The Real Effect and Consequence of Regulation Reform in Corporate Finance and Banking

Yue Zhou

Submitted in fulfilment of the requirements of the Degree of Doctor of Philosophy

Adam Smith Business School

College of Social Science

University of Glasgow

October 2020

Abstract

This thesis includes three thorough studies which examine the real effect and consequence of regulation reform in banking and corporate finance over the last decades.

It starts with a cross-country study which investigates how regulation and supervision over banks affect their systemic risk. Motivated by a new database of banking regulation and supervision from the Bank Regulation and Supervision Survey of the World Bank, we conduct an empirical analysis for banks from 65 countries from the period 2001 to 2013. We find that bank activity restriction, initial capital stringency and prompt corrective action are all positively related to systemic risk which is measured by *Marginal Expected Shortfall*. Next, to address the potential endogenous issue which can undermine the baseline results, we employ the staggered timing of Basel II regulation across countries as an exogenous event, and also instrumental variable analysis. Our results are held for both tests. On top of that, we conduct a series of robustness tests, including using weighted-least-square regression analysis to account for the differences in the number of banks across countries, subsamples, and using an alternative measure of systemic risk by SRISK. Last, we provide further evidence to show that positive relationship between regulation and supervision and systemic risk is through banks' capability of raising capital: the positive impact of bank regulation and supervision on systemic risk tents to be amplified if banks are bigger, but the effect can be alleviated of banks are better capitalized or more diversified. Overall, this study highlights the importance of capability of banks' capital raising, especially during difficult times. Our findings do not argue that bank regulation and supervision are detrimental to systemic risk, but instead call for the proper design and implementation of bank regulation.

In the second one, we focus on how firms' CSR performance respond to the Interstate Banking and Branching Efficiency Act (IBBEA) passed in the U.S 1994. The interstate deregulation increases the bank competition at the state level significantly, expanding the availability and reducing the cost of credit. We find that firms which experience the deregulation show a significant and persistent decrease in

CSR, suggesting firms show "doing good" for the access to finance in an uncompetitive credit market. To address the potential concern about reverse causality, we examine the dynamic effect of interstate banking deregulation on firms' CSR performance. We find no evidence on the pre-trend in the change of firm CSR performance prior to deregulation but a significant decrease in the year of bank deregulation. We further conduct a placebo test by employing falsified deregulation years and randomly assigned to different states. The results show that falsified deregulation is unlikely to affect firms CSR performance. Next, we attempt to rule out an alternative explanation of bank relationship lending for the main findings. In the end, we provide direct evidence on the channel of financial constraints through which firms' CSR performance is reduced after the bank deregulation. The results found in this study suggest that banks may engage in CSR as a strategical investment to delight external stakeholders. While when the needs from stakeholders decrease, firms' CSR engagement can reduce consequently.

In the third study, we extend the research scope to examining the effect of general corporate income tax on firm investment efficiency. There are well-established literature on how corporate tax can affect firms investment decisions, mainly on the absolute investment level, while whether the tax-induced investment is efficient for firms is underexplored. In this study, we stand from shareholders' perspective and examine the impact of corporate income tax on the efficiency of firms' investment decision by exploiting staggered changes in state-level corporate income tax rates. We find that the tax rate changes can asymmetrically affect firms' investment efficiency: the tax increase aggravates overinvestment while tax cut mitigates underinvestment. Additional evidence suggests the tax changes are more significant for firms which engage aggressively in tax planning or less capable in tax avoidance activities. We further confirm the asymmetrical effects of tax changes through financing channel and agency cost channel respectively. Our results are held to endogeneity tests and a series of robustness tests. Taken together, our study add new evidence to how general tax policies can distort investment decision.

Acknowledgement

I am thankful for all the support and help I have received from my family, friends, supervisors, fellow doctoral students, faculty and co-authors over the past three years in the University of Glasgow.

First, I wish to express my sincere appreciation to my supervisor team. Professor Frank Hong Liu, who gives me wings so that I can pursue my Ph.D. study, who guides and coaches me so positively throughout my study and life, who always encourages me and leaves me sufficient space to grow up, who would be my lifelong mentor and friend. Dr Betty Wu and Dr Antonios Siganos, who consistently support and encourage me to be professional and do the right thing even when the road gets tough. Without their persistent help, the success of my Ph.D. study would have not been realized. Also, thanks to the College of Social Science, who provides the scholarship to fund the three-year Ph.D. study.

I would also like to express my gratitude to my friends and colleagues. Lidan Lin, who is always by my side, sharing everything with me and ready for a cuddle when the day is clouded. Ting Men and Chuanhong Ni who keep me connected by their remote emotional support. Yaoyao Fan, Yuxiang Jiang, Yichu Huang, Lu Xing and Nhung Vu, who are my precious friends and give me a lot of support in my research work as well. My doctoral peers who are from 11/12 Southpark Terrace, Yihan Zou, Jinpeng Liu, Zhekai Zhang, Hualin Li, I will never forget the days with you, hotpot and Supreme.

The greatest love goes to my parents and my families: My mother Shujuan and my father Guogang, for giving unconditional and selflessly support to my whole life; My cousin Jingya, for taking care of me and the whole families all the time; My special thanks to Zhonghao, for grabbing me coffee even in a raining pouring day, for always prioritizing me and making me feel protected, for fulfilling my life and future.

Words cannot express the gratitude my own to my family, friends, peers and supervisors for their love and support during my time in the Ph.D. programme. None of this would have been possible if it were without you.

Authors Declaration

I declare that, except where explicit reference is made to the contribution of others, that this dissertation is the result of my own work and has not been submitted for any other degree at the University of Glasgow or any other institution.

Printed Name: Yue Zhou

Signature:

Contents

Chapter 1:

Introduction

This thesis examines the real effect and consequence of financial regulatory reform and development over the last decades. Due to the importance and uniqueness, financial markets have been highly regulated that aims to sustain an efficient and stable financial system. In the last twenty years, several financial crises have happened over the world and the financial regulations have been changed significantly. Tighter, more detailed and more complex standards now are applied to the financial system and the overall regulatory framework has been improving over time. Since the 1990s, for example, financial regulation in banking has been relaxed through the Interstate Bank Branching Effective Act 1994 in the U.S.. While the introduction of the Basel framework over the banking system across countries obviously improves the standards over banks. Understand the real effect and consequence of financial regulation change is not only an interesting research question, but the policy implications from the research are also important that contribute to future reforms. In this thesis, three thorough studies have been carried out which focus on different aspects of the regulation changes in the last decades.

1.1 Background and Motivation

One of the most important features of bank regulation is the capital requirement. Banks in counties with restrict requirements on capital may ask for higher capital ratio as well as limits the categories of funds which are official and can be used to initially capitalize a bank. Such banks may experience greater difficulties in raising sufficient capital to meet the regulatory requirements, especially when the overall system is undercapitalized, therefore are more likely to have capital shortfall. Besides, the level of regulation stringency can limit the freedom of bans' activities. Based on the portfolio theory, the combined cash flows from non-correlated revenue sources should be more stable than the constituent parts (Baele et al. 2007). Hence, banks face greater stringency in banks activities can access financing source capital through their limited business lines. Besides, if banks' activities are constrained in a limited scope, banks' business lines are more likely to be correlated to each other. When the crisis comes,

banks may expose to the shock together but be less capable of raising capital because of the limited financing channel, hence, a greater possibility of experiencing a capital shortfall.

In the first chapter, we investigate how bank regulation and supervision affect individual banks' systemic risk across countries. Since the 2007 global financial crisis (GFC), government regulators across the world have been working to strengthen the regulation in the financial sector. The Basel III framework is a central element of the Basel Committee's, which is introduced to response to the GFC. It addresses several overlooked areas in the pre-crisis regulatory framework and provides a foundation for making a more resilient and stable banking system (Bank for International Settlements, 2017). The Basel III reforms significantly tight the regulation framework, especially the capital requirement and liquidity measure on banks. However, the inappropriate regulations and ineffective monitoring and supervision by official agencies have been criticized a lot which were regarded as the key cause of the global financial crisis of 2007-2009. Although several studies have examined the impact of bank regulation and/or supervision on systemic stability, there is rare evidence on how the regulation can affect individual banks' exposure to the systemic risk. The first study intends to fill this gap in the literature.

Regulation reform in banking could redefine the relation between lenders and borrowers as well. Asymmetric information increases external financing cost and difficulty. In 1994, the U.S. passed the Riegle-Neal Interstate Banking and Branching Efficiency Act (IBBEA) which significantly relaxes bank branching restrictions. IBBEA effectively permits bank holding companies to enter other states without permission and to operate branches across state borders. The deregulation increases competition and consolidation of banks within states, and the effects tend to spill over to non-financial sectors, including better external financing access and lower borrowing cost (Black and Strahan, 2002; Cetorelli and Strahan, 2006; Rice and Strahan, 2010; Krishnan et al., 2015; Cornaggia et al., 2015). On the other side, a growing literature on CSR attempts to understand CSR activities of firms according to incentives or conflict of interest among stakeholders. There are two views on firms' engagement in corporate social responsibility (CSR) activities. The resource-based view argues that the level of CSR engagement is determinate by financial resources

(Mcwilliams and Siegel, 2001; Waddock and Graves, 1997; Johnson and Greening, 1999; Campbell, 2007; Hong et al., 2012). While based on the profit-maximizing view, CSR is treated as a strategical investment that is used to meet corporate strategical needs. Previous studies document that socially responsible firms are associated with more transparent and reliable financial information (Spence, 1973; Benabou and Tirole, 2010; Kim et al., 2012). Better CSR performance shows a better disclosure and a lower level of information asymmetry, consequently better access to external financing (Goss and Roberts, 2011; Cheng et al., 2014). These evidence show that superior CSR performance tends to be rewarded. However, as suggested in (Dharmapala and Khanna, 2018), when the rewarding of CSR activities is reduced, firms will cut their investment in CSR activities. Therefore, if firms are involuntarily engaged in CSR activities under certain pressures, how would they respond when such pressure is removed? Therefore, in the second study, we examine the effect of bank deregulation on firms' CSR.

Previous two studies focus on financial regulation development in banking, the impact over bank themselves and the potential spillover effect on industry firms. Inspired by the previous two studies, in the third study, we extend the research scope by examining how the financial regulatory change affect industry firms, specifically, how the investment efficiency will response to corporate income tax changes. As the most important fiscal instrument, the tax has been employed by the government to accelerate firms' investment and stimulate the local economic growth and employment. Under the neoclassical theory framework, the investment is only driven by the marginal q ratio (Abel, 1983; Hayashi, 1982; Modigliani and Miller, 1958; Yoshikawa, 1980). However, because of the frictions in the real world, e.g. information asymmetry, the investment decision could be distorted, consequently, firms can expose to either under- or over- investment issues (Fazzari et al., 1988; Myers and Majluf, 1984). The nature of corporate income tax charge on the net cash flow to companies, which increases the investment cost and reduces the after-tax profit. While, because of the tax deductibility, firms are motivated to take advantage of tax deductibility and reduce the tax burden. Therefore, firms could adjust their investment strategy when they expose to corporate tax changes (Atanassov and Liu, 2020; Gaertner et al., 2020; Heider and Ljungqvist, 2015).

Although existing literature on how tax can affect firm investment is well-established, there is rare studies examine whether the tax-induced investment is efficient from shareholders' perspective. Given that a firm's investment decision is not only affected by firm-specific factors but also the external policy reform, the tax serves as a key incentive to affect firms investment decision. When firms expose to a tax increase, firms expect to higher tax burden but higher tax saving per dollar tax deduction. This indicates that the motivation for taking advantage of tax sheltering increase simultaneously. For firms, the investment decision could be distorted when they considerate the tax benefits through an investment. Besides, managers can reduce the time and efforts in investing when the after-tax return decreases (Atanassov and Liu, 2020). In the end, firms can suffer overinvestment issues. While the tax cut brings firms tax cash saving, which serves as an internal financing source for investment. Specifically, firms which experience the financial constraints will benefit most from this additional financing source to support their investment activities. At the same time, tax cut also reduces the required rate of return, consequently more investment options are profitable for firms to choose. With the cash windfall, which created by the tax cut and greater range of investment choices, firms are more likely to capture the growth opportunities and therefore reduce underinvestment. In the third study, we test these conjecture and examine how corporate income tax change affect firm's investment efficiency.

1.2 Key Findings and Contribution

In the first study, we use data for banks from 65 countries for the period 2001-2013 and find that bank activity restriction, initial capital stringency and prompt corrective action are all positively related to systemic risk. To address the potential concern of endogeneity, we employ the staggered implementation of Basel II regulation across countries as an exogenous event and instrumental variable analysis to mitigate the reverse causality concern. We also conduct a series of robustness tests, including using weighted least square regression, subsamples and an alternative measure of systemic risk. Our results are continuously held after these tests. In the end, we conduct further empirical analyses to support our argument that the strict regulation and supervision may impede bank's capability of raising capital when the whole system is undercapitalized, therefore expose banks to higher systemic risk. We find that the positive impact of regulation and supervision on systemic risk to be intensified

if the bank is larger since the larger bank may need a greater amount of capital to smooth its exposure to the systemic risk, but reduced if the bank holds greater capital or has more diversified revenue flows.

In the second study, we exploit the staggered deregulation across U.S. states as the plausible exogenous increases in the credit supply at the state-level. We present evidence to show that deregulation leads to a significant and persistent decrease in firm CSR, suggesting firms show "doing good" for the access to finance when they are captured by an uncompetitive credit market. Next, to enhance the credit of our empirical setting, we conduct a dynamic estimation of the relationship between deregulation and CSR performance to address the potential pre-trend concern. In addition, we conduct a placebo test by falsifying the deregulation year of states and randomly assigned to each state. After the series of endogeneity tests and robustness tests, our results continue to be held. It suggests that using staggered banking deregulation across states should be exogenous to the decreasing CSR performance.

Next, we rule out the alternative explanation to our results that the deregulation change the borrower-lender relationship from relationship lending to transaction basis. With large banks enter and decline of small banks after the deregulation, which can lead to bank borrowing rely more on "hard information", e.g. financial statement, instead of "soft information", e.g. CSR performance (Black and Strahan 2002; Brammer and Pavelin 2006; Cole, Goldberg, and White 2004; DeYoung, Hunter, and Udell 2004; Elyasiani and Goldberg 2004). Therefore, if this is the potential mechanism is through relationship lending channel rather than financial constraints channel, we expect to see a stronger effect for states with more relationship lending prior to the deregulation. However, we find no evidence to support this argument, therefore the changed bank lending relationship is unlikely to explain our main results. In the end, we further provide direct evidence to show that the channel of financial constraints through which firms' CSR activities are reduced after the bank deregulation.

Following recent studies (Heider and Ljungqvist, 2015; Ljungqvist et al., 2017; Mukherjee et al., 2017), in the third study, we adopt a difference-in-differences approach by exploiting staggered corporate income tax changes at the US state level

over 1990 to 2015. The results show that firms responses to corporate income tax changes are asymmetrical: the tax increase aggravates overinvestment while the tax cut mitigates underinvestment. One challenge of studies in that the relation of tax rate and investment efficiency can be endogenously determinate. To address the potential reverse causality concern which can undermine the baseline findings, we conduct a dynamic estimation around the tax change year. The results suggest that there is no pre-existing trend in investment efficient, but a significant difference between the treatment group and the control group. Although the difference of the investment efficiency is only significant in the year after tax rate change and disappear in the following years. Next, we address another concern that the changes of state corporate income tax rate may be triggered simultaneously with other unobservable factors, like local economic conditions, which can be the true reasons affect firm investment efficiency. We conduct a falsification test by examining whether firms response to their neighbouring state tax changes while there is no tax change in their home state. The results found in the falsification test suggest that unobserved local confounding factors cannot drive the observed variation in investment efficiency to tax rate change. Taken together, these evidence confirm that our baseline result is less likely driven by omitted variable issues or reverse causality, and strength the credit of our empirical identification.

To provide further evidence that the effect of corporate tax on investment efficiency is indeed tied to the variation in the corporate tax rate, we perform cross-sectional variation among firms in terms of their sensitivity to tax changes. We find that the effect of the tax rate change is stronger for firms which are more aggressive in tax planning, or firms who are less capable to manipulate their taxable incomes.

Finally, we propose two different channels to explain the asymmetrical impact of tax rate changes on investment efficiency. We provide evidence to show that the mitigated underinvestment after the tax cut is through the financial constraint channel; while the aggravated overinvestment after tax increase is through the agency cost channel. We also conduct a series of robustness test, including using an alternative measure of investment efficiency etc. Our results continue to be held.

1.3 Contribution and implication

This thesis contribute to literature in several ways. In the first study, first, we add new evidence to the existing literature in the relationship between regulation and systemic risk. Linked with previous studies which examine the relationship between bank regulation and bank behaviours, e.g. banks risk-taking at the individual level, we provide evidence that regulation and supervision can also affect banks' systemic risk exposure. Besides, this study contributes to the recent emphasis on the determinants of bank systemic risk. Although these work does not focus on the effect of regulation or supervision on bank systemic risk, they highlight the importance of appropriately designed regulation. Our paper provides further evidence in support of these arguments, showing that the regulatory and supervisory environment in which banks operate has significant impacts on their systemic risk.

The second study contributes to the existing literature in several ways. First, we provide a clean setting on the exogenous increase in banking competition caused by regulations and show firms significantly reduce CSR activities afterwards. This is the first study which links firm CSR with external financial environment development induced by regulatory reform. Our results support the view that firms use CSR as a strategical investment to accessing bank financing when credit supply is likely to be rationed due to lack of competition. Our results highlight the importance of a competitive credit market, especially for firms that heavily rely on external financing. Policymakers and regulators should continue to make reform to dismantle market frictions and enhance the competition in the financial market to strength firms capability of accessing credit. Besides, the study provides novel empirical evidence to suggest that firms' CSR activities are not socially efficient when borrowers are susceptible to being captured by lending groups. Therefore, future policy designs should take the institutional development and financial market frictions into consideration if the government intends to see more socially responsible activities from firms.

For the third study, we add new evidence to the growing literature on the determinates of firm-level investment efficiency. The results show how firms' investment efficiency response to general tax policy changes, expanding existing literature that tax motivated investments can distort firms' investment efficiency from

shareholders' perspective. Besides, this study also has important policy implications. Since the federal corporate tax reforms which are rare and intend to affect all firms at the same time, state-level tax policy changes are more likely to be exploited by the government as a short-term fiscal instrument. Understand the real effects and consequence of these general tax changes would benefit to future tax policy designs.

1.4 Structure of this thesis

The rest of the thesis constructs as follows. Chapter 2 investigates how bank regulation and supervision affect bank systemic risk. Chapter 3 studies how firm CSR performance responds to external financial market development. Chapter 4 examines the impact of general corporate income tax on firm investment efficiency. Chapter 5 concludes.

Chapter 2:

Bank Regulation and Systemic Risk: Cross Country Evidence

2.1 Introduction

The inappropriate regulations and ineffective monitoring and supervision by official agencies have been regarded as a critical cause of the global financial crisis of 2007-2009 (Acharya 2009; Goodhart 2008; Laeven and Levine 2009; Schwarcz 2008). For example, Acharya (2009) argues that Basel regulations require banks to hold a certain ratio of capital to reduce individual banks' liquidity risk but overlook the correlated risk banks take which can lead to joint failures. Despite the increasing calls for a renewed focus on systemic stability and macro-prudential regulation (e.g. Acharya et al., 2012), our understanding of how bank regulation and supervision affect systemic stability tends to be very limited (Arnold et al. 2012; Barth, Lin, et al. 2013).

A few studies have examined the impact of bank regulation and/or supervision on systemic stability (Barth, Caprio, and Levine 2004; Demirgüç-Kunt and Kane 2002; Houston, Lin, and Ma 2011). Based on bank regulation data from the World Bank Survey, Barth et al. (2004) find that banks operating in countries with higher regulatory restriction are more likely to experience a banking crisis. Demirgüç-Kunt and Detragiache (2011), on the other hand, fail to find the relationship between the adherence to the Basel core principles and systemic risk measured by a system-wide Z-score. However, there is a lack of evidence on how the current bank regulatory system affects individual banks' exposure to systemic risk. Our paper thus attempts to fill this gap in the literature.

Bank regulation comprises two main aspects, capital regulation and supervision, and restrictions on non-banking activities. In this paper, we argue that both aspects of bank regulation can be positively related to bank's exposure to systemic risk. First, Acharya et al. (2012) and Brownlees and Engle (2017) define a bank's level of systemic risk as its capital shortfall, where a more undercapitalized bank compared to its risk level (but not government required level) contributes more to the whole financial system's (in)stability, conditional on severe distress in the entire system. In an environment of more stringent bank capital regulation and supervision, banks find it is harder to raise capital when the entire system is undercapitalized (i.e. economy downturn or financial crisis), and hence are more likely to have capital

shortfall. The higher probability of banks' capital shortfall would increase the systemic instability of the whole system.

Second, the level of regulation stringency can limit the freedom of banks' activities. With stricter regulation, banks will have less opportunity to engage in a wider range of non-traditional bank activities. Based on the portfolio theory, the combined cash flows from non-correlated revenue sources should be more stable than the constituent parts (Baele, De Jonghe, and Vander Vennet 2007). In other words, banks who are able to engage in different business lines tend to have more stable revenue flows compared to their peers and are thereby less likely to have capital shortfall when external shock happens. In addition, banks who are allowed to engage in broader activities are more able to raise capital from different sources, which therefore lowers their likelihood of experiencing capital shortfall. Similarly, when banks are only allowed to engage in limited activities, they are more likely to share a similar business structure, and such similarity in banks' business lines could result in lower systemic stability (Allen, Bali, and Tang 2012).

To investigate the impact of bank regulation on systemic risk, we use the new database by Barth et al. (2013a) bank regulation and supervision and employ data for banks from 65 countries for the period 2001-2013. Following Laeven and Levine (2009) and Li et al. (2019), we consider four aspects of bank regulation, including regulation on bank activities restriction, initial capital stringency, deposit insurer power and prompt corrective action. Employing the factor analysis, we reduce the four regulation and supervision measures and construct a single measure of bank regulation stringency. We use *Marginal Expected Shortfall* (MES), developed by Acharya et al., (2017), as our main systemic risk measure.

We find that bank activity restriction, initial capital stringency and prompt corrective action are positively related to systemic risk. Such a positive association is also found for the total regulation index we developed. This is consistent with our expectation based on the definition of systemic risk adopted in our study, suggesting that banks operating in countries with more stringent regulation and supervision appear to suffer from higher exposure to systemic risk. To alleviate the concern of endogeneity, we first employ the staggered timing of the implementation of Basel II

regulation across countries to identify the changes in bank regulation. The results show that the implementation of Basel II increases the bank's systemic risk more than those countries which have not yet implemented the capital regulation, while there is no such a trend before the implementation. Next, we employ the country's latitude as the instrument variable and conduct two-stage least squares regression analysis, and the same results are observed for the instrumental variable regression analysis. Our findings hold robust after using an alternative measure of systemic risk (Brownlees and Engle, (2017) SRISK) and employing the weighted-least-square regression analysis to account for the differences in the number of banks across countries.

We then provide further evidence on our conjecture that the impact of bank regulation on systemic risk is through bank's capital shortfall. We would expect this impact to be more intensified if the bank is more likely to experience capital shortfall when in a distressed period, and vice versa. Specifically, we posit that the positive impact of bank regulation on systemic risk will be intensified if the bank is larger since a larger bank needs a higher level of capital to smooth its exposure to the systemic risk, but reduced if the bank holds a higher level of capital, and if the bank has more diversified revenue flows. We thus introduce three interaction terms of our main regulation measures with bank size (measured by log total assets), bank equity to assets ratio and diversification (measured by non-interest income to total operation income, respectively, and include them in the main regressions. Our results confirm the hypotheses indicated above.

Our findings do not suggest that bank regulation and supervision are detrimental to systemic stability, but instead call for the proper design and implementation of bank regulation. Literature on regulatory forbearance points out that policymakers' control strategy tends to be influenced by strong political forces (e.g. Kane, 1980). The global financial crisis has drawn much attention and critiques from the government and public to the banking sector, imposing considerable political forces to the banking regulators and supervisors. As a response, an increasing level of bank regulation stringency has been implemented in different countries. However, whether bank regulatory and supervision rules could effectively address the concerns raised by the market and the public appears to be unclear due to limited empirical evidence. This paper aims to empirically test the impact of bank regulation on systemic

risk based on cross-country evidence and has important policy implications. We contribute to the literature in several ways.

First, the extant literature on bank regulation paid little attention to its impact on systemic risk. Although a few empirical studies have examined this relationship, the measures of systemic risk they used appear to be limited at the country level (Hoque et al. 2015). Our paper contributes to the literature in this regard, examining the impact of bank regulation on individual banks' exposure to the overall systemic risk and providing important evidence. Our findings suggest that the increased similarity in the banking system due to the restrictions on non-banking activities would increase systemic risk. This is consistent with the recent theoretical work on financial stability that highlights the importance of diversity in banking (Allen et al. 2012; Wagner 2010, 2011), showing that some degree of diversification in banks' asset portfolios is socially optimal so that banks do not have to liquidate their identical assets at the same time when financial shocks happen and generate a fire-sale externality that lowers welfare. Our results also highlight the importance of bank regulation in allowing banks more capability to raise capital when the whole system is undercapitalized. This is consistent with the recent changes to Basel III regulation, which promote the build-up of buffers in good times that can be drawn down in periods of stress. Although our paper does not directly test the effect of government capital injection to the financial system during crisis periods, the implication of our results is supportive of government action to reduce the capital shortfall of the banking system. This is also consistent with the empirical evidence provided by Berger et al. (2019) that the U.S. Troubled Assets Relief Program (TARP) significantly reduced banks' contributions to systemic risk.

Second, our paper contributes to the recent emphasis on the determinants of bank systemic risk. Existing literature has found that bank systemic risk is affected by the degree of competition (Anginer, Demirguc-Kunt, and Zhu 2014a), consolidation (Weiß, Neumann, and Bostandzic 2014), the structure of the financial network (Acemoglu, Ozdaglar, and Tahbaz-Salehi 2015), bank size and their capital level (Laeven, Ratnovski, and Tong 2016). For example, Acemoglu et al. (2015) argue that the structure of the financial network is a determinant of systemic risk, with more diversified patterns of interbank liabilities leading to less fragility when the negative

shock is below a critical threshold and vice versa. Laeven et al. (2016) show that systemic risk increases with bank size, but the systemic risk is significantly lower for well-capitalized banks. Although their work does not focus on the effect of regulation or supervision on bank systemic risk, it highlights the importance of appropriately designed regulation. Our paper provides further evidence in support of these arguments, showing that the regulatory and supervisory environment in which banks operate has a significant impact on their systemic risk.

The remainder of the paper is structured as follows. In section 2, we summarize relevant literature about bank regulation and supervision and systemic risk. In Section 3, we develop the hypotheses. Our data, variables and descriptive statistics are presented in section 4. Section 5 discusses the main results of our analyses, and section 6 concludes the paper.

2.2 Literature review

In this section, we summarize relevant literature on the regulation and supervision and systemic risk in banking.

2.2.1 Regulation and supervision in banking

Since the Global Financial Crisis in 2007, the importance of banks for the real economy is brought into sharp focus. At the same time, this crisis also uncovers the weaknesses in the design and implementation of bank regulation and supervision, and it has sparked a heated discussion on the lessons to be learned. Moreover, how to design efficient and safer banking systems draw a lot of attention from the government and policymakers. One clear outcome of the GFC has been a period of intense regulation, with several initiatives put in motion to address the flaws that were revealed during the crisis (Anginer et al. 2019). The World Bank (2013) report suggests that the GFC was caused by excessive risk-taking by financial institutions and little capital buffer hold by the financial institutions to cover the unexpected financial losses. For example, a disproportionate reliance on wholesale funding to support bank lending, lower lending standards, inaccurate credit ratings and complex financial derivatives. In addition to these excessive risk-taking behaviours of financial institutions, the

regulation design also stimulates banks to engage in speculative investments. The poorly designed, e.g. deposit insurance scheme, provides banks incentives to take on excessive risk since banks are expected to be rescued if they fail (Anginer and Demirgüç-Kunt 2019; Caprio, Demirguc-Kunt, and Kane 2010). The GFC has highlighted the importance of adequate bank regulation and supervision, with the passage of the Doff-Frank Wall Street Reform and the Consumer Protection Act in the United States in 2010. There is an extensive debate on the effect of tighter bank regulation. In general, policymakers believe that strengthened bank regulation may promote a more resilient and stable banking sector, while practitioners and researchers raise their concern in terms of the cost of regulatory compliance which may outweigh the benefits. Existing researches also show mixed results regarding the relationship between bank regulation and bank behaviours, e.g. risk-taking, lending behaviours and efficiency etc..

The rules on bank capital are one of the most prominent aspects of regulation over banks. If banks are required to hold more capital at risk, they would enjoy from greater risk taking by the potential loss of their capital. Therefore, official capital adequacy regulation is employed to play an essential role in aligning the incentive of banks owners with depositors and other creditors, which generates more careful lending (Barth et al., 2008; Barth et al., 2013b). However, this view only considers the public interest while ignores the high regulatory cost of capital holding by banks. Banks who bear high cost are induced to take excessive risk for better return. Hakenes and Schnabel (2011)'s model shows that capital regulation may destabilize the banking sector through its effect on banking competition. The ambiguous effect of competition on banks' risk taking translates into an ambiguous effect of capital regulation. Their model suggests that's that capital regulation may not be suited in all circumstances to prevent excessive risk-taking in banking. Repullo (2004) examines the role of capital requirements and deposit rate ceilings as a regulatory tool to reduce risk-shifting incentives in the situation of increased competition in banking. The study suggests that for impacted competition in the deposit market, both instruments are in general effective in preventing the banks from taking excessive risks.

In addition to the theoretical work in capital requirement and bank performance, Deli and Hasan (2017) provide empirical evidence to show the effect of the full set of

bank capital regulations on bank loan growth of 125 countries. They find that overall capital stringency only has a weak negative effect on loan growth. Moreover, such effect is completely offset if banks hold moderately high levels of capital. Besides, capital stringency that has the strongest negative effect on loan growth are those related to the prevention of banks to use capital borrowed funds and assets other than cash or government securities. This result suggests that increased capital stringency targeted at the risk side of banking activities and increased freedom in the use of alternative assets as capital.

The scope of activities helps define what is meant by a "bank" and the scope of permissible activities differs across countries, therefore, the activities engaged by banks are not the same across counties (Barth et al., 2013a). Moreover, bank regulations define the extent to which banks and nonbanks may combine to form financial or mixed conglomerates. Boyd et al. (1998) suggest that broad financial activities can intensify moral hazard problems and provide banks with more opportunities to increase risk. However, Barth et al. (2004) suggest that restrict bank activities is negatively associated with bank stability and increases the probability of a banking crisis. They first point out five main theoretical reasons for restricting bank activities and banking commerce links. First, conflict of interest may arise if banks are involved in diverse activities, e.g. securities, insurance, underwriting and real estate investment. Under this situation, banks may utilize their information advantage over investors and to sale troubled securities. Second, as stated in Boyd et al. (1998), the moral hazard problem can incentive banks to engage in riskier investments, thus increase banks' overall risk. On top of these two reasons, the allowance of broader activities of banks will lead to the complexity of banks and more difficult to monitor such banks. Also, the large size of the bank leads to the "too-big-to-fail" problem, which makes them both politically and economically powerful (Laeven and Levine 2007). Last, large financial conglomerates may reduce competition and efficiency (Barth et al., 2013b). On the contrary side, there are alternative theoretical reasons for allowing banks to engage in a broad range of activities. For example, fewer regulatory restrictions permit the exploitation of economies of scale and scope. Besides, fewer regulatory restrictions can increase the franchise value of banks and consequently augment incentives for more prudent behaviours. Lastly, broader activities provide banks with opportunities to diversify their income streams and thereby create more stable banks (Baele et al. 2007). The empirical results find in Barth et al. (2004)

support the later view that the effect of restrictions on bank activities. Similarly, Barth et al., (2013b) suggest tighter restrictions are negatively associated with bank efficiency.

A widely adopted policy to promote financial stability in the banking section is the deposit insurance scheme, which has been proven very successful in protecting bank runs but in turn, causes moral hazard problem. The empirical evidence points out the importance of design features and shows that poorly designed schemes can increase the likelihood that a country will experience a banking crisis. Demirgüç-Kunt and Kane (2002) suggest that in institutionally weak environments, it is hard to design deposit insurance arrangements that will not increase the probability and depth of future banking crisis. For countries with weak institutions, adopting explicit deposit insurance promises to spur financial development only in the very short run, if at all. Anginer and Demirgüç-Kunt (2019) imply the importance of deposit insurance schemes to incorporate features to help internalize risk-taking by banks. In addition to the specific design feature, deposit insurance that is complemented by more stringent capital regulations and a system in which supervisors are empowered to take prompt corrective action, tend to function more effectively in practice. In countries that lack strong institutional environments, explicit deposit insurance can end up doing more harm than good in terms of improving financial stability. More empirical evidence tends to support these argument. For example, Barth et al. (2004) find a positive association between the generosity of the deposit insurance scheme and the possibility of suffering a major banking crisis, and such a relationship is economically large. More recently, Anginer et al. (2014b) find that deposit insurance increases systemic fragility in the former period, but lower bank systemic risk in countries with deposit insurance coverage during the crisis. Their findings suggest that the "moral hazard effect" of deposit insurance dominates in good times, while the ''stabilization effect'' of deposit insurance dominates in turbulent times.

Emphasising the role of the central bank as the last resort of failed financial institutions, Ponce and Rennert, (2015) propose a model where systemic and non-systemic banks are exposed to liquidity shortfalls so that a lender of last resort policy is required. Under this framework, a systemic bank coexists with a non-systemic bank and the collapse of the systemic bank imposes larger, negative effects to the rest of the

system. The failure of the systemic bank may hurt the non-systemic bank but not vice versa. They suggest that the existence of systemically important banks implies that the central bank should act as lender of last resort for non-systemic banks in a larger range of its liquidity shortfalls. They find that it is first-best socially optimal to provide emergency liquidity assistance to banks with assets of high quality, while the support for lower assets quality banks should be refused support. Hence, keeping other things equal, it is more desirable to use the unconditional support rule. Other the other hand, the central bank, in providing liquidity assistance to a systemic bank, will be softer than for a non-systemic bank. Therefore, the allocation of more responsibilities as the lender of last resort to the central bank. This study highlight the role and responsibility of the central bank, and how the central bank can play its role to sustain the stability of the banking system.

In addition to the studies discussed above, there is a serial of empirical studies that examine the impact of regulation and supervision on banks' performance. Many of them examine the relationship between regulation and supervision on banks' performance by employing the Bank Regulation and Supervision Survey from the World Bank and conducting a cross country study. For example, Barth et al. (2013b) examine whether bank regulation, supervision and monitoring enhance or impede bank operating efficiency by analysing 4050 banks in 72 countries. They find that tighter restrictions on bank activities are negatively associated with bank efficiency, while greater capital regulation stringency is marginally and positively related to bank efficiency. In addition, strengthening of official supervisory power is positively associated with bank efficiency, but only in countries with independent supervisory authorities. This result points out that the independence of supervisory agencies from both politicians and banking firms is conducive to improved bank efficiency. Putting the official supervisory power in the hands of independent supervisors may be helpful to improve the efficiency of the banking system. Also, supervisor experience is important as it positively related to bank efficiency. Last, they suggest that market-based monitoring of banks in terms of more financial transparency is positively associated with bank efficiency, while generous deposit insurance coverage is negative associated with bank operating efficiency. Li et al. (2019) study the relation between bank regulation stringency and announcement effects of seconded equity offering across 21 countries. They find that bank regulation has a nonlinear relation with bank-issued SEO announcement effects: an inverted U-shaped relation with the SEO

announcement effect. This effect increases as the level of bank regulation increases and then decreases as the level of bank regulation continues to increase. Specifically, higher initial capital stringency, prompt corrective action, deposit insurer power, and total regulation particularly exert a positive impact on the SEO announcement effect initially but that the impact becomes negative when these regulations rise too high. They conclude that bank regulation may play a dual role in affecting the stock pricing reaction to SEO announcements.

On the other side of this strand of literature, studies show the effect of regulation depends on the structure of banks as well as the overall macro institutional environment. Laeven and Levine (2009) show that the relation between bank risk and capital regulation, deposit insurance policies and restriction on bank activities depends critically on each bank's ownership structure. Same regulation can exert different effects on bank risk taking depending on the bank's corporate governance structure. In Agoraki et al. (2011), they consider the regulation including capital requirements, restrictions on bank activities and official supervisory power and focus on the Central and Eastern European banking sectors. The highlight of empirical tests is placed on whether these regulations have an independent effect on bank risk taking, and whether their effect changes with the level of market power possessed by banks. An important finding is that capital requirements and supervisory power tend to show a direct impact on credit risk by reducing non-performing loans. While the stabilizing effects of capital regulations diminish when banks have sufficient market power to increase their credit risk and are reversed for banks that possess moderate to high market power. These results point out that regulations alone may not be adequate to control banks credit risk and that a thorough investigation of the market power of banks is also needed. Therefore, one implication of this paper is that regulators may be able to limit bank risk-taking by placing restrictions on banks' activities. In the study, further test results show that higher bank activities restrictions in combination with more market power reduce both credit risk and risk of default. Using data from 1900 to 1930, where a period that predates active federal government stabilization policies, Kupiec and Ramirez (2013) show that different regulatory and economic environments affect the relationship between bank failures and economic distress. Specifically, state deposit insurance systems amplify the degree to which bank failures propagated economic distress. Taken together, official supervisory power is a direct and effective channel in reducing both credit and solvency risk regardless of the level of bank market power.

For policymakers, they need to consider improving the auditing of banks and impose sanctions where appropriate.

2.2.2 Systemic risk

2.2.2.1 Systemic risk measurement

In existing studies of systemic risk, some researchers have focused on individual measures of systemic risk, which predicts how much a stock is expected to fall in a market downturn. Acharya et al. (2012) lay the theoretical foundation of such an approach. When the systemic is under distress, financial institutions may fall short of capital that can lead to a bank run unless the regulator will need to replenish capital, and such bank run can be contagious. They develop a theoretical approach to systemic risk by postulating that the aggregate capital shortfall of the financial sector imposes a negative externality on the real economy. Whenever the capital shortfall exceeds some fraction of total assets, the externality becomes effective. Specifically, when the externality is large enough, there is a financial crisis. Therefore, they propose an estimation of the capital shortfall of the financial sector, where the first step is to estimate the marginal expected shortfall (MES) of a financial institution. Later, Acharya et al. (2017) propose an economic model of systemic risk in which undercapitalization of the financial sector as a whole is assumed to harm the real economy, leading to a systemic risk externality. In this model, they define each financial institution's contribution to systemic risk can be measured as its systemic expected shortfall (SES), which is the propensity to be undercapitalized when the system as a whole is undercapitalized. SES increases in the institution's leverage and its MES, which is its losses in the tail of the system's loss distribution. As an extension of MES, Brownlees and Engle, (2016) introduce SRISK to measure the systemic risk contribution of a financial firm. SRISK measures the capital shortfall of a firm conditional on a severe market decline, and is a function of its size of firm, its degree of leverage, and its expected equity loss conditional on the market decline, which they call Long Run MES. SRISK is used to construct rankings of systemically risky institutions that firms with the highest SRISK are the largest contributors to the undercapitalization of the financial system in the time of distress. In addition, SRISK can be used as a measure of overall systemic risk in the entire financial system as the sum of SRISK across all financial institutions. Compare to SES which estimation

approach is based on structural assumptions and requires observing a realization of the systemic crisis for estimation, therefore, cannot be used for *ex-ante* measurement.

A related and very influential paper is Adrian and Brunnermeier (2016) who propose a measure of systemic risk, *ΔCoVaR*, defined as the change in the value at risk of the financial system conditional on an institution being under distress relative to its median state. Specifically, where an institution' *CoVaR* related to the system is defined as the VaR of the whole financial sector conditional on the institution being in a particular state. Therefore, the *ΔCoVaR* is the difference between the *CoVaR* conditional on the distress of an institution and the *CoVaR* conditional on the median state of that institution. Different from MES which is conditional on a large negative market return realization, *CoVaR* measures conditions on the distress of a single financial institution. As argued in Engle (2018), *CoVaR* ignores the externality that is the focus of many systemic risk theories, e.g. MES and SRISK. Acharya et al. (2012) suggest that under certain distributional assumptions about firm's returns, *CoVaR* treats two firms identically in terms of systemic risk if the firms have the same return correlation with the aggregate market even though they might have very different return volatilities. While the conditioning events differ, both *CoVaR* and MES focus on extreme left-tail events and either can be used to identify extremal left-tail stock return dependence (Kupiec and Güntay, 2016).

In addition to the systemic risk measures we discussed above, several papers use different methods to measure systemic risk. Some researchers have used market-based indices as the measure of systemic risk. For example, Huang et al., (2009) use data on credit default swaps (CDSs) of financial firms and stock return correlations across these firms to estimate expected credit losses above a given share of the financial sector's total liability. Following that, Huang et al., (2012) develop the measure of systemic risk as to the price of insurance against systemic financial distress and assess individual banks' marginal contribution to the systemic risk. Allen et al., (2012) propose an aggregate systemic risk index called CATFIN, which associates systemic risk to the VaR of the financial system. Another strand of studies connects the market-based systemic risk measurement with the degree of interdependence among financial firms. Billio et al., (2012) measure systemic risk based on principal components analysis and Granger-causality networks across within different parts of

the financial sector. Segoviano and Goodhart (2009) regard the financial sector as a portfolio of individual financial firms, and look at how individual firms contribute to the potential distress of the system by using the CDSs of these firms within a multivariate setting. Gravelle and Li, (2013) propose a set of market-based measures on systemic importance of a financial institution or a group of financial institutions by its contribution to systemic risk, and use multivariate extreme value theory approach to estimate these measures.

2.2.2.2 Application of systemic risk measures in empirical studies

One set of studies conduct empirical analyses of systemic risk by examining the relationship between competition and bank stability. In Beck et al. (2013), they examine how bank competition affects bank stability and the role of regulation which interact with the relationship. They document significant cross-country heterogeneity in the competition-stability relationship. They show that an increase in competition will have a larger impact on banks' fragility in countries with stricter activity restrictions, lower systemic fragility, better developed stock changes, more general deposit insurance and more effective systems of credit information sharing. They highlight that activities restrictions and herding trends can exacerbate the negative impact of competition on bank stability so that regulatory reforms have to take this into account. Besides, the results also stress the importance of the moral hazard risk of generous deposit insurance, which exacerbated in a more competitive environment. They suggest a direct effect of policies on risk-taking incentive of banks, as well as the indirect effect by dampening or exacerbating the effect of competition on banks' riskiness. Anginer et al. (2014) study the relationship between bank competition and systemic risk and find conflict results. They find that greater competition encourages banks to take on more diversified risks, making the banking system less fragile to shocks. Besides, the institutional and regulatory environment on bank systemic risk shows that banking systems are more fragile in countries with weak supervision and private monitoring, greater government ownership of banks, and with public policies that restrict competition. Similar to Anginer et al. (2014), Fu et al. (2014) analysis the tradeoff between competition and financial stability, but shifting the study focus to 14 Asia pacific economies. They find that greater concentration foster financial fragility and the lower pricing power induce bank risk exposure. Moreover, tougher entry restrictions may benefit bank stability while stronger deposit insurance schemes are

positively related to bank fragility. The results from these two studies suggest that the competition among banks helps to sustain the stability of banking system, while regulation and supervision stringency tend to moderate such positive relationship. In all these studies, they use the Distance to Default Model (Merton 1974) as the market-based risk measure and/or Z-score as the accounting-based risk measure to estimate the individual bank fragility. Weiß et al. (2014) analyse the systemic risk effects of bank mergers to test the "concentration- fragility" hypothesis. They adopt MES as systemic risk measure to capture the merger-related change in an acquirer's contribution to systemic risk. They find a significant increase in the merging banks', the combined banks' and their competitors' contribution to systemic risk following mergers, therefore confirming the "concentration-fragility" hypothesis. Overall, these studies suggest that regulation and supervision policies can directly or indirectly induce banks competition, consequently affect the fragility of banking system.

Another strand of existing studies use the systemic risk measurement and conduct empirical studies by connecting some factors with systemic risk. For example, Laeven et al. (2016) adopt $\Delta CoVaR$ and SRISK as the systemic risk measure to test the relationship with bank size. They find that systemic risk increases with bank size, and systemic risk is lower in more-capitalized banks, with the effects particularly more pronounced for large banks. They suggest that large banks pose excessive systemic risk, and could be seen as evidence in support of calls to limit the size or activities of banks. López-Espinosa et al. (2012) use the CoVaR approach to identify the main factors behind systemic risk in a set of large international banks. They find that short-term wholesale funding is a key determinant in triggering systemic risk episodes. Their result suggests that short-term wholesale funding emerges as the most relevant systemic factor, which supports the Basel Committee's proposal to introduce a net stable funding ratio, penalizing excessive exposure to liquidity risk. The recent financial crisis also highlights the importance of going beyond a purely micro-based approach to financial regulation and supervision. Gauthier et al. (2012) suggest financial stability can be enhanced by implementing a systemic perspective on banking regulation. Macroprudential capital requirements need a fixed point at which each bank's capital is consistent with its contribution to the total risk of the banking system under a proposed capital allocation. They derive macroprudential capital requirements as a fixed point using five risk allocation mechanisms, including MES and $\Delta CoVaR$. Crossing all risk allocation mechanisms, macroprudential capital requirements reduce

the default probabilities of individual banks as well as the probability of a systemic crisis.

In terms of most recent studies in systemic risk, Berger et al. (2019) employ the U.S. Trouble Assets Relief Programme (TARP) to examine how the bank bailouts affect systemic risk. Using a Difference-in-difference analysis, the results suggest that TARP significantly reduced contributions to systemic risk, particularly for large and safer banks located in better local economies. Furthermore, they document a capital cushion channel that reduces bank leverage risk. Brunnermeier et al. (2019) find non-interest income to be positively correlated with total systemic risk. Specifically, by decomposing total systemic risk measured by $\Delta CoVaR$, they find non-interest income has a positive relationship with a bank's tail risk, a positive relationship with a bank's interconnectedness risk, and an insignificant or positive relationship with bank's exposure to macroeconomic and financial factors.

2.2.3 Hypothesis development

2.2.3.1 Bank activity restriction and systemic risk

Some may argue that giving banks more freedom in their activities could also encourage banks to take excessive risk. For example, the moral hazard that may arise under this situation is likely to provide more opportunities for banks to engage in risky behaviour (Boyd et al. 1998), consequently increases the possibility of systemic failure. Therefore, restricting bank activities, to some extent, can help improve the financial stability of the market. However, traditionally, portfolio theory predicts that the combined cash flows from non-correlated revenue sources should be more stable than the constituent parts (Baele et al. 2007). Less restriction on bank activities allows banks to engage in a broad range of activities, which has the potential to decrease conglomerate risk (Kwan and Laderman 1999). If this is the case, banks under strict activity regulation will be less likely to diversify their business line. As a result, they may experience a higher individual risk and be exposed to greater capital shortfall when a crisis comes. In addition, when banks are only allowed to engage in limited business lines, the structure of their portfolios will become more similar. This means that risks are highly correlated among those banks compared with their peers who have more diversified business lines. Wagner (2010) argues that diversity that arises from

heterogeneity in banks' activity mix can reduce systemic risk and increase welfare, while similarity cannot. Barth et al. (2004) use a country-level database to analyse the influence of bank activity restrictions on the likelihood of a banking crisis, showing that greater regulatory restrictions on bank activities are associated with an increase in the likelihood of suffering a major crisis. Beck et al. (2006) find that imposing fewer restrictions on bank activities can reduce banking system fragility. Based on the aforementioned arguments, we would expect that banks under greater activity restrictions would experience greater systemic risk.

H1: Greater restriction on bank's activities leads to higher systemic risk.

2.2.3.2 Capital requirements and systemic risk

Since the global financial crisis, bank capital requirements have been substantially tightened. Capital can absorb losses and mitigate against credit risk. When systemic shock happens, banks with higher capital ratio are more likely to survive compared with their counterparts which have a lower capital ratio. If there exists a systemic shock, banks with higher capital ratio might be easier to survival compared with their counterparts with lower capital ratio. Capital requirements put into place to ensure that banks are not involving or holding high risk portfolio which can increase the risk of default and make sure they have sufficient capital to sustain operating losses while still honouring withdrawals. Regulators would hold the view that banks should hold a contain ratio of capital to minimise insolvency risk and the contingent system breakdown. The The World Bank (2013) shows that crisis countries tended to have lower stringency on capital and lower actual capital ratios in the 2007~09 financial crisis. However, banks prefer to hold less capital due to the high cost. At the same time, banks are more likely to seek opportunities to compensate for the high cost of holding unprofitable capital. Unregulated sectors are banks' preference due to the higher return compare with regulated sectors. However, when a banking crisis develops, business in unregulated sectors will be first attacked and lead to the 'domino effect' to the whole financial system (Goodhart 2008). Bahaj and Malherebe (2020) develop a model in which capital is costly from a bank's perspective due to an implicit subsidy from a government guarantee. They suggest that at a given level of lending, a higher capital requirement reduces the subsidy and increases the bank's weighted

average cost of funds consequently. If the systemic risk is defined as capital shortfall, greater capital stringency may lead to increased systemic risk as it can create challenges for banks, especially in the crisis time. When the system is undercapitalized, it will no longer supply a credit for the routine business. Banks under greater capital stringency will find it more difficult to raise capital, and hence will be more likely to experience capital shortfall and exposure to greater systemic instability. Hakenes and Schnabel (2011) point out that capital regulation may destabilize the banking sector through its effect on banking competition and suggest that capital regulation may not be suited in all circumstances to prevent excessive risk-taking in the banking sector. Therefore, we would expect that greater capital stringency could cause higher systemic risk for individual banks.

H2: Greater capital stringency leads to higher systemic risk of banks.

2.2.3.3 Official supervisory action and systemic risk

Strong theoretical explanations are arguing for greater official supervision power. Banks are difficult to monitor, especially for the debtholders who are not in a position to monitor managers because they are small and uninformed (Dewatripont and Tirole 1993; Santos 2001). From this perspective, strong official supervision can monitor and discipline banks, prevent managers from excessive risk-taking behaviour, and thus reduce market failure (Beck et al. 2006). However, such an argument is based on the assumption that the supervisory agencies are acting according to the public interest. Under the private interest or regulatory capture view (Agoraki et al. 2011; Barth et al. 2004), governments and supervisors may act in the interest of a few specific groups, e.g. powerful banks, rather than the society. If this held then a stronger supervisory power might have uncertain and even adverse implications for the bank's lending behaviour (Agoraki et al. 2011; Beck et al. 2006). Beck et al. (2006) investigate the relationship between bank supervision and corruption in lending and find that the empowerment of official supervisory agencies to monitor, discipline, and influence banks directly does not improve the integrity of bank lending. In the study by Barth et al., (2004), no significant association is found between official supervisory power and the likelihood of suffering a crisis. Moreover, greater government intervention may undermine the self-regulation faction in the banking system and

increase moral hazard due to a decline in the market discipline (Gropp and Vesala 2004; Hryckiewicz 2014). If banks engage in excessive risk taking, they may suffer higher individual risks that could in the end lead to systemic instability. Hryckiewicz, (2014) investigates the impact of policy injections into banks in 23 countries during the 2007-2009 financial crisis, and find that government interventions are strongly correlated with subsequent risk increase in the bank sector. The paper argues that the increased role of the government in the banking sector might encourage politicians to act in self-interests. In line with the view of private interest, we would therefore expect a positive relationship between prompt corrective power and systemic risk.

H3: Greater prompt corrective power leads to higher systemic risk of banks.

2.2.3.4 Depositor protection and systemic risk

Explicit deposit insurance has been gaining popularity in recent years since 1908s and has become the standard for the newly created single banking market (Demirgüç-Kunt and Sobaci 2001). Deposit insurance helps to reduce the likelihood of bank runs and enhance the financial stability. However, it has been widely recognised that deposit insurance can aggravate the moral hazard problem in the banking sector by encouraging excessive risk-taking behaviour (Anginer et al. 2014b; Barth et al. 2004; Bisias et al. 2012). Besides, banks' ability to attract deposits no longer depend on the risk of their asset portfolio. Depositors can monitor bank risk-taking behaviour by charging higher interest rates, but they may have less incentive to monitor banks if deposits are insured, and the lack of market discipline is likely to result in excessive risk taking culminating in banking crises (Anginer et al. 2014b). The higher the individual risk, the greater the capital shortfall when banks are in distress, and consequently the more they contribute to systemic instability. Introduction of explicit deposit insurance helps banks to attract additional external liabilities. If there is a guarantee provided by the State to cover losses stemming from a systemic crisis, banks will have incentives to take on correlated risks (Acharya 2009). Banks are encouraged to invest high-risk, high-return projects, which undermine bank stability in the long run (Demirgüç-Kunt and Kane 2002). Guaranteed banks are less willing to diversify their operations since the guarantee takes effect only if other banks fail at the same time. Moral hazard problems can also arise and banks are more likely

to take higher risk with explicit deposit insurance. Cull et al. (2002)argue that deposit insurance can increase risk taking of banks and in turn leads to increased systemic instability. Countries with generous insurance schemes tend to be more bank fragile (Demirgüç-Kunt and Sobaci 2001). Deposit insurance has a greater adverse effect on systemic stability in countries less regulated and supervised. Based on these discussion, the positive impact and negative impact of deposit insurer power on systemic risk may cancel off each other. Therefore, we expect an insignificant relationship between depositor insurer power and systemic risk:

H4: The depositor insurer power is insignificantly related to systemic risk of banks.

2.3 Data, variables and descriptive statistics

2.3.1 Data and sample

The dataset used in this study is compiled from several sources. First, we obtain bank-level financial information from Datastream. Second, the data of banking regulation and supervision are selected from the Bank Regulation and Supervision Survey database of the World Bank. This database is developed by Barth et al., (2013b) based on four world-wide surveys they completed before[1]. Following Barth et al. (2013b) and Li et al. (2019), we use the Survey I information for the value of the regulatory and supervisor variables for the year 2001, Survey II data for the period 2002-2004, Survey III data for the period 2005-2008 and Survey IV data for the period 2009-2013. Third, in order to measure the systemic risk, we collect the daily stock returns data from Datastream. Fourth, we obtain economic development measures from the World Bank's World Development Indicator (WDI) database.

We then match bank-level information, information about regulation and supervision in different countries and other national data based on data availability. Because of the incomplete overlap among the three datasets, there are a significant number of missing data and the final sample used in our study contains 6305

[1] Survey I was completed in 1999 and covered 118 countries; Survey II provided information on bank regulatory and supervisory policies in 151 countries for 2002; Survey III captured information on banking policies in 2006 for 142 countries; and Survey IV provided information in 125 countries for 2011 (Barth et al. 2013a).

observations, including 1588 individual banks from 65 countries over the sample period of 2001-2013[2]. It should be noted that the observations in our sample appear to be unbalanced and we attempt to address this concern in the robustness test.

2.3.2 Variables of bank regulation and supervision

The extensive database on bank regulation and supervision is based on four surveys conducted by the World Bank[3]. The Bank Regulation and Supervision Survey is a unique source of comparable economy-level data on how banks are regulated and supervised around the world. Following previous studies (Anginer et al., 2014; Barth et al., 2013; Beck et al., 2013; Li et al., 2019), we are concerned with four types of regulation and supervision: restriction on bank activities, initial capital stringency, prompt corrective action and deposit insurer power. Variables are defined following the work of Barth et al. (2004) and Barth et al. (2013b)[4].

2.3.2.1 Activity restriction

The regulators license banks and specify permissible activities. Banks' in countries may be allowed for engaging a narrow range of activities, such as traditional bank activities of depositing and lending. Or they can engage in a broad array, for example, securities and insurance. Therefore, bank regulations define the scope of bank activities can vary from country to country. We use *Activity restriction* index to capture the degree to which the national regulatory authorities in countries allow banks to engage in (1) Securities (2) Insurance (3) Real estate. More specifically, securities activities include securities underwriting, brokering, dealing and all aspects of the mutual fund industry. Insurance activities refer to insurance underwriting and selling, and real estate activities involve real estate investment, development and management. A value of 1 to 4 is added if an activity is

2 Due to the high advanced banking system and large number of banks from US and UK, banks from these two countries have been excluded in our baseline analysis.

[3] https://www.worldbank.org/en/research/brief/BRSS

[4] Detailed information about variable definition, including the specific survey questions used and how the variables are constructed, can be found in Appendix. We only define the variables briefly in this sub-section.

(1) Unrestricted – A full range of activities in the given category can be conducted directly in the bank.

(2) Permitted – A full range of activities can be conducted, but all or some must be conducted in subsidiaries.

(3) Restricted – Less than a full range of activities can be conducted in the bank or subsidiaries.

(4) Prohibited – the activities cannot be conducted in either the bank or subsidiaries.

By adding the values together and then dividing by 12, the activity restriction index can range from 0 to 1 and higher value indicates greater activity restriction.

2.3.2.2 Initial capital stringency

Capital regulations are the key pillar of banking sector policies. Many rules and regulations require the precise amount and nature of capital that banks must hold. In terms of the nature of capital, there are policies concerning the definition of capital beyond cash or government securities, the definition and valuation of bank assets, and whether the regulatory and supervisory authorities' variations are needed. Therefore, we use the *Initial capital stringency,* which measures whether certain funds may be used to initially capitalize a bank and whether they are official. To be specific, questions include:

(1) Are the sources of funds to be used as capital verified by the regulatory/supervisory authorities?

(2) Can the initial disbursement or subsequent injections of capital be performed with assets other than cash or government securities?

(3) Can the initial disbursement of capital be performed with borrowed funds?

For question (1), we assign a value of 1 to a 'yes' answer and 0 to a 'no' answer. For question (2) and (3), we assign 0 to a 'yes' answer and 1 to a 'no' answer. By adding the values together and dividing by three, we get the Initial capital stringency index which ranges from 0 to 1, with higher value implying greater stringency.

2.3.2.3 Prompt corrective action

An important aspect of supervision is whether the supervisory authorities possess the powers to acquire information from banks and take an assortment of actions to change the behaviour of banks based on the assessments of the official supervisory authority. Authorities in countries may be authorised to take corrective actions to address a problem, while authorities in other countries may have the discretionary power to act as they see sit. Moreover, for example, courts may intervene in some cases and consequently limit, delay or even reverse actions taken by the supervisory authorities, while in other cases, the courts have less power over the regulatory and supervisory agencies. We construct *Prompt corrective action*, which is used to measure whether a law establishes pre-determined levels of bank solvency deterioration which force automatic enforcement actions, such as intervention, and the extent to which supervisors have the requisite, suitable powers to take such actions. Specific questions include:

(1) Can the supervisory authority force a bank to change its internal organizational structure?

(2) Are there any mechanisms of cease and desist-type orders, whose infraction leads to the automatic imposition of civil and penal sanctions against the bank's directors and managers?

(3) Can the supervisory agency order the bank's directors or management to constitute provisions to cover actual or potential losses?

(4) Can the supervisory agency suspend the director's decision to distribute dividends?

(5) Can the supervisory agency suspend the director's decision to distribute bonuses?

(6) Can the supervisory agency suspend the director's decision to distribute management fees?

We assign a value of 1 if the answer is yes and a 0 otherwise. This variable is constructed by adding together these variables and then dividing by 6, with a range

from 0 to 1. Higher value of the variable implies more promptness in responding to problems.

2.3.2.4 Deposit insurer power

Policies associated with insuring the deposits of banks may also shape the performance of the banking system. Countries usually adopt deposit insurance to prevent bank runs. When depositors ask to withdraw their money all at once, this will lead some illiquid but solvent individual banks may be forced into insolvency and there is also the potential for contagious bank runs to the rest of the banking system. Therefore, many countries implement deposit insurance schemes to alleviate the probability of systemic crises. However, deposit insurance also encourages excessive risk-taking by banks since this reduces the incentives of depositors to monitor bank executives and curtail excessive risk taking. Therefore, the precise design of deposit insurance schemes, including coverage limits, the scope of coverage, whether coinsurance is a feature, sources of funding, premia structure, and management and membership requirements, may materially shape bank and depositor behaviours. We use the *Deposit insurer power* which is an index used to measure each country's deposit insurance regime and to trace its evolution from 1999 to 2011. The index is based on the answers to the following questions, for which we assign a value of 1 to a 'yes' answer and 0 to a 'no' answer:

(1) Does the deposit insurance authority make the decision to intervene in a bank?

(2) Can the deposit insurance agency/fund take legal action for violations of laws, regulations, and bylaws (of the deposit insurance agency) against bank directors or other bank officials?

(3) Has the deposit insurance agency/fund ever taken legal action for violations of laws, regulations, and bylaws (of the deposit insurance agency) against bank directors or other bank officials?

(4) Were any deposits not explicitly covered by the deposit insurance at the time of the failure compensated when the bank failed (excluding funds later paid out in liquidation procedures)?

This index is equal to {[(1)+(2)+(3)]/3 + (4)}/2, with a range from 0 to 1, where higher value indicates more power.

2.3.2.5 Total regulation

Based on the above four measures of specific types of bank regulation and supervision, we develop a single regulation measure using factor analysis. We estimate the following equation:

$$Y_{i,s,t} = \beta_i Regulation_{i,s,t} + \varepsilon_{i,t} \quad (2.1)$$

Where the subscripts i, s, and t refer to countries, the four regulation measures, and years, respectively. The left-hand-side variables ($Y_{i,s,t}$) are the four regulation measures, all of which are stacked into a single factor, whereas *Regulation* is not observed and is estimated along with the factor loadings β. We follow the standard practice of normalizing proxy measures included on the left-hand side to have a mean of zero and a variance of one before we conduct the factor analysis. The estimation of Equation (2.1) generates predicted values for both a set of factors ($Regulation_{ist}$) and a set of factor loadings β_i. As our data are well described by a one-factor model that captures approximately 52% of the variation in the four regulation measures, we take the factor with the greatest explanatory power as our measure of total regulation. Higher value means greater stringency.

2.3.3 Measure of systemic risk

Following Acharya et al. (2017), our study adopts the *Marginal Expected Shortfall (MES)* as the measure for determining the systemic risk exposure of individual banks. The systemic expected shortfall of an institution describes the capital shortage a financial institution would experience when there is a systemic event. The capital shortfall depends on the institution's leverage and equity loss conditional on an aggregate market decline. *Marginal Expected Shortfall (MES)* of a financial institution is the expected loss to which an equity investor in a financial institution would be exposed if the systemic declined substantially. Following Acharya et al. (2017), we

adopt MES as our systemic risk measure. MES evaluates the average daily return for the market as whole in the tail of its loss distribution:

$$MES_t^i = E\left(R_t^i \middle| R_t^m < C\right) \tag{2.2}$$

R_t^i is the equity return of financial firm i, and R_t^m is the aggregate equity return of the entire banking system at the country level. A systemic event is defined as a drop of the market index below a threshold, C, over a given time horizon. We estimate the MES by following Acharya et al. (2017) at a standard risk level of 5%, using daily data for equity return from Datastream. For better interpretation of our results, we take the negative value of MES to ensure that our measures are increasing in systemic risk.

2.3.4 Other control variables

We control for a set of bank-specific and country-specific variables in the regression analysis, including bank size, profitability, market-to-book value, loan loss provision, GDP growth, inflation and economic freedom, which have been used in some previous studies of bank regulation and risk (Anginer et al. 2014a; Barth et al. 2004; Delis, Molyneux, and Pasiouras 2011). For example, Anginer et al. (2014a) find that larger banks pose greater systemic risk, while banks with higher market-to-book value tend to have lower systemic risk exposure. Nijskens and Wagner (2011) find that banks with higher ROA tend to use CDS to protect against defaults on their portfolios, and this helps to decrease individual risk while increasing the joint risks.

Bank size is measured by the natural logarithm of individual bank's total assets. We use return on average assets (ROA) to capture the profitability of banks, and market-to-book value (MTBV) to control for bank growth opportunities. Loan loss provisioning is an accounting indicator that directly influences the volatility and cyclicality of bank earnings, as well as information properties of banks' financial reports with respect to reflecting loan portfolios' risk attributes (Bushman and Williams 2012).

With regard to the country-level factors, GDP growth is the annual growth rate of GDP, and inflation is defined as the annual growth rate of GDP deflator. Following Li et al. (2019), we derive the variable of Economic Freedom from the Heritage Foundation. It is the mean value of an index of economic freedom in terms of trade freedom, business freedom, investment freedom, and property rights for the period 2001-2013. The Economic Freedom measures the extent of the freedom individuals and firms can obtain from their governments to conduct their business. All variable definitions can be found in Appendix A.1.

2.3.5 Descriptive statistics

Table 2.1 Panel A summarises the mean value for the regulation variables in each country during the sample period 2001-2013. We observe a wide variation in the four specific regulation measures and also the total regulation index. *Activity Restriction* varies from the lowest value of zero in Kazakhstan and of 0.15 in Germany to a high value of 0.692 in China and of 0.714 in Indonesia, indicating that Indonesia and China forbid banks from engaging in most non-bank activities, while banks in Germany and Kazakhstan have relatively more freedom to extend their operations into securities, insurance or real estate markets. Finland has the highest *Initial Capital Stringency*, with a value of 0.869, while the mean value of *Initial Capital Stringency* in countries including Kazakhstan, Tunisia and Croatia are equal to zero, representing that banks in these countries can include assets other than cash or government securities and borrowed funds as regulatory capital. With respect to *Prompt Corrective Action*, Panama and Slovakia have the highest value of 1, while Sweden has the lowest value of 0.167. *Deposit insurer power* varies from the lowest value of zero in fifteen countries, including Brazil, China, India, Israel and Italy, to the highest value of 0.877 in Canada. This suggests that in Brazil, China and Cyprus etc., which indicates that deposit insurer power is very limited in these countries. Among the sample countries, Kenya has the highest *Total Regulation Index* value (0.872), while Kazakhstan has the lowest (0.113).

In Panel B, we report the number of observations under each survey period. As discussed in section 2.3.1, we use the Survey I information for the value of the regulatory and supervisor variables for the year 2001, Survey II data for the period

2002-2004, Survey III data for the period 2005-2008 and Survey IV data for the period 2009-2013. From Panel B, we observe that countries with more total observations usually are covered by four survey period, e.g. Demark, France and Germany, etc. While countries with less total observations tend to be covered only by one or two survey period, for example, Ecuador with total 16 observations are all under by Survey IV period. The main reason for the unbalanced observation distribution under four survey period across countries is due to data availability. We will address this unbalanced observation issue in section 2.4.3 by conducting a series of robustness tests.

Table 2.1 Summary statistics for the regulation variables
This table includes the countries that are included in our study. Panel A report the regulation restrictions across countries in the sample period 2001 to 2013. Column N represents the number of observations. The remainder of the table reports the mean figures (in percentage form) of the regulation variables over the sample period for each country. In panel B, we report the number of observation under each Survey period. We use the Survey I information for the value of the regulatory and supervisor variables for the year 2001, Survey II data for the period 2002-2004, Survey III data for the period 2005-2008 and Survey IV data for the period 2009-2013. A detailed description of the definitions of the variables is included in Appendix.

Panel A: regulation restrictions across countries

Country	N	Activity Restriction	Initial Capital Stringency	Prompt Corrective Action	Depositor	Regulation Total
Argentina	71	0.418	0.531	0.511	0.707	0.564
Australia	127	0.445	0.780	0.880	0.139	0.633
Austria	108	0.468	0.441	0.674	0.0540	0.446
Bahrain	75	0.613	0.489	0.849	0.0889	0.600
Bangladesh	115	0.470	0.333	0.964	0.464	0.619
Belgium	20	0.394	0.583	0.825	0.300	0.571
Botswana	15	0.438	0.333	0.800	0	0.427
Brazil	124	0.573	0.543	0.867	0	0.580
Bulgaria	13	0.466	0.333	0.554	0.231	0.417
Canada	129	0.532	0.793	0.407	0.616	0.642
Chile	81	0.610	0.309	0.747	0.208	0.538
China	13	0.692	0.0256	0.808	0	0.456
Colombia	53	0.568	0.509	0.594	0.160	0.516
Croatia	44	0.607	0	0.598	0.333	0.422
Cyprus	25	0.532	0.333	0.920	0	0.514
Czech	11	0.409	0.485	0.530	0.561	0.514
Denmark	231	0.341	0.766	0.561	0.181	0.481
Ecuador	16	0.500	0.667	0.600	0.167	0.536
Egypt	99	0.383	0.316	0.899	0.167	0.472
Finland	28	0.536	0.869	0.286	0.0536	0.479
France	361	0.386	0.695	0.554	0.391	0.533
Germany	248	0.150	0.536	0.502	0.490	0.378
Greece	58	0.444	0.833	0.604	0.0144	0.523
Hong Kong SAR	70	0.584	0.505	0.821	0.124	0.590
Hungary	17	0.548	0.431	0.941	0.176	0.605
Iceland	14	0.554	0.190	0.381	0.119	0.326
India	380	0.434	0.344	0.781	0.0158	0.426
Indonesia	150	0.714	0.333	0.988	0.341	0.713
Ireland	13	0.462	0.333	0.769	0.167	0.471
Israel	91	0.420	0.667	0.799	0.0440	0.534
Italy	301	0.509	0.762	0.328	0.203	0.486
Japan	875	0.484	0.623	0.939	0.0838	0.609
Jordan	106	0.352	0.333	0.628	0	0.327
Kazakhstan	8	0	0	0.800	0	0.113
Kenya	33	0.625	0.859	0.885	0.621	0.872
Kuwait	166	0.667	0.333	0.509	0	0.438
Lebanon	33	0.616	0.333	0.770	0.212	0.558
Lithuania	13	0.688	0.667	0.723	0.590	0.778

Luxembourg	23	0.283	0.667	0.804	0.0362	0.467
Malaysia	139	0.249	0.667	0.622	0.157	0.420
Malta	20	0.406	0.833	0.900	0.0833	0.624
Mexico	74	0.429	0.802	0.786	0.273	0.635
Morocco	68	0.413	0.647	0.831	0.0662	0.541
Niger	6	0.542	0.389	0.611	0	0.430
Nigeria	20	0.625	0.333	0.800	0.333	0.604
Norway	201	0.428	0.333	0.477	0.558	0.457
Oman	23	0.435	0.667	0.696	0.0580	0.509
Pakistan	173	0.413	0.541	0.910	0	0.518
Panama	2	0.563	0.333	1	0	0.556
Peru	68	0.479	0.711	0.708	0.206	0.587
Poland	159	0.307	0.667	0.642	0	0.414
Portugal	47	0.431	0.695	0.706	0.0426	0.516
Qatar	34	0.463	0.333	0.765	0	0.427
Russian	8	0.656	0.667	0.550	0.167	0.594
Singapore	38	0.257	0.675	0.654	0.0746	0.416
Slovakia	33	0.419	0.798	1	0.232	0.692
South Africa	23	0.688	0.667	0.400	0	0.515
Spain	94	0.328	0.397	0.555	0.291	0.386
Sri Lanka	109	0.636	0.538	0.583	0	0.513
Sweden	41	0.329	0.561	0.167	0.0610	0.245
Switzerland	235	0.609	0.694	0.792	0.294	0.695
Thailand	163	0.248	0.444	0.803	0.0542	0.386
Tunisia	56	0.375	0	0.600	0	0.225
Venezuela	109	0.398	0.502	0.811	0.0734	0.483
Zimbabwe	4	0.625	0.667	0.800	0.167	0.665
Total	6305	0.450	0.554	0.708	0.183	0.518

Panel B: Observations under each survey period by country

Country	N	Survey I	Survey II	Survey III	Survey IV
Argentina	71	5	15	22	29
Australia	127	10	33	46	38
Austria	108	9	29	35	35
Bahrain	75	0	6	34	35
Bangladesh	115	0	0	25	90
Belgium	20	2	8	5	5
Botswana	15	0	0	0	15
Brazil	124	12	34	34	44
Bulgaria	13	0	0	6	7
Canada	129	10	30	40	49
Chile	81	6	14	21	40
China	13	1	0	12	0
Colombia	53	0	11	17	25
Croatia	44	0	0	19	25
Cyprus	25	0	0	12	13
Czech	11	2	5	4	0
Denmark	231	23	58	77	73
Ecuador	16	0	0	0	16
Egypt	99	5	15	33	46
Finland	28	2	7	9	10
France	361	37	99	105	120
Germany	248	28	69	80	71
Greece	58	5	12	22	19
Hong Kong SAR	70	0	18	26	26
Hungary	17	1	5	6	5
Iceland	14	0	4	10	0
India	380	12	65	127	176
Indonesia	150	11	0	66	73
Ireland	13	1	4	3	5
Israel	91	6	21	29	35
Italy	301	36	87	92	86
Japan	875	114	321	440	0
Jordan	106	0	0	39	67
Kazakhstan	8	0	0	0	8
Kenya	33	0	0	14	19
Kuwait	166	0	12	67	87
Lebanon	33	0	0	14	19
Lithuania	13	0	0	7	6
Luxembourg	23	4	7	7	5
Malaysia	139	11	41	43	44
Malta	20	0	0	10	10
Mexico	74	5	17	22	30
Morocco	68	4	14	23	27
Niger	6	0	0	1	5
Nigeria	20	0	0	0	20
Norway	201	0	51	70	80

Oman	23	0	0	8	15
Pakistan	173	0	30	65	78
Panama	2	0	0	0	2
Peru	68	5	17	25	21
Poland	159	12	39	53	55
Portugal	47	4	12	14	17
Qatar	34	0	4	0	30
Russian	8	0	0	4	4
Singapore	38	8	13	17	0
Slovakia	33	1	3	12	17
South Africa	23	0	0	0	23
Spain	94	12	32	32	18
Sri Lanka	109	4	14	34	57
Sweden	41	5	18	18	0
Switzerland	235	19	56	69	91
Thailand	163	11	43	56	53
Tunisia	56	0	0	0	56
Venezuela	109	7	24	41	37
Zimbabwe	4	0	0	0	4
Total	6305	450	1417	2222	2216

Table 2.2 Descriptive statistics

This table provides the summary statistics in Panel A and the correlation matrix in Panel B for the variables of the regulation, bank-specific and country-specific variables used in baseline analysis over the sample period of 2001to 2013, * indicates the correlation is significant at 95% significance level. The sample consists of 6305 banks across 65 countries. The variables are defined as outlined in Appendix. N denotes the number of observations.

Panel A: Summary statistics

Variable	N	Mean	Standard Deviation	25th	Medium	75th
MES	6305	0.992	1.140	0.0959	0.751	1.640
Activity Restriction	6305	0.450	0.222	0.313	0.438	0.563
Initial Capital Stringency	6305	0.554	0.241	0.333	0.667	0.667
Prompt Corrective Action	6305	0.708	0.263	0.500	0.800	1
Depositor	6305	0.183	0.244	0	0	0.333
Regulation Total	6305	0.518	0.178	0.395	0.526	0.673
MTBV	6305	1.398	0.980	0.760	1.160	1.750
LgTA	6305	9.322	2.389	7.632	9.153	10.96
LLP	6305	0.233	2.973	0.0488	0.140	0.271
ROA	6305	1.005	4.516	0.320	0.830	1.600
GDP Growth	6305	2.970	3.702	1.136	2.587	5.278
Inflation	6305	4.263	6.348	0.795	2.555	6.387
Economic Freedom	6305	65.35	8.882	59.20	64.90	70.90

Panel B: Correlation Matrix

	Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1)	MES	1												
(2)	Activity Restriction	0	1											
(3)	Initial Capital Stringency	0.027**	0.01	1										
(4)	Prompt Corrective Action	0.139***	0.189***	0.034***	1									
(5)	Deposit Insuer Power	-0.072***	-0.047***	0.077***	-0.162***	1								
(6)	Regulation Total	0.056***	0.683***	0.474***	0.576***	0.278***	1							
(7)	MTBV	0.094***	-0.042***	-0.061***	-0.058***	0.014	-0.076***	1						
(8)	lgTA	0.167***	0.058***	-0.062***	0.025**	0.085***	0.052***	0.090***	1					
(9)	LLP	-0.024*	-0.004	-0.016	0.001	-0.020*	-0.016	-0.012	0.025**	1				
(10)	ROA	-0.073***	-0.028**	-0.012	-0.016	0.013	-0.026**	0.019	-0.016	-0.303***	1			
(11)	GDP Growth	-0.048***	-0.075***	-0.216***	0.070***	-0.068***	-0.125***	0.149***	0.125***	-0.01	0.109***	1		
(12)	Inflation	-0.116***	0.018	-0.252***	-0.036***	-0.02	-0.121***	0.093***	0.116***	0.009	0.119***	0.216***	1	
(13)	Economic Freedom	0.029**	0.033***	0.248***	-0.038***	0.081***	0.135***	-0.006	-0.155***	-0.006	-0.068***	-0.269***	-0.468***	1

*** p<0.01, ** p<0.05, * p<0.1

Table 2.2 provides the descriptive statistics for the variables of systemic risk, regulation, bank-specific and country-specific factors for the entire sample. In panel A, we report the summary statistics for all the variables we used in our baseline analysis. We observe a wide variation in the systemic risk measure for the sample banks over the period of 2001 to 2013, with a mean value 0.992 and standard deviation 1.140.

The mean value of the *Activity Restriction* variable is 0.45, showing that the average level of restriction on bank activities is medium. Banks on average have a value of 0.554 for *Initial Capital Stringency*, suggesting that more than half of the banks in the sample can include funds other than cash, government securities and borrowed funds as regulatory capital. The *Prompt Corrective Action* variable shows a mean value of 0.708, indicating that on average the supervision power is high in the sample banks. However, the power of the deposit insurer in most countries appears to be limited as the average value of *Deposit Insurer Power* is only 0.183.

In terms of control variables, the average of *Market-to-book-value (MTBV)* is 1.398, ranging from 25^{th} percentile of 0.760 to 75^{th} percentile of 1.750. We use the natural logarithm of total assets to measure the size of the banks. On average, the logarithm value of total assets is 9.322, with a standard deviation of 2.389. We observe a large variation in the *LLP* variable, with an average value of 0.233% and standard deviation of 2.973. The value at 25^{th} percentile is 0.0488% while it reaches to 0.271% at 75^{th} percentile. *GDP growth* and *Inflation* reports the mean value as 2.970 and 4.263 respectively. The *Economic Freedom Index* presents significant variation from 59.20 (25^{th} percentile) to 70.90 (75^{th} percentile), with 65.35 on average.

In panel B, we report the Pearson correlations for the variables used in this paper. Overall, the table suggests the multicollinearity is not a serious problem. Most of the correlation coefficients are below 0.3, which allows us to include these variables simultaneously in the regression model. We find some preliminary evidence suggests that regulation stringency tend to positively related to systemic risk. Furthermore, we see that countries with greater regulation and supervision stringency over banks tend to have lower GDP growth, higher inflation but more economic freedom. In addition,

banks in these countries tend to be larger but lower market-to-book value. We will explore the relation more rigorously in later multivariate analysis.

2.4 Empirical results

2.4.1 Baseline results

We start with five baseline models using OLS to examine the association between bank regulation and systemic risk. More specifically, we estimate the following equation:

$$MES_{ijt} = \alpha + \beta \times regulations_{jt} + \Omega \times bank\ and\ country\ controls_{ijt} + \gamma_i + \lambda_t + \varepsilon_{ijt} \quad (2.3)$$

The dependent variable is the systemic risk measured by *MES* of bank *i* in country *j* in year *t*. The main independent variable is the regulation variables, namely *Activity Restriction, Initial Capital Stringency, Prompt Corrective Action, Deposit Insurer Power* and the *Total Regulation Index,* respectively. Control variables include bank-level and country-level variables since these factors could potentially affect systemic risk. γ_i is bank fixed effects to control time invariant bank heterogeneity and λ_t is calendar year fixed effects. The standard errors for the regressions are estimated as heteroscedasticity-robust standard errors clustered for banks and presented in brackets. Table 2.3 reports the results.

Table 2.3 Baseline Results

This table reports the panel regression results of the estimation of different regulations and systemic risk from 65 countries for the period from 2001 to 2013. The dependent variable is the systemic risk measure by MES. Control variables include *MTBV, lgTA, LLP, ROAA, GDP Growth, Inflation and Economic Freedom*. Detailed definitions of the variables can be found in Appendix. Bank fixed effect and year fixed effects are both included. The standard errors for the regressions are estimated as heteroskedasticity-robust standard errors clustered for banks and are presented in brackets *, **, and *** represent statistical significance at the 10%, 5%, and 1% significance level, respectively.

	(1) Activity Restriction	(2) Initial Capital Stringency	(3) Prompt Corrective Action	(4) Depositor	(5) Regulation Total
Regulation	0.204**	0.361***	0.200***	-0.093	0.419***
	(0.091)	(0.081)	(0.077)	(0.062)	(0.105)
MTBV	0.072***	0.073***	0.076***	0.071***	0.076***
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
lgTA	-0.110**	-0.113**	-0.108**	-0.128***	-0.090**
	(0.045)	(0.044)	(0.044)	(0.044)	(0.044)
LLP	-0.010*	-0.010*	-0.010*	-0.010*	-0.010*
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
ROA	-0.002	-0.002	-0.003	-0.003	-0.002
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
GDP Growth	0.006*	0.004	0.006*	0.005	0.006*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Inflation	-0.001	-0.001	-0.001	-0.002	-0.000
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Economic Freedom	0.006	0.004	0.005	0.004	0.006
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
_cons	1.335**	1.323**	1.292**	1.629***	1.051*
	(0.598)	(0.590)	(0.595)	(0.589)	(0.595)
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes
Time-fixed effect	Yes	Yes	Yes	Yes	Yes
N	6305	6305	6305	6305	6305
adj. R-sq	0.267	0.270	0.268	0.267	0.269

We find a positive relationship between the majority of regulation stringency variables (*Activity Restriction*, *Initial Capital Stringency*, *Prompt Corrective Action* and *Regulation Total*) and systemic risk. In column (1), we observe a positive relation between *Activity Restriction* and MES, suggesting that banks in countries with tough activity restriction are exposed to higher systemic risk. Specifically, compared to countries with no restriction on banks activities, the systemic risk is 20.4 percentage points higher which is 21% of the sample mean for MES. Traditional portfolio theory predicts that the combined cash flows from non-correlated revenue sources should be more stable than the constituent parts (Baele et al. 2007). Activity restrictions may result in herding behaviour and greater correlated risk taking (Anginer et al. 2014a), as the structure of bank portfolios will become more similar and risks are highly correlated among those banks. Wagner (2010) argues that diversification in banks' activities can reduce systemic risk and increase welfare, while similarity cannot. Less restriction on bank activities allows banks to engage in a broad range of activities, which has the potential to decrease conglomerate risk (Kwan and Laderman 1999). Our results provide evidence to support the above arguments. This is also consistent with the findings of previous empirical work. Based a country-level database to analyse the influence of bank activity restrictions on the likelihood of a banking crisis, Barth et al. (2004) find that greater regulatory restrictions on bank activities are associated with an increase in the likelihood of suffering a major crisis. Beck et al., (2006) show that imposing fewer restrictions on bank activities can reduce banking system fragility.

Similarly, we find a significantly positive association between *Initial Capital Stringency* and systemic risk in column (2). Capital requirement has been one of the most important bank regulatory instruments under the work of the Basel Committee of Banking Supervision. Capital, as a buffer for losses in bad times and also an incentive adjustor, is likely to reduce the principal-agent problem between shareholders and debt-holders and prevent excessive risk taking (Chortareas et al., 2012; Ellis et al., 2014). In this sense, better capitalized banks seem to contribute less to systemic risk (Laeven et al. 2016).

However, if the systemic risk is defined as capital shortfall of an individual bank when the whole financial system is under distress, greater capital stringency may

lead to increased systemic risk as it can create challenges for banks, especially in the crisis time. When the system is undercapitalized, it will no longer supply credit for the routine business. Banks under greater capital stringency will find it more difficult to raise capital, and hence will be more likely to experience capital shortfall and exposure to greater systemic instability. Moreover, stringent regulation design in banking can cause the boundary problem (Goodhart 2008). If regulations are asymmetric between the banking industry and other financial sectors, such as the insurance sector, banks will be tempted to engage in regulatory arbitrage which could conceivably lead to an increase in overall systemic risk (Allen and Gale 2007). Therefore, it is not surprising that a positive association between *Initial Capital Stringency* and systemic risk is found in this study, suggesting that banks under greater initial capital stringency tend to have higher systemic risk.

Our results in Column (3) show that the enhanced *Prompt Corrective Power* can also contribute negatively to the financial stability of the market in the sample countries. There are strong theoretical explanations arguing for greater official supervision power. Banks are difficult to monitor, especially for the debtholders who are not in a position to monitor managers because they are small and uninformed (Dewatripont and Tirole 1993; Santos 2001). From this perspective, strong official supervision can monitor and discipline banks, prevent managers from excessive risk-taking behaviour, and thus reduce market failure (Beck et al. 2006).

However, such an argument is based on the assumption that the supervisory agencies are acting according to the public interest. Under the private interest or regulatory capture view (Agoraki et al. 2011; Barth et al. 2004), governments and supervisors may act in the interest of a few specific groups, e.g. powerful banks, rather than the society. If this held true then a stronger supervisory power might actually have uncertain and even adverse implications for banks' lending behaviour (Agoraki et al. 2011; Beck et al. 2006). In the study by Barth et al. (2004), no significant association is found between official supervisory power and the likelihood of suffering a crisis. Greater government intervention may also undermine the self-regulation faction in the banking system and increase moral hazard due to a decline in the market discipline (Gropp and Vesala 2004; Hryckiewicz 2014). Hryckiewicz (2014) investigates the impact of policy injections into banks in 23 countries during the 2007-2009 financial

crisis, and find that government interventions are strongly correlated with subsequent risk increase in the bank sector. He argues that the increased role of the government in the banking sector might encourage politicians to act in self-interests. Our results provide evidence to support the latter view, showing higher prompt corrective power leads to increased systemic risk.

Last, the coefficient for the *Total Regulation Index* shown in column (5) is significantly positive, consistent with the aforementioned results. All these results suggest that banks under strict regulation and supervision tend to have higher systemic risk. One potential reason is that under more stringent regulation and supervision, banks are more likely to have moral hazard problem and less self-monitored, and also they will have more difficulty in raising capital and be more likely to experience capital shortfall[5].

The only regulation variable for which no significant relationship exists is *Depositor Insurer Power*. Following the establishment of the first national insurance system in the U.S. in 1934, explicit deposit insurance schemes to prevent widespread bank runs have been adopted in different countries since the 1980s (Barth et al. 2004; Demirgüç-Kunt and Kane 2002). However, it has been widely recognised that deposit insurance can aggravate the moral hazard problem in the banking sector by encouraging excessive risk-taking behaviour (Anginer et al. 2014b; Barth et al. 2004; Bisias et al. 2012). Depositors can monitor bank risk-taking behaviour by charging higher interest rates, but they may have less incentive to monitor banks if deposits are insured, and the lack of market discipline is likely to result in excessive risk taking culminating in banking crises (Anginer et al. 2014b). The higher the individual risk, the greater the capital shortfall when banks are in distress, and consequently the more they contribute to systemic instability.

More empirical evidence tends to support this argument (Barth et al. 2004; Demirgüç-Kunt and Kane 2002). For example, Barth et al. (2004) find a positive association between the generosity of the deposit insurance scheme and the possibility

[5] As we stated before, we exclude banks from US and banks because of their high developed banking system and the large number of banks. However, we estimate the baseline regression include US and UK banks which represents one third observation of the whole sample. The results are reported in Appendix, Table B.1. Our baseline results are still held.

of suffering a major banking crisis, and such a relationship is economically large. More recently, Anginer et al. (2014b) find that deposit insurance increases systemic fragility in the years leading to 2007-2009 financial crisis, but lower bank systemic risk in countries with deposit insurance coverage during crisis. Their findings suggest that the ‘‘moral hazard effect’’ of deposit insurance dominates in good times, while the ‘‘stabilization effect’’ of deposit insurance dominates in turbulent times. The cancelling effects of deposit insurer power in the sample countries may explain why there is no significant relationship found in our study.

In terms of control variables, the signs and significance levels of these variables are in line with our expectations. For bank specific characteristics, the coefficient on bank size (measured as logarithm of total assets) appears to be negatively and statistically significant in all regressions, indicating that larger banks are less likely to be exposed to higher systemic risk. While the MTBV is positively related to the systemic risk, which suggests that higher market valued banks are exposing to higher systemic risk. Besides, we find weak evidence showing that the GDP growth is positively related to systemic risk, which suggests that banks in countries with higher GDP growth tend to be exposed to higher systemic risk. Similar results are reported in existing studies (Anginer et al. 2014a; Berger et al. 2019).

2.4.2 Endogeneity test

The results from our baseline regression analysis have documented a positive relationship between regulation stringency and systemic risk. One question which can undermine our main result is that our results derive from reversed causality. For example, when policymakers or government observed that banks in their countries are exposing to a higher systemic risk, and they would like to limit this risk exposure by exposing restricted regulation and supervision. If this is the case, it would lead to the results we observed in section 2.4.1 that greater restriction in banking regulation and supervision is positively related to banks’ systemic risk. Therefore, in this section, we conduct a *Difference-in-Differences* (DiD) analysis by employing the staggered timing of the introduction of Basel II regulation across countries and Instrument Variable Approach to address the potential endogeneity between bank regulation and systemic risk.

2.4.2.1 Basel II implementation and systemic risk

First, we conduct a Difference-in-Differences (DiD) analysis to address the potential endogeneity between bank regulation and systemic risk by employing the staggered timing of the introduction of Basel II regulation across countries. Basel II was designed to improve the way that regulatory capital requirements could reflect underlying risks and address the financial innovation accrued in previous years[6]. Following the release of Basel II in June 2004, different countries adopted this new framework at a staggered process. In our sample, Australia was the first country implementing Basel II in 2005, followed by Japan, a serial of EU member countries and others which implemented it in 2007. The staggered introduction of Basel II provides a DiD empirical setting, which allows us to use countries that had not adopted it at a point of time to control for potentially confounding effects. We estimate the difference in systemic risk exposure of banks in a country before and after the Basel II implementation to such differences for banks in countries where Basel II has not been implemented during the same time period. If strict regulation and supervision increase the individual banks' exposure to systemic risk, we would expect an increase in systemic risk after the implementation of Basel II. We manually collect the time of individual countries implementing Basel II, and then introduce a dummy variable of Basel II, which equals to one for the time after the country adopted Basel II and 0 otherwise. The baseline regression was re-run by replacing the variable of $Regulations_{i,t}$ with Basel II Dummy. The result is reported in column (1) of Table 2.4.

[6] Basel II comprises three pillars: a) Minimum Capital Requirements, which seeks to develop and expand the standardised rules on the calculation of total minimum capital requirements for credit, market and operational risk; b) supervisory review process, which is intended to encourage banks to develop and use better risk management techniques in monitoring and managing their risks; c.) Market Discipline, which aims to promote effective use of disclosure as a lever to strengthen market discipline and encourage sound banking practices (Basel Committee on Banking Supervision, 2004).

Table 2.4: Additional Evidence: Basel II implementation and systemic risk

This table reports the panel regression results of the estimation of different regulations and systemic risk from 65 countries for the period from 2001 to 2013. The dependent variable is the systemic risk measure by MES. Column (1) reports the results of estimation Basel II implementation and systemic risk. Basel II is a series of dummy variables set to one in the t year after (before) the country in which bank is located implement the Basel II and zero otherwise. Column (2) reports the dynamic change of systemic risk prior/after the Basel II implementation. $Basel\ II_{it}$ is a series of dummy variables which sets to one in the t^{th} after (before) the country in which bank is located implement the Basel II and zero otherwise. Control variables include MTBV, lgTA, LLP, ROAA, GDP Growth Inflation and Economic Freedom. Detailed definitions of the variables can be found in Appendix. Bank fixed effect and year fixed effects are both included. The standard errors for the regressions are estimated as heteroskedasticity-robust standard errors clustered for banks and are presented in brackets *, **, and *** represent statistical significance at the 10%, 5%, and 1% significance level, respectively

	(1)	(2)
Dependent Variable	MES	MES
Basel II Dummy	0.175**	
	(0.085)	
Basel II t-4		-0.275
		(0.213)
Basel II t-3		-0.063
		(0.177)
Basel II t-2		-0.074
		(0.127)
Basel II t-1		-0.084
		(0.090)
Basel II t+1		0.281***
		(0.094)
Basel II t+2		0.269**
		(0.131)
Basel II t+3		0.478***
		(0.170)
Basel II t+4		0.484**
		(0.215)
Basel II t+5		0.781***
		(0.265)
Basel II t+6		0.999***
		(0.314)
_cons	1.204*	1.061
	(0.715)	(0.787)
Control variables	Yes	Yes

Continue:		
Bank fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
N	4880	4880
adj. R-sq	0.285	0.287

As expected, the coefficient of Basel II Dummy is positive and significant at 95% confidence level, showing that the adoption of Basel II is related to higher systemic risk, which suggests the implementation of Basel II tends to increase systemic risk in a country.

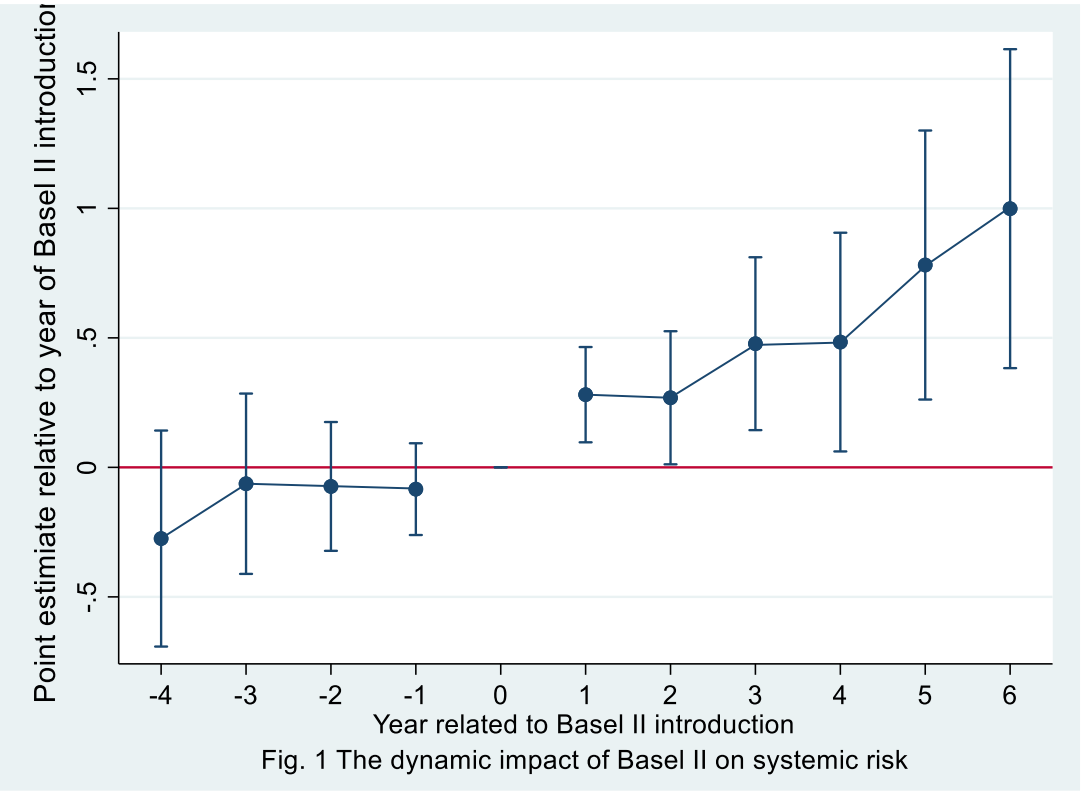
One key assumption of the DiD setting is that without the treatment effects, the treated group should experience the same trend in systemic risk as the control group. Although the staggered adoption of Basel II represents an exogenous shock to bank regulation, country-level factors that manifest differently across countries could affect the timing of Basel II adoption in different countries. To ensure there is no trend before the event, we further examine the dynamics of the relation between Basel II implementation and bank systemic risk exposure by including a series of dummy variables in equation (3) to trace out the year-by-year effects of Basel II implementation on systemic risk. Specifically, we conduct analysis for the following equation (4):

$$\begin{aligned} Y_{it} = \alpha + \beta_{-4} Basel\ \text{II}_{i\,t-4} + \beta_{-3}\text{Basel II}_{i\,t-3} + \beta_{-2}\text{Basel II}_{i\,t-2} \\ + \beta_{-1}\text{Basel II}_{i\,t-1} + \beta_{1}\text{Basel II}_{i\,t+1} + \cdots \\ + \beta_{6}\text{Basel II}_{i\,t+6} + \Omega \times bank\ and\ country\ controls_{ijt} \\ + \gamma_i + \lambda_t + \varepsilon_{ijt}. \end{aligned} \tag{2.4}$$

Where the $Basel\ \text{II}_{i\,t}$ equals to one in the years before (after) the country in which bank is located implement the Basel II in year t and zero otherwise. $Basel\ \text{II}_{i\,t-4}$ is set to one for years up to and including four years prior to Basel II implementation and zero otherwise; $Basel\ \text{II}_{i\,t+6}$ set to one for years up to and including six years after Basel II implementation. The omitted variable in this regression is the year of Basel II introduction (*t=0*). Therefore, we can estimate the dynamic effect of Basel II implementation on systemic risk relative to the year of implementation. If there is an increasing systemic risk simultaneously happened with the implementation of Basel II, we should observe a trend before and after the implementation of Basel II. Otherwise, the result derived from column (1) should not result from reverse causality.

Figure 1. plots the coefficients estimate of Basel II implementation and their associated 95% confidence intervals as shown by the vertical bars of Equation (2.4) and the regression results are reported in Column (2) of Table 2.4. Overall, we find that the coefficients on Basel II are insignificant for years before implementation, therefore we can confirm that there is no trend of systemic risk change prior to Basel II implementation. On the other side, we observe that the coefficients become significantly positive since the first and following years after Basel II implemented. On top of the statistical significance, the magnitudes of the coefficients are increasing since the year introduced Basel II. These results have important implications. Firstly, it suggests that there is no trend on systemic risk before the implementation of Basel II, and support our main findings are less likely derived from reverse causality. Secondly, the results found in this section also show an increasing trending after the Basel II implementation, indicating that implementation of Basel II has a positive impact on banks' systemic risk and such impact tends to be amplified by years.

Figure 2.1 Basel II implementation and systemic risk: dynamic results



This figure presents the dynamic impact of Basel II implementation on systemic risk. The impact of Basel II on systemic risk is shown by the connected dots; the vertical bars correspond to 95% confidence intervals with bank-level clustered standard error. All estimates are relative to the year before Basel II implementation. Specifically, we report estimated coefficients from the following specification: $Y_{it} = \alpha + \beta_{-4}Basel\ \text{II}_{i\,t-4} + \beta_{-3}\text{Basel II}_{i\,t-3} + \beta_{-2}\text{Basel II}_{i\,t-2} + \beta_{-1}\text{Basel II}_{i\,t-1} + \beta_{1}\text{Basel II}_{i\,t+1} + \cdots + \beta_{6}\text{Basel II}_{i\,t+6} + \Omega \times bank\ and\ country\ controls_{ijt} + \gamma_i + \lambda_t + \varepsilon_{ijt}$. Where the $Basel\ \text{II}_{i\,t}$ equals to one in the years after the country in which bank is located implement the Basel II in year t and zero otherwise. $Basel\ \text{II}_{i\,t-4}$ is set to one for years up to and including four years prior to Basel II implementation and zero otherwise, $\text{Basel II}_{i\,t+6}$ set to one for years up to and including six years after Basel II implementation . The omitted variable in this regression is the year of Basel II implementation (t=0). γ_i and λ_t are bank and year fixed effects, respectively.

2.4.2.2 Instrumental Variable Analysis

Next, we use an Instrument Variable approach to conduct further analysis to address the potential endogeneity issue. Following previous studies of theoretical and empirical work in the law, institution and finance literature (Acemoglu, Johnson, and Robinson 2001; Beck, Demirgüç-Kunt, and Levine 2003), the latitude is selected as our exogenous variable.

The endowment theory suggests that the initial endowment and geographical environment shape the construction of institution and policies, which can be used to explain the cross-country variation in financial intermediary and financial institution development (Acemoglu et al. 2001; Beck et al. 2003; La Porta et al. 1999). Both the location and ethnic fractionalization tend to affect the bank regulation and supervision framework in different countries, but they are less likely to directly affect banks systemic risk nowadays. We use *Latitude*, which is the absolute value of the latitude of the country and normalized to take a value between 0 and 1, as instrumental variables for causal inference. Similar approach and instrumental variable have been used in previous studies for estimating the impact of bank regulation and supervision (Barth et al. 2009; Barth, Lin, et al. 2013; Beck et al. 2006; Houston et al. 2011). We employ a two-stage least squares (2SLS) model to conduct the instrumental variable analysis, and the results are reported in Table 2.5.

In panel A, we present the first stage results of the two-stage least squares regressions. It can be seen that instrumental variable, *Latitude*, is significantly and negatively related to regulation variables (except for *Activity Restrictions*), suggesting that the historical endowments can affect the regulation and supervision framework in different countries. Previous studies suggest that countries located in high latitude area are richer and less interventionist, therefore the regulation and supervision in banking of these countries tend to be less restrict (La Porta et al. 1999). The results of F-test also suggest that the instrumental variables are valid in our first stage estimation.

In panel B, we report the second stage results by using the predicted value of regulation variables of the two-stage least squares regressions. We find that the coefficient of *Activity Restriction, Initial Capital Stringency, Prompt Corrective Action, Deposit Insurer Power* and *Regulation Total* are all positively and significantly related to systemic risk. Overall, our main empirical findings are robust to the

instrumental variable regression analysis, confirming the positive impact of bank regulation on systemic risk which is less likely derive from reverse causality issue.

Table 2.5 Endogenous test: Instrumental variables analysis

This table reports the two-stage least squares regression results of the estimation of different regulations and systemic risk from 65 countries for the period from 2001 to 2013. The dependent variable is the systemic risk measure by MES. Instrumental variables for bank regulations is latitude. We report both the first and second stage results. In the first stage regression, we regress bank regulation measures on the latitude of the country. In the second stage, we use the predicted value of bank regulation measures from the first stage as the independent variable. Panel A reports the corresponding first-stage regression results with endogenous variable bank regulation as dependent variable. Panel B reports the second-stage regression results from the 2SLS analysis. The independent variable is the systemic risk measured by MES. Bank-fixed effect and time-fixed effects are included. The standard errors for the regressions are estimated as heteroskedasticity-robust standard errors clustered for banks and are presented in brackets *, **, and *** represent statistical significance at the 10%, 5%, and 1% significance level, respectively

	(1) Activity Restriction	(2) Initial Capital Stringency	(3) Prompt Corrective Action	(4) Deposit Insurer Power	(5) Regulation Total
Panel A: First stage					
Latitude	0.496***	-0.641***	-0.336***	-1.195***	-0.387***
	(0.111)	(0.248)	(0.108)	(0.087)	(0.077)
Control Variables	Yes	Yes	Yes	Yes	Yes
First stage F-test (p-value)	0.000***	0.000***	0.000***	0.000***	0.000***
Panel B: Second stage					
Regulation	0.412*	1.354*	1.061*	1.793*	0.536*
	(0.224)	(0.735)	(0.576)	(0.973)	(0.291)
MTBV	0.072***	0.072***	0.086***	0.078***	0.075***
	(0.024)	(0.024)	(0.026)	(0.025)	(0.024)
lgTA	-0.125***	-0.122***	-0.123***	-0.129***	-0.125***
	(0.044)	(0.043)	(0.043)	(0.045)	(0.044)
LLP	-0.009*	-0.010*	-0.009*	-0.011*	-0.009*
	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)
ROAA	-0.002	-0.002	-0.002	-0.004	-0.002
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
GDP Growth	0.007*	0.005	0.009**	0.002	0.006*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Inflation	-0.001	0.004	0.003	-0.002	0.000
	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)
Economic Freedom	0.005	0.009*	0.003	0.007	0.005
	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)
_cons	1.432***	0.611	0.934**	1.322***	1.322***
	(0.538)	(0.506)	(0.471)	(0.512)	(0.512)
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes

Continue:					
Time-fixed effect	Yes	Yes	Yes	Yes	Yes
N	6305	6305	6305	6305	6305
adj. R-sq	0.266	0.266	0.266	0.266	0.266

2.4.3 Robustness test

In this section, we conduct a series of additional regression analyses to verify the robustness of our main results. As mentioned in section 2.3, the countries included in our sample are based on data availability. As a result, there might be concerns with our baseline results because of the existence of unbalanced observations cross countries. Therefore, we first run the analysis for equation (2.3) by employing the weighted-least-square regression to address the issue of unbalanced panel data. We take the inverse of the number of observations for a country as the weight for each bank in the country so that each country receives the equal weight in the estimation. The results are reported in Table 2.6. Consistent with our main regression results presented in section 2.4.1, the relationship between the majority of regulation variables and systemic risk is positive and significant, showing that our main findings are robust and are less likely to be biased due to unbalanced observation cross countries.

Table 2.6 Robustness test: WLS regression

This table reports the WLS regression results of the estimation of different regulations and systemic risk from 65 countries for the period from 2001 to 2013. The weight is the inverse of the number of observations for a country. The dependent variable is the systemic risk measure by MES. Control variables include *MTBV, lgTA, LLP, ROAA, GDP Growth Inflation and Economic Freedom*. Detailed definitions of the variables can be found in Appendix. Bank fixed effect and year fixed effects are both included. The standard errors for the regressions are estimated as heteroskedasticity-robust standard errors clustered for banks and are presented in brackets *, **, and *** represent statistical significance at the 10%, 5%, and 1% significance level, respectively.

	(1)	(2)	(3)	(4)	(5)
	Activity Restriction	Initial Capital Stringency	Prompt Corrective Action	Depositor	Regulation Total
Regulation	0.410***	0.551***	0.433***	-0.084	0.766***
	(0.111)	(0.100)	(0.096)	(0.080)	(0.129)
MTBV	0.042	0.047	0.050	0.044	0.049
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)
lgTA	-0.154**	-0.149**	-0.133**	-0.188***	-0.103*
	(0.060)	(0.058)	(0.060)	(0.059)	(0.060)
LLP	-0.010	-0.011*	-0.010	-0.011	-0.010
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
ROA	0.003	0.003	0.002	0.003	0.002
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
GDP Growth	0.003	0.000	0.004	0.001	0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Inflation	-0.004	-0.003	-0.003	-0.005	-0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Economic Freedom	0.006	0.008	0.005	0.004	0.008
	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)
_cons	1.875**	1.586**	1.559**	2.405***	1.144
	(0.749)	(0.714)	(0.732)	(0.726)	(0.741)
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes
Time-fixed effect	Yes	Yes	Yes	Yes	Yes
N	6305	6305	6305	6305	6305
adj. R-sq	0.352	0.355	0.353	0.349	0.356

Table 2.7 Robustness test: Subsamples

This table presents the results of regression analyses of the relationship between systemic risk and regulations by using the subsample a.) without countries less than 10 observations in each year b.) the subsample excluded observations of Japan since it counts around 13.88% of the full sample. Detailed definitions of the variables can be found in Appendix. Bank fixed effect and year fixed effects are both included. The standard errors for the regressions are estimated as heteroskedasticity-robust standard errors clustered for banks and are presented in brackets. . *, **, and *** represent statistical significance at the 10%, 5%, and 1% significance level, respectively

	without countries less than 10 observations per year					Without Japan				
	Activity Restriction	Initial Capital Stringency	Prompt Corrective Action	Depositor	Regulation Total	Activity Restriction	Initial Capital Stringency	Prompt Corrective Action	Depositor	Regulation Total
Regulation	0.288**	0.652***	0.328***	-0.074	0.706***	0.249***	0.317***	0.241***	-0.088	0.445***
	(0.114)	(0.112)	(0.095)	(0.071)	(0.134)	(0.090)	(0.083)	(0.079)	(0.061)	(0.105)
MTBV	0.047	0.052*	0.058*	0.047	0.057*	0.092***	0.092***	0.096***	0.090***	0.096***
	(0.029)	(0.029)	(0.030)	(0.029)	(0.029)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
lgTA	-0.188***	-0.195***	-0.168***	-0.215***	-0.140**	-0.066	-0.084*	-0.067	-0.092**	-0.050
	(0.064)	(0.061)	(0.065)	(0.063)	(0.063)	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)
LLP	-0.009	-0.010	-0.009	-0.009	-0.009	-0.009*	-0.009*	-0.009	-0.009	-0.009
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
ROA	-0.005	-0.005	-0.006	-0.006	-0.006	-0.006	-0.006	-0.006	-0.007	-0.006
	(0.006)	(0.007)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
GDP Growth	0.010	0.007	0.013*	0.009	0.013	0.008**	0.006*	0.008**	0.007**	0.008**
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)
Inflation	-0.004	-0.005	-0.003	-0.005	-0.003	0.001	0.001	0.001	0.000	0.002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Economic Freedom	0.025***	0.023***	0.022**	0.022**	0.026***	0.006	0.003	0.005	0.004	0.006
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
_cons	0.906	0.826	0.744	1.396*	0.211	0.892	1.111*	0.811	1.289**	0.624
	(0.768)	(0.734)	(0.751)	(0.750)	(0.750)	(0.648)	(0.634)	(0.649)	(0.637)	(0.646)
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4391	4391	4391	4391	4391	5430	5430	5430	5430	5430
adj. R-sq	0.278	0.285	0.279	0.276	0.283	0.234	0.235	0.234	0.232	0.236

Second, regressions are run to test the relationship between systemic risk and the five variables of bank regulation and supervision based on two subsamples. For the first subsample, we exclude countries with less than 10 observations in each year, and the results are shown on the left side of Table 6. The total observations of Japan account for around 13.88% of the full sample and the predominance of the banks in Japan may bias our results. So we run the regressions after dropping banks in Japan from our sample. Results of regression analyses with the subsample of excluding Japan are presented on the right side of Table 2.7. All regressions include year and bank fixed effects. Our main findings still hold for both subsamples.

Third, we employ an alternative measure of systemic risk, namely SRISK, to assess the relationship between bank regulation and systemic risk. Brownlees and Engle (2017) introduce SRISK to measure an individual financial institution's contribution to the systemic risk. SRISK is concerned with the capital shortfall of a firm conditional on a severe market decline, and is a function of its size, leverage and risk. Specifically, SRISK measures how much capital the financial institution would need in a crisis time to maintain a given capital-to-assets ratio. The measure can readily be computed using balance sheet information and an appropriate LRMES (Long Run Marginal Expected Shortfall) estimator. Following previous studies such as Brownless and Engle (2016) and Berger et al. (2019), we measure SRISK based on the following equation:

$$\begin{aligned} SRISK_{i,t} &= E_{t-1}(\, Capital\ Shortfall_i | Crisis) \\ &= E_{t-1}(k(Debt_i + Equity_i) - Equity_i | Crisis) \\ &= kDebt_{i,t-1} \\ &\quad - (1-k)\big(1 - LRMES_{i,t}\big)Equity_{i,t} \end{aligned} \tag{2.5}$$

where k is the capital requirement, and we set k =8% in this research. $LRMES_{i,t}$ is the long-run marginal expected shortfall at time t for bank i, defined as the decline in equity values conditional on a financial crisis. Higher value of SRISK indicates greater contribution of systemic risk.

We run the baseline regression by using SRISK as the systemic risk measure. The results are reported in Table 2.8. Overall, the results are consistent with the main results. We find that the coefficients for *Activity Restriction*, *Initial Capital Stringency*, *Prompt Corrective Action* and *Total Regulation Index* are still significantly positive, suggesting that the stringency of regulation and supervision have a positive impact on banks' systemic risk as measured by SRISK. Besides, we also find weak evidence show that the regulation stringency of depositor protection is negatively related to systemic risk. As we argued in the previous section that the impact of depositor policies should have both positive and negative impact on bank systemic risk. Therefore we observe no significant on the coefficient between the *Depositor* and systemic risk because these effects are cancelling off each other. While the weak result find is this section may suggest that the negative impact of depositor protection on systemic risk tends to be stronger, and this may result from different measures of systemic risk. However, such results is not consistent across the overall tests.

Table 2.8 Alternative measure of systemic risk: SRISK

This table reports the panel regression results of the estimation of different regulations and systemic risk measured by SRISK from 35 countries for the period from 2001 to 2013. The dependent variable is the systemic risk measure by MES. Control variables include *MTBV, lgTA, LLP, ROAA, GDP Growth Inflation and Economic Freedom*. Detailed definitions of the variables can be found in Appendix. Bank fixed effect and year fixed effects are both included. The standard errors for the regressions are estimated as heteroskedasticity-robust standard errors clustered for banks and are presented in brackets *, **, and *** represent statistical significance at the 10%, 5%, and 1% significance level, respectively.

	(1) Activity Restriction	(2) Initial Capital Stringency	(3) Prompt Corrective Action	(4) Depositor	(5) Regulation Total
Regulation	0.581***	0.279***	0.212*	-0.239*	0.561***
	(0.205)	(0.098)	(0.114)	(0.130)	(0.196)
MTBV	-0.044	-0.047	-0.045	-0.051	-0.040
	(0.040)	(0.041)	(0.041)	(0.042)	(0.040)
lgTA	-0.152	-0.213	-0.193	-0.222	-0.159
	(0.149)	(0.150)	(0.154)	(0.151)	(0.154)
LLP	-0.037	-0.036	-0.035	-0.036	-0.036
	(0.028)	(0.028)	(0.028)	(0.028)	(0.029)
ROA	-0.025***	-0.025***	-0.025***	-0.025***	-0.025***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
GDP Growth	-0.007	-0.010*	-0.008	-0.009	-0.008
	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)
Inflation	0.012*	0.011*	0.012*	0.011	0.013*
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Economic Freedom	-0.026***	-0.033***	-0.032***	-0.033***	-0.029***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
_cons	2.600	3.618*	3.388*	3.903**	2.788
	(1.847)	(1.887)	(1.949)	(1.913)	(1.940)
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes
Time-fixed effect	Yes	Yes	Yes	Yes	Yes
N	5510	5510	5510	5510	5510
adj. R-sq	0.002	0.002	0.002	0.002	0.002

2.4.4 Heterogeneity effects

In previous sections, we present results of our main regression analyses and robustness tests, showing that stringent regulation and supervision can increase systemic risk through greater capital shortfall. In this section, we conduct further empirical tests to support our arguments by looking at three interaction terms.

First, we argue that if the greater capital shortfall results in an increase in systemic risk, the effect is likely to be amplified for larger banks since larger banks may need a higher level of capital to smooth their shortage which may lead to systemic instability. It is probably more difficult for larger banks to raise sufficient capital during hard times as they could experience a larger capital gap compared with small banks. Hence, we introduce the interaction term between regulatory variables and bank size measured by the logarithm value of their total assets. The results are presented in Panel A of Table 2.9.

Table 2.9 Heterogeneity effects

This table reports the panel regression results of the estimation of different regulations and systemic risk measure by MES. In Panel A, we introduce the interaction between the bank size measured by lgTA and regulation stringency level. In Panel B, we introduce the interaction between the bank regulation stringency and Equity-to-Assets ratio. In Panel C, we introduce the interaction between the bank regulations and bank diversification. The standard errors for the regressions are estimated as heteroskedasticity-robust standard errors clustered for banks and are presented in brackets. . *, **, and *** represent statistical significance at the 10%, 5%, and 1% significance level, respectively.

	(1)	(2)	(3)	(4)	(5)
Panel A:	Activity Restriction	Initial Capital Stringency	Prompt Corrective Action	Depositor	Regulation Total
Regulation	-1.216***	0.290	-1.594***	-1.229***	-1.936***
	(0.376)	(0.355)	(0.306)	(0.356)	(0.385)
Regulation*lgTA	0.148***	0.008	0.194***	0.121***	0.249***
	(0.038)	(0.038)	(0.033)	(0.037)	(0.040)
lgTA	-0.182***	-0.116**	-0.236***	-0.151***	-0.216***
	(0.050)	(0.048)	(0.051)	(0.045)	(0.051)
_cons	2.158***	1.351**	2.448***	1.827***	2.257***
	(0.646)	(0.611)	(0.628)	(0.587)	(0.635)
Other Control Variables	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effect	Yes	Yes	Yes	Yes	Yes
N	6305	6305	6305	6305	6305
adj. R-sq	0.272	0.270	0.275	0.269	0.277
	(1)	(2)	(3)	(4)	(5)
Panel B:	Activity Restriction	Initial Capital Stringency	Prompt Corrective Action	Depositor	Regulation Total
Regulation	0.292***	0.564***	0.424***	-0.045	0.705***
	(0.110)	(0.119)	(0.110)	(0.087)	(0.133)
Regulation × Equity/Assets	-0.008	-0.018**	-0.019***	-0.004	-0.024***
	(0.007)	(0.008)	(0.007)	(0.006)	(0.007)
Equity/Assets	0.005	0.010*	0.014**	0.001	0.013***
	(0.005)	(0.006)	(0.006)	(0.004)	(0.005)
_cons	1.226*	1.129*	1.102*	1.594**	0.850
	(0.671)	(0.660)	(0.661)	(0.657)	(0.668)
Other Control Variables	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effect	Yes	Yes	Yes	Yes	Yes
N	6305	6305	6305	6305	6305
adj. R-sq	0.268	0.271	0.270	0.267	0.271

Continue:

Panel C:	(1) Activity Restriction	(2) Initial Capital Stringency	(3) Prompt Corrective Action	(4) Depositor	(5) Regulation Total
Regulation	0.206**	0.356***	0.273***	-0.108*	0.529***
	(0.100)	(0.108)	(0.079)	(0.064)	(0.123)
Regulation*Diversification	-0.014	0.017	-0.180***	0.045	-0.273*
	(0.107)	(0.204)	(0.047)	(0.053)	(0.163)
Diversification	0.021	0.012	0.192***	-0.003	0.160*
	(0.030)	(0.069)	(0.047)	(0.023)	(0.087)
_cons	1.371**	1.358**	1.239**	1.672***	1.018*
	(0.598)	(0.588)	(0.590)	(0.588)	(0.596)
Other Control Variables	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effect	Yes	Yes	Yes	Yes	Yes
N	6296	6296	6296	6296	6296
adj. R-sq	0.267	0.270	0.269	0.266	0.270

We find a significant and positive coefficient of the interaction between bank size and *Activity Restriction, Prompt Corrective Action, Deposit Insurer Power* and *Regulation Total*, respectively, indicating that the positive effect of bank regulation on systemic risk is amplified for large banks. It supports our main argument that stringent regulation and supervision can increase banks' systemic risk through their potentially greater capital shortfall. Although we observe that the coefficients of regulatory variables turn negative after including the interaction between bank size in the regression. If we take the mean of *LgTA* 9.322, the total effects of regulation on systemic risk still stay positive. Our argument is still held.

Second, if the increase in banks' systemic risk is due to their greater capital shortfall, we would expect that such an impact is likely to be alleviated for banks which hold more capital as capital can absorb the potential loss and thereby reduce capital shortfall. To validate this hypothesis, we introduce the interaction between regulatory variables and *Equity-to-Assets ratio*. The results are presented in Panel B of Table 2.9. Overall, we observe that the interaction terms are significant and negative (except the interaction between *Activity Restriction /Depositor* and *Equity-to-Assets ratio* which are insignificant), indicating that the positive impact of regulation on systemic risk will be reduced if banks hold more capital. These results support our assumption that bank regulation increases systemic risk through banks having greater capital shortfall.

Last, if the capital shortfall is the channel through which regulation and supervision increase systemic risk, we would expect that diversification of banks can alleviate such impact. First, based on the portfolio theory, the combined cash flows from non-correlated revenue sources should be more stable than the constituent parts (Baele et al. 2007). If banks can maintain stable income flows, the likelihood of suffering capital shortage will be lower. In addition, diversification also provides more choices for banks to raise capital. In other words, banks who succeed in diversifying their business lines tend to have more channels to raise capital when they meet capital shortage, and thereby tend to be safer compared to their counterparts who rely on onefold source. We then introduce the interaction between regulatory variables and *Diversification* which is measured by non-interest income divided by total operating

income. If our argument holds true, we would expect a negative relationship between the interaction term and the dependent variable in the regression models. Panel C of Table 2.9 shows the results of this heterogeneity test. We observe that the coefficients of interaction terms are negative and significant in columns (3) and (5). These results suggest that the positive influence of regulation and supervision on systemic risk can be alleviated for better diversified banks, which is consistent with our earlier expectation. Overall, our heterogeneity tests provide further evidence to support our main argument that stringent regulation and supervision can increase systemic risk and such an impact is likely to occur through intensified capital shortfall.

2.5 Conclusions

There has been increasing interest in academic research on bank regulation and supervision since the financial crisis of 2007-2009. However, the theoretical debates on whether bank regulation and supervision can help to maintain financial stability remain open due to limited evidence on the relationship between bank regulation and systemic risk. Hoque et al. (2015) argue that the correlation in the risk-taking behaviour of banks is much more relevant than the absolute level of risk that individual banks take. The paper aims to investigate how some specific types of bank regulation and supervision affect individual banks' systemic risk across countries. Based on a new database developed by Barth et al. (2013a), we provide robust evidence on the impact of bank activity restriction, capital requirements, official supervision and deposit insurer power on systemic risk in 65 countries during the period 2001-2013. We also develop a *Total Regulation Index* based on the four specific regulation variables in order to examine the combined effect of regulatory and supervisory policies.

We find that more stringent regulation and supervision lead to higher systemic risk. Specifically, countries with more restrictions on bank activities, higher initial capital stringency or stronger prompt correction power tend to suffer from higher systemic risk. We also find that the *Total Regulation Index* is positively related to the systemic index measure, confirming that increased systemic risk is more likely to happen in a stringent regulatory and supervisory environment. This is consistent with our expectation based on the view that systemic risk can be defined as the capital

shortfall of a financial institution conditional on a severe market decline (Acharya et al. 2017; Brownlees and Engle 2017) and a bank is more likely to have capital shortfall when it is in an environment with more stringent regulation. To address the potential endogeneity issue, we employ Basel II staggered implementation across countries as exogenous event and use latitude for Instrument Variable analysis. Our findings appear to be robust after employing WLS to control the potential effect of unbalanced panel data, regressing on subsamples and using alternative systemic risk measure. We also provide further evidence by examining interaction effects. By interacting regulatory variables with bank size, equity-to-asset ratio and diversification, we find the positive impact of bank regulation and supervision on systemic risk would be amplified if the bank is large, but reduced if the bank holds more capital and has a diversified income flow.

Our findings contribute to the limited understanding of the association between bank regulation and systemic stability, and have important implications for governments and regulators. Since the financial crisis of 2007-2009, we have seen a growing awareness of the need for a macroprudential approach to regulation (Arnold et al. 2012). Governments in different countries have introduced a variety of regulatory and supervisory policies to regulate the banking industry and manage the financial cycle. However, these stringent regulations have potential drawbacks. They may indeed decrease banks' standalone risks but fail to look at the correlated risks they take. Our findings show that, opposite to what governments and regulators have expected, stringent regulatory and supervisory policies result in less systemic stability, although such effect could be alleviated by the banks having a greater level of equity.

Our paper has important implications for policymakers. Despite the significant policy reforms introduced after the financial crisis, there have been increasing concerns on whether regulatory mechanisms designed according to stringent regulatory and supervisory policies, such as activity restrictions, based only on the perspective of individual bank risk, are effective in reducing the probability of systemic crises. Indeed, the "utopian" objective function of policymakers, that is, to maximize the expected value of a constrained social welfare function (Kane, 1980), has been long questioned due to influence of politic forces. Kane (1980) argues that effective policy control has three elements: policy instruments, intermediate policy

targets and policy goals. To achieve long term policy goals, it is important for policymakers to have appropriate intermediate policy targets that can be tracked closely and are based on theoretical and empirical predictions. In this sense, timely empirical studies on the impact of bank regulation and systemic risk are in dire need. Our findings suggest that the currently designed tight regulation appears to have effects opposite to the expectations of governments. In order to sustain the stability of banking, regulatory and supervisory mechanisms should be designed based on inter-bank correlation. This is consistent with other researchers' call for prudential regulation that operates at a collective level (Acharya 2009).

Chapter 3:

Doing Good For Borrowing? Evidence from a Quasi Natural Experiment on Bank Deregulation

3.1 Introduction

What drives Corporate Social Responsibility (CSR)? Understanding the determinants of CSR is important because CSR helps to establish companies' social capital (Sacconi and Antoni, 2010) and trust among stakeholders (Lins et al., 2017). The answer to this question is closely related to other important questions on how CSR affects firm value. "Shareholder expense" and "shareholder value maximization" are the two competing theories. The empirical evidence is also inconclusive, partly because most existing literature fails to identify the causality relation between CSR and firm value. Several recent empirical studies using a natural experiment in India find that mandatorily increased CSR activities will lead to a significant drop in firm value (Manchiraju and Rajgopal, 2017; Dharmapala and Khanna, 2018), which supports the view that firms voluntarily choose CSR levels to maximize firm value, and an enforcement on CSR may trigger negative responses from the markets.

In this paper, we present evidence that firms involuntarily engage in CSR activities under certain pressure, and consequently reduce their CSR engagement when such pressure is removed. Specifically, we examine how firms change their CSR activities in response to the reduction in financial constraints due to exogenous change in the lending market. If firms are under pressure from banks to conduct CSR activities, i.e., involuntarily "doing good" for borrowing, we would expect their CSR levels to be decreased once their financial constraints are reduced.

Asymmetric information can cause external financing costly and difficult (Sharpe, 1990; Sufi, 2007). As a complement of firm information disclosure, CSR performance provides a new information stream beyond traditional financial statements. Socially responsible firms are shown to be linked with more transparent and reliable financial information, and a lower likelihood of subjecting to regulatory investigation (Spence, 1973; Benabou and Tirole, 2010; Kim et al., 2012). Empirical researches find that firms behave in CSR are rewarded externally, e.g. better external financing, lower financing cost and improved competitiveness (Cheng et al., 2014; Goss and Roberts, 2011; Flammer, 2015). However, the engagement in CSR activities can be involuntary when there is strong demand from the external environment (Cao et al., 2019). The involuntary choice to spend resources on CSR essentially results in

an underinvestment and social welfare loss. Once the external pressure on CSR is alleviated permanently, firms will reduce CSR levels significantly.

Empirically, we exploit the staggered deregulation of interstate bank branching laws in the United States. The Interstate Banking and Branching Efficiency Act (IBBEA), which allowed unrestricted interstate banking, was passed by the U.S. Congress in 1994. The deregulation process varied from different states and lasted until 1997 when IBBEA was formally legalized across the country. Rice and Strahan (2010) find that more bank branches were opened and competed with one another due to IBBEA. Existing evidence suggests that this increase in competition expands the availability of credit within a state, lowers the cost of capital therein and increase access to bank financing (Krishnan et al., 2015; Rice and Strahan, 2010). As such, we conjecture that before IBBEA, firms in the U.S. tend to be captured by banks who have exclusive lending relationship due to lack of competition. Firms have strong incentives to invest more in CSR to please the lending banks, and such incentives will then be reduced after the enforcement of IBBEA, which alleviates financial constraints for these firms, especially external-finance-dependence firms.

We construct the tests using this deregulation event as the plausibly exogenous increases in the credit supply of state-level finance. For CSR measure, we employ an improved measure introduced by Carroll et al. (2016) which is called D-SOCIAL-KLD index. Compared to traditionally CSR measure - KLD index, this measure uses the same underlying dataset rather than simply adding up the binary indices, thus offering a more reliable comparison of firms. Besides, the new measure differentiates firms that have identical scores on an additive scale by treating every underlying CSR indicator differently. Empirical tests show that firms in the states that are completely open to interstate branching decrease by 0.32, which is about 11% of the median level of CSR performance, after the branching deregulation compared to those in the states with the most restrictions on interstate branching. This result is robust in analysis controlling for firm-level characteristics, state fixed effect, year fixed effect, and different sample period.

Although the staggered deregulation of interstate bank branching laws provides the plausibly exogenous changes to banking competition, there may exist a pre-

existing trend of firms' CSR change, which is parallel to the bank deregulation change. To address this potential concern about reverse causality, we examine the dynamic effect of interstate banking deregulation on firms' CSR performance. We do not find any pre-existing trend in the changes in firm CSR performance prior to deregulation. The decrease in CSR performance occurred on the year of bank deregulation, suggesting the effect is immediate. Further, such a decrease in CSR performance after the deregulation continues to remain statistically significant for at least five years after the banking deregulation, with an increasing magnitude over time.

Another potential endogeneity of our results is that an omitted variable coinciding with the branching deregulation could be the true underlying cause of the change in CSR performance. If this is the case, the change in CSR before and after the banking deregulation may reflect merely an association rather than a causal effect. To address this concern, we conduct a placebo test. We employ a falsified deregulation year and randomly assign it to different states. Therefore, if an unobservable shock happens at approximately the same time as the deregulation events, it should show a great impact on the testing framework and drive similar results. On the contrary, if no such shock exists, our artificial deregulation to the assigned but randomly chosen states should yield insignificant results in the baseline regression. Indeed, we cannot find a significant result from this placebo test, which indicates that it is unlikely that an omitted variable unrelated to the branching deregulation drives the decrease of CSR performance. Therefore, our strategy of using staggered banking deregulation across states should be exogenous to the decreasing CSR performance.

Next, we attempt to rule out an alternative explanation on bank relationship lending for our main findings. While the bank deregulation leads to a reduction in firm financial constraints, it may also result in a change in bank's lending methods. Banks tend to rely more on "soft information", i.e., relationship lending prior to the deregulation. Post-deregulation, banks would shift to more "hard information", i.e., transactional lending due to large bank's entry. If CSR performance were used by firms to signal their long-term focus and differentiate themselves to increase transparency (Spence, 1973; Benabou and Tirole, 2010), they may have more incentives to do so prior to the deregulation when relationship lending dominates, and these incentives will be reduced under the transactional lending method. Above all, it is their "hard

information" shown in financial balance sheets that matters more after the deregulation. If the true mechanism is through relationship lending channel rather than financial constraints, we would expect this effect to be stronger for the states with more relationship lending prior to the deregulation. It is empirically challenging to measure the two different lending methods over the two periods. As such, we focus on the role of small banks in different states and assume that small banks rely more on "soft information" (Deyoung et al.,2004) while large banks rely more on "hard information" (Elyasiani and Goldberg, 2004). We fail to find that the CSR reduction effect is more pronounced in the states with more small banks after the deregulation, which is against this alternative explanation.

Finally, we provide direct evidence on the channel of financial constraints through which firms' CSR activities are reduced after the bank deregulation. We would expect that the effects of the bank deregulation on firm CSR levels become more intensified for firms more external-financial-dependence. We first use three proxies to measure the level of external-financial-dependence level: firms age, WW index and SA index (Barrot, 2016; Whited and Wu, 2006; Hadlock and Pierce, 2010; Cornaggia et al., 2015). On top of that, we conduct an additional test conditional on firm's financial strength, including firm size, leverage, cash holding, payout and collateral (Barrot, 2016). All the results confirm our predictions.

This paper contributes to the research on finance and economics in several ways. We provide a clean setting on the exogenous increase in banking competition caused by regulations and show firms significantly reduce CSR activities afterwards. This is the first paper linking firm CSR with financial environment related to the lending market. Goss and Roberts (2011) investigate the impact of CSR performance on the cost of bank loans and suggest that banks charge more for loans to firms with social responsibility activities concerns but do not reward firms with CSR strengths. Hong et al., (2012) argue that goodness is costly and goodness is a complement to profits, and firms do so only when they have financial slack. We provide evidence that firms more susceptible to capture by banks exhibit a more pronounced decrease in CSR when such capture is dismantled by IBBEA. The exogenous event with IBBEA in the lending market allows us to reveal that banks with market monopolistic power may cause firms to invest excessively in CSR. Once banks' market monopoly power

disappears, firms will make optimal decision in CSR by suppressing excessive investment. The evidence suggests that CSR is socially inefficient in uncompetitive markets.

Our paper provides new empirical results to support recent studies on CSR. Although there are a growing number of studies on why firms engage in CSR activities (Barnea and Rubin, 2010; Cespa and Cestone, 2007; Elfenbein et al., 2012; Jensen, 2001), most researchers either consider CSR from shareholder view (Friedman, 1962) or stakeholder interest (Jones, 1995). Flammer (2015a) provides evidence viewing "CSR as a competitive strategy" and finds that the product market competition affects CSR performance. These papers emphasize that CSR is the outcome of managerial decisions related to incentives or corporate governance. Differently from the literature on the economic role of CSR to maximize firm or stakeholder value, we consider CSR as a strategical investment caused by the firms' financial constraints due to lack of competition in banking. One related paper is Dharmapala and Khanna (2018) that analyses CSR activity using quasi-experimental variation created by Section 135 of India's Companies Act of 2013.[1.] Indian firms used to invest more than 2% prior to the Act but decreased their CSR spending after the Act coming into effect. In this sense, CSR needs to be studied in the joint consideration of managerial incentives, corporate governance and regulatory environment. The evidence in this paper suggests that CSR serves as "doing good for borrowing" when firms operate in an uncompetitive lending market facing bank capture.

The rest of paper is organized as follows. Section 2 reviews relevant literature in bank deregulation and CSR, and develop the hypothesis in section 3. Section 4 summarizes the data, variable constructions and sample statistics. Section 5 reports the main regression results and discusses their implications. Section 6 concludes the paper.

3.2 Literature review and hypothesis development

To derive the theoretical predictions on the firms CSR performance and the impact of external lending market development, we draw from different strands of the

[1] The Act requires firms satisfying specific size or profit thresholds spend a minimum of 2% of their net profit on CSR.

literature. We begin this section by introducing the background of the bank deregulation and the research on the real effect and consequence of the deregulation. Next, we discuss the nature of CSR and how CSR activities may be affected by some exogenous shock. In the end, we put forward two contradictory predictions based on the reviews and discussions made in this section.

3.2.1 The Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994 (IBBEA)

The McFadden Act which passes in 1927 prohibit interstate branching banking, therefore, U.S. banks could only operate within one state. From 1978 to 1994, several states allow bank holding companies (BHC) to own commercial banks across state borders (interstate banking) while interstate branching was not allowed. During the same period, some states repealed the unit banking laws and other intrastate restriction within the state. Until 1994, with the passage of the Riegle-Neal Interstate Banking and Branching Efficiency Act, which effectively permitted BHC to enter other states without permission and to operate branches across state lines and allowed the transition to full interstate banking. However, IBBEA gave permission of nationwide branching, it also allowed the individual state to have flexibility over the restriction or limitation of interstate branching. States could use the provisions contained in IBBEA to erect barriers to some forms of out-of-state entry, to raise the cost of entry, and to distort the means of entry. From the time of implementation in 1994 until the branching trigger date of June 1, 1997, IBBEA gave states to employ various manners to erect these barriers.

Rice and Strahan (2010) summarize regulations on interstate branching with regard to four important provisions: (1) the minimum age of the target institution. This means states are allowed to set their own minimum age requirements with respect to how long a bank must have been in existence prior to its acquisition in an interstate bank merger, with a maximum age limitation of 5 years. Many states set this age requirement at 5 years, but several states implemented a lower age requirement, like 3 years or less, or required no minimum age limit at all. (2) de novo interstate branching. De novo interstate branching means a bank may only open a new interstate branch if the state set this requirement under IBBEA. A de novo branching rule subjects existing

banks to more new competition by out-of-state institutions by making it easier for an entering bank to locate its branches in markets with the greatest demand for financial service. Without de novo branching, entry into a particular out-of-state market becomes more difficult as it is only possible via an interstate whole-bank merger, and it also potentially distorts or limits the entering bank's choice of where to locate within the state. (3) the acquisition of individual branches. This indicates that an interstate merger transaction may involve the acquisition of a branch (or a number of branches) of a bank without the acquisition of the whole bank, only if the state in which the branch is located permits such an acquisition. Different from being required to enter the market by purchasing a whole bank, an entering bank can instead pick and choose those interstate branches which it wants to acquire. With this permission, the entry cost for interstate banks decreases. (4) a statewide deposit cap. Under IBBEA, each state is authorized to cap, by statute, regulation or order, the percentage of deposits in insured depository institutions in the state that is held or controlled by any single bank or BHC. IBBEA specifies a statewide deposit concentration limitation of 30% with respect to interstate mergers that constitute an initial entry of a bank into a state. While a state is flexible to set the concentration limitation to above 30% or to impose a deposit cap on an interstate bank merger transaction below 30% and with respect to initial entry. This requirement would be to prevent a bank from entering into a large interstate merger in the state. For example, if a state set a deposit cap of 15%, a bank could not enter into an interstate merger transaction with any institution that holds more than 15% of the deposit in that particular state. (Rice and Strahan 2010) employ these four state powers to build a simple index of interstate branching restrictions, ranging from zero which proxies the most open to out-of-state entry to four which proxies the least open state. The state deregulations have continued and the restrictions on interstate branch of each state revised since 1997. This regulatory shock provides excellent quasi-natural experiment to study the effects of banks on the real economy. As the changes happened at different time across the state, the impacts may be seen in the different state economies.

3.2.2.1 Deregulation and Bank Performance

The bank deregulation significantly increases banking competition and efficiency. For example, Jayaratne and Strahan (1998) find that bank performance improves significantly after restrictions on bank expansion are lifted. Specifically, the

operating costs and loan losses decrease sharply after states permit statewide branching and, to a lesser extent, after states allow interstate banking. They explain that improvement after interstate branch deregulation is because better banks grow at the expense of their less efficient rivals. Branching restrictions also reduce the performance of the average banking assets. Most of the reduced cost were passed along to bank borrowers in the form of lower loan rates. Johnson and Rice (2008) first summarize the interstate branching regulation changes and analysis the empirical association between the restrictiveness and out-of-state branch banking entry. They show that states with greater restrictions have fewer interstate branches as a share of total branches. The reduced protection of competition for inefficiency local banks by allowing more efficiency banking organizations to enter, consequently improve bank output. However, evidence found in Jiang et al. (2019) suggest that an intensification of competition exert a negative effect on liquidity creation per bank assets. Specifically, regulatory induced competition decreases liquidity creation more among banks with less risk-absorbing capacity, such as less profitable banks. In additional, Goetz et al. (2013) suggest geographic diversity intensifies agency problems by making it more difficult for outside investors to monitor a BHC and exert effective corporate control. The increases in geographic diversity due to interstate bank deregulation reduced BHC valuations. More lending by BHCs to the executives of their subsidiary banks and an increase in nonperforming loans drive the drops in the valuations.

3.2.2.2 Deregulation and Industry Firms

There is a cluster of empirical researches on the geographic bank branching deregulation and its effects on nonfinancial firms. Black and Strahan (2002) test whether the deregulation fostered competition and consolidation of in banking helps or harms entrepreneurs. They find that the rate of new incorporations increases following deregulation of branching restrictions and that deregulation reduces the negative effect of concentration on new incorporation. Besides, the formation of new incorporations increases as the share of small banks decreases, indicating that diversification benefits of size outweigh the possible comparative advantage small banks may have in forging long-term relationships with borrowers. When the banking market becomes more open to competition, the banking industry has experienced nationwide consolidation and a consequent decline in the importance of small banks. Overall, consolidation and the associated decrease in small bank market share tend to

help entrepreneurs. Similarly, Cetorelli and Strahan (2006) examine how competition affects the market structure of nonfinancial sectors. The empirical evidence found in this study suggests that in markets with concentrated banking, potential entrants face greater difficulty gaining access to credit than in markets in which banking is more competitive. The competition reduces the size of the typical establishment. Better bank competition also increases the share of establishments in the smallest size group and increases the total number of establishment. While the increased competition shows no effect on the largest establishments. Consistent with these findings, Kerr et al. (2009) takes a further step and examine entrepreneurship and creative destruction following the banking deregulation. They find the exceptional growth in entrepreneurship but also business closures, and most closures are the new ventures themselves. The banking deregulation causes a greater firm turnover. They argue that creative destruction requires many business failures along with the few great success, and highlight the importance of democratizing entry which is a key feature of a well-functioning capital market.

Rice and Strahan (2010) construct the IBBEA deregulation index to exploit the effect on small business finance. The differences in states' branching restrictions affect credit supply. In states more open to branching, small firms borrow at interest rates 80 to 100 basis points lower than firms operating in less open states. Besides, firms in open states are better access to bank financing. Although the interstate branch openness expands credit supply, there is no evidence shows that state restrictions on branching on the number of small firms borrowing. Overall, the study suggests that decreased cost and improved access to bank financing is positively related to the state branch openness. The increased access to bank financing created by banking deregulation also positively affect firm productivity. As suggested in Krishnan et al. (2015), greater access to financing benefits firms total factor productivity significantly, especially the financially constrained firms, allowing them to invest in productive projects that they may otherwise have to forego. The increased bank competitive following deregulation intends to affect investment differently in terms of firms' age. Given the greater competition among banks, Zarutskie (2006) finds that newly formed firms (i.e. aged five years or less) used significantly less outside debt financing and more external financing from their equity holders and internal financing (i.e. retained earnings) to fund investment. At the same time, newly founded firms also invest less, suggesting that greater banking competition increased financial constrained for these

firms. On the contrary side, for older firms (i.e. aged 16 or more) used more outside debt financing and invested more when bank competition increase. But, overall, the total economic impact of increased bank competition following the bank deregulation on the borrowing and investment of privately held firms was likely positive. Jiang et al. (2020) suggest the deregulation intensified competition among banks reduced corporate risk, especially among firms which heavily rely on bank financing. Since the enhanced competition eases credit constraints when firms experience adverse shock and reduce the procyclicality of borrowing, consequently reduce corporate volatility.

Several studies connect the bank deregulation and its impact on firm innovation, while the results of empirical studies are somewhat mixed. Amore et al. (2013) suggest interstate banking deregulation significantly benefit the quality and quantity of innovation activities, especially for firms highly dependent on external capital and located closer to entering banking. The explanation for this result is because of the greater ability of deregulated banks to geographically diversify credit risk. Chava et al. (2013) find that intrastate banking deregulation increases the local market power of banks, which leads to a decrease in the innovation level and risk of young, private firms. However, interstate banking deregulation which decreased the local market power of banks increased the level and risk of innovation by young, private firms. These results further confirmed in Cornaggia et al. (2015). They find that innovation increases among private firms, especially for the one dependent on external finance and the one have limited access to credit from local banks. They argue that banking competition enables small, innovative firms to secure financing instead of being acquired by public corporations. Hence, greater bank competition reduced the supply of innovative targets, which reduces the portion of state-level innovation attributable to public corporations. However, Hombert and Matray (2017) show that the deregulation exerts a negative shock to relationship lending, which reduced the number of innovative firms, especially those that depend more on relationship lending, such as small, opaque firms. This is because that the credit supply shock created by deregulation leads to reallocation of inventors whereby young and productive inventors leave small firms and move out of geographic areas where lending relationships are hurt. Deregulation increased access to credit for non-innovative firms, but lead to further tightening of financial constraints for innovative firms, particular for small ones.

3.2.2.3 Deregulation and Economic Environment

Another strand of bank deregulation studies examines the impact on the overall economic environment. Jayaratne and Strahan (1996) show that financial markets can directly affect economic growth with the relaxation of bank branch restrictions. The rates of real, per capita growth in income and output increase significantly following intrastate branch reform. They argue that these changes in growth derive from the changes in the banking system. Specifically, the improved quality of bank lending instead of the increased volume of bank lending is the reason for faster growth. Morgan et al. (2004) investigate how the integration of bank ownership across state induced by bank deregulation affect economic volatility within states. Deregulation allows bank holding companies operating banks across many states, therefore a much more integrated banking system. This helps stabilize growth fluctuation within states and reduce divergence between states. In the end, state business cycles become smaller but more alike. In conclusion, deregulation reduces economic growth fluctuations. Beck et al. (2010) assess the impact of bank deregulation on the distribution of income. They find that the intensified bank competition and improved bank performance result from the deregulation materially tightened the distribution of incomes by boosting incomes in the lower part of the income distribution. While such impact is less significant on incomes above the median. Bank deregulation tightened the distribution of income by increasing the relative wage rates and working hours of unskilled workers, therefore reduces the income inequality.

3.2.3 Corporate social responsibility and firm behaviours

In recent years, a significant increase in academic research devoted to the exploration of potential links between CSR and firm behaviours. CSR activities not only affect investing stakeholders such as stockholders and debtholders but also non-investing stakeholders such as customers, community, social organizations and so on (Mcwilliams and Siegel, 2001). At the same time, according to the resource-based view, firms need inputs or resource to generate CSR attributes. For example, capital, material and service and labour. However, existing researches show mixed results on the relationship between CSR and firm behaviours.

3.2.3.1 CSR and CSR outputs

Many studies exploit the benefits and costs of CSR activities and contribute to the investment implication for socially responsible investments. Albuquerque et al. (2019) model CSR as an investment to increase product differentiation that allows firms to benefit firm higher profit margins. By formalizing and testing a channel through which CSR policies affect firms systematic risk and value, they find CSR decrease systematic risk and increase firm value that these effects are stronger for firms with high production differentiation. They argue that customers who are more important stakeholders than investors in determining firms' CSR policies. More detailed tests have been undertaken in Buchanan et al. (2018), which examines how CSR jointly with influential institutional ownership affect firms value around the 2008 global financial crisis. They find that the effect of CSR on firm value variable with the level of influential ownership and depends upon economic conditions. Specifically, compare with non-CSR firms, CSR firms have higher firm value before the financial crisis but experience more loss in firm value during the crisis. This result indicates that the overall CSR effect depends on the two effects: conflict-resolution and overinvestment effect. Besides, in terms of the level of influential institutional ownership, CSR positively affects the value of lower institutional ownership firms and the effect is significantly weaker for firms with higher influential ownership before the crisis. While during the crisis, the CSR-firm value relation is positive for higher institutional ownership firms, indicating that overinvestment concerns dominate when the crisis occurs. But such a positive institutional ownership effect is not significant for CSR firms with high rollover risks. Similarly, Cornett et al. (2016) focus on banks and examine the relation between banks' CSR and financial performance in the context of the 2007 global financial crisis. In general, banks appear to be rewarded for being socially responsible as financial performance (i.e. ROE) is positively and significantly related to CSR score. Compare with smaller banks, the biggest banks pursue socially responsible activities to a significantly greater extent. Also, these largest banks significantly increase their CSR strengths and decrease CSR concerns after the crisis.

There are several studies dedicatedly examine how CSR activities affect firm performance in controversial industries. Cai et al. (2012) specifically examine CSR engagement of firms in controversial industries and document a positive association with firm value. These results support the value-enhancement hypothesis and are

consistent with the premise that the top management of U.S. firm in controversial industries, in general, considers social responsibility important even though their products are harmful to human being, society, or environment. Similarly, Jo and Na (2012) examine the relation between CSR and firm risk in controversial industry sectors. They find that CSR engagement inversely affects firm risk. Specifically, the effect of risk reduction through CSR engagement is more economically and statistically significant in controversial industry firms than in non-controversial industry firms. Overall, these evidence further support the argument in Cai et al. (2012) that top management of U.S. firms in controversial industries is risk-averse and their CSR engagement helps their risk management efforts.

Another strand of literature focus on how CSR affects firms' financial behaviours. Cheung (2016) examines the relation between CSR and firm cash holdings. This study finds that CSR is correlated with corporate cash holding significantly and positively. Furthermore, the study document that the systematic risk channel is a major channel through which CSR affects corporate cash holdings. It explains that price-inelastic demand due to customer loyalty and/or investor loyalty to CSR firms makes these firms less sensitive to aggregate market shocks (i.e., lowers the systematic risk), and this may increase or decrease the cash holding. The need for cash holding may decrease because of lower systematic risk, while the need may increase because firms with lower systematic risk tend to have a shorter debt maturity structure and therefore a higher refinancing risk. The findings in this study support the latter view and rule out another two channels, namely the idiosyncratic risk channel and the corporate governance channel through which CSR affects corporate cash holdings. Dutordoir et al. (2018) examine whether CSR creates value for seasoned equity issuers (SEO) and document a positive association between CSR performance and stock price reaction to SEO announcements. However, they argue that high CSR scores can mislead shareholders into attributing value-increasing motives to seasoned equity issues. Specifically, they find seasoned equity issuers with high CSR scores tend to have a higher post-SEO increase in cash holding, and lower investment in real assets, than issuers with lower CSR scores. Also, high-CSR issuers have worse post-SEO operating and stock price performance than low-CSR issuers. Bhandari and Javakhadze (2017) investigate the relationship between CSR strategies and firm-level resource allocation efficiency, suggesting CSR can distort investment sensitivity to Q. They show that the relation between Q and investment is weaker for high CSR firms.

Moreover, the distortionary CSR on investment sensitivity to Q is stronger for firms with imperfectly aligned shareholder-manager incentives. While stakeholder engagement and financial slacks can alleviate the relation that CSR reduces external finance sensitivity to Q. In the end, they provide evidence to show that CSR can reduce both accounting and stock-based future corporate performance. Overall, the authors argue that focusing on aggregate CSR strategy may impose costs to a firm in the form of foregone investment opportunities that in the long run is manifested in the loss of shareholder wealth.

Firms' CSR performance can affect their access to external finance. Goss and Roberts (2011) examine the link between CSR and bank debt, focusing on banks exploits their specialized role as delegated monitors of the firm. They find that firms with social responsibility concerns face a higher loan spread than more responsible firms. Banks are more sensitivity to CSR concerns and regard concerns as risks, responding with less attractive loan contract terms. While in terms of discretionary CSR investment, low-quality borrowers that engage in discretionary CSR spending face higher loan spreads and shorter maturities, while there is no difference among high-quality borrowers. Similarly, Cheng et al. (2014) find that firms with better CSR performance face significantly lower capital constraints. The negative relation between CSR performance and capital constraints can result from better stakeholder management and transparency around CSR performance which consequently reduce capital constraints. Barigozzi and Tedeschi (2015) model how CSR of banks impacts the lending behaviours. Lenders offer loans to standard and motivated borrowers who undertake ethical projects (i.e. projects with both social and economic profitability but lower expected revenue) or standard projects. The ethical banks are lenders who commit to financing only ethical projects and are not interested in operating in markets for standard projects. While standard banks have no restriction on the types of projects which they can support. Their models suggest that motivated borrowers are keen to invest in ethical projects and to deal with ethical banks. When these lenders and borrowers are both active, ethical banks can increase social welfare because the matching of ethical lenders with motivated borrowers reduces the frictions caused by the agency issue.

Firms' CSR performance can also affect investors evaluation directly or indirectly. Elliott et al. (2014) use an experiment to investigate how investors value a firm fundamental value conditional on the firm's CSR performance. Their results support the perdition: when CSR performance is positive (negative), investors who do not explicitly assess CSR performance will estimate the firm's fundamental value to be higher (lower), but the influence of CSR performance will diminish with an explicit assessment of CSR performance. The results support the theory "affect-as-information" that firm's CSR performance can create unintended influence on investors' behaviours. Cho et al. (2013) suggest CSR disclosure can reduce information asymmetry, either CSR concerns or strengths. While the influence of negative CSR performance is much stronger than that of positive CSR performance in reducing information asymmetry. Moreover, the negative association between CSR performance and bid-ask spread decreases for firms with a high level of institutional investors compared to those with a low level of institutional investors, indicating that informed investors may exploit their CSR information advantage. In addition, Kim et al. (2012) suggest that socially responsible firms also behave in a responsible manner to constrain earnings management, thereby delivering more transparent and reliable financial information to investors as compared to firms that do not meet the same social criteria. Taken together, the results suggest that CSR performance plays a positive role for investors by reducing information asymmetry and that regulatory action may be appropriate to mitigate the adverse selection problem faced by less-informed investors.

3.2.3.2 CSR and CSR Input

On the contrary, CSR can be regarded as investment output, which can vary upon different conditional. However, many of previous studies fail to disentangle whether better financial conditions lead to superior CSR performance or vice versa, and whether firm's financial performance and CSR engagement are both respond to variables omitted from the estimation model. Campbell (2007) provides a theoretical study of CSR consisting of a series of propositions specifying the conditions under which corporations are likely to behave in a socially responsible way. The study proposes two conditions, i.e. economic conditions and institutional conditions impact firms' CSR engagement. Many studies argue that CSR is a product of financial conditions. For example, Hong et al. (2012) argue that financial constraint is an important factor to drive corporate social responsibility activities. The results found in

this study show that during the Internet bubble, previously constrained firms experience a temporary relaxation of their constraints and their goodness temporarily increased relative to their previously unconstrained peers. On top of that, a constrained firm's sustainability score increases more with its idiosyncratic equity valuation and lower cost of capital than a less-constrained counterpart. Overall, firms are more likely to engage in CSR activities when they have enough resource. Consistent with the resource-based view, Sun and Gunia (2018) suggest that firms condition their CSR policies on the availability of economic resources by employing a firm's real estate as a measure of exogenous shocks on the firm's economic resource. They find that increases in resources reduce CSR concerns and decreases in resources increase CSR concerns, while such relationship between resources and CSR concerns depends on several organizational variables that influence a firm's preferences for CSR investment. Besides, they show that firms reactions for resources availability tend to be asymmetric that the resource losses increase CSR concerns are more markedly compare to resource gains. Overall, these evidence imply that firms employ CSR decision in much the same way as other investment decisions.

Several papers examine the influence of corporate governance mechanisms on CSR. Cheng et al. (2013) use the 2003 Dividend Tax Cut as an exogenous shock which increases after-tax insider ownership. In this study, they find that increasing managerial ownership decreases measures of firm goodness. Specifically, firms with moderate levels of insider ownership cut goodness by more than firms with low levels (where the tax cut has no effect) and high levels (where agency is less of an issue). On top of that, better monitoring also reduces corporate goodness that passage of shareholder governance proposals leads to slower growth in goodness. Taken together, these evidence show that improvements in managerial incentives and governance lead to a reduction in firm goodness, which supports the view of agency theory of unproductive corporate social responsibility. Consistent with the view of agency theory on CSR, the work conduct by Adhikari (2016) examine this relation through external monitoring channel. Adhikari (2016) suggests that firms with greater analyst coverage tend to be less socially responsible. Analyst coverage can influence CSR activities via analysts' influence on the value of managerial ownership and discretionary spending. The results imply that CSR is a manifestation of agency problem and that financial analysts curb such discretionary spending by discipline managers.

Another view of CSR engagement argument that treats CSR as an investment strategy which rewards firms in turn. Flammer (2015b) shows product market competition affects CSR by employing a quasi-natural experiment provided by a large import tariff reductions that occurred between 1992 and 2005 in the U.S. manufacturing sector. The study finds that domestic companies respond to tariff reductions by increasing their engagement in CSR. This funding supports the view of "CSR as a competitive strategy" that allows companies to differentiate themselves from their foreign rivals. The study highlights the importance of trade liberalization, which is an important factor shapes CSR practices.

Firms with different ownership structure will have different incentives for engaging CSR activities. Abeysekera and Fernando (2020) study the differences in policy toward CSR between family and non-family firms, showing that family firms are more responsible to shareholders than non-family firms in making environment investments. When shareholder interests and societal interests are consistent, there is no difference between family firms and non-family firms in protecting shareholder interests. However, when the interests diverge, i.e. the environmental investment only benefit society but not shareholders, family firms protect shareholder interests by undertaking a significantly lower level of such investment than non-family firms. This finding implies that lack of diversification by controlling families creates strong incentives for them to act in the financial interest of all shareholders, which more than overcomes any noneconomic benefits families may derive from engaging in social causes that do not benefit non-controlling shareholders.

3.2.4 Hypothesis development

A cluster of studies in finance examines the impact of the deregulation on banks and the spillover effect on firms. Prior to the interstate deregulation, interstate bank branching was not allowed until the passage of the Interstate Banking and Branching Efficiency Act of 1994 (IBBEA). IBBEA effectively permitted bank holding companies to enter other states without permission and to operate branches across state lines. The deregulation increases competition/consolidation of banks and reduces the share of small banks at the state level (Black and Strahan, 2002). The competition in local banking markets also affects the market structure of non-financial

sectors, as the consequence of the bank expansion, the rate of new incorporation increases (Black and Strahan, 2002). Potential entrants in markets with concentrated banking face greater difficulty gaining access to credit than in markets in which banking is more competitive (Cetorelli and Strahan, 2006). Furthermore, firms in states more open to branching enjoy a lower interest rate than firms operating in less open states; firms in open states are more likely to borrow from banks (Rice and Stranhan, 2010). Also, banking competition fosters the innovation and business productivity especially for small firms, which benefited from the greater credit supply provided by banks (Krishman et al, 2014; Cornaggia et al, 2015).

Current research argues that financial condition is a key factor impacting CSR performance. According to the resource-based view, firms must devote resources to generate CSR characteristics (Mcwilliams and Siegel, 2001; Waddock and Graves, 1997; Johnson and Greening, 1999). The resources include capital, materials and services, such as special equipment and machinery. Human resource is also needed to implement policies and manage practices which are relevant to CSR. Previous studies suggest that firms' financial performance is positively related to CSR activities (Campbell, 2007). Empirical findings in Hong et al. (2012) suggest that financially constrained firms do less CSR activities and their goodness will be temporarily increased once their financial constraints were temporarily relaxed. The IBBEA deregulation served as an exogenous shock to bank competition, which increases the credit supply and provides firms with greater access to external bank financing. If firm's CSR performance is positively associated with the spare resources they have, firms should be more likely to invest in CSR when the financial resource are relaxed due to the increase in credit supply. Therefore, we have the following prediction:

***H_a**: The IBBEA deregulation has a positive impact on firm CSR.*

On the other hand, based on the profit-maximizing view, CSR is treated as a strategical investment that is used to meet corporate strategical needs. Firms engaging in CSR activities are likely to be rewarded since CSR can be used to differentiate themselves from competitors (Mcwilliams and Siegel, 2001; Campbell, 2007; Flammer, 2015). (Flammer 2015a) suggests that CSR as a product differentiation strategy for domestic firms to compete against their foreign rivals, which responds to

the tariff reductions that increase competition in the local market. Besides, better CSR performance indicates more transparency, lower level of informational asymmetry between firms and investors, and lower the likelihood of negative regulatory, legislative, or fiscal action. For example, (Goss and Roberts 2011) find that lower CSR performance firms face higher loan spreads and shorter maturities. Cheng et al., (2014)find that firms with better CSR performance face significantly lower capital constraints. However, a recent study by (Dharmapala and Khanna 2018) suggest that when the rewarding of CSR activities is not held the same level as before, firm's voluntary engagement in CSR activities will reduce. The Section 135 of India's Company Act of 2013 requires firms who meet specific size or profit thresholds to spend a minimum of 2% of their net profit on CSR. Their study finds that for firms initially spending less than 2% increase their CSR activity after the implementation of the act. In the setting provided in our paper, when the banking market is less competitive, firms are more likely to be captured by banks. Firms are induced to engage in CSR activities to differentiate themselves from their peers to gain better access to finance. However, with the bank deregulation, more availability of credit supply eases the bank financing access, rendering firms less likely to be captured by banks. Therefore, we have the following prediction which is contradictory to the previous one:

***H_b**: The IBBEA deregulation has a negative impact on firm CSR.*

3.3 Sample selection and summary statistics

3.3.3 Data

To assess the effect of branch deregulation on CSR performance, we gather data on the timing of deregulation from (Rice and Strahan 2010). CSR performance index is obtained from Carroll et al. (2016), firm and banking specific characteristics are from the Compustat. We merge these three datasets and keep observations only when consolidated data is available. We further restrict our observation with available data throughout the IBBEA deregulation, although several states further deregulated banking sectors after 1997 by removing the barriers set before. To enrich our sample's observation firms with available data throughout the further deregulation are also included. We exclude all financial industry firms (SIC from 6000 to 6999). The total

number of observations in the baseline analysis is 4,696 with 364 unique companies from 1994 to 2009[2].

3.3.4 Measure of CSR

We derive our CSR measure from Carroll et al. (2016). Previous researchers have suggested several measures for CSR performance, and the most used one is Kinder, Lydenberg, Domini, & Co. (KLD) index. This dataset includes more than 80 binary indicators across eight broad dimensions related to CSR, including the environment, community, human rights, employee relations, diversity, product attributes, governance and involvement in controversial business issues, etc. KLD refers to indicators as 'strengths', which proxies social responsibility, and other indicators as 'concerns', which proxies social irresponsibility. From 1991 to 2000, the dataset covers only those firms in the S&P 500 and Domini 400 Social index. From 2001 onward, KLD expanded its coverage to include all firms that were among the 1,000 largest in the United States. In most cases, researches construct the CSR proxy by subtracting all binary "concerns" index from all binary "strength" index, which is the 'net' KLD index (Cornett, et al., 2016; Goss and Roberts, 2011; Hong and Kacperczyk, 2009), or by adding up all "strengths" or "concerns" index along these dimensions as the proxies (Flammer, 2015; Kacperczyk, 2009). Although these methods have been widely used in academics, some raise questions on the precision of the KLD index. First, constructing the CSR index by using additive indices means each observable is treated as equally weighted, but this may not be true in many cases. Besides, using "net" KLD index fails to provide a valid measure of CSR since the "strengths" and "concerns" lack convergent validity (Mattingly and Berman, 2006). In addition, Entine (2003) argues that KLD Index may lead to bias of firms CSR performance because the differences in different industries are not considered.

A consus is raised by Carroll et al. (2016) with the introduction of an improved measurement technique that treats these observables in test questions with different weights, which is called *D-SOCIAL-KLD* index. They adopt Item Response Theory

[2] Our sample period is shorter than the dataset provide by Carroll et al. (2016) which covers observation until 2012. This is because the Dodd-Frank Act which enacted in 2010 also affected interstate branching requirements. Based on Rice and Strahan (2010), the last recorded interstate deregulation change is Washington in 2005. Therefore, our sample stops in year 2009.

(IRT) model and use the binary KLD dataset to estimate latent traits may be a set of responses to a series of questions or a set of other observed measures. The basic model is presented as follows:

$$\Pr\left(y_{i,j}=1\middle|\,\rho_i,\alpha_j,\beta_j\right)=F(-\alpha_j+\beta_i\rho_i) \tag{3.1}$$

Where i refers to individual respondents, j refers to the items used to assess those respondents. $F(\cdot)$ is typically the logistic or standard normal function, making this specification similar to a logit or probit model when working with binary data. One key difference between the IRT model and the above specification is that there is typically no independent variable with observed data in IRT; rather, it is replaced by the ρ_i term representing ability or another latent trait that the researcher wish to estimate. In other words, the outputs of a basic two-parameter model, ρ_i, are estimates of the latent trait for each individual in the dataset, α_j refers to the estimates for how difficult each item is and β_j indicates how well each item discriminates among individuals.

In terms of corporate decision making in constructing the IRT model, Carroll et al. (2016) employ a model focusing on the utility or benefit which a firm receives from adopting or not a particular CSR-related policy. Specifically, the utility model is presented below:

$$u_{i,j,t}^{d}=-\left|\rho_{i,t}-\tau_{j,t}^{d}\right|^2+\varepsilon_{i,j,t}^{d} \tag{3.2}$$

Where $u_{i,j,t}^{d}$ proxy the utility that firm i obtains from making decision d on observable CSR policy j in time period t. Firm i's utility is a function of its underlying, latent level of CSR which is proxied by ρ_i, the level of CSR reflected in pursuing CSR policy j for all firms $\tau_{j,t}^{d}$ and an error component $\varepsilon_{i,j,t}^{d}$. Therefore, the utility for adopting a pro-CSR policy is a function of how "far" the resulting CSR policy is from

the firm's unobservable level of CSR to reflect the idiosyncratic factors that may also play a role in the firm's decision. Similarly, the utility from not adopting the policy is a function of whether the non-adoption the policy is a function of whether the non-adoption is consistent with the firm's underlying responsibility.

The firm chooses to adopt a policy (*A*) rather than to reject it (*R*) if it receives a higher utility from adoption than rejection.

$$
\begin{aligned}
z_{i,j,t} &= u^{A}_{i,j,t} - u^{B}_{i,j,t} \\
&= -\left|\rho_{i,t} - \tau^{A}_{j,t}\right|^{2} + \varepsilon^{A}_{i,j,t} + \left|\rho_{i,t} - \tau^{R}_{j,t}\right|^{2} + \varepsilon^{R}_{i,j,t} \\
&= \left(\tau^{R}_{j,t}\tau^{R}_{j,t} - \tau^{A}_{j,t}\tau^{A}_{j,t}\right) + 2\left(\tau^{A}_{j,t} - \tau^{R}_{j,t}\right)\rho_{i,t} + \left(\varepsilon^{A}_{i,j,t} - \varepsilon^{R}_{i,j,t}\right) \\
&= \alpha_{j,t} + \beta_{j,i}\rho_{i,t} + \varepsilon_{i,j,t} \qquad (3.3)
\end{aligned}
$$

Where $z_{i,j,t}$ proxies firm i's net benefit for choosing to adopt a policy on observable *j* in time period *d*. This simplified formula shares the same structure as the two-item IRT model. Under the context of firm decision making in corporate social responsibility engagement, $\alpha_{j,t}$is the likelihood that a firm adopts policy *j* at time *t*, given a particular level of CSR. Meanwhile, $\alpha_{j,t}$ increases, all firms are more likely to adopt policy *j* at time *t*. $\beta_{j,i}$ is the discrimination parameter for adopting policy *j* in time period *t*. A positive sign of $\beta_{j,i}$ indicates more socially responsible firms are more likely to adopt policy *j*, while a negative sign suggests more socially responsible firms are less likely to adopt *j*. Therefore, $\alpha_{j,t}$ and $\beta_{j,t}$ both indicate policy-specific characteristics. $\rho_{i,t}$ presents the underlying responsibility for firm i in time period *t*, is the model's sole assessment of the firm's latent qualities given the policy-specific qualities.

This approach produces a better measure of CSR performance which offers a more reliable comparison across firms than simply adding up the binary indices. By modelling firm behaviour over time in a single space which accounts for dynamic behaviour, we can make comparisons among firms, or groups of firms over time. Compare with KLD index which simply adding the binary index in an equal-weighted

way, *D-SOCIAL-KLD* index generated from IRT model can be better used in the empirical analysis for (1) making over-time comparisons within a given firm, as the various underlying items can be more or less important in different years while the KLD index does not take into account; (2) making comparison across different types of firms, since the KLD index does not take into consideration that firms in different industries could have different advantages over scoring well on underlying KLD items than others. Specifically, for firms with large number of potentially "offsetting" strengths and concerns, or cluster around the modal zero value. *D-SOCIAL-KLD* index offers a much more nuanced measure of CSR when to make over-time comparisons within a given firm, or across different types of firms. By employing the IRT model and utilizing the KLD dataset, Carroll et al. (2016) generate the ρ value of the unobservable level of CSR for firms over time period from 1991 to 2012. They present 05-95 inter-percentile ranges which are analogous to a confidence interval in frequentist statistics. In our empirical analysis, we use the 50 inter-percentile of ρ value as the proxy for firm's CSR. We derive the dataset of firm-year *D-SOCIAL-KLD* index directly from the website[3] that is now publicly available.

3.3.5 Measure of deregulation and control variables

Banks were not allowed to open interstate branches until the passage of the Interstate Banking and Branching Efficiency Act of 1994 (IBBEA). IBBEA effectively permitted bank holding companies to enter other states and to operate branches across state lines. It was passed in 1994 but states had the discretion to set up their interstate bank branching regulations under the IBBEA any time before 1997 (Krishnan et al., 2015; Rice and Strahan, 2010). Specifically, states could set barriers on interstate branching in terms of four aspects: (1) the minimum age of the target institution; (2) *de novo* interstate branching; (3) the acquisition of individual branches; and (4) a state-wide deposit cap. Following Rice and Strahan (2010), we use these four aspects of state powers to build the *Deregulation* index. We add one to the index when a state removed any of the four barriers as described[4]. Therefore, the *Deregulation* index can

[3] The data is available from http://socialscores.org/

[4] See Rice and Stranhan (2010) for a detailed discussion on the institutional background and the construction of the index.

range from zero to four with zero indicating the most restrictive stance toward interstate entry and four indicating the most open stance toward interstate entry.

In our analysis, we control for a vector of firm-level characteristics that may affect corporate social responsibility performance. Following previous literature (Flammer, 2015; Godfrey et al., 2009), we compute all variables for firm i over its year t. The control variables include Log total assets (the logarithm value of total assets), Leverage (total debt divided by total assets), Cash ratio (cash holding to total assets), Market-to-Book ratio (market value to book value) and ROE (return on equity).

3.3.6 Summary statistics

Table 1 provides the descriptive statistics of the variables used in this research. In Panel A, we report the summary statistics for variables used in regressions. *CSR* is our dependent variable, which is *D-SOCIAL-KLD* index with a mean of 2.759 and standard deviation of 2.743. The key independent variable is the *Deregulation index*, with the average value 1.845, indicating that states on average have nearly two barriers when they open their local markets to outside banks. In terms of control variables, the average size of firm in our sample is around $13 billion and the median size is $3.9 billion. The *Age* of firm is measured as ln (Age+1), and the data of age is the establishment date of the firm and obtained from Loughran and Ritter (2004). In our sample, the average age is 21 years since the establishment date. The average rate of *Relationship Lending* is 5.56%, which is measured by the sum of all bank assets held by banks with total assets below $100 million divided by the sum of all bank assets in the state-year. These figures are similar to previous studies (Cheng et al., 2014; Cornaggia et al., 2015; Flammer, 2015).

In panel B, we present the Pearson correlations for the variables used in this study. First, we observe that the deregulation index is positively correlated with CSR, suggesting firms located in more competitive state tend to have higher CSR performance. Besides, we notice a significant and positive correlation between firms size and CSR(0.7132), indicating that larger firms are more likely to have a better CSR performance. However, the correlation includes limited information of firms and we

next turn to multivariate tests to further examine the relationship between bank deregulation and CSR.

Table 3.1 Descriptive statistics

This table reports summary statistics in Panel A and the correlation matrix in Panel B for the firm-year observations during 1991 -2007 in this paper's sample, including dependent, independent and control variables. The dependent variable is CSR performance and the data comes from Carroll et al. (2016). Deregulation is the index of bank competition level followed by Rice and Strahan (2010). Panel A report the summary statistics of the sample firm Definitions of the variables are in Appendix.

Panel A: Summary statistics

Variables	N	Mean	P50	Sd	P25	P75
CSR	4,696	2.759	2.900	2.743	0.803	4.697
Deregulation	4,696	1.845	1	1.501	1	3
Log Total assets	4,696	8.193	8.280	1.683	7.132	9.413
Leverage	4,696	0.245	0.239	0.173	0.128	0.344
Cash ratio	4,696	0.0775	0.0449	0.0940	0.0158	0.103
MV ratio	4,696	3.505	2.599	16.32	1.632	4.140
ROE	4,696	0.177	0.141	1.913	0.0705	0.218
Age	4,696	2.961	3.091	0.919	2.398	3.555
WW index	4,696	-0.404	-0.414	0.167	-0.471	-0.352
SA Index	4,696	-3.709	-3.513	1.485	-4.771	-2.628
Relationship Lending ($100 million)	4,696	0.0565	0.0312	0.0680	0.0139	0.0718

Panel B: Correlation Metrix

	Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	CSR	1										
(2)	Deregulation	0.191***	1									
(3)	Log Total assets	0.713***	0.082***	1								
(4)	Leverage	0.168***	0.066***	0.266***	1							
(5)	Cash ratio	-0.055***	0.049***	-0.281***	-0.315***	1						
(6)	MV ratio	0.02	-0.011	0.002	-0.023	0.014	1					
(7)	ROE	0.038***	0.026*	0.027*	0.024*	0.015	0.330***	1				
(8)	Age	0.122***	0.106***	0.120***	-0.062**	-0.049*	0.027	-0.001	1			
(9)	WW index	-0.372***	-0.024*	-0.513***	0.032**	0.187***	-0.008	-0.007	-0.072**	1		
(10)	SA Index	-0.122***	-0.132***	-0.080***	-0.022	0.048*	-0.031	0.019	-0.520***	0.021	1	
(11)	Relationship Lending ($100 million)	-0.169***	-0.444***	-0.102***	0.004	-0.144***	-0.014	-0.016	-0.011	0.017	0.061**	1

*** p<0.01, ** p<0.05, * p<0.1

3.4 Empirical results

3.4.3 Empirical strategy

Our main econometric model focuses on the relationship between bank deregulation and corporate social responsibility. The empirical specification we estimate is as follows:

$$Y_{it} = \alpha + \beta Deregulation_{jt} + \delta Z_{it} + Year_t + Firm_i + \varepsilon_{it} \quad (3.4)$$

The independent variable Y_{it} is a measure of corporate social responsibility of firm i located in state j and year t. The variable of interest is $Deregulation_{jt}$, which is the bank deregulation index proxy for state j in year t. The coefficient, β, indicates the impact of bank deregulation level on corporate social responsibility. A positive and significant β suggests that greater deregulation improves the performance of corporate social responsibility, while a negative and significant β means that deregulation exerts a negative effect on corporate social responsibility. Z_{it} is a set of controls that includes *Log total assets*, *Leverage*, *Cash ratio*, *MV ratio* and *ROE*. We control for year fixed effects in $Year_t$ for nation-wide shocks and trends which may potentially influence corporate social responsibility performance, such as economic cycle, national changes in regulations and laws etc. We also control for firm fixed effects in $Firm_i$ for time invariant, unobserved firm characteristics which affect firm's performance on social responsibility. ε_{it} is the error term. We cluster standard errors at the firm level.

3.4.4 Deregulation and corporate social responsibility: baseline results

We report the regression results of specification (1) in Table 3.2. Our interested coefficient is β, which indicates the relationship between bank deregulation and CSR performance. Overall, the results show that bank deregulation is negatively related to CSR performance. Column (1) reports the results of the basic specification of Equation

(1). We find that the coefficient estimate on the bank competition is negative and significant at 1% level. In Column (2), we add a cluster of firm characteristics variables, including *Log total assets*, *Leverage*, *Cash ratio*, *MV ratio* and *ROE*. The magnitude of the coefficient is similar to the results in column (1). The regression analysis suggests that firms located in states which completely open to interstate branching decrease by 0.32, which is about 11% of the median level of CSR performance compare with firms located in states with the most restrictions on interstate branching.

In terms of control variables, we find that larger firms tend to have higher CSR performance. The explanation can be that larger firms tend to have lower average costs for providing CSR attributes than smaller firms but benefit more due to the scale economics and the visibility, thereby have greater incentives to invest on CSR (McWilliams and Siegel, 2000). Besides, we also find firms leverage is positively related to CSR performance. Since CSR disclosure increases the data availability and reduces the informational asymmetry between firms and investors (Cheng et al. 2014). Firms with better CSR performance are easier to attract external financing, thus increase their leverage. These results are consistent with previous empirical researches (Godfrey et al., 2009; Waldman et al., 2006; Cheng et al., 2014).

Table 3.2 Baseline results

This table reports OLS regression estimates for baseline regression. The dependent variables is CSR performance and this measure derives from Carroll et al. (2016). Deregulation is the index of bank competition level followed by Rice and Strahan (2010). Column (1) reports the baseline regression results without any controls, and we include several firm-level characteristic variables as control variables in column (2). Firm-clustered robust standard errors are reported in parentheses. *,** and*** indicate significance level at 10%, 5% and 1%, respectively.

	(1)	(2)
Dependent variable	CSR	CSR
Deregulation	-0.079**	-0.081**
	(0.036)	(0.035)
Log Total assets		0.369***
		(0.112)
Leverage		0.880***
		(0.300)
Cash ratio		0.596
		(0.433)
MV ratio		0.001
		(0.001)
ROE		-0.003
		(0.008)
_cons	0.515***	-2.511***
	(0.078)	(0.869)
Year fixed effect	Yes	Yes
Firm fixed effect	Yes	Yes
N	4696	4696
adj. R-sq	0.674	0.684

3.4.5 Deregulation and the CSR: endogeneity tests

Although the staggered deregulation of interstate branching represents an exogenous shock to banking competition, state-level factors that manifest differently across states could affect the timing of deregulation in different states (Kroszner and Strahan, 1999). To ensure there is no trend before the event date, we next examine the dynamics of the relationship between bank deregulation and CSR. We do this by including a series of dummy variables in the Equation (3.4) to trace out the year-by-year effects of interstate deregulation on the CSR performance. We employ the regression as follows:

$$\begin{aligned} Y_{it} = \alpha &+ \beta_{-4} Deregulation_{j\,t-4} + \beta_{-3} Deregulation_{j\,t-3} \\ &+ \beta_{-2} Deregulation_{j\,t-2} + \beta_0 Deregulation_{j\,t} + \cdots \\ &+ \beta_5 Deregulation_{j\,t+5} + \delta Z_{it} + Year_t + Firm_i + \varepsilon_{it} \end{aligned} \tag{3.5}$$

where i indexed firm, j indexes state and t indexed the year. In specification 3, we replace the deregulation index with dummy variables for each year from four years before to five years after. The deregulation dummy variables, $Deregulation_{j\,t}$ set to one in year t where the state in which firm is located adopts interstate bank branching deregulation brought about by IBBEA and zero otherwise. $Deregulation_{j\,t-n}$ ($Deregulation_{j\,t+n}$) equals to one for state j in the nth year before (after) deregulation. $Deregulation_{j\,t-4}$ ($Deregulation_{j\,t+5}$) includes years up to and including the fourth (fifth) years before (after) bank deregulation. The omitted year in this regression is the year before banking deregulation (t-1), therefore we can estimate the dynamic effect of bank deregulation on the CSR performance relative to the year before deregulation. Similar method has been applied in previous studies (Beck et al., 2010;Chava et al., 2013; Cornaggia et al., 2015).

Figure 3.1 plots the coefficients of *Deregulation* and their associated 95% confidence intervals as represented by the vertical bars of Equation (3.5), which

includes a series of dummy variables corresponding to pre-treatment lead (years up to and including t_{-4} and t_{-2}) and post-treatment lags (t_0,…, t_4, and years t_5 and all subsequent years). We also report the regression results in Table 3. We notice that the coefficients on the deregulation dummy variables are insignificantly different from zero for all the years before deregulation. If bank deregulation caused a change in CSR performance but not vice versa, then the CSR performance in the year before deregulation should be statistically indistinguishable from all other years prior to deregulation. This is exactly what we observe from Figure 3.1, which means the reverse causality is of little concern in our setting. Next, we observe that there is a statistically significant decrease in CSR performance after the bank deregulation, and such decrease continues to remain for at least five years after banking deregulation and the magnitude is increasing over time.

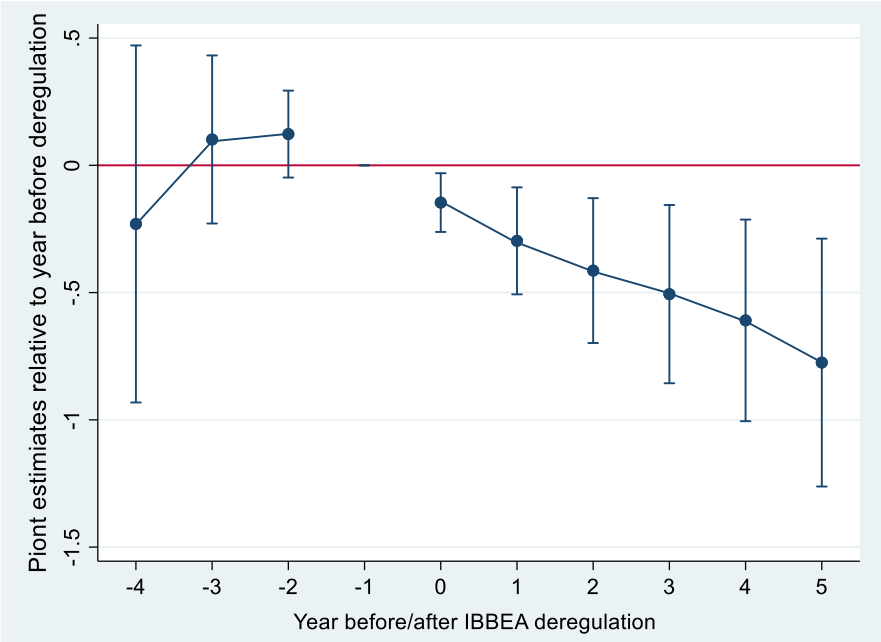


Figure 3.1. The dynamic impact of deregulation on firm CSR

This figure presents the dynamic impact of interstate deregulation on CSR performance. The impact of deregulation on CSR is presented by the connected dots; the vertical bars correspond to 95% confidence intervals with firm-level clustered standard error. All estimates are relative to the year before deregulation. Specifically, we report estimated coefficients from the following regression:

$Y_{it} = \alpha + \beta_{-4}Deregulation_{j\,t-4} + \beta_{-3}Deregulation_{j\,t-3} + \beta_{-2}Deregulation_{j\,t-2} + \beta_0 Deregulation_{j\,t} + \cdots + \beta_5 Deregulation_{j\,t+5} + \delta Z_{it} + Year_t + Firm_i + \varepsilon_{it}$.

Y_{it} is CSR performance measure derives from Carroll et al. (2016) of firm i in year t. $Deregulation_{jt}$ is a dummy variable set to one if the state j in which firm is located adopts IBBEA in in year t and zero otherwise. $Deregulation_{j\,t-4}$ is set to one for years up to and including four years prior to interstate banking deregulation and zero otherwise. $Deregulation_{j\,t+5}$ is set to one for all years five years after interstate banking deregulation and zero otherwise. The omitted variable in this regression is the year before banking deregulation (t-1). $Year_t$ and $Firm_i$ are year and firm fixed effects, respectively.

Table 3.3: Endogeneity test: dynamic results

This table reports the trend in IBBEA deregulation and CSR in the pre-event and post event window. The dependent variables is CSR performance and this measure derives from Carroll et al. (2016). $Deregulation_{jt}$ is a dummy variable set to one if the state j in which firm is located adopts IBBEA in in year t and zero otherwise. $Deregulation_{j\,t-4}$ is set to one for years up to and including four years prior to interstate banking deregulation and zero otherwise. $Deregulation_{j\,t+5}$ is set to one for all years five years after interstate banking deregulation and zero otherwise. The omitted variable in this regression is the year before banking deregulation (t-1). Firm-clustered robust standard errors are reported in parentheses. *,** and*** indicate significance level at 10%, 5% and 1%, respectively.

Dependent variable	CSR
Deregulation $_{j\,t-4}$	-0.230
	(0.357)
Deregulation $_{j\,t-3}$	0.102
	(0.168)
Deregulation $_{j\,t-2}$	0.123
	(0.087)
Deregulation $_{j\,t}$	-0.146**
	(0.059)
Deregulation $_{j\,t+1}$	-0.297***
	(0.107)
Deregulation $_{j\,t+2}$	-0.414***
	(0.145)
Deregulation $_{j\,t+3}$	-0.506***
	(0.178)
Deregulation $_{j\,t+5}$	-0.609***
	(0.201)
Deregulation $_{j\,t+5}$	-0.775***
	(0.248)
_cons	-2.762***
	(0.834)
Control variables	Yes
Year fixed effect	Yes
Firm fixed effect	Yes
N	4696
adj. R-sq	0.686

Another concern that prevents us from drawing a causal interpretation of banking competition on CSR performance from our baseline regressions is the omitted variables problem: unobservable shocks or variables that are omitted from our analysis but coincide with national level deregulatory events could drive our results. To address this concern, we conduct placebo tests to check whether our results disappear when we falsify the deregulation year instead of the actual deregulation year. Following Cornaggia et al. (2015), we randomly assign state into deregulation years according to the empirical distribution provided by Rice and Strahan (2010). By doing so, we can maintain the distribution of deregulatory years from our baseline specification, but it disrupts the proper assignment of deregulation years to states. Therefore, if an unobserved national shock occurs at approximately the same time along with the deregulation, we should still observe a significant result from the regression with falsified regulation years. However, if no such shock exists, then the artificial assigned deregulation year should show insignificant when we run the baseline regression. The results are reported in the column (1) of Table 3.4. We find that the coefficient estimates of *Deregulation* are statistically insignificant.

Overall, the tests above for reverse causality and omitted variables bias support that notion that the increased bank competition due to the branching deregulation has a causal and negative effect on firms' corporate social responsibility performance.

Table 3.4 Placebo test, robustness test and alternative explanation

This table reports OLS regression estimates of baseline with randomized deregulation years. The dependent variables is CSR performance and this measure derives from Carroll et al. (2016). Deregulation is the index of bank competition level followed by Rice and Strahan (2010). Column (1) is the placebo test, we randomly assign state into deregulation years according to the empirical distribution provided by Rice and Strahan (2010). Column (2) report the results of robust test. We include sample from year 1994 to 2005 only and run the baseline specification. Column (3) reports the results of adding additional two control variables: Sales Growth is the percentage change in sales from year t-1 to year t and R&D which measured as the R&D expense scale by sales. Column (4) reports the regression results of interactions between bank deregulation and the level of relationship lending which measures by the percentage of the sum of all bank assets held by banks with total assets below $100 million divide by the sum of all bank assets in the state-year. Firm-clustered robust standard errors are reported in parentheses. *,** and*** indicate significance level at 10%, 5% and 1%, respectively.

	Dependent variable: CSR			
	Placebo test	Sample period: 1994-2005	Additional control variables	Alternative explanation: Relationship Lending
	(1)	(2)	(3)	(4)
Deregulation	0.048	-0.072**	-0.079**	-0.076*
	(0.043)	(0.032)	(0.035)	(0.039)
RL(Relationship lending)				0.555
				(1.340)
Deregulation * RL				-0.197
				(0.596)
Log Total assets	0.365***	0.403***	0.366***	0.368***
	(0.112)	(0.126)	(0.112)	(0.112)
Leverage	0.873***	0.712***	0.921***	0.882***
	(0.299)	(0.270)	(0.306)	(0.300)
Cash ratio	0.545	0.536	0.578	0.592
	(0.433)	(0.436)	(0.435)	(0.433)
MV ratio	0.001	0.002	0.001	0.001*
	(0.001)	(0.001)	(0.001)	(0.001)
ROE	-0.003	-0.013**	-0.003	-0.003
	(0.008)	(0.005)	(0.008)	(0.008)
Sales Growth			-0.025***	
			(0.010)	
R&D			-0.002***	
			(0.000)	
_cons	-2.473***	-2.616***	-2.490***	-2.558***
	(0.867)	(0.982)	(0.868)	(0.882)
Year fixed effect	Yes	Yes	Yes	Yes

Firm fixed effect	Yes	Yes	Yes	Yes
N	4,696	3,459	4696	4,696
adj. R-sq	0.683	0.646	0.684	0.684

3.4.6 Subsample test and additional control variables

Another concern may result from our choice of sample period, which covers the 2007-09 financial crisis period. We hence conduct a robust test to exclude the financial crisis period and keep our sample period from 1994 to 2005. The results are reported in the column (2) of Table 3.4. The significant level and the magnitude of *Deregulation* are almost unchanged compared with the baseline regression results.

Existing studies suggest that firms can condition their CSR engagement on the availability of economic resources (Campbell, 2007; Hong et al., 2012; Sun and Gunia, 2018). Besides, firms' R&D investment can also generate CSR characters which can positively correlate with CSR performance (McWilliams and Siegel 2000; Padgett and Galan 2010). However, more investment in R&D may also reduce the investment in CSR activities. Therefore, to address potential omitted variables issue which can bias our regression results, we add additional control variables to our regression model and conduct a robustness test. We further control firm *Sales Growth* which is the percentage change in sales from year t-1 to year t and *R&D* which measured as the R&D expense scaled by the sales of firm. The results are reported in Column (3) Table 3.4. Consistent with our baseline results, the coefficient and significance level of *Deregulation* is unchanged. However, we observe that the two additional control variables are both negatively and significantly related to CSR. The potential explanation is that firms with higher sales growth rates have less incentive to employing CSR to promoting themselves. While more investment in R&D activities will reduce the available resource to CSR projects, therefore negatively affect the CSR performance. Overall, our baseline results are insensitive to controlling sales growth and R&D in the regression model.

3.5 Alternative explanation

As we argue in the previous sections, the increased competition among banks after the deregulation results in greater credit supply for firms and makes firms less likely to be captured by monopoly banks. However, these results can also be explained from the perspective of relationship lending, that is, reduced relationship lending but increased transactional lending after the deregulation. CSR performance has been

treated as 'soft' information and can represent firm's reputation and reliability to some extent (Brammer and Pavelin, 2006). Under relationship lending, the lender base lending decision in substantial part on 'soft' information, e.g., the information about the character and reliability of the firm. Several studies find that large banks will specialize in standardized loans based on 'hard information', such as financial statement and credit score, while small banks tend to focus on non-standardized relationship-based loans using 'soft' information (Cole et al., 2004; Elyasiani and Goldberg, 2004). The deregulation enhanced competition and consolidation in banking, leading to a decline of small banks (Black and Strahan, 2002), while small banks are the key provider of personalized service and relationships based on soft information (DeYoung et al., 2004). As the consequence, banking organisations grow larger through consolidation after the interstate banking deregulation, less likely to choose to make relationship loans (Berger and Udell, 2002; Uchida et al., 2012). At the same time, the increased competition of banks after the deregulation makes it easier for borrowers to switch lenders, which reduces the incentive to invest in relationships at outset (Black and Strahan, 2002). Under this situation, CSR performance, which has been treated as 'soft' information to build the relationship with lenders, now becomes less impactful in lending negotiations. We thus expect that the reduction of CSR performance following the banking deregulation happens through the channel of the reduction in relationship lending.

To empirically test this conjecture, we employ the following specification:

$$Y_{it} = \alpha + \beta Deregulation_{jt} + Deregulation_{jt} \times RL_{jt} + RL_{jt} + \delta Z_{it} + Year_t + Firm_i + \varepsilon_{it} \quad (3.6)$$

Where *RL* (*relationship lending*) is the percentage of the sum of all bank assets held by banks with total assets below $100 million divided by the sum of all bank assets in the state-year. It represents the likelihood of relationship lending at the state level. If deregulation reduces CSR performance through the channel of relationship lending, we should expect an intensified impact of bank deregulation on firm CSR if the states rely more on relationship lending prior to the deregulation, i.e., we should

observe a significantly positive coefficient of the interaction term between deregulation and share of small banks.

We run the specification (3.6) and the results are reported in column (4) of Table 3.4. We do not find that the interaction term and RL are significant, indicating that the impact of the bank deregulation on firm CSR is independent of the bank lending method. Therefore, these results rule out this alternative explanation.

3.6 Mechanism: How bank deregulation affects CSR performance

In the previous sections, we find that there is a negative relationship between bank deregulation and CSR performance. We conduct a serial of tests to demonstrate that our results are robust. We argue that the increased competition among banks after deregulation create greater credit supply and lax financial constraints of firms, and consequently, firms are less likely be captured by banks and hence engage in less CSR activities. We also rule out the alternative explanation that our results are driven by reduced relationship lending after the bank deregulation. In this section, we provide direct evidence that the channel through which bank competition affects CSR performance is through the reduction of firms' financial constraints after the bank deregulation.

Following previous studies (Barrot, 2016; Cheng et al., 2014; Cornaggia et al., 2015; Hadlock and Pierce, 2010), we adopt three different measures of firm external financial dependence. The first measure is *Age*, measured as the logarithm value of firms age plus one. Older firms tend to be less dependence on external finance. The second measure is *WW index* introduced by (Toni M. Whited and Wu 2006). Higher value of the *WW index* indicates that the firm faces more financial constraints. Lastly, we follow (Hadlock and Pierce 2010) to construct the *SA index* to measure the level of financial constraints, and greater value means greater financial constraints. We employ the following specification:

$$Y_{it} = \alpha + \beta_1 Deregulation_{jt} \times Bottom + \beta_2 Deregulation_{jt} \times Top + \delta Z_{it} + Year_t + Firm_i + \varepsilon_{it} \quad (3.7)$$

Where *Bottom* and *Top* are two dummy variables. *Bottom* (*Top*) equals to one for firm whose external financial dependence level is in the bottom (top) half of the sample distribution at the year before deregulation or zero otherwise in term of the three external financial dependence proxies: i) *Age*; ii) *WW index* and iii) *SA index. Bottom (Top)* indicates firms are more (less) external financial dependent. The coefficient estimate on the interaction term between *Deregulation* and *Bottom (Top)* reflects the different effects of bank competition on CSR performance for companies at different level of external financial dependence. We would expect that firms which are more reply on external financing take more advantage of the greater access to credit after the banking deregulation and thereby decrease significantly of their CSR activities.

We report the results from the regression specification Equation (3.7) in Table 3.5. Overall, we observer the coefficient on the interaction between *Deregulation* and *Bottom* are all significantly negative. Compare to their counterparties, firms which is more external financial dependence tend to reduce their CSR activities by 8.9% to 31.2% as reported from column (1) to column (3) in table 3.5. We observe no significant evidence on less external financial dependent firms, although the coefficients across these three columns of *Deregulation* and *Top* are all negative. These results are consistent with our expectation.

To further support the channel of financial constraints, we conduct an additional test conditional on firm financial strength according to financial ratios (Barrot, 2016). By doing so, we first measure financial strength by ranking firms based on *Size, Leverage, Cash holding, Payout* and *Collateral,* in the year before the deregulation. We follow the same procedure above and run the regression respectively. *Bottom* (*Top*) equals to one for firms in the bottom (top) half of the sample distribution at the year before deregulation or zero otherwise in term of (1) *Size* (logarithm value of total assets), (2) *Leverage*, measured by 1 minus debt to total assets ratio; (3) *Cash*,

measured by cash holding to total assets; (4) *Payout*, measured by cash dividends to cash holding and (5) *Collateral*, measured by the total net property, plant and equipment to total assets. The bottom (top) halves of all these variables represent firms are more (less) financial constrained. We would expect the firms which are more financially constrained before the shock would experience greater decline in CSR performance compared to their less financially constraint counterparties.

Table 3.6 presents the estimation of the effect of the bank competition on CSR performance conditional on the five proxies of financial strength. In general, financially more constrained firms experience 9.5% to 12.6% decrease in their CSR performance. While for financially less constrained firms, they do not experience any decrease in their CSR performance (as all the interaction term between *Deregulation* and *Top* are insignificant). This result further confirms the financial constraints as the channel to explain our main results.

Table 3.5 External financial dependence with alternative proxies: Age, WW index, and SA index

This table report OLS regression estimates the impact of banking deregulation on CSR performance. The dependent variables is CSR performance and this measure derives from Carroll et al. (2016). Deregulation is the index of bank competition level followed by Rice and Strahan (2010). Bottom (Top) is a dummy variable equals to one for firm whose external financial dependence level is in the bottom (top) half of the sample distribution at the year before deregulation or zero otherwise in term of the three external-financial-dependence proxies: i) Age; ii) WW index and iii) SA index. Bottom (Top) indicates firms are more (less) external financial dependent. Firm-clustered robust standard errors are reported in parentheses. *,** and*** indicate significance level at 10%, 5% and 1%, respectively.

	Dependent variable: CSR		
	Age	WW index	SA index
	(1)	(2)	(3)
Deregulation *Bottom	-0.312*	-0.130**	-0.089**
	(0.160)	(0.053)	(0.039)
Deregulation *Top	-0.058	-0.028	-0.050
	(0.036)	(0.041)	(0.072)
Log Total assets	0.389***	0.383***	0.365***
	(0.107)	(0.111)	(0.112)
Leverage	0.843***	0.871***	0.883***
	(0.304)	(0.295)	(0.299)
Cash ratio	0.543	0.582	0.593
	(0.428)	(0.431)	(0.435)
MV ratio	0.001*	0.001	0.001
	(0.001)	(0.001)	(0.001)
ROE	-0.003	-0.003	-0.003
	(0.008)	(0.008)	(0.008)
_cons	-2.620***	-2.597***	-2.482***
	(0.837)	(0.860)	(0.868)
Year fixed effect	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes
N	4696	4696	4696
adj. R-sq	0.686	0.685	0.684

Table 3.6. External financial dependence with alternative proxies: additional evidence

This table report OLS regression estimates the impact of banking deregulation on CSR performance. The dependent variables are CSR performance and this measure derives from Carroll et al. (2016). Deregulation is the index of bank competition level followed by Rice and Strahan (2010). Bottom and Top are dummies, equals one for firms in the bottom (top) half of the sample distribution at the year before deregulation in terms of (1) Size (logarithm value of total assets), (2) Leverage, measured by 1 minus debt to total assets ratio; (3) Cash, measured by cash holding to total assets; (4) Payout, measured by cash dividends to cash holding and (5) Collateral, measured by total net property, plant and equipment to total assets. The bottom (top) halves of all these variables represent firms are more (less) financial constrained. Firm-clustered robust standard errors are reported in parentheses. *,** and*** indicate significance level at 10%, 5% and 1%, respectively.

	Dependent variable: CSR				
	Size	Leverage	Cash	Payout	Collateral
	(1)	(2)	(3)	(4)	(5)
Deregulation *Bottom	-0.103*	-0.117***	-0.095**	-0.128***	-0.126**
	(0.054)	(0.038)	(0.045)	(0.049)	(0.050)
Deregulation *Top	-0.056	-0.034	-0.064	-0.058	-0.047
	(0.041)	(0.054)	(0.046)	(0.043)	(0.044)
Log Total assets		0.365***	0.353***	0.372***	0.371***
		(0.111)	(0.113)	(0.110)	(0.111)
Leverage	0.940***		0.828***	0.853***	0.863***
	(0.327)		(0.295)	(0.296)	(0.300)
Cash ratio	0.204	0.402		0.578	0.597
	(0.438)	(0.430)		(0.435)	(0.431)
MV ratio	0.001	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ROE	-0.003	-0.001	-0.002	-0.003	-0.003
	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)
_cons	0.294***	-2.272***	-2.342***	-2.526***	-2.515***
	(0.106)	(0.848)	(0.874)	(0.859)	(0.866)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes	Yes
N	4696	4696	4696	4696	4696
adj. R-sq	0.677	0.682	0.684	0.685	0.685

Overall, the evidence reported in this section indicates that the reduction of firms' social responsibility after the banking deregulation will be amplified if firms are more financially constrained. These results provide direct evidence that the impact of bank competition on firms' CSR performance works through the credit supply channel.

3.7 Conclusion

A growing literature on CSR attempts to understand CSR activities of firms according to incentives or conflict of interest among stakeholders. One difficulty on this important topic that insiders or managers make endogenous decisions of CSR. We first time show that CSR can be a result of credit market frictions. Banking competition is an important element in a well-functioning capital market to alleviate credit rationing and capture in lending relationship. However, banking competition is not necessarily a natural outcome of the market but often a consequence of regulations. In this research, we study whether bank competition casts any economic effects on CSR performance by exploiting a regulatory change in the banking industry as the exogenous shock to banking competition. This research design allows us to document a causal effect of external banking environment on CSR.

The interstate branching deregulation has led to an increase in competition among banks to supply credit. We employ the exogenous staggered deregulation of state-level branching laws to identify changes in banking competition. The interstate banking deregulation results in a drop of CSR performance at individual firm-level, with the magnitude both economically and statistically important. Our results hold in a serial of endogenous tests and robustness tests, confirming the negative impact of interstate deregulation on CSR is likely causal. To provide further evidence of the channels through which deregulation affect CSR, we test whether firms will react differently conditional on variations in financial constraints level and relationship lending. We show that the deregulation results in the negative change in CSR performance is unlikely to explain by the reduced relationship lending after deregulation. While such negative effects will be amplified if firms are more financially constrained. Our results support the view that firms use CSR as a strategical investment to accessing bank financing when credit supply is likely to be rationed due to lack of competition. The interstate branching deregulation expands access to credit

and relaxes firms' financial constraints, which allows firms to make investments in CSR without "window dressing" themselves to please banks to credit.

There are several important contributions that this paper makes. First, our study highlights that a competitive credit market is important, especially for firms that rely heavily on external financing. Policymakers and regulators should continue to make reforms to dismantle market frictions and enhance competitions in the financial market to increase access to credit. Second, we offer novel empirical evidence to suggest that firms' CSR activities are not socially efficient when borrowers are susceptible to being captured by lending groups. In this sense, CSR needs to be considered jointly with institutional development and financial market frictions.

Chapter 4:

Corporate income tax and investment efficiency

4.1 Introduction

The impact of taxes on corporate investment is the main driving force for government reform strategy which have been used as one of the most important tools to accelerate the domestic economy. The recent Tax Cuts and Jobs Act (TCJA) signed in 2017 which makes a significant change of the corporate tax rate, reducing from 35 percent in 2017 to 21 percent in 2018 and thereafter, intending to stimulate corporate investment and employment. Majority of existing studies are focusing on how the tax policy affects firms' behaviours in terms of investment, financing and payout policies (Fazzari, Hubbard, and Petersen 1988; Hanlon and Heitzman 2010; Ohrn 2018). The theoretical analysis of the effect of taxes on the level of investment well developed, while how the tax incentive affect firm investment efficiency is rarely studied. In this paper, we investigate the effect of corporate tax on investment efficiency by using the staggered changes of corporate income tax across U.S. states from 1990 to 2015.

Under the neoclassical theory framework, the investment is only related to the marginal q ratio which suggests firms will invest until the marginal cost exceeds it return (Abel 1983; Hayashi 1982; Modigliani and Miller 1958; Yoshikawa 1980). However, in the real world, the information asymmetry between insiders and outsider causes capital frictions and therefore distort the investment efficiency, either underinvestment or overinvestment (Fazzari et al. 1988; Myers and Majluf 1984). For example, the capital rationing can result in the capital shortage and firms may need to forego profitable investment opportunities, consequently underinvest. While the agency problem and moral hazard that suggest managers would engage in investment to satisfy their own interests or to achieve personal favoured financial outcomes can also affect the investment quality (Jensen 1986a). For example, the empire building resulting from the agency problem which usually associates with overinvestment.

The corporate income tax charge on the net cash flow to the company increase the investment cost and reduce the after-tax profit. On the other side, because of tax deductibility, firms are motivated to take advantage of tax shelter to reduce the tax burden (Hall and Jorgenson 1967). Prior studies suggest that firms tend to maximize the utility of the tax deductibility by adjusting their investment strategies when they are exposed to tax policy reforms (Gaertner, Lynch, and Vernon 2020; Heider and

Ljungqvist 2015). Given that a firm's investment decision is not only affected by firm specific factors but also the external policy reform, the tax serves as a key incentive to affect firms investment decision. When firms expose to a tax increase, firms expect to higher tax burden but higher tax saving per dollar tax deduction. This indicates that the motivation of taking advantage of tax sheltering increase simultaneously. For firms, the investment decision could be distorted when they considerate the tax benefits through an investment. Besides, managers can reduce the time and efforts in investing when the after tax return decreases (Atanassov and Liu, 2020). In the end, firms can suffer overinvestment issues. While the tax cut brings firms tax cash saving, which serves as an internal financing source for investment. Specifically, firms which experience the financial constraints will benefit most from this additional financing source to support their investment activities. At the same time, tax cut also reduce the required rate of return, consequently more investment options are profitable for firms to choose. With the cash windfall which created by the tax cut and greater range of investment choices, firms are more likely to capture the growth opportunities and therefore reduce underinvestment.

To analyse the impact of tax changes on investment efficiency, we follow recent studies on investment efficiency which is defined as the extent of firm investment deviates from the expected level of investment (Biddle, Hilary, and Verdi 2009; García Lara, García Osma, and Penalva 2016; Kim, Kim, and Zhou 2020). Next, we adopt a difference-in-differences approach by exploiting staggered corporate income tax changes at the US state level over 1990 to 2015 (Heider and Ljungqvist 2015; Mukherjee, Singh, and Žaldokas 2017), and estimating overinvestment and underinvestment respectively based on whether the firm's investment is higher or lower than its expected level of investment. We find that the tax changes tend to affect investment efficiency asymmetrically: the tax increase can aggravate overinvestment while the tax cut mitigates underinvestment. Specifically, with other conditions remaining the same, firms who expose to tax increase exacerbate overinvestment by 0.021 compare to their counterparties with no tax rate change, which represents 14% increase in the mean of overinvestment. For firms experience a decline in their tax rate, they tend to mitigate the underinvestment inefficiency by 0.004, which represents 4.3% decrease in the mean of underinvestment.

The nature of staggered state tax changes provides a clean identification strategy and allows us to disentangle the effect of taxes on investment efficiency from other factors which can affect the investment efficiency as well. Nevertheless, we notice that a fundamental assumption underlying of our empirical identification strategy is that there is a parallel trend in investment efficiency between the treated and control groups without the tax changes. To strength the credit of our empirical identification, we conduct a dynamic estimation to show the changes in investment efficiency around the event time. The results suggest that the pre-treatment trend are actually indistinguishable between treated and control groups. But we can observe the significant differences in their investment efficiency after the tax changes.

Another potential concern which can undermine our baseline results is that the changes of state corporate income tax rate may be triggered simultaneously with other unobservable factors, like local economic conditions, which can be the true reasons affect firm investment efficiency. To address this concern, we exploit the fact that economic conditions are likely to be similar across neighbouring states, whereas the effect of state-level tax policy stops at the state's border. We conduct a falsification test to examine whether firms response to their neighbouring state tax changes while there is no tax change in their home state. The results show that firms' investment efficiency are unlikely to be affected by neighbouring states tax changes, while we continue to find significant impacts of home state tax changes on firms investment efficiency. This evidence implies that unobserved local confounding factors cannot be driving the observed variation in investment efficiency to tax rate change.

To provide further evidence that the effect of corporate tax on investment efficiency is indeed tied to the variation in corporate tax rate, we perform cross-sectional variation among firms in terms of their sensitivity to tax changes. Intuitively, firms who engage more in tax planning imply that they have stronger needs in tax saving and therefore should be more sensitive to tax changes. Following this argument, we show that the treatment effect is stronger for firms which are more aggressive in tax planning. In addition, if firms are less capable to manipulate their taxable incomes, e.g. shifting taxable incomes from high tax jurisdictions to low jurisdictions, they should be sensitive to their home state tax rate changes. We examine this argument by exploiting differences among states tax policies in terms of combined reporting

requirement, which restrict firms' ability to shift taxable profits to lower tax rate jurisdictions. Consistent with our prediction, we find that firm located in states which implement combined reporting requirement shows a stronger response to tax changes. Firms located in states with a combined reporting mitigate (exacerbate) their underinvestment (overinvestment) inefficiency when they expose to a tax cut (increase). Overall, these results not only suggest the relationship between tax changes and investment efficiency varies among firms with different tax sensitivities, but such effect can also be driven by the tax benefits (costs) brought from tax changes.

To support our argument of the baseline findings, we provide further tests to shed light on two channels through which tax changes affect investment efficiency respectively: the financial constraints channel and the agency cost channel. With respect to the financing channel, we argue that the tax cut produces a cash windfall for firms and increase the internal cash flow suddenly, which is a vital source for firms investment activities. We find that the tax cut reduces underinvestment more for firms which are more financially constrained. With respect to the agency cost channel, we argue that the tax increase induces tax motivated investment, and managers tend to make less efforts in investment project selection due to the lower after-tax return, therefore engaging in suboptimal projects. We find that firms with higher agency cost, higher free cash and less monitored by institutional shareholders, exacerbating overinvestment after the tax increase. These evidence consistent with our argument that taxes affect investment efficiency through different channels.

Finally, we conduct a series of robustness tests. We use an alternative measure of investment efficiency by following Chen et al. (2011), which estimate the expected investment as a function of revenue growth; we limit observations only to domestic firms who have no foreign taxable incomes, to address the potential effect of tax policy changes impact firms with foreign subsidiaries; we also add additional state macroeconomic controls in the regression to control the macroeconomic conditions. The impact of tax changes on investment efficiency continues to be held.

Our research contributes to several strands of literature. First, we add new evidence to the growing literature on the determinates of firm-level investment efficiency (Biddle et al., 2009; R. Chen et al., 2017; T. Chen et al., 2017; Cheng et al.,

2013; Choi et al., 2020; Goodman et al., 2014). While the prior literature focuses on how the information asymmetry and agency problem, e.g. the quality of financial reporting and analyst forecasting, can affect firm-level investment efficiency. Our study addresses the effects of external tax policy change which is one of the most important factors that can affect firms investment decision making. Our results show that corporate tax plays an important role which influent investment efficiency in asymmetrical ways: the increase in corporate income tax intend to aggravate overinvestment inefficiency while the tax cut mitigates underinvestment inefficiency. These asymmetric effects of tax changes on investment efficiency indicate that the mechanism underlying the investment efficiency changes can be different. We provide further evidence to show the different channels, the financial constraints and the agency cost, through which the tax changes affect investment efficiency respectively.

Second, this paper adds to the literature on tax policies and firms behavioural response. Previous studies on effects of taxes on corporate policies largely focus on firms' investment choice and economic growth (Blouin et al., 2020; Hall and Jorgenson, 1967; Mukherjee et al., 2017), or the impact on firm value and capital structure (e.g. the trade-off theory) (Heider and Ljungqvist, 2015; Modigliani and Miller, 1958). In this study, we extend this body of work and examine that tax-motivated investments distort firm's efficiency from shareholders' perspective. The recent study which is relevant to ours is the one by Blouin et al. (2020) who examine the impact of tax cut on mergers and acquisition and how it enhances shareholders wealth. The evidence found in their study shows that the tax cuts improve acquisition quality as well as the quantity which is consistent with the predictions of the neoclassical theory of firms and theory of financial constraints.

Our research also has policy implication. The tax reform has become particulate prominent today and the impact of tax reform on firms' behavioural changes draws much of the attention from both government and academia. Existing studies mainly focus on federal level tax reforms which usually bring significant changes to the U.S. tax system. For example, the most recent change made on U.S. tax policy system is the Tax Cuts and Jobs Act (TCJA) signed in 2017 and the Domestic Production Activities Deduction (DPAD) enacted in 2004, which are the most two far-reaching tax legislation since the Tax Reform Action of 1986 (Bennett,

Thakor, and Wang 2019; Gaertner et al. 2020; Lester 2019; Poterba 2004). Actually, the state taxes are a meaningful part of U.S. firms' overall tax burden which account for about 21% of total income taxes paid in Compustat, while there are few studies focus on the state-level tax policies (Heider and Ljungqvist 2015; Ljungqvist and Smolyansky 2018; Ljungqvist, Zhang, and Zuo 2017; Mukherjee et al. 2017). Given the fact that the federal corporate tax reforms which are rare and intend to affect all firms at the same time, state-level tax policy changes are more likely to be exploited by government as a short-term fiscal instrument. Therefore, understanding the real effects and consequence of these general tax changes is important for future tax policy design.

The rest of the paper proceeds as follows. Section 2 provides the hypothesis development of this paper. Section 3 describes the research identification strategy and present the empirical results in Section 4. Finally, Section 5 concludes.

4.2 Literature Review and hypotheses development

In this section, we review relevant literature investigating the influence of tax on corporate investment decisions.

4.2.1 Tax and investment

4.2.1.1 Studies in *q* theory

Back to Modigliani and Miller (1958, 1963) who lay the foundation of a theory of the valuation of firms and shares in a world of uncertainty, an operational definition of the cost of capital and how to use that concept as a basis for rational investment decision making within the firm. They suggest that every project with a positive net present value (NPV) is funded as it arises, and negative NPV projects should be forego. So the key insight is that market valuation should be related to underlying claims to income streams in future and this assumption is built upon a world without frictions. This neoclassical theory of corporate investment is based on the assumption that management seeks to maximize the present net worth of the company, which is proxied

by the market value of the outstanding common shares. Tobin (1969) suggests that the rate of investment is a function of *q*, the ratio of the market value of new additional investment goods to their replacement cost. Following that, Yoshikawa (1980) proves that *q* theory can be derived from a choice-theoretic framework which explicitly takes account of adjustment costs associated with the investment. The study also shows that the *q* theory explains how investment is motivated by the apparent short-run disequilibrium, which the adjustment cost plays a crucial role in the theory. Further, Hayashi (1982) proves the optimal rate of investment as a function of marginal *q* adjusted for tax parameters. Since in the *q* theory, the marginal *q*, the ratio of the market value of an additional unit of capital to its replacement cost, is unobservable. The study proves an exact relationship between marginal *q* and average *q* which can be observed. It suggests that the marginal *q* is relevant to the firm's investment decision should reflect tax rules concerning corporate tax rate, investment tax credit and depreciation formulas. Finally, the marginal *q* adjusted for tax parameters is then calculated from data on average *q* by assuming the actual U.S. tax system concerning corporate tax rate and depreciation allowances.

Starting with Modigliani-Miller's model, researchers examine the impact of taxes on investment decisions. Due to the asymmetrical tax on equity and debt, which provides firm's incentive of choice of financing. Kraus and Litzenberger (1973) and Scott (1976) introduce the "static trade-off theory", which suggests that firm's financial structure is determined by a trade-off between the tax-saving brought from leverage and the financial cost of the enhanced probability of bankruptcy associated with high debt. The higher the tax advantages of debt, the higher the optimal debt-equity ratio. In turn, the higher the non-debt tax shields, the lower the desired leverage. Feldstein and Flemming (1971) use a generalized neoclassical investment function to assess the effects of tax policy on investment in Britain. The results show that both the accelerated depreciation allowances and the use of differential taxation to induce the retaining of corporate profits had substantial and significant impacts on investment behaviours. Sandmo (1974) studies the effect of the corporate income tax on investment incentives. The framework of this study is under the neoclassical theory of investment and capital, which is the firm's optimal use of labour and capital over time derived from the basic criterion of present value maximization. They prove that corporate income tax may distort investment decisions in many ways. For example, the treatment of depreciation, in incomplete interest deduction and in the treatment of

capital gains. Therefore, the corporate income tax may change relative prices in favour of either short-term or long-term capital goods. Summers et al. (1981) present an analysis of the effects of tax policy on capital accumulation and valuation based on the *q* theory of investment. Following Tobin's explanation, the aggregated investment can be expected to depend in a stable way on *q*, the ratio of the stock market valuation of existing capital to its replacement cost. This model connects the stock market to investment which has been examined, but it overlooks the impact of tax policies. In Summers et al. (1981), the effects of tax changes on future profits are used to estimate the impact of those changers on stock market. In turn, the estimations are used as a basis for gauging the impact of the tax changes on capital formation. The results suggest that the most desirable investment incentives are those that operate by reducing the effective purchase price of new capital goods. They maximize the investment and minimize the windfall to corporate shareholders upon tax policy enactment. The increase in the after-tax return to shareholders from a reduction in dividend tax is exactly offset by the increased after-tax cost of retaining earnings. Reducing corporate tax rates has effects in between these extremes. This study also stresses the importance of announcement and time effects of tax changes. The use of investment tax credit or accelerated depreciation stimulates investment will depend on the timing of announcement and enactment. For example, because of the accelerate depreciation, an announced but not yet implemented permanent tax cut will have a larger impact on investment than will a permanent cut that has already been implemented. Bolton et al. (2011) propose a model of dynamic investment and highlight the central importance of the endogenous marginal value of liquidity for corporate decision. Because of the external financing cost, firms' investment is no longer determined by equating the marginal cost of investment with marginal *q*. Instead, investment of a financially constrained firm is determined by the ratio of marginal *q* to the marginal cost of financing. House and Shapiro (2008) use a tax policy reform, the bonus depreciation, to estimate the investment supply elasticity. They find that investment in qualified capital increased sharply. While there is no evidence that market prices reacted to the subsidy, suggesting that adjustment costs are internal or that measurement error masks the price changes. They also argue that for long-lived durable capital goods, even changes in tax policy that last for several years can safely be modelled as temporary. Bonus depreciation appears to be a powerful effect on the composition of investment.

4.2.1.2 Empirical Studies in Tax Reforms

On top of the theoretical studies in tax policies and corporate investment, empirical studies also examine the relationship between tax and investment behaviours. Most of them examine the real effects and consequences of the tax reforms which enact at country level, and how these reforms affect firms investment behaviours, e.g. level of capital investment, merger and acquisition activities, etc.. The literature has argued about whether greater internal capital corresponds to greater investment was driven by relaxing of financing constraints enabling investment that would otherwise have been forgone or whether the higher internal cash flow merely proxied for improvements in investment opportunities beyond the controls in their specification. Beschwitz (2018) studies the effect of cash windfalls on the acquisition policy of companies. The study employs a German tax reform that permitted firms to sell their equity stakes with no tax. This tax reform creates a cash windfall by selling equity states see an increase in the probability of acquiring another company by 14%, but additional acquisitions destroy firm value. Besides, firms which affected by the tax reform shows a lower return in acquisition announcement, and the effects are stronger for greater cash windfalls. Another study on the relationship between corporate tax and investment is conducted by Dobbins and Jacob (2016), which exploit the 2008 tax reform in Germany that substantially cut corporate taxes as an exogenous policy shock and expect domestically owned firms' investment to be more responsive to the reform. The results show a significant increase in real investment of domestic firms after the tax reform, especially for the one who is heavily relying on internal funds or benefit more from the tax reform. These results suggest that tax reform created cash windfall can distort firm's investment decision therefore affect the investment efficiency.

a). Enact of Domestic Production Activities Deduction (DPAD) in 2004

In 2004, the enact of the American Jobs Creation Act (AJCA) draws a lot of attention from academia which is one of the largest U.S. corporate tax expenditure since the 1990s. As a part of AJCA, Domestic Production Activities Deduction (DPAD) which is a corporate tax provision that allows firms to deduct a percentage of their domestic manufacturing income from their taxable income. Dharmapala et al., (2011) show that repatriation did not increase domestic investment, employment, or R&D,

even for firms that appeared to be financially constrained to lobby for the holiday. Instead, they find an increase in shareholder payouts. Faulkender and Petersen (2012) use this temporary shock to the cost of internal financing, they examine the role of capital constraints in firms' investment decision. The AJCA significantly lowered U.S. firms' tax cost when accessing their repatriated foreign earnings thus the cost of funding domestic investments with internal foreign cash. Because firms own U.S. tax on their foreign earnings only when they repatriate the income, which raises the cost of funding domestic investment with foreign cash. With the pass of AJCA which temporarily reducing the tax cost of repatriating foreign earnings, hopes to increase domestic investment. They find that, on average, there is little increase in investment response to the act. However, for those capital constrained, they do find a significant increase in investment. Different from previous studies which examine the effect of external capital constraints when firms are short of internal funds, they study the changes in the costs of funds that are already internal to firms. They suggest that when the cost of internal capital is not identical for all internal capital, the frictions present a form from allocating its internal capital in the most efficient way is important and need to study. They also highlight the importance of financial theory in the design of tax incentives. Changes in tax rates and rules can change the relative cost of funding sources, and these changes can affect the investment decision of the firm or only change the source of capital used to fund those investments. Government policy that attempts to increase investment must target incentives toward capital-constrained firms. The results found in Faulkender and Petersen (2012) is opposite to Dharmapala et al., (2011). They explain that the different results are attributable to differences in the empirical method. Although both of them adopt a difference-in-differences regression method, the later one differs in how the firms in the sample are classified into treated and untreated groups in the DID regression. Despite these difference, we can still see that tax policy changes definitely can affect firms decision, either on investment or payout policy.

In addition to these two studies in DPAD, Ohrn (2018) find that corporations respond strongly to the DPAD, and corporate income tax rate cuts more generally, by increasing investment and payout and decreasing debt usage. Specifically, a 1 percentage point reduction in tax rates increases investment by 4.7 percent of installed capital, as well as increases payout by 0.3 percent of sales, but decrease debt by 5.3 percent of total assets. The responses to the policy are mainly driven by older, larger

more liquid firms who expose to higher marginal tax rate. These results suggest that lower corporate tax rates and faster accelerated depreciation each stimulate a similar increase in investment, per dollar in lost revenue. Later, Lester (2019) find that DPAD indeed associates with an increase in the amount of domestic investment spending, but this result only holds for domestic only firms. While for multinationals, they claim the tax deduction incentives show an increase in foreign investment spending post-DPAD. One explanation for this delayed investment spending is that firms' are different in their priority in terms of accounting response, they may first engage in income shifting across time and borders. As such activities allow firms to quickly respond to the incentives and reap the maximal tax saving in the first year of DPAD benefit was available. Blouin et al. (2020) study the impact of the DPAD on mergers and acquisitions and the results found in this study is a bit different. DPAD reduces corporate tax rates on income from work or goods made in the US. Their results suggest that both the quality and quantity of acquisition bids by DPAD-advantaged firms increase. The greater quality of acquisition may derive from incremental DPAD benefits, e.g. tax-related synergies. Besides, their results also suggest that financially constrained firms increase their acquisition activity even more than unconstrained firms. All these results support predictions from neoclassical M&A theory as well as the theory of financial constraints, a modest tax rate changes can have substantial effect on acquisition activities and qualities.

b). Enact of Tax Cut and Job Act (TCJA) in 2017

The recent biggest change in U.S. tax system is the Tax Cut and Job Act (TCJA) in 2017 which is the largest gross tax cuts. The TCJA has two key elements: a reduction in the corporate income tax rate from 35 percent to 21 percent; and a one-tax tax holiday that cuts the tax on cash repatriation from foreign subsidiaries from 35 percent to 15.5 percent. The TCJA significant reduces the tax incentive for US corporations to hold cash overseas by reducing tax-related frictions in the operation of their global internal capital market. By employing the TCJA, Bennett et al., (2019) study the effects of tax cut on repurchases, leverage and investment. The TCJA generates tax windfalls through a repatriation tax cut and a corporate income tax cut. They find that the surge of repurchases after the TCJA is driven by the repatriation tax cut but not the income tax cut. And such repurchase effect tends to spill over across multinational

firms on domestic firms' repurchase. Also, investments increase, primarily in response to the income tax cut and especially for capital constrained, low leverage, or profitable firms. Wagner et al. (2018) also examine the relationship between tax cuts and overall market moves. They find that from Trump's election until the TCJA's pass, on those days when high-tax firms outperformed (underperformed) low-tax firms the market tended to move upward (downward). These results point out that taxes are a very important component of firm value.

4.2.1.3 Studies in State Tax Reforms

In addition, there are several studies empirically examine the impact of corporate tax policy and firms responses at the state level. Different from country level tax policy reform, state level tax rate changes provide better identification setting for studies in examining the real effects of tax changes. One key challenge of testing the tax effects on corporate policies is that firm's tax status is often endogenous to its investment strategies. Exploiting country level changes in the income tax rate are usually adopted by researchers. In fact, country level tax changes are rare and usually far between. Moreover, such policy changes usually affect all firms in the economy at the same time, which makes it difficult to find a control group with which to establish a plausible counterfactual. An alternative approach is exploiting cross-country differences in tax policies. This provides a larger number of tax shocks than studies using country level tax changes, while whether firms classified as treated or control are comparable is usually a concern that can undermine the credibility of the empirical setting. One fact draws researchers attention is that U.S. companies pay not only federal income tax but also state income tax. As noticed in Heider and Ljungqvist (2015), state taxes account for about 21% of total income taxes paid in Compustat, which is a key component of the overall tax burden for firms. On top of that, changes in state corporate income tax rate are numerous which are staggered across states and time, lend themselves to a difference-in-differences research design. Such identification setting can disentangle the effects of tax changes from other microeconomic shocks that affect firms' investment decision if the underlying assumptions are satisfied. This approach allows us to establish a counterfactual using control groups that experience similar economic conditions but are not themselves subject to a tax change.

Heider and Ljungqvist (2015) first use state staggered corporate income tax changes to explore taxes' impact on corporate capital structure (non-financial companies). In this study, they identify 43 tax increases in 24 states and 78 tax cuts across 27 states from 1989 to 2011. They find that firms increase long-term leverage by around 40 basis points for every percentage point increase in the tax rate. However, on the other hand, when the tax rate falls, firms are less likely to change their leverage. These results support the dynamic tradeoff model. The explanation for this asymmetrical impact of tax rate changes on firm's capital structure is that the marginal benefit exceeds the marginal default cost and thereby shareholders are better off if they increase leverage. When the tax rate decreases, the marginal cost exceeds the marginal benefits, the firm should reduce its leverage. However, reducing debt would reduce the value of shareholders' option to default; and the value of debt would rise to the point where the firm's current debtholders captured the entire benefit of the reduction in risk. Consequently, shareholders have no incentives to reduce leverage. These results are consistent with the static tradeoff theory suggested. Another work conduct by Faulkender and Smith (2016) also provide empirical evidence to support the tradeoff theory of capital structure by estimating how much variation in tax structure arising from global operations explains the variation in capital structure among U.S. public traded multinational firms. They find that firms do have higher leverage ratios and lower interest coverage ratios when they operate in countries with higher tax rates, which is consistent with tradeoff theory suggested.

Inspired by Heider and Ljungqvist (2015), Mukherjee et al. (2017) examine how the corporate tax rate affects future innovation. Following the empirical setting in Heider and Ljungqvist (2015), they find that an increase in corporate income tax tends to reduce firm's future innovation: taxes affect not only patenting and R&D investment but also new product introductions. Similarly, firms are less likely to respond to their innovation activities to tax cuts. They explain that the decline in after-tax profit from innovation projects lead innovators to reduce o redirect effort, effecting aggregate innovation activities. Also, the increase tax rate raises the leverage level for firms, which is not the favoured form of financing for innovation. Further evidence to show that tax increases lead to a significant number of investors parting with their employers that tax increase induces less innovation and innovators choosing to shift to less innovative activities. Besides, they also find a systematic decline in the riskiness of innovation projects undertaken by firms after tax increase.

Later, Ljungqvist et al. (2017) using the same setting to examine the relationship between corporate income tax and firm risk taking. Income tax affects corporate risk taking since they can induce asymmetry in a firm's payoff. Firms should respond to tax increase by choosing safer projects and thereby reducing the risks they take due to the lower after-tax profit. Absent other frictions, firms should respond symmetrically to tax cut by increasing risk taking. However, higher risk reduces the value of claims held by creditors, for example, by means of debt covenants. Therefore, with frictions, the effect of tax cut on risk taking is likely attenuated for many firms. This study provides evidence to support these arguments: firm affected by tax increase reduces its earnings vitality related to other firms in the same industry that is not subject to a tax change in their headquarter state that year. The main ways in which firms achieve these risk reductions are efforts to shorten their operating cycle, and to fund less risky ways to commercialize their R&D projects. Besides, they also find that the negative effect of tax increases on risk taking is largely driven by firms with a limited ability to offset losses, and asymmetrically reduce risk when their ability to carry back losses is reduced. This study contributes to the tax literature and to the literature on the effects of taxes on corporate policies by documenting that firm-tune their risk profiles when their tax rates change. Also, this study adds a new angle to the literature on corporate risk taking by identifying taxes as an important determinant. Overall, the three studies we discussed above shows that state corporate income tax changes can exert impact on corporate decisions in terms of capital structure, investment decision and also risk taking. Besides, the staggered introduction of state corporate income tax policy changes can be a clean setting to help us to identify the real effect of taxes and its impact on firm's investment decision.

Another work by Atanassov and Liu (2020) examine the impact of tax cuts on innovation using significant decreases of at least 100 points (bps) in the top-bracket state corporate income tax rate. Different from previous studies, this paper identifies the most relevant state to which the tax rate is applied by using the most mentioned state in a firm's 10-K reports instead of the state where the firm headquartered. They find that tax cuts significantly increase the number of patents and citations per patent, and the quality of innovation is affected strongly by changes in taxes. Besides, they also find that tax increases have a negative and significant effect on innovation while the economic magnitude is smaller. They also find that corporate governance, financial constraints, collateral, and tax-avoidance channels capture distinct aspects of the

relation between corporate income taxes and innovation. Different from Mukherjee et al. (2017) which fail to find an effect for tax cuts on innovation, Atanassov and Liu (2020)'s study mainly focus on tax cuts and also examine several previously unexplored mechanism to better understand why tax cuts are an important driver of corporate innovation. In addition, the focus of this study is on innovation output rather than input, demonstrate that both corporate income tax increases and decreases have a significant impact on the quantity and quality of innovation.

Additional to the studies discussed above that examining the impact of state corporate tax on firms responses, Schandlbauer (2017) focuses on the role and significance of taxes for the capital structure decisions of U.S. bank holding companies. The study uses local U.S. state tax increases as a quasi-natural experiment and employs a difference-in-differences estimation approach to compare banks that affected by a tax increase to those that are not affected. It shows that an increase in the local U.S. state corporate tax rate affects the banks' financing and operating decisions. Better capitalized banks raise their long-term non-depository debt once they are exposed to a tax increase. The reason is that the better capitalized banks have the ability to benefit from an enlarged tax shield of debt and therefore offset part of their larger tax expense by increasing their leverage ratio. This result is consistent with Heider and Ljungqvist, (2015). On contrast, less capitalized banks reduce their lending because a higher tax rate increases the tax-adjusted cost of funding, which renders the marginal loan unprofitable and cannot offset part of their larger tax expense via more debt. The paper highlight that the reaction to a tax increase critically depends on the banks' financial strength.

In conclusion, as we discussed above, we can see that corporate income tax intend to affect investment decision, and the impact can through at least through two channels, the incentives in taking advantage of tax and the tax saving/cost generated from tax policy reforms.

4.2.2 Investment Efficiency

4.2.2.1 Agency problem and investment efficiency

In the field of studying investment efficiency, economists have focused on how financial frictions affect investment decisions. For example, Jensen (1986) and Myers (1977) introduce agency problems at various levels of corporate structure, e.g. managerial team, specific claimholders. This shift of attention to agency considerations in corporate finance received considerable support from large empirical literature and the practice of institutional design. Jensen and Meckling (1976) point out that agency costs are as real as any other cost, and incentive problem raises the cost of external finance. Outside financing dilutes management's ownership stake, therefore intensify incentive problem that arises when managers control the firm but do not own it. Later, Myers and Majluf (1984) emphasis the role of information, which management is assumed to know more about the firm's value than outsider investors. They suggest that firms may refuse to issue stock when they need to raise cash to support their investment activities. When the firm's security is underpriced in some conditions, managers will be reluctant to issue securities because raising the cost of external finance. Therefore, they may pass up valuable investment opportunities. Under this situation, managers will find it more attractive to finance investment with internal funds. Both such cases will lead to capital rationing. In Hoshi et al. (1991), they present evidence that information and incentive problems in the capital market affect investment. The moral hazard suggests that the *ex post* incentive problem reduced the amount of capital supplied *ex ante*. For the second case, the information asymmetry suggests an adverse selection problem. Managers will try to sell overpriced securities while being reluctant to sell underpriced securities. Rational investors will in response, increase the cost of capital and decrease the amount demanded. Therefore, in both case, frictions case the reduced amount of external capital supplied to the firm. However, firms who can generate internal cash flow can mitigate such effects, which causes capital investment to be correlated with the availability of internal financing source. Fazzari et al., (1988) suggest that firms that are liquidity constrained, e.g. cannot finance their investment externally, need to rely more on their internally generated funds.

There is a series of studies in investment efficiency with the introduction of the conception of agency cost. Jensen (1986) imply that managers have incentive to grow their firms beyond their optimal size. Although external financing place managers' activities to be monitored and disciplined by capital providers, internal financed projects avoid and therefore allowing mangers to overinvest. Blanchard et al. (1994) provide empirical support for this view. They examine how will firms act when firms receive cash windfall. In perfect financial market, mangers should return the money to the capital suppliers, since this cash windfall does not change the Tobin's q ratio, which means the investment opportunities stay the same. However, the results they find that managers tend to invest in unrelated projects that typically fail. Their results support the agency model of managerial behaviour, in which managers try to ensure the long-run survival and independence of the firms with themselves.

4.2.2.2 Accounting information disclosure and investment efficiency

Recent studies empirically examine the determinates of investment efficiency, standing at the point of accounting information disclosure. These studies acknowledge multiple potential channels such as the reduction in adverse selection costs as well as moral hazard costs. Biddle and Hilary (2006) first examine how accounting quality related to firm-level capital investment efficiency. In this study, they point that capital investment can be correlated with internally generated funds because managers do not return to investors excess cash coming from rent or other assets in place. Following previous studies, which suggests information asymmetry and agency problem both affect firm's investment decision, they put forward the assumption that if managers could commit to revealing all of their private information, then the outsiders would not ration capital. In their study, they suggest that higher quality accounting permitted perfect monitoring and alleviate the agency problem. Therefore, the higher quality accounting reduces the investment cash flow sensitivity at the firm level; such impact is more salient in economies dominated by stock markets than in those dominated by creditors.

Extending the findings in Biddle et al. (2006), Biddle et al. (2009) examine the relationship between financial reporting quality and capital investment efficiency. They suggest that firms with higher financial reporting quality are found to deviate

less from predicted investment levels, and show less sensitivity to macro-economic conditions. These results imply that accounting reporting reduce the frictions, such as moral hazard and adverse selection which impede efficiency investment. Different from previous studies, this study not only examines the how the accounting quality affect the absolute level of firm capital investment, but they introduce a model to measure firm's optimal level of investment, with which we can observe firm's deviation and therefore investment efficiency. Similarly, Chen et al. (2011) examine the role of financial reporting quality in private firms from emerging markets, a setting in which existent researches suggest that financial reporting quality would be less conducive to the mitigation of investment inefficiencies. They reach the same conclusion as in Biddle et al. (2009) that financial reporting quality positively affects investment efficiency. Besides, the positive relationship between financial reporting quality and investment efficiency tend to be amplified in bank financing but less significant in incentives to minimize earnings for tax purpose. This implies that tax incentives also affect investment decisions of firms, especially for private firms that tax consideration is especially important. Gomariz and Ballesta (2014) examine the role of financial reporting quality and debt maturity in investment efficiency by using a sample of Spanish listed companies. Consistent with previous studies in financial reporting quality and investment efficiency, they also document the positive relationship between financial reporting quality and investment efficiency. On top of that, they take a further step to examine the role of debt maturity. Due to the less developed capital market compare with the U.S. or the U.K. and the higher information asymmetry, private debt is the main financial source for Spanish firms. Therefore, banks may play a more important role in monitoring of short-term debt and alleviating capital market imperfections. The evidence shows that shorter debt maturity mitigates both overinvestment and underinvestment. In those firms with lower short-term debt, the financial reporting quality effect on investment efficiency is stronger than for those firms with a higher degree of short-term debt. These results suggest that a substitutive role of financial reporting quality and shorter maturities in reducing information asymmetries and monitoring managerial behaviour to limit expropriation of creditors and minority shareholders. In conclusion, in those firms that present higher financial reporting quality, accounting information may be used to monitor investment inefficiency problems.

To address the potential endogeneity concern in previous studies, Cheng et al. (2013) examine the financial reporting quality and investment efficiency by exploring the disclosed internal control weakness under the Sarbanes-Oxley (SOX) Act. Previous literature, such as Biddle et al. (2009), have already documented a positive relationship between financial reporting quality and investment efficiency. While one concern of the previous studies is that they fail to establish a causal relation for the positive association. In Cheng et al. (2013), they provide more direct evidence for this causal relation by taking advantage of a provision in the SOX Act that requires firms to disclose if they have a material internal control weakness (ICW) in their financial reporting. An ICW suggests that there is an information problem in the firm's financial reporting system. They examine the investment behaviours of a sample of ICW firms surrounding their first disclosure of ICWs. They first find that in the year prior to the first disclosure of an ICW, relative to a control firm with similar financial conditions, financially constrained ICW firms underinvest, while financially unconstrained ICW firms overinvest based on the pooled sample. Next, they conduct a regression analysis and find that after the initial disclosure of material weakness, the investment inefficiency of ICW firms becomes small and insignificant relative to control firms. With further analysis, the result confirms the investment levels of ICW firms are no longer significantly different from those of the control firms with similar financial conditions, and a significant reduction in the investment inefficiency of ICW treated firms. Taken together, these findings suggest that ineffective internal control over financial reporting has a significant adverse impact on investment efficiency. The ICM disclosures lead shareholders and other stakeholders in the firm to increase their monitoring and hence to improve firms' financial quality. And these changes mitigate agency problems such as adverse selection and moral hazard and thereby increase the efficiency of investment.

4.2.2.3 Financial forecasts and investment efficiency

Several studies examine the quality of earnings forecasts which can be used to infer the quality of corporate investment decision. Following the intuition that managers draw on similar skills when generating external earnings forecasts and internal payoff forecasts for their investment decisions, Goodman et al. (2014) find that managers with higher quality in external earnings forecasts make better investment decisions. Forecasting quality is positively associated with the quality of

both acquisition and capital expenditure decision. They suggest that externally observed forecasting quality can be used to infer the quality of capital budgeting decisions within firms. Chen et al. (2017) examine the impact of financial analysts' forecast quality and how it affects corporate investment efficiency. They use the accuracy and dispersion of financial analysts' earnings forecasts a proxy of analyst expertise and quality in making forecasts. They find that high quality forecast is associated with higher investment if the firm is more likely to underinvest or lower investment if the firm is more likely to overinvest, suggesting that forecast quality increase firm investment efficiency. Furthermore, such effects are stronger for firms with higher information asymmetry and lower institutional ownership, which provides support to the information intermediary and monitoring agent explanation for why analyst quality increase investment efficiency. The information and monitoring roles played by financial analysts are not subsumed by other information intermediaries, attributes of information environment of firms, or other governance mechanisms. The results highlight the notion that higher quality of analyst forecast increases the information environment and external monitoring, which in turn increases investment efficiency.

In addition to earnings forecast, Choi et al. (2020) further examine the analysts' capital expenditure forecasts and how it affects corporate investment efficiency. They find that firms with analyst Capex forecasts show higher investment efficiency. Specifically, the effect is stronger when the forecasts are issued by analysts with higher ability or greater industry knowledge. Moreover, the effect of Capex forecasts on investment efficiency varies with the signals they convey about future growth opportunities: positive growth signals are more effective in reducing underinvestment, while negative growth signals are more effective in reducing overinvestment. They also provide additional evidence to show these effects operate at least in part through both a financial channel and a monitoring channel. This study further confirms that analysts' forecasts convey useful information about firms growth opportunities to managers and investors and facilitate efficient investment. Different from the literature on the attributes and effects of analyst earnings forecasts, which focus on cash flow and revenue forecast, Capex forecasts affect corporate investment efficiency by serving as an informative signal about the quality of firms' investment. This provides insights on a relatively new and underexplored analyst research output which can also affect firm investment quality.

4.2.2.4 Accounting attitudes and investment efficiency

Related literature exploits the accounting feature as an attribute of the financial reporting system that moderates managers' desire to engage in investment decision which to satisfy self-interests. García Lara et al. (2016) suggest that conservatism improves investment efficiency. Accounting conservatism imposes more stringent verifiability requirements for the recognition of economic gains relative to losses which improve investment efficiency by reducing managerial overinvestment. On the one side, conservatism mitigates underinvestment among firms facing financing difficulties. Since conservatism reporting discourages managers from engaging in risky investment because of the timely recognition of losses. Such conduct facilitates additional debt for financially constrained firms seeking investment but does not necessarily facilitate their access to additional equity. On the other side, conservatism also limits overinvestment problems. In general, overinvestment problems usually exist among firms with high investment capability, and managers are more capable to engage in projects which with a negative NPV but generate private benefits for them. Because of timely reporting of losses, makes the self-interested decisions to show up sooner, and more likely to be detected by stakeholders to discipline the behaviours of managers. Consequently, reduce overinvestment which not only through acquisitions but also for other harder-to-monitor types of investments. These effects of conservatism on investment and financing are more pronounced in the presence of information asymmetries. Overall, these results suggest that conservatism can lead to a direct benefit to investors in the form of more efficiency investments.

Similar to García Lara et al. (2016), Laux (2020) also examine how biases in financial reporting affect mangers' incentive to develop innovative projects and to make appropriate investment decisions. The model of innovation involves a manger who must first exert costly effort to develop a viable innovation and then decide whether to implement the innovation based on private information about its success probability. The study finds more conservatism reduces the probability that risky investments yield high earnings reports and therefore weakens the manager's incentive to spend effect working on new ideas ex ante. Conservatism increase the profitability of threshold above that the manager invest in a new idea, which either increases or decreases investment efficiency, depending on whether the manager is initially attempted to overinvest or underinvest in the innovation. These results are consistent

with previous literature. A study of Nan and Wen (2014) who examine the effect of accounting biases on firm's investment efficiency. They show that biased accounting information system functions better in improving firms' financing and investment efficiency than a neutral system. Specifically, in industries with generally low-profit prospects, a more downwards bias helps mitigate both investment and financing inefficiency; while for industries with high-profit prospects, an upward-biased accounting system helps improve financial efficiency.

4.2.2.5 Financial conditions and investment efficiency

Another strand of literature studies the financial conditions of firms and how it affects investment efficiency. Richardson (2006) examines the extend of firm level overinvestment of free cash flow. The results found in this study is consistent with agency cost explanation that overinvestment is concentrate in firms with highest levels of free cash flow, while governance structures, e.g. the presence of activist shareholders, tend to mitigate overinvestment. Almeida and Campello (2007) also suggest that financing frictions affect investment decision. Since tangible assets sustain more external financing as tangible assets mitigate contractibility problems, which increases the value that can be captured by creditors in default status. Their results show that asset tangibility positively affects the cash flow sensitivity of investment in financial constrained firms, but no impact on unconstrained firms. By investigating the patterns of capital allocation between high growth and low growth conglomerate segments, and the overall internal capital market efficiency across the business cycle and across constrained and unconstrained conglomerates, Hovakimian (2011) provides evidence on the relationship between financial constraints and the efficiency of internal capital markets of diversified firms. This study finds that when external capital is easier to access, internal capital markets tend to be inefficiency during non-recession periods. However, during recessions, accessing external capital markets become more restrictive, conglomerates significantly enhance the efficiency of internal capital markets by shifting more capital to high growth segments relative to low growth segments. This effect is significantly strong for conglomerates which are ex ante financial constrained. The results also suggest that under low levels of liquidity, the standards of project selection improve significantly. Similar results also find in Chaney et al. (2012). When the value of a firm's real estate appreciates, its overall investment increase. This investment is financed through additional debt issue.

And such impact of real estate shock on investment is salient for firms which are more financially constrained. All these studies suggest the role of financing constraints and investment decisions.

Overall, these studies indicate that the benefit of the financial flexibility to reallocate capital between projects become more important when external capital markets are less accessible. Internal financial resource can be a key factor affect firm's investment efficiency, especially when firms are financially constrained or external financing resources are limited.

4.2.2.6 The role of government in investment efficiency

A strand of literature on investment efficiency focus on the role of government and how they can affect firms investment efficiency. Chen et al. (2011) examine the impact of external governance on investment efficiency by exploiting government interventions which is another form of frictions can distort firm' investment behaviour and leads to investment inefficiency in China. In this study, they find that the sensitivity of investment expenditure to investment opportunities is significantly weaker for State Owned Enterprises (SOE). Besides, political connections significantly reduce investment efficiency in SOEs but not for non-SOEs. They explain that the Chinese government intervenes in SOEs to help accomplish social and political goals such as employment, fiscal health, regional development, social stabilities, etc., which alter firms' investment behaviours and consequently reduce the efficiency on investment. Therefore, government intervention in SOEs through majority state ownership or the appointment of politically connected mangers distorts investment behaviours and harms investment efficiency. Consistent with the view that government intervention undermines investment efficiency, Deng et al. (2017) examine government intervention affects firms' investment and investment efficiency by exploiting world's largest economic stimulus package (ESP) during the 2008 global financial crisis period. This action taken by Chinese government intends to restore the economy by promoting investment in priority areas, which provides an exogenous shock to firms' investment environment and exacerbated the impact of government intervention on firms' investment and investment efficiency. The results suggest that government intervened firms invested more than unaffected firms. The post-

investment performance was poor: investment efficiency of government-intervened firms decreased and government-intervened firms overinvested after ESP. Specifically, the source of funding for investment is mainly from bank loans rather than internal cash flows. Chen et al. (2017) examine the relationship between ownership type and firm level capital allocation as captured by the sensitivity of investment expenditure to investment opportunities. They argue that government and foreign institutional owners are associated with different levels of information asymmetry and agency problem. Consistent with the view that government ownership leading to serious information asymmetry and agency problems. They find that government ownership weakens investment-*Q* sensitivity and lower investment efficiency. On the other side, they find a positive relationship between foreign intuitional ownership in newly privatized firms and investment efficiency. They explain that foreign institutions mitigate agency problems and information asymmetry by improve governance and transparency. This study provides evidence to show that investment efficiency is affect by ownership type as well, although the channel through which is similar to previous studies. Overall, the results suggest that government intervention can be another friction that distort firms' investment decisions and invest inefficient.

4.2.2.7 Other factors affect investment efficiency

There are several studies on investment efficiency find other factors also affect firm investment efficiency, from the perspective of executive characteristics, institutional ownership, external industry characteristics, etc.. Eisdorfer et al. (2013) examine how the similarity between the executive compensation leverage ratio and the firm leverage ratio affects the quality of firms investment decisions. They find that greater gaps between these two ratios can lead to greater distortions in investment decisions. Firms with higher raw leverage gap display lower investment intensity, which managers tend to underinvest (overinvest) when their interests are more aligned with those of the bondholders (shareholders). This indicates that managers with more debt-like components in their compensation package will prefer a more conservative investment policy. At the same time, when the compensation leverage is lower than firm leverage, investment distortion in general positively deviate from the optimal investment level which overinvests. On the contrary, when compensation leverage higher than firm leverage, they tend to underinvest to increase the value of debt. Taken together, the results suggest that managers have personal incentives to deviate from

optimal investment policy in order to increase the value of the compensation package. Therefore, they suggest that setting compensation leverage close to firm leverage can reduce the agency cost. Stoughton et al. (2017) consider a strategic game of information acquisition where market structure plays a major role in determining the nature of information acquired by firms in the first place. They find that competition causes firms to acquire less information and investments to become more inefficient relative to a first-best case with the same market structure, investment tend to be more efficiency in concentrated industries. Ward et al., (2020) find that motivated monitoring by institutional investors mitigates firm investment inefficiency. The results show that closer monitoring mitigates the problem of both overinvestment free cash flows and underinvestment due to managers career concerns. Also, the effectiveness of the monitoring by institutional investors appears to increase monotonically with respect to the firm's relative importance in their portfolio. Cook et al. (2019) examine how corporate social responsibility (CSR) affect firm value through investment efficiency and innovation. The evidence shows that firms with greater CSR performance tend to invest more efficiently, as well as generate more patents and patent citations. They explain that higher CSR performance firms actually are more profitable and valuable, consequences partially attributable to efficiency investments and innovation. Kim et al. (2020) show that linguistically induced time perception relates to cross-country variation in investment efficiency. They find that underinvestment is less prevalent in countries where there is a weaker time disassociation in the language. They explain that speakers with weak future time reference languages apply a lower discount rate in evaluating investment projects and avoid decisions that would result in negative future consequences, therefore less likely to be underinvested. However, when strong short-term incentives or empire-building incentives neutralize weak future time reference speakers' concerns about negative future consequences form suboptimal investment decisions, the discount effect prevails and weak future time reference leads to overinvestment. The results suggests that time encoding in languages influence speakers cognition and their investment decisions, which build a new link between languages and corporate investment decisions.

4.2.3 Hypothesis Development

The neoclassical theory suggests that a firm will invest until the value of the marginal return exceeds its cost (Abel 1983; Hayashi 1982; Yoshikawa 1980). The marginal Q ratio is the sole driver of the capital investment policy, and the internally generated cash flows should play no role in investment decision (Biddle and Hilary 2006; Modigliani and Miller 1958). Therefore, managers should always adopt projects with positive net present value (NPV). Firms are considered as investing efficiently if they undertake projects with positive NPV under the scenario of no market frictions (Biddle et al., 2009). However, literature also document that firms can depart from this optimal level and invest inefficiently. The existence of information asymmetry can lead to capital rationing. For example, the moral hazard and adverse selection caused by the information asymmetry between insiders and outsider investors can reduce the amount of external capital supplied to firms and therefore result in the underinvestment (Hoshi et al. 1991). Besides, due to agency problems, managers may engage in suboptimal projects when all positive NPV projects have been taken. Such suboptimal investments can be used for specific purposes, e.g. managers' incentive of empire-building (Hope and Thomas, 2008; Jensen, 1986). Under this situation, firms can expose to overinvestment. Given these frictions, firms may depart from their optimal level of investment, either under- or over- invest: the former includes passing up investment opportunities with positive NPV, while the latter is defined as investing in projects with negative NPV.

The basic principle of tax is to levy a charge on the net cash flow to the company resulting from its real economic activities (King 1986). The corporate income tax plays an important role in corporate financing, investment and also payout decision (Fazzari et al. 1988; Hanlon and Heitzman 2010; Ohrn 2018). Firms also adjust their investment strategy in response to tax reform (Blouin et al., 2020; Mukherjee et al., 2017). Any investment decision will affect pre-tax accounting earnings through deprecation or expensing. Corporate taxes on profit will increase the cost of investment while allowances for depreciation and investment tax credit reduce it (Hall and Jorgenson 1967). Also, the expected future taxable income not only relies on the net revenue from a specific project, but on the overall activities of a firm (Brown 1962). The statutory tax change can affect firm investment efficiency through at least two channels: the incentive in taking advantage of tax and tax saving/cost generated

from tax policy changes. Previous studies document that managers intend to alter their investment decision to meet their favourable financial outcomes (Burgstahler and Dichev 1997; Graham, Hanlon, and Shevlin 2011; Graham, Harvey, and Rajgopal 2005), for example, managing reported earnings to avoid earnings decrease and losses. Specifically, there are two components of earnings, cash flow from operations and changes in working capital, are used to achieve increases in earnings. Therefore, if firm wants to achieve its specific earnings outcomes, it is very likely to alter its investment strategy which can affect both the cash flow and working capital. When a firm is exposed to an income tax increase, the firm will experience a decline in its after-tax profit, but concurrently enjoy a higher tax saving with per dollor's deduction. This incentivises managers to look for tax shelter and reduce their tax obligations, either through interest deduction or non-debt tax shelter such as investment tax credit and depreciation. Heider and Ljungqvist (2015) find that firms will increase leverage to respond to an increase in income tax, firms with a higher marginal tax rate have greater incentive to take on more debt in response to a tax rise. This incentive in tax benefits can distort the firm's investment decision and reduce investment efficiency. Also, such firms are more likely to engage in suboptimal investment to satisfy tax related purpose, especially firms are capable to do so (e.g. less financial constrained or governed). Besides, the increased tax rate reduced the profit of investment. Under this situation, the incentives for managers to exert time and effort in investing can be reduced (Atanassov and Liu, 2020), consequently, reduce investment efficiency. Taken together, because of the tax related benefits and the lower after-tax profit from investment can both distort firm's investment decision, which leads to engaging in negative NPV projects especially when investment opportunities are limited. If this is the case, we predict that firms which are exposed to tax increases will exacerbate overinvestment.

Based on the discussion above, we present the hypothesis of tax increase on investment efficiency, separately for under- and over- investment as below:

$H1_a$: Firms expose to tax increase will exacerbate the over-investment.

$H1_b$: Firms expose to tax increase will not affect the under-investment.

Since the tax charges on the net cash flow, the tax cut can create a cash windfall for firms. When there are positive NPV projects, firms will finance them either by internal cash flow or access the external capital market. The tax cut increases after-tax profit and the tax cash saving provides additional internal financing source. Previous studies find that firms under a tax cut experience lower internal financing costs and are more likely to invest in general (Dobbins and Jacob 2016; Faulkender and Petersen 2012). Firms also increase investment if they can obtain additional financing sources. For example, firm increase investment when the value of pledgeable assets (e.g. real estate assets) experiences a climbing, who can be financed through additional debt issues (Almeida and Campello 2007; Chaney et al. 2012). Blouin et al. (2020) find that firms which can take the tax cut advantages will engage more in merger and acquisitions, especially for those cash-financed. The lower income tax also indicates the required rate of return decrease because of the reductions in the tax burden, therefore more investment options are profitable for firms. Taken together, under a tax cut, firms will benefit from the additional cash saving and are more likely to respond to growth opportunities, consequently mitigating underinvestment (Kim et al. 2020). If this is the case, we predict that tax cut will mitigate the underinvestment inefficiency.

As we discussed above, we predict that the tax decrease exert asymmetric impacts on firms' investment efficiency. We present the hypothesis separately for under- and over- investment as below:

$H2_a$: Firms expose to tax cut will not affect the over-investment.

$H2_b$: Firms expose to tax cut will mitigate the under-investment.

4.3 Research Design

We test these hypotheses by adopting following methods. We follow Biddle et al. (2009) to construct the measure of investment efficiency. By employing the staggered changes of corporate income tax across states from 1990 to 2015, we are able to measure the corporate income tax changes applied to individual firms. This difference-in-differences (DiD) approach allows us to control for time-invariant, firm-

specific omitted variables and nationwide shocks. Similar identification strategy has been applied in Heider and Ljungqvist (2015) and Mukherjee et al. (2017).

We first examine how corporate income tax changes affect firm investment efficiency. A key identifying assumption underlying the DiD strategy is that firms exposed to the state corporate income tax change should share a parallel trend with the unexposed firms in the absence of the tax change. Therefore, any differences in the investment efficiency between the treatment and control groups should result from the tax change exposure.

To enhance the credibility of the DiD strategy, we add a series of time dummies before and after the tax changes and conduct a dynamic estimation of tax changes on investment efficiency. If our identification strategy is valid, we should not observe any trend of the investment efficiency between treated and control groups prior to the tax change, but we should observe the difference after the intervention of tax change. The dynamic estimation not only provides us with evidence of the time-varying effects of tax changes on investment efficiency, but also allows us to see how quickly firms respond to the tax changes and how long such effects last.

On top of the dynamic estimation, we intend to strengthen our argument by addressing potential confounding factors through a falsification test. We estimate the tax changes which happen in a neighbouring state, and see whether firms respond to such exchanges when there is no tax change in their own home state. Furthermore, we provide evidence demonstrating that the impact of tax changes on investment efficiency differs among firms with different levels of tax sensitivity, and potential channels through which tax changes affect investment efficiency, including financial constraints and agency cost respectively. Last, we conduct a series of robustness tests, e.g. using an alternative measure of investment efficiency, limiting the sample to domestic firms, adding state macro-economic characterising as control variables.

4.3.1 Measure of investment efficiency

Following Biddle et al. (2009) we model a firm's deviation from the expected level of firm-specific investment based on a firm's investment opportunity as the

measure of investment efficiency. Underinvestment and overinvestment are defined as the deviation from this expected level. The model is presented below:

$$Investment_{i,t+1} = \alpha + \beta * Sales\ Growth_{i,t} + \epsilon_{i,t+1} \quad (4.1)$$

Where the $Investment_{i,t+1}$ is the total investment and $Sales\ Growth_i$ is the percentage change in sales from year $t-1$ to t. The model is estimated for each industry-year based on the Fama and French 48-industry classification for all industries with at least 20 observations in a given year. The residual from estimating Equation (1) captures the extent to which a firm's investment deviates from the optimal investment level and we take the residual as the measure of investment (in)efficiency. Specifically, we classify firm-year observations with positive residuals as overinvestment firms and those with negative residuals as underinvestment firms. We take the positive residual as the measure of investment efficiency of overinvestment firms. For underinvestment, we take the absolute value of the residual as the measure of investment efficiency of underinvestment firms. Therefore, a higher value of the measure of investment efficiency indicates a greater deviation from the optimal level and lower efficiency.

4.3.2 Baseline Empirical Model

Following Heider and Ljungqvist (2015) and Mukherjee et al. (2017), we use the staggered tax changes across states as a difference-in-differences approach to examine the effect of changes in states' corporate income tax rates on firms' investment efficiency. We estimate the baseline model using ordinary least squares (OLS) regressions. Specifically, we employ the following specification separately for the under- and overinvestment:

$$Investment\ Efficiency_{\ i,s,t+1}$$
$$= \alpha + \beta_I * Tax\ Increase_{s,t} + \beta_D * Tax\ Decrease_{s,t}$$
$$+ \gamma Control_{\ i,t} + Firm_i + Year_t + \epsilon_{i,s,t+1} \quad (4.2)$$

Where i, s, t proxy firms, states and years, respectively. Our dependent variable is $Investment\ Efficiency_{\ i,s,t+1}$ capture the investment (in)efficiency which is the absolute value of the residuals from estimating the investment model. The main variables of interest are $Tax\ Increase_{s,t}$ and $Tax\ Decrease_{s,t}$ which are dummy variables set to one if state s increase or decrease corporate income tax at year t or zero otherwise. We control for a set of variables which have been found to affect firm investment efficiency (Biddle et al. 2009; M. Cheng et al. 2013; Choi et al. 2020). We first include a vector of basic firm characteristics including firm size (*Size*) measured as the natural logarithm of total assets; leverage (*Leverage*) measured as the ratio of long-term debt to sum of long-term debt to the market value of equity; the market-to-book ratio (*M/B*) measured as the ratio of the market value of total assets to book value of total assets; return on assets (*ROA*); bankruptcy risk proxied by *Z-score* which is a measure of bankruptcy risk, calculated as 3.3*pretax income + sales + 0.25*retained earnings + 0.5*(current assets-current liabilities), scaled by total assets; *Tangibility* measured as the ratio of plant, property and equipment (PP&E) to total assets; industry leverage (*Ind. K-structure*) which is the mean leverage for firms in the same SIC 3-digit industry; dividend payout ratio (*Dividend*) which is an indicator variable set to one if the firm paid a dividend and zero otherwise; financial slack (*Slack*) which is the ratio of cash and cash equivalents to PP&E; cash flow from operation divided by sales (*CFOsale*). Second, Liu and Wysocki (2011) suggest that operating volatility can affect the cost of capital, and consequently can affect the investment efficiency. Therefore, we also include a set of variables which measure the uncertainty level of firms' operating environment, including cash flow volatility (*sd_Cash*) measured as the standard deviation of cash flow from operations scaled by average total assets from year t-5 to t-1; sales volatility (*sd_Sales*) which measured as the standard deviation of sales deflated by average total assets from year t-5 to t-1 and investment volatility (*sd_Investment*) which measured as the standard deviation of investment from year t-5 to t-1. Third, existing studies (Ajello 2016; Bachmann and

Bayer 2014) suggest that firms in different stages of business cycle may have different investment strategy. To address the potential impact on investment efficiency, we control a series of measures of business cycle, including firm's age (*Age*), the length of the operation cycle (*Cycle*) measured as the log of receivables to sales plus investor to cost of goods sold multiplied by 360, and the frequency of losses (*Loss*) which is an indicator variable equals one if income before extraordinary items is negative and zero otherwise. Last, we consider the role of analyst and institutional investors on investment efficiency. Several studies find that analyst earnings forecast and expenditure forecast can reduce the information asymmetry and enhance investment efficiency (Chen et al. 2017; Choi et al. 2020). Also motivated monitoring by institutional investors can mitigate firm investment inefficiency (Ward et al., 2020). Therefore, we further include institutional ownership (*Institutions*) which measured as the percentage of firm shares held by institutional investors and financial analyst (*Analyst*) which is the number of analyst following the firms as the control variables. Detailed variable definitions are provided in Appendix A.3. Firm and year fixed effects are included to control for unobserved firm characteristics and time-varying trends respectively. Standard errors are clustered at firm level. As we discussed before, we predict that the tax increase will exacerbate overinvestment inefficiency ($\beta_I > 0$), while the tax cut will attenuate the underinvestment inefficiency ($\beta_D < 0$).

4.4 Empirical Results

4.4.1 Sample and Descriptive Statistics

We collect financial reporting data from Compustat, analyst data from IBES and institutional ownership from Thomson-Reuters Institutional Holdings (13F) Database. Consistent with previous studies (Biddle et al. 2009; Heider and Ljungqvist 2015; Mukherjee et al. 2017), we exclude firms in the financial sector (SIC code 6000-6999), utilities (SIC code 4900s), the public sector (SIC code 9000s) and firms headquartered outside the U.S. Based on the data provided by Heider and Ljungqvist (2015), we identify 36 instances of state tax increase across 23 states and 68 instances of tax cut across 26 states over our sample period. After excluding missing firm-year observations, our final sample for baseline regressions consists of 40351 firm-year observations with 6175 unique firms spanning from 1990 to 2015.

Table 4.1 Panel A presents the summary statistics for the variables described above. The mean value of *Investment Efficiency* is 0.11, which suggests the average deviation from the expected investment level. Around two-third (27269 out of 40351) of the observation in our sample are exposed to underinvestment, the average deviation from expected investment level for underinvestment firms (0.0922) is lower compare to overinvestment firms (0.148). This result suggests that firms are more likely to subject to underinvestment inefficiency compare to overinvestment. The average sample firm has $1,142 (logarithm value 5.058 as shown in the table) million in total assets with ROA 5.32%, and trades at market-to-book ratio of 2.123. In addition, there are around 4.63 analysts following an average firm and 41.4% of shares outstanding are held by institutional investors. Overall, the pattern of these variables is similar to previous studies (Chen et al., 2011; Cheng et al., 2013; Choi et al., 2020).

Panel B of Table 1 reports the Pearson correlations between our main variables. In general, firm size, ROA and Z-score is negatively correlated with *Investment Efficiency*, while the Market-to-Book ratio is positively correlated with *Investment Efficiency*. We find that our control variables are significantly correlated with investment efficiency in general, which is consistent with previous studies' findings. Since the correlation includes limited information of firm and industry characteristics, we next turn to multivariate tests.

Table 4.1 Descriptive statistics
This table present summary statics of the control variables for 40351 firm-year observations during year 1990 to 2015 which are used in the baseline analysis. For variable definitions and details of the construction, see Appendix A.

Panel A:Summary statistics

variable	N	mean	sd	p25	p50	p75
Investment Efficiency	40351	0.110	0.130	0.0370	0.0763	0.138
Underinvestment	27269	0.0922	0.0697	0.0409	0.0766	0.128
Overinvestment	13082	0.148	0.200	0.0291	0.0758	0.178
Size	40351	5.058	1.892	3.683	4.939	6.295
Leverage	40351	0.153	0.205	0	0.0589	0.236
M/B	40351	2.123	2.256	1.081	1.501	2.350
ROA	40351	0.0532	0.275	0.0280	0.110	0.172
Z-score	40351	1.170	2.895	0.672	1.440	2.111
Tangibility	40351	0.251	0.216	0.0848	0.183	0.353
Ind. K-structure	40351	0.164	0.109	0.0754	0.130	0.227
Dividend	40351	0.316	0.465	0	0	1
Slack	40351	5.828	84.06	0.111	0.568	2.646
CFOsale	40351	-1.499	74.46	-0.00143	0.0588	0.123
sd_Cash	40351	0.0984	0.748	0.0355	0.0615	0.109
sd_Sales	40351	0.224	0.268	0.0854	0.153	0.273
sd_Investment	40351	1.402	130.9	0.0296	0.0637	0.145
Age	40351	2.541	0.791	1.946	2.565	3.135
Cycle	40351	4.674	0.844	4.281	4.773	5.182
Loss	40351	0.343	0.475	0	0	1
Analyst	40351	4.633	6.243	0	2	6
Institutions	40351	0.414	0.294	0.142	0.381	0.666

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1)	Investment Efficiency	1									
(2)	Size	-0.150***	1								
(3)	Leverage	-0.085***	0.227***	1							
(4)	M/B	0.177***	-0.132***	-0.267***	1						
(5)	ROA	-0.201***	0.343***	0.083***	-0.276***	1					
(6)	Z-score	-0.150***	0.171***	0.016***	-0.334***	0.706***	1				
(7)	Tangibility	-0.046***	0.189***	0.356***	-0.144***	0.164***	0.034***	1			
(8)	Ind.K-structure	-0.149***	0.201***	0.513***	-0.232***	0.172***	0.121***	0.473***	1		
(9)	Dividend	-0.094***	0.333***	0.040***	-0.078***	0.214***	0.153***	0.173***	0.196***	1	
(10)	Slack	0.040***	-0.028***	-0.033***	0.051***	-0.024***	-0.024***	-0.069***	-0.049***	-0.020***	1
(11)	CFOsale	-0.022***	0.012**	0.006	-0.028***	0.069***	0.045***	-0.002	0.017***	0.012**	-0.012**
(12)	sd_Cash	0.022***	-0.048***	-0.026***	0.040***	-0.060***	-0.039***	-0.037***	-0.029***	-0.022***	0.011**
(13)	sd_Sales	0.042***	-0.201***	-0.052***	0.059***	-0.069***	0.057***	-0.155***	-0.039***	-0.127***	0.013**
(14)	sd_Investment	0.003	-0.012**	0.006	0.003	-0.005	-0.010*	0.006	0.006	-0.007	-0.001
(15)	Age	-0.097***	0.328***	0.079***	-0.136***	0.177***	0.124***	0.077***	0.100***	0.383***	-0.008*
(16)	Cycle	-0.023***	-0.109***	-0.126***	0.015***	-0.052***	-0.043***	-0.322***	-0.221***	-0.039***	-0.047***
(17)	Loss	0.091***	-0.296***	0.074***	0.080***	-0.528***	-0.362***	-0.095***	-0.109***	-0.280***	0.030***
(18)	Analyst	-0.074***	0.709***	-0.046***	0.089***	0.198***	0.072***	0.121***	-0.001	0.187***	-0.012**
(19)	Institutions	-0.078***	0.707***	-0.032***	0.007	0.258***	0.123***	0.019***	-0.001	0.176***	0.001

Continue:

		(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
(11)	CFOsale	1								
(12)	sd_Cash	-0.004	1							
(13)	sd_Sales	0.009*	0.044***	1						
(14)	sd_Investment	0	0.023***	0.015***	1					
(15)	Age	0.012**	-0.035***	-0.182***	-0.012**	1				
(16)	Cycle	-0.068***	-0.003	-0.114***	-0.004	0.046***	1			
(17)	Loss	-0.030***	0.035***	0.087***	0.007	-0.210***	0.015***	1		
(18)	Analyst	0.004	-0.030***	-0.133***	-0.007	0.145***	-0.070***	-0.215***	1	
(19)	Institutions	0.010**	-0.037***	-0.175***	-0.010*	0.211***	-0.066***	-0.270***	0.546***	1.0000

*** p<0.01, ** p<0.05, * p<0.1

4.4.2 Baseline results

We report the results from estimating Equation (4.2) in Table 4.2. Column (1) to (3) and (4) to (6) present the estimation of tax changes on under/over investment efficiency respectively. We find that tax cut reduces underinvestment but have no significant effect on overinvestment. Be specific, firms who expose to a tax cut indent to reduce the underinvestment by 0.004, which presents 4.3% decrease in the mean of underinvestment. As we discussed before, the main reason for underinvestment is capital rationing. The tax cut creates a cash windfall for firms, relaxes firms' financial constraints and increase internal cash flow which is a key financing source for investment. Consequently, firms are more likely to grasp the investment opportunities and mitigate underinvestment inefficiency. On the other side, the results present from (4) to (6) show that firms exposed to tax increase experience intensified overinvestment. *Ceteris paribus,* tax increases aggravate overinvestment by 0.021, which represents a 14% increase in the mean of overinvestment. However, they are unlikely to respond to tax cut. When firms expose to an increase in their income tax, they are induced to take advantages of the tax shelter and such incentives can distort the investment decision. The engagement in suboptimal project, in the end, leads to the over investing inefficiency. We also notice that the coefficient magnitude of tax increase on overinvestment is greater compare to tax decrease on underinvestment, and this may result from the different channels that tax changes on investment efficiency. We will provide further discussion and evidence in later sections to support these arguments.

In terms of control variables, we notice that firm size is significantly and positively related to underinvestment but negatively related to overinvestment. The potential explanation could be larger firms tend to have better monitoring, therefore reduce the agency problem and mitigate the overinvestment inefficiency. Similar pattern also finds for leverage. Firms with higher leverage and experience net operation loss are more like to under invest but more likely to engage in overinvestment. While firms with higher market–to-book value less experience underinvestment but more likely to engage in overinvestment. We also find that

corporate monitoring, measured by analyst covering and share of institutional investor are significantly and negatively related to underinvestment but such effect disappears in overinvestment efficiency estimation. In general, our findings are similar to previous studies (Biddle and Hilary 2006; T. Chen et al. 2017; Choi et al. 2020).

Table 4.2 Baseline results

This table presents the OLS regression estimates for baseline regression. The dependent variable is investment efficiency measures by Underinvestment and Overinvestment respectively. The main variables of interest are $Tax\ Increase_{s,t}$ and $Tax\ Decrease_{s,t}$ which are dummy variables set to one if state s decrease or increase corporate income tax at year t or zero otherwise. Column (1) to (3) report the tax changes on underinvestment and column (4) to (6) report the tax changes on overinvestment. Firm-clustered robust standard errors are reported in parentheses. *,** and*** indicate significance level at 10%, 5% and 1%, respectively. The definition of variables are reported in Appendix A.3.

	(1) Underinvestment	(2) Underinvestment	(3) Underinvestment	(4) Overinvestment	(5) Overinvestment	(6) Overinvestment
Tax Increase	0.002		0.001	0.021**		0.021**
	(0.002)		(0.002)	(0.009)		(0.009)
Tax Decrease		-0.005***	-0.005***		-0.010	-0.009
		(0.002)	(0.002)		(0.007)	(0.007)
Size	0.012***	0.012***	0.012***	-0.068***	-0.068***	-0.068***
	(0.001)	(0.001)	(0.001)	(0.006)	(0.006)	(0.006)
Leverage	0.024***	0.024***	0.024***	-0.192***	-0.193***	-0.192***
	(0.004)	(0.004)	(0.004)	(0.024)	(0.024)	(0.024)
M/B	-0.001**	-0.001**	-0.001**	0.008***	0.008***	0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ROA	0.007	0.007	0.007	-0.069***	-0.068***	-0.069***
	(0.006)	(0.006)	(0.006)	(0.026)	(0.026)	(0.026)
Z-score	-0.000*	-0.000*	-0.000*	-0.002	-0.002	-0.002
	(0.000)	(0.000)	(0.000)	(0.004)	(0.004)	(0.004)
Tangibility	-0.011	-0.011	-0.011	-0.025	-0.025	-0.026
	(0.008)	(0.008)	(0.008)	(0.032)	(0.032)	(0.032)
Ind. K-structure	-0.062***	-0.062***	-0.062***	-0.076*	-0.076*	-0.075*
	(0.008)	(0.008)	(0.008)	(0.039)	(0.039)	(0.039)
Dividend	-0.001	-0.001	-0.001	0.006	0.006	0.006
	(0.001)	(0.001)	(0.001)	(0.009)	(0.009)	(0.009)
Slack	0.000***	0.000***	0.000***	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CFOsaleS	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
sd_Cash	-0.001***	-0.000***	-0.000***	-0.011	-0.010	-0.010
	(0.000)	(0.000)	(0.000)	(0.029)	(0.029)	(0.029)

Continue						
sd_Sales	0.006**	0.006**	0.006**	-0.029*	-0.029*	-0.029*
	(0.002)	(0.002)	(0.002)	(0.016)	(0.016)	(0.016)
sd_Investment	0.000***	0.000***	0.000***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age	-0.006***	-0.006***	-0.006***	0.008	0.008	0.008
	(0.002)	(0.002)	(0.002)	(0.011)	(0.011)	(0.011)
Cycle	0.000	0.000	0.000	-0.018***	-0.018***	-0.018***
	(0.002)	(0.002)	(0.002)	(0.006)	(0.006)	(0.006)
Loss	0.008***	0.008***	0.008***	-0.041***	-0.041***	-0.041***
	(0.001)	(0.001)	(0.001)	(0.006)	(0.006)	(0.006)
Analyst	-0.001***	-0.001***	-0.001***	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Institutions	-0.013***	-0.013***	-0.013***	0.027	0.027	0.027
	(0.004)	(0.004)	(0.004)	(0.019)	(0.019)	(0.019)
Year Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
_cons	0.031***	0.031***	0.031***	0.497***	0.499***	0.498***
	(0.010)	(0.010)	(0.010)	(0.045)	(0.045)	(0.045)
N	27269	27269	27269	13082	13082	13082
adj. R-sq	0.106	0.106	0.106	0.101	0.101	0.102

4.4.3 Pre-treatment trends

One key assumption behind our difference-in-difference approach is that there is a parallel trend of investment efficiency between the treatment and control groups if the tax changes do not exist, any difference we find between the two groups should derive from the tax changes. Although we use one-year leading value of firm's investment as the dependent variable, it is less likely that our results are driven by the reserve causality. However, to examine pre-treatment trends in the investment efficiency of the treated and control groups, we introduce a series of indicator variables. Specifically, we employ the equation below:

$$\begin{aligned} Investment\ Efficiency_{\ i,s,t+1} &= \alpha + \sum_{n=-2}^{3} \beta_{I,t+j} * Tax\ Increase_{s,t+n} \\ &+ \sum_{n=-2}^{3} \beta_{D,t+j} * Tax\ Decrease_{s,t+n}\, \beta_I + \gamma Control_{\ i,t} + Firm_i + Year_t \\ &+ \epsilon_{i,s,t+1} \end{aligned} \tag{4.3}$$

Where $Tax\ Increase_{s,t}$ and $Tax\ Decrease_{s,t}$ which are dummy variables set to one if state s decrease or increase corporate income tax at year t or zero otherwise. $Tax\ Increase_{s,t+n}$ and $Tax\ Decrease_{s,t+n}$ indicate that it is n years before (or after) the tax increase or decrease. We consider six-year time window, spanning from three-year before and three-year after the tax change, and omit the year 3 before tax change as the benchmark year. Year and firm fixed effects are included and the standard errors are clusters at the firm level.

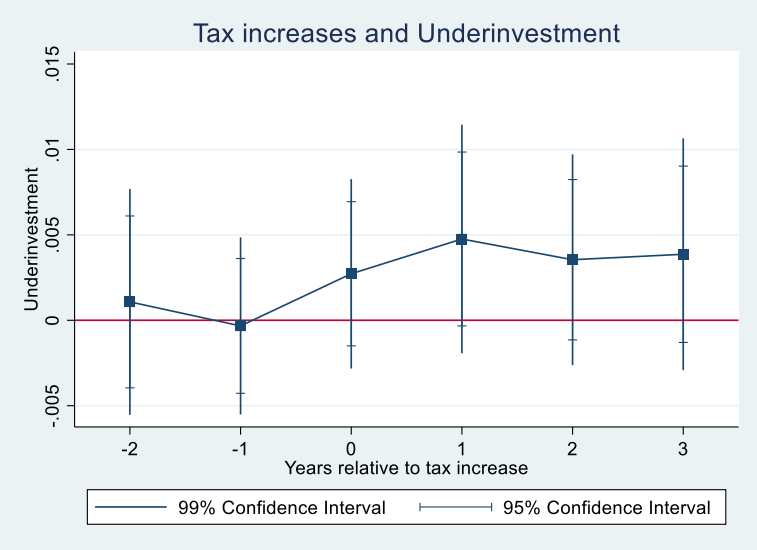
Figures 4.1 Corporate income tax and investment efficiency: pre-trends and post-trends

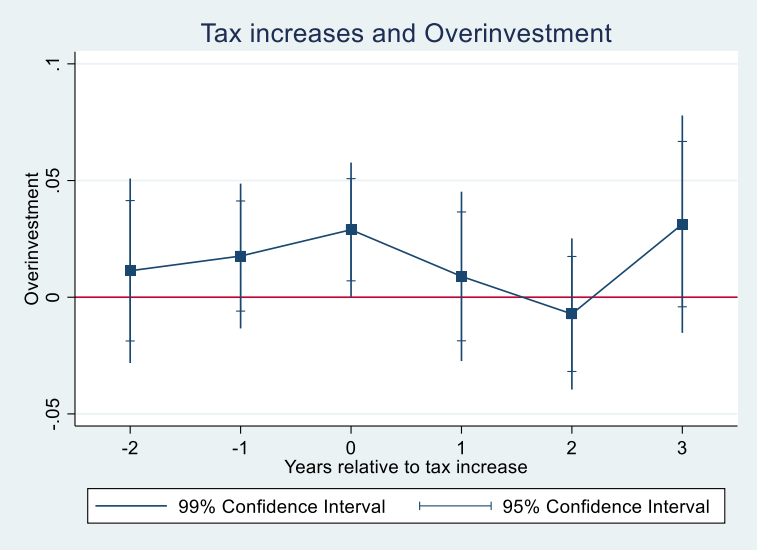
The figures below present the change of investment efficiency measured as underinvestment and overinvestment separately following the change in corporate income tax. Figures plot the difference in the investment efficiency between the treatment and control groups averaged around event time; the vertical bars correspond to 99% and 95% confidence intervals with firm-level clustered standard error. Specifically, we report the estimated coefficients from the following regression:

$$Investment\ Efficiency_{\ i,s,t+1} = \alpha + \sum_{n=-2}^{3} \beta_{I,t+j} * Tax\ Increase_{s,t+n} + \sum_{n=-2}^{3} \beta_{D,t+j} * Tax\ Decrease_{s,t+n}\ \beta_I + \gamma Control_{\ i,t} + Firm_i + Year_t + \epsilon_{i,s,t+1}$$

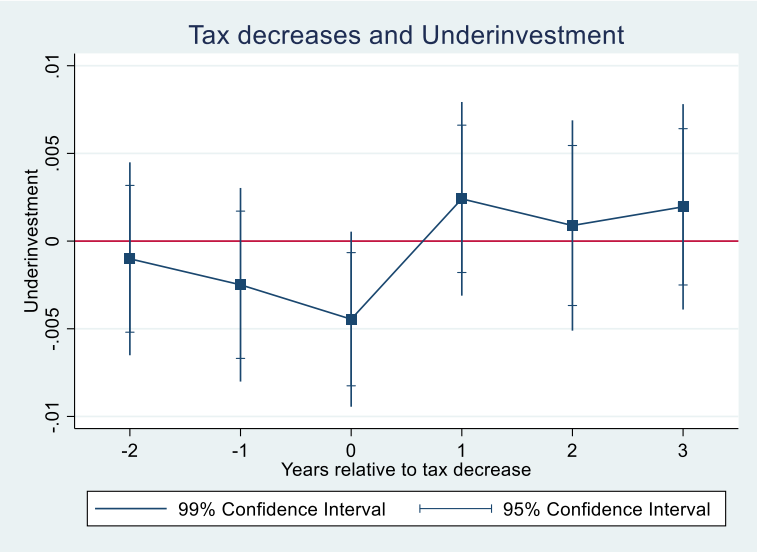
$Investment\ Efficiency_{\ i,s,t+1}$ is a firm-level measure of total investment inefficiency, which is the absolute value of the residuals from the estimating model (Biddle et at., 2009). $Tax\ Increase_{s,t}$ and $Tax\ Decrease_{s,t}$ which are dummy variables set to one if state s decrease or increase corporate income tax at year t or zero otherwise. All estimations are relative to the year t -3. $Firm_i$ and $Year_t$ are year and firm fixed effects, respectively. The standard errors are cluster at firm-level.

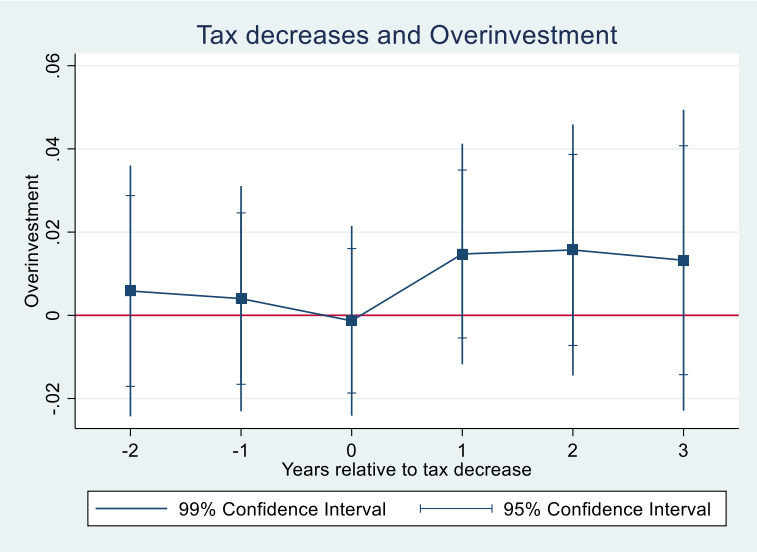
Panel A: Tax increase and investment efficiency





Panel B: Tax decrease and investment efficiency





In figure 4.1, we plot the point estimates for coefficients which estimate the difference in the investment efficiency between treatment and control groups averaged around the event time from Equation (4.3). The graph represents coefficients plots and their associated 95% and 99% confidence intervals respectively by the vertical bars. We use the year 3 ($Tax\ Increase_{s,t-3}$ and $Tax\ Decrease_{s,t-3}$) before tax change as the reference year. This suggests that the coefficients in these plots capture the rate of change in investment efficiency in any year compare to three-year before tax changes. The coefficients of interest are years before tax changes, as their magnitude and significance prove that whether there is a parallel trend between treated and control firms in investment efficiency before tax changes.

Overall, we observe no significance for years before tax reform. The tax increase is unlikely to affect underinvestment efficiency. However, for overinvestment, firms respond quickly and significant in year 0, but such effect diminish in the following years. Similar trend also found in tax cut and underinvestment. Underinvestment inefficiency is mitigated (significant at 95% confidence interval) at the year of tax cut (year 0), but such effect disappears in following years. No evidence shows that tax decrease is related to overinvestment. These results are consistent with our previous argument. Moreover, the results also prove that firms' reaction to tax changes are immediately but such effect only last in a very short time period. One explanation is that firms react to tax changes through adjusting their investment decision is a short-term strategy for taxing planning which is less likely to affect investment efficiency in a long run (Ljungqvist et al. 2017).

The results found in this section have important implications. First, the statistically insignificant and relatively small coefficients of pre-event variables suggest that there is no different trend between treated firms and control firms in investment efficiency before the tax changes. Also, the absence of significant lead effects indicates that treated firms do not anticipate the future tax changes or they take no actions in their investment strategies. The reason can be that even if the tax changes are anticipatable, firms do not act in advance since they can take the advantage of the tax changes (e.g. tax shelter or cash windfall) only until the new tax rate takes into effect. Last, the fact that firms change in their investment efficiency only after new tax rate implements suggests that the relation is not the result of any trending omitted

variables or reverse causality. Instead, we find firms response only when they can reap the benefit of tax changes.

4.4.4 Unobservable confounding factors

Another concern which will undermine our empirical strategy is the unobservable confounding local economic conditions. The local economic condition can drive the state tax changes, and also affect firms' investment efficiency. This can lead to observing the causality between tax changes and investment efficiency which is found in the baseline estimation. To address this concern, we conduct a falsification test by examining whether firms respond to tax changes that happen in their neighbouring states but not in their home state.

The tax changes can be driven by local economic conditions which simultaneously cause the changes in investment efficiency. However, different from the state income tax law changes which stop at the state borders, economic conditions would spill across state borders which will affect firms located in the reform states as well as the neighbouring ones. If this is the case, firms located in treated states and their neighbouring firms in untreated states should both respond to the tax changes if this results from the economic condition changes and which will transmit across borders (Heider and Ljungqvist 2015; Mukherjee et al. 2017).

To address this possibility, we first examine whether firms' investment efficiency respond to neighbouring states' tax change. Column (1) and (2) of table 4.3 report the results. We find that the investment efficiency actually does not react to the tax changes which happen in a neighbouring state, the coefficient of tax increase or tax decrease is both insignificant in column (1) and (2). Next, we include both home state tax change indicators and also the indicators for tax changes that occur in a neighbouring state in our regression estimation. The results are reported in column (3) and (4). Consistent with previous results, we find that the coefficient of home state tax changes are significant in both estimations and the magnitude of the coefficients are similar to our baseline results: firms which experience a tax cut tend to mitigate their underinvestment inefficiency but an intensