer market capitalization. I also include leverage to control for firm risk that can be related to financial distress costs, tax shields of debt, and asset substitution (Harris & Raviv, 1991).

Table 25 Descriptive statistics

This table presents summary statistics of the final sample used in the regression. The sample consists of 21, 252 acquisitions with the 9,510 unique acquirers from the period between 1989 and 2012. σA is an asset volatility of an acquirer that estimated from the Merton model by using the information from the market of 60 trading days. Pre-σA is an asset volatility of an acquirer one month before the announcement date. Post-σA is an asset volatility of an acquirer six months after the effective date. %ΔσA is the percentage change in an acquirer's asset volatility after acquisition, and defined as $\frac{(\text{Post}-\sigma A)-(\text{Pre}-\sigma A)}{\text{Pre}-\sigma A} * 100$. ΔσA is the absolute change in an acquirer's asset volatility after acquisition, and defined as Post-σA - Pre-σA. The other variables are described in the Appendix. All data are winsorized at the 1 and 99 percentiles prior to calculations.

Variable	Obs	Mean	Median	Std. Dev.	Min	Max
Pre-σ_A	21,252	0.25	0.17	0.23	0.04	1.46
Post-σ_A	21,252	0.22	0.15	0.19	0.03	1.15
%$\Delta\sigma_A$	21,252	13.15	-10.81	115.64	-97.69	2666.48
$\Delta\sigma_A$	21,252	-0.03	-0.02	0.22	-1.43	1.11
Corporate tax rate (%)	21,252	36.85	39.26	4.17	26.14	42.94
Actual tax paid (%)	19,153	22.98	28.00	14.72	0.00	42.94
Deal size/market value	21,252	0.68	0.17	7.97	0.05	730.43
Leverage	21,252	0.34	0.30	0.30	0.00	1.64
Cash	21,252	0.54	1.00	0.49	0.00	1.00
Ln total assets	21,252	19.08	19.10	2.13	13.07	24.05
Ln ΔMarket cap	21,252	0.05	0.06	0.15	-0.92	0.84
ΔMarket volatility	21,252	0.01	0.00	0.10	-0.36	0.47
Creditor rights index	21,252	1.72	1.00	1.24	0.00	4.00
Ind Diff	21,252	0.41	0.00	0.49	0.00	1.00
Cross border	21,252	0.23	0.00	0.42	0.00	1.00

Furthermore, characteristics (types) of deals can also affect the firm's overall risk after acquisitions. The effects of acquisitions on change in the firm's risk are different on whether mergers are between firms in different industries or between firms within-industry mergers (Furfine & Rosen, 2011). Literature also reports that the market reactions and the firm's risk diversifications resulting from cross-border and domestic acquisitions are significantly different from each other (Kaplan & Weisbach, 1992). More importantly, Travlos (1987) reports that using overvalued stock to purchase a target can increase risk of firms after acquisition. On the other hand, financing with cash will be preferred when acquirers consider their stock undervalued (Hansen, 1987; Myers & Majluf, 1984). Therefore, I control for deal characteristics by considering whether mergers are within or across industries, domestic or cross-border acquisitions, and payment methods. As shown in Table 25, among 21,252 deals in the sample, 54.3% involve with cash, 40.5% merge with a target from different industries according to the two digits SIC codes, and 23.1% are cross-border acquisitions

As for the market- and country-level characteristics, I capture the overall state of market and economy by including changes in the stock market capitalization and stock market volatility to control for the change of market states that can affect the change in asset risk of acquirers (Eisdorfer, 2008). We also include creditor rights index to control for difference of creditor protection across countries that could affect change in asset risk (Acharya et al., 2011).

Table 25 also reports the key dependent variables of tax measures. The mean (median) statutory tax rate of 36.847% (39.260%). The mean (median) of the rate of actual tax paid is lower at 22.979% (28.0%). The statutory corporate tax is measured by a top marginal country statutory corporate tax rate, and the rate of actual tax paid is the percentage of average tax rate paid by the company on its earned income, calculated by dividing tax expenses to the taxable income. The difference in these two corporate tax measures suggest that acquirers in the sample, on average, paid less taxes than the statutory corporate rate by 13.868%. As in the unreported result, the correlation between the statutory tax rate and the rate of actual tax paid is approximately 22%.

Finally, as for the risk-taking measures, the summary statistics of asset volatility before and after acquisitions are also reported in Table 25. The average of asset volatility is 0.248 before acquisitions and 0.216 afterwards. A decreasing pattern also can be observed in the reported median statistics. These findings suggest that, in general, asset volatility declined after acquisitions. In contrast, the average percentage change in asset volatility $\%\Delta\sigma_A$ is 13.154% and a positive figure suggests an increase in asset volatility after acquisitions. This finding may seem surprising for some readers, but a closer look into the median percentage change (-10.814%) provides some logical reasons. First, more than 50% of the firms in the sample saw a decline in its asset volatility after acquisitions, while only a small portion of the sampled firms (18.324%) witnessed an increase in asset volatility. However, their increases were substantial, offsetting the majority of the firms with a decline in asset volatility and resulting a positive percentage change in the average statistic. The statistics of the absolute change in asset volatility appear to corroborate this reasoning, as the mean is -0.031 and median -0.015. Altogether, these findings provide other reason that can explain such a conflicting result, such that firms with low initial asset volatility increased their risk in percentagewise after M&A more than firms with high initial asset volatility. Despite the fact that these initially low risk firms were not many, their risk increases were sizeable enough to dominate the other group of firms with a decrease in their asset risk and led to a positive statistic in the average percentage change in asset volatility.

4.5 Empirical evidence on taxes and risk-taking

4.5.1 Univariate analysis

As mentioned in section 4.3, corporate taxes and risk-taking can be explained through the two different mechanisms. On the one hand, the reputation building model predicts that higher tax rates decrease risk-taking because corporate tax (through the tax-shield benefit) gives shareholders an incentive to invest in low-risk projects. The Merton model, on the other hand, predicts that higher corporate tax rates increase risk-taking. That is, the value of equity decreases in the tax rate so that shareholders can make up for such a tax-induced value loss of their claims by increasing their firm's asset volatility. To investigate these alternative predictions, I analyze $\%\Delta\sigma_A$ (estimated from equation (2)) across tax quintiles.

Firstly, changes in the firm's asset volatility are examined by partitioning the sample into five quintiles according to the level of tax rates (both the actual tax paid and statutory tax rates), which are ranked from the lowest (τ_1) to the highest quintile (τ_5). Table 26 presents the mean (median) change in asset volatility $\%\Delta\sigma_A$ of acquirers across actual rates of tax paid and statutory corporate tax rates. The results show that means of $\%\Delta\sigma_A$are positive in all tax quintiles, and these positive figures appear in both tax measures. As can be seen across five quintiles of actual tax rates, $\%\Delta\sigma_A$ decreases from 18.61% (-0.133) in (τ_1) to 6.68% (-0.110) in (τ_5), and these two means are significantly different from each other. Not only $\%\Delta\sigma_A$ declines when firms pay more actual tax, the reduction pattern also shows that $\%\Delta\sigma_A$ are monotonically decreasing on the actual tax measure. This decreasing pattern is also can be observed in the statutory tax measure. These findings suggest that the increase in asset risk through acquisitions becomes smaller when firms face higher actual tax and statutory tax rates. These results are in line with the prediction based on the reputation models, suggesting that corporate tax and risk-taking are negatively correlated.

Table 26 Changes in asset volatility across different tax quintiles

This table presents the univariate results of the percentage and absolute changes in an acquirer's asset volatility after the acquisition. The table reports the number of mergers and acquisitions, the mean (median) percentage changes in an acquirer's asset volatility, and the mean (median) absolute change in an acquirer's asset volatility across tax levels. Tax levels are divided into 5 quintiles. τ_1 is the lowest and τ_5 is the highest quintiles accordingly. $\tau_5 - \tau_1$is the difference in an acquirer asset volatility between the highest and the lowest tax quantiles. The last column of the table presents the p-value of the t-test of the difference of the means between $\tau_5 - \tau_1$

Actual tax paid	τ_1	τ_2	τ_3	τ_4	τ_5	All	$\tau_5 - \tau_1$	p-val
Numbers of deals	4,946	1,558	2,072	4,813	5,764	19,153		
$\%\Delta\sigma_A$	18.61	10.42	9.23	8.75	6.68	10.94	-11.94	0.000
	(-0.13)	(-0.13)	(-0.12)	(-0.11)	(-0.11)	(-0.12)		
Corporate tax rate	τ_1	τ_2	τ_3	τ_4	τ_5	All	$\tau_5 - \tau_1$	p-val
Number of deals	1,112	3,256	2,463	12,011	2,410	21,252		
$\%\Delta\sigma_A$	25.15	12.23	17.56	11.98	10.23	13.15	-14.92	0.000
	(-0.06)	(-0.15)	(-0.62)	(-0.10)	(-0.12)	(-0.10)		

To further explore the correlation between tax and risk-taking, I also examine changes in the firm's asset volatility by exploit cross-country variation of tax rates from the G7 nations. The sample is divided into seven groups based on the country where an acquirer is located, and from the lowest to the highest tax rates. Table 27 report mean changes in asset volatility across G7 nations. Panel A reports the change in asset risk through the rate of actual tax paid while Panel B reports the statutory tax rate. Among G7 nations, the mean percentage change in asset risk is the lowest in Japan, where the actual tax rates are the highest. Canada and the United Kingdom, on the other hand, are the two countries with the lowest rates of actual tax paid and corporate tax rates respectively, and the percentage change in asset risk appears to be larger.

In line with Table 26, the findings in Table 27 show that the percentage change in the firm's asset risk ($\%\Delta\sigma_A$) tend to be smaller when facing with a higher tax rates, although results does not show the monotonically decreasing pattern as in the Table 26.

Taken together, the findings from Table 26 and Table 27 indicate that corporate taxation decreases risk-taking, which are in line with the reputation building framework.

Table 27 Change in asset volatility across countries

This table presents the univariate results of the percentage and absolute changes in an acquirer's asset volatility after the acquisition. The table reports the percentage changes in an acquirer's asset volatility, and the absolute change in an acquirer's asset volatility across the G7 nations. Panel A reports the average percentage and absolute changes in asset volatility across the G7 countries ranked by average percentage of actual tax rates. Panel B reports the change in asset volatility across the G7 countries ranked by average percentage of statutory corporate tax rates.

Panel A: Change in asset volatility across the average actual tax paid from the lowest to the highest countries

	Acquirers country origin							
Tax rates	G7 nations	Canada	UK	USA	France	Italy	Germany	Japan
Actual tax paid (%)	24.40	18.76	22.26	25.19	27.72	27.72	28.72	32.04
$\%\Delta\sigma_A$	10.94	14.02	11.43	9.82	15.22	36.63	14.37	6.20

Panel B: Change in asset volatility across the average statutory tax rate from the lowest to the highest countries

	Acquirers country origin							
Tax rates	G7 nations	UK	France	Canada	USA	Italy	Japan	Germany
Corporate tax rate (%)	36.85	30.55	36.67	37.74	39.27	39.35	44.02	45.42
$\%\Delta\sigma_A$	13.29	13.52	15.02	16.01	12.63	39.92	5.76	16.19

4.5.2 Regression analyses of taxes and risk-taking

To examine the effect of corporate tax on risk-taking, I employ the regression as follow:

$$\%\Delta\sigma_{A_i} = \alpha_i + \beta Tax_{i,j} + \boldsymbol{\gamma}' controlVar_{i,j} + \epsilon_i, \quad (5)$$

where $Tax_{i,j}$ is the statutory corporate tax rates or rates of actual tax paid of firm i in country j, $controlVar_{i,t}$ is a vector of control variables, and ϵ_i is the error term.

Regression results from equation (5) for the effects of taxes on changes in the firm's asset volatility are reported in Table 28. Model (1) provides initial regression analysis. Without controlling for year and firm fixed effects, a coefficient of corporate tax rate shows that tax rates and percentage changes in asset risk are negatively and significantly correlated. Consistent with model (1), by using actual tax paid as a tax measure, the coefficient of tax remains significant with a negative sign. By adding the control variables discussed in section 4.4, model (3) shows that the sign remains negative and significant. I incorporate year and firm fixed effects in model (4). I also cluster standard errors by firm and country-year to account for within-firm and within-country-year correlation in our sample (Petersen, 2009). As shown in model (4), the coefficient of statutory corporate tax rate becomes positive (1.703) and significant (with *p*-value of 0.022) with large improvement in the adjusted R^2 (from 0.11% and 1.1% to 27.5%). The significant improvement in the adjusted R^2 indicates that the asset volatility can be time-varying (Heston, 1993; Hull & White, 1987), and risk-taking is different across firms due to the unobservable time-invariant firm-specific factors (Eisdorfer, 2008). As a result, tax rates are positively and significantly correlated with the change in the firm's asset risk after acquisitions. Specifically, a one percentage point increase in the statutory tax rate leads to approximately 170 basis points increase in asset risk.

Model (5) and (6) repeat the analysis in model (3) and (4) by using the rate of actual tax paid as a tax measure. In line with statutory tax rate, the coefficients of actual tax paid from model (5) and (6) have the same sign as model (3) and (4), respectively, and remain significant. Notably, the effects of statutory tax rates in model (3) and (4) appear to be more pronounced than those of the actual tax, according to the size of the tax coefficients. Together with the model (3) and (4), these results suggest that, once controlling for the firm and year fixed effects, firms have greater incentives to increase risk as they face greater tax rates, regardless of whether it is the actual tax they pay or statutory taxes.

Table 28 Regression analysis of taxes and changes in firm's asset volatility

This table presents results from a regression analysis of the association between taxes and changes in firm’s asset volatility of acquirers from the G7 nation between the between 1989 and 2012. The dependent variables of model (1) to (5) are the percentage changes in acquirer’s asset volatility, and the dependent variable of the model (6) is the absolute change in acquirer’s asset volatility. The industry fixed effects represent acquirers’ primary 2-digit SIC industries. All variables are described in the appendix. In parentheses is p-value based on the White standard errors that are robust to clustering at the acquirer level. Coefficients that are statistically different from zero at the 1%, 5%, and 10% significance level are denoted by ***, **, *, respectively

	Dependent variables					
	(1)	(2)	(3)	(4)	(5)	(6)
Explanatory variables	$\%\Delta\sigma_A$	$\%\Delta\sigma_A$	$\%\Delta\sigma_A$	$\%\Delta\sigma_A$	$\%\Delta\sigma_A$	$\%\Delta\sigma_A$
Corporate tax rate	-0.56***		-0.85**	1.70**		
	(0.00)		(0.01)	(0.02)		
Actual tax paid		-0.32***			-0.16***	0.22*
		(0.00)			(0.00)	(0.06)
Deal size/market value			0.00	0.01	0.00	-0.01**
			(0.20)	(0.80)	(0.36)	(0.03)
Leverage			-0.18***	-0.22***	-0.17***	-0.23***
			(0.00)	(0.00)	(0.00)	(0.00)
Cash			-0.06***	-0.06***	-0.05***	-0.06**
			(0.00)	(0.00)	(0.00)	(0.01)
Ln total assets			-0.03***	-0.07***	-0.02***	-0.07***
			(0.00)	(0.00)	(0.00)	(0.00)
Ln ΔMarket cap			-0.09	0.32***	-0.06	0.33***
			(0.12)	(0.00)	(0.26)	(0.00)
ΔMarket volatility			0.56***	0.49***	0.67***	0.56***
			(0.00)	(0.00)	(0.00)	(0.00)
Creditor rights index			-0.03**	0.41*	-0.01	0.38
			(0.01)	(0.09)	(0.45)	(0.12)
Ind Diff			0.05***	0.04*	0.05***	0.03
			(0.00)	(0.09)	(0.00)	(0.23)
Cross border			0.01	-0.02	0.00	-0.03
			(0.57)	(0.39)	(0.97)	(0.18)
Constant			1.11***	0.37	0.68***	0.98*
			(0.00)	(0.57)	(0.00)	(0.09)
Adjusted R^2 (%)	0.11	0.21	1.1	27.5	1.1	27.1
Number of usable observations	21,252	19,153	21,252	21,252	19,153	19,153
Year fixed effects				Yes		Yes
Firm fixed effects				Yes		Yes

As for the control variables included in the regression analysis in Table 28, the results are consistent with the majority of the existing empirical literature that examine the determinants of risk-taking incentive. According to model (4), the coefficient of the ratio of deal value to market value of acquirer is significantly negative, however, the impact is economically small. Leverage of an acquirer before the announcement date is negatively and significantly related to change in the firm's asset risk. This finding is in line with Eisdorfer (2008) reporting the weaker incentive of risk-taking in a highly levered firm. A coefficient of acquisitions involved with cash financing is significantly negative. This result supports Faccio and Masulis (2005), which suggest that financing with cash increases the level of diversification. Size of firms has a negative significant coefficient. This finding is consistent with Furfine and Rosen (2011) and Langenmayr and Lester (2016) which report that large acquirers may be more diversified than smaller acquirers, all else equal. Both change in market capitalization and market volatility have positive significant coefficients. This implies that change in the firm's asset risk and the change in market volatility are correlated. In other words, when market become more volatile, investment from firms become riskier as well. The coefficient of cross-industry merger is positive, although weakly significant. This implies that acquisition across industries increase risk of acquirer more than acquisitions between with the target within the same industry. This result is in line with Furfine and Rosen (2011). Lastly, model (4) and (6) report negative insignificant coefficients of cross-border acquisitions.

To this extent, the empirical evidence from Table 28 suggests that firms have stronger incentive to engage in risk-taking when they face a higher tax rate. This result supports the prediction of the positive correlation between corporate income tax and risk-taking based on the Merton framework. The finding in this chapter provides a better understanding of the role of taxes on risk-taking, and also contribute to the growing body of evidence supporting tax effects of risk-taking (Langenmayr & Lester, 2016; Ljungqvist et al., 2016). The relationship between taxes and risk-taking has proven that the corporate taxation is one of the key factors that firms consider during their selection of risky investments.

4.5.3 Leverage and tax effects

The previous section confirms empirically that corporate taxes and risk-taking are positively correlated. However, the expected tax-shield benefits may vary across firms with different levels of leverage. As theorized in section 4.3, with higher tax rates, firms with low leverage and hence a better opportunity to raise further borrowing are likely to be more concerned with the change in tax rates due to a relatively large expected tax-shield benefits. On the other hand, because of the small expected tax-shield benefits from further borrowing, high-levered firms are less likely to be concerned with reputation.

To explore the possibility that the effects of tax on risk-taking vary across firm types, I estimate equation (5) for acquirers in the leverage subsample. The sample is further divided into three sub-groups, where I classified firms according to their leverage levels, namely the lowest 30%, the middle 40%, and the highest 30% leverage before acquisitions. Although firms may be optimal operating at relatively low leverage, this optimal is given as a feasible leverage that conditioning on all constraints due to the moral hazard problem. However, if there is a possibility that firms with relatively low leverage to borrow more, they would do so to obtain the tax shield benefits. On the other hand, firms with relatively high leverage should have less incentive to do so since they already had high leverage in the first place. Thus, using leverage subsample is appropriate to study the effects of taxes on risk-taking through the reputation concerns.

Estimates of the sub-sampling on leverage are reported in Table 29. Results for acquirers with the lowest leverage, medium leverage, and the highest leverage are reported in specifications (1), (2), and (3) respectively. The dependent variable is the statutory corporate tax rates. Model (1) shows that the coefficient of the statutory tax rate is negative (-1.924) for low leverage firms. Although statistically insignificant, the negative sign of the coefficient supports the reputation building model, which is in contrast to the results reported in Table 28. Such a coefficient of taxes, however, becomes positive and significant for medium leverage firms (2.857) as reported in model (2). Model (3) also shows that, when acquirers are high-levered firms, the tax coefficient becomes 5.790. Not only is it larger but it remains significant with the positive sign. The increasing pattern of such a coefficient on the statutory corporate tax rate provides the evidence that the effects of taxes on risk-taking are stronger when firms are highly-levered.

Models (4) through (6), from firms with the lowest to the highest leverage, employ the rates of actual tax paid as the dependent variable. Model (4) shows that the coefficient of the actual tax paid is positive. The coefficient sign is consistent with the effects of taxes found in Table 28, albeit insignificant. The coefficient of taxes in model (5) becomes significant and grows substantially larger, and remains positive. Model (6) also reports a positive coefficient of tax with a slightly smaller magnitude than that of model (5). Notably, the magnitude of the tax coefficient in model (6), high-leverage firms, is still larger than those reported in low-leverage in model (4).

When viewed together, the effects of tax on risk-taking from models (4) through (6) are broadly in line with the results from models (1) through (3), though less discernible. That is, the correlation between taxes and risk-taking is stronger when testing on the statutory corporate tax rates. This finding implies that, in general, risk-taking decisions are more sensitive to the change in the statutory corporate tax rate than the rate of actual tax paid. One plausibility is that the changes in the statutory corporate tax are exogenous to firms and their investment decisions. On the other hand, the rate of actual tax paid is calculated from the financial statements and varies across firms. Lastly, as for all other control variables, the results are broadly in line with the extant literature and the findings from Table 28.

Table 29 Regression analysis of corporate tax and changes in firm's asset volatility across different leverage levels

This table presents results from a regression analysis of the relation between taxes and change in firm's asset volatility of acquirers from the G7 nation between 1989-2012 by partitioning the sample into three sub-groups based on leverage ratio quantiles. Models (1) and (4) report coefficient estimates of fixed effects regression from the sample in the lowest leverage quantile (x ≤ 30%). Models (2) and (5) report coefficient estimates of fixed effects regression from the sample in the middle leverage quantile (30% < x ≤ 70%). Model (3) and (6) report coefficient estimates of fixed effects regression from the sample in the highest leverage quantile (70% < x). The dependent variables of model (1) to (6) are the percentage changes in acquirer's asset volatility. The industry fixed effects represent acquirers' primary 2-digit SIC industries. All variables are described in the appendix. In parentheses is p-value based on the White standard errors that are robust to clustering at the acquirer level. Coefficients that are statistically different from zero at the 1%, 5%, and 10% significance level are denoted by ***, **, *, respectively

	Dependent variables (%ΔσA)					
	Leverage			Leverage		
	(1)	(2)	(3)	(4)	(5)	(6)
Explanatory variables	Low	Mid	High	Low	Mid	High
Actual tax paid	-1.92	2.86**	5.79*			
	(0.18)	(0.02)	(0.07)			
Corporate tax rate				0.06	0.41*	0.25
				(0.79)	(0.05)	(0.54)
Deal size/market value	0.02	-0.01	0.03	-0.04	-0.02	0.02
	(0.74)	(0.16)	(0.27)	(0.18)	(0.27)	(0.39)
Leverage	-1.26*	-0.97***	0.12	-1.03*	-0.93***	0.06
	(0.07)	(0.00)	(0.44)	(0.08)	(0.00)	(0.74)
Cash	-0.06	-0.05	-0.07	-0.05	-0.06	-0.02
	(0.18)	(0.18)	(0.15)	(0.22)	(0.10)	(0.62)
Ln total assets	-0.01	-0.02	-0.24***	-0.06	-0.04	-0.17***
	(0.75)	(0.41)	(0.00)	(0.14)	(0.25)	(0.00)
Ln ΔMarket cap	0.22	0.31**	0.023	0.54**	0.32**	0.02
	(0.39)	(0.04)	(0.92)	(0.04)	(0.04)	(0.93)
ΔMarket volatility	0.44*	0.68***	-0.09	0.58**	0.69***	0.04
	(0.06)	(0.00)	(0.79)	(0.01)	(0.00)	(0.91)
Creditor rights index	0.16	0.17***	-0.39**	0.01	0.05	-0.26
	(0.54)	(0.00)	(0.01)	(0.81)	(0.26)	(0.16)
Ind Diff	-0.01	0.09**	0.03	-0.04	0.09***	0.00
	(0.81)	(0.01)	(0.67)	(0.43)	(0.00)	(0.98)
Cross border	-0.07	0.01	0.02	-0.10**	0.01	0.00
	(0.12)	(0.72)	(0.65)	(0.03)	(0.76)	(0.98)
Constant	0.62	-0.61	3.20*	1.15	0.77	3.78***
	(0.54)	(0.41)	(0.06)	(0.11)	(0.23)	(0.00)
Adjusted R^2 (%)	56.9	6.1	13.6	55.9	6.6	18.7
Number of usable observations	6,376	8,503	6,373	5,747	7,661	5,745
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

In sum, with the large expected benefit of tax-shield, low-leverage firms have a weaker incentive to engage in risk-taking when facing high tax rates. On the other hand, the risk-taking effects of tax are likely to be more pronounced among high-leverage firms with a smaller borrowing opportunity. Taken together, although the Merton model predicts that the tax effect does not vary with leverage, the results from Table 29 lend empirical support to the reputation building model. This finding suggests that the effects of taxes on risk-taking vary across firm leverage due to the different expected future benefit of tax shields. Firms may consider the implication of taxes when differentiating and selecting investment projects based on their different levels of riskiness.

4.5.4 Creditor protection and tax effects

Firm leverage significantly impacts tax effect on risk-taking as reported in Table 29. However, not only does risk-taking can be influenced by the firm-specific characteristic, recent evidence documents that country-specific factors also have an impact on risk-taking. Among these factors, a growing body of literature examines creditor rights as an institutional factor, and shows that corporate policies such as dividend payouts (Brockman & Unlu, 2009), debt issuances (Djankov, McLiesh, & Shleifer, 2007), and capital structure (Öztekin & Flannery, 2012) can be influenced by creditor protection. The study on an association between creditor rights and risk-taking, however, is still very limited, especially with the effect of taxes.

To the extent that creditor protection serves to protect the quality of collateral held by debt-holders (La Porta et al., 1998), therefore, risk-taking effect of taxes should be weaker in countries with strong creditor protections. To investigate this implication, how taxes effect varies across different degrees of creditor protection, I estimate equation (5) in creditor protections subsample. The sample is then divided into two sub-groups based on the value of the creditor rights index obtained from La Porta et al.

(1998) and Djankov et al. (2007).[50] The value of the creditor rights index between 0-2 will be considered as a country with relatively weak creditor protection, and relatively strong creditor protection otherwise.

Table 30 reports the results of regressions of the change in asset risk on taxes from firms between low- and high-creditor protection countries. For a firm in low-creditor protection environment, model (1) shows that the coefficient of the statutory tax rate is positively and significantly correlated to the percentage change in asset volatility. This finding is in line with the result from Table 28 that report the positive coefficient of taxes. A higher tax rate increases risk-taking, and this relation remains valid for a firm which operate in a country where the creditor protection is weak. On the other hand, as for a firm in stronger creditor protection, model (2) reports that the coefficient of taxes become insignificant for an acquirer located in a country with strong creditor protections. In other words, the positive effect of taxes on risk-taking is disappearing (taxes have no effect on the risk-taking) in a country with stronger creditor protection. Although firms have stronger incentive to increase asset volatility when tax rates become higher as shown in the Table 28, they may not do so because of the higher costs in default.

[50] According to La Porta et al. (1998), the levels of creditor protection of a country can be classified by their creditor rights scores, from the weakest to the strongest protection of 0 to 4. These numbers are calculated from the sum of four 0-1 indicator variables that evaluate whether there is no automatic stay on assets, whether secured creditor paid first, whether there are restrictions on going into reorganization, and whether management stays in the reorganization. As reported in the table 1, the mean and the median of the creditor rights index are 1.716 and 1 respectively. Accordingly, I split the sample into two sub-group based on the value of the creditor rights index, which are a country with low creditor rights index or weak creditor protection, and a country with high creditor rights index or strong creditor protection. In order to divided the sample into two sub-group, I select the cut-off point of the creditor rights index of 2 due to the mean of this index. That is, the value of the creditor rights index between 0-2 will be considered as a country with weak creditor protection, and stronger creditor protection otherwise. I also rerun the regression analysis with different cut-off point of the creditor rights index (0-1 and 2-4, and 0-1 and 3-4), and find that results are qualitatively similar.

Models (3) and model (4) repeat the analysis of model (1) and (2) by using the rates of actual tax paid as an independent variable instead of statutory tax rate, and provide consistent results by showing that the coefficient of taxes is positively and significantly affect change in asset volatility for a firm in a country with low creditor protections.

Table 30 Regression analysis of tax and change in firm's asset volatility for firms in low and high creditor protection countries

This table presents results from a regression analysis of the relation between taxes and change in firm's asset volatility of acquirers from the G7 nation between 1989-2012 by partitioning the sample into two sub-groups based on creditor rights. Models (1) and (3) report coefficient estimates of fixed effects regression from the sample in countries with low creditor rights (creditor right index between 0-2 according to La Porta et al. (1998) and Acharya et al. (2011)). Models (2) and (4) report coefficient estimates of fixed effects regression from the sample in countries with high creditor rights (creditor right index between 3-4). The dependent variables of model (1) to (4) are the percentage changes in acquirer's asset volatility. The industry fixed effects represent acquirers' primary 2-digit SIC industries. All variables are described in the appendix. In parentheses is p-value based on the White standard errors that are robust to clustering at the acquirer level. Coefficients that are statistically different from zero at the 1%, 5%, and 10% significance level are denoted by ***, **, *, respectively.

	Dependent variables (%ΔσA)			
	Creditor rights		Creditor rights	
	(1)	(2)	(3)	(4)
Explanatory variables	Low (0-2)	High (3-4)	Low (0-2)	High (3-4)
Actual tax paid	1.78**	-0.98		
	(0.04)	(0.61)		
Corporate tax rate			0.28*	-0.13
			(0.05)	(0.72)
Deal size/market value	0.00	-0.01	0.01*	-0.01
	(0.88)	(0.15)	(0.06)	(0.19)
Leverage	-0.31***	0.01	-0.32***	0.00
	(0.00)	(0.95)	(0.00)	(0.98)
Cash	-0.05**	-0.10*	-0.04*	-0.10*
	(0.03)	(0.05)	(0.06)	(0.06)
Ln total assets	-0.07***	-0.07*	-0.07***	-0.09*
	(0.00)	(0.08)	(0.00)	(0.06)
Ln ΔMarket cap	0.45***	0.02	0.46***	0.02
	(0.00)	(0.92)	(0.00)	(0.95)
ΔMarket volatility	0.56***	0.30	0.63***	0.37
	(0.00)	(0.29)	(0.00)	(0.21)
Ind Diff	0.04	0.06	0.02	0.06
	(0.17)	(0.25)	(0.41)	(0.26)
Cross border	-0.03	0.00	-0.05*	0.01
	(0.23)	(0.93)	(0.07)	(0.81)
Constant	0.82	2.03**	1.30***	2.11**
	(0.17)	(0.03)	(0.00)	(0.03)
Adjusted R^2 (%)	56.9	6.1	13.6	55.9
Number of usable observations	16,493	4,759	14,845	4,308
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes

As for firms in countries with stronger creditor protection, the result shows that the coefficients of taxes for both rates of actual tax paid and statutory corporate tax rates are negative and insignificant. Notably, untabulated results indicate that the coefficients of both tax measures are significantly differ in acquirers from countries with low and high creditor protections. Lastly, the results for the control variables that report in Table 30 are broadly in line with Table 28 and Table 29.

To this extent, the empirical evidence from Table 30 indicates that tax effect of risk-taking varies across different degrees of creditor protections. Specifically, the positive relation between taxes and risk-taking exists only in countries with low creditor rights. These findings contribute to a growing body of literature revealing that risk-taking can be influenced by creditor protections (Acharya et al., 2011; Cho, El Ghoul, Guedhami, & Suh, 2014). Despite the importance of tax as a risk-taking incentive, its effect appears to be curbed by the legal rights enjoyed by debt-holders.

4.6. Conclusion

While there has been a vast extent of literature on the effects of taxes on capital structure decisions and investment policies, empirical evidence on risk-taking decisions remain limited and inconclusive. This chapter seeks to uncover more valid evidences on whether and to what extent corporate tax affects corporate risk-taking by exploiting mergers and acquisitions events. Through estimating the asset volatility by adopting the Merton framework, empirical results show that corporate tax rates affect the risk levels of firm investment decisions. I find that, on average, when there is an increase in tax rates, firms have stronger incentive to engage in risk-taking. These findings support the Merton’s argument based on the option nature of equity.

On the other hand, the empirical results also support the reputation building model. When examining tax effects based on firm leverage, the results show that, when facing with higher tax rates, risk-taking incentive becomes weaker for a low-levered firm. In contrast, firms with high leverage are more likely to engage in risk-taking when the tax rate is higher. Furthermore, the empirical results from subsamples on creditor protection indicate that effects of taxes also vary across countries rules. With higher tax rates, firms in a country with lower creditor protection have more incentives to engage in risk-taking, and this effect of taxes on risk-taking disappears in a country with strong creditor protection, indicating that firms pay more attention to the riskiness of their assets by reducing asset volatility through their investment in countries that have higher creditor protections.

In summary, the empirical results indicate that taxes affect risk-taking positively in general while the actual effects of whether taxes have positive or negative relationship with risk-taking depend on the firm's characteristic such as leverage as well as the countries' creditor protection rules. Unlike any other previous studies, this chapter is the first to investigate the change in asset risk, estimating by the option pricing framework, through studying a particular event: mergers and acquisitions. The results from this research provide an extended understanding to the role of taxes on risk-taking. The implications of this chapter can be beneficial to policy makers when considering the alteration of tax rates, as it will affect the riskiness of firm investment decisions.

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APPENDIX

A. Variable Definitions for Chapter 4

Variables used in the Merton's model to estimate the acquirer's asset volatility

Variable	Definition
V_E	The market value of equity of an acquirer
r	1-year T-bill rate
T	The debt maturity. We follow Eisdorfer (2008) by estimating the firm's average debt maturity from the book value-weighted average of the maturities of short- and long-term debt. That is, $T = \frac{0.5STD+5LTD}{TD}$, where STD, LTD, and TD are the book values of short-term, long-term, and total debt respectively.
X	The total liabilities of an acquirer.

Country level variables

Variable	Definition
Corporate tax rate	A top marginal country statutory corporate tax rate.
Ln ΔMarket cap	Natural logarithm of the change in market capitalization of the stock exchange market where an acquirer is located.
ΔMarket volatility	The change in the average annualized volatility over a 30 (weekday) period of a stock market where an acquirer is located.
Creditor rights index	The sum of four 0-1 indicator variables that evaluate whether there is no automatic stay on assets, whether secured creditor paid first, whether there are restrictions on going into reorganization, and whether management stays in the reorganization. This index was first estimate in La Porta *et al*. (1998) and updated in Djankov *et al*. (2007)

Firm level variables

Variable	Definition
σ_A	An asset volatility of an acquirer that estimated from the Merton model by using the information from the market of 60 trading days.
Actual tax paid	The percentage of average tax rate paid by the company on its earned income, calculated by dividing tax expenses to the taxable income.
Deal size/market value	The ratio of deal value to the market value of acquirer one month before the announcement date
Leverage	Ratio of total liabilities to total assets
Cash	A dummy variable that takes the value 1 if and only if the acquisition is financed at least partially with cash.
Ln total assets	Natural logarithm of the firm's total asset
Ind Diff	A dummy variable that takes the value 1 if and only if the target and the acquirer are in different industries according to the 2 digits SIC.
Cross border	A dummy variable that takes the value 1 if and only if the target and the acquirer are in different countries.

VITA

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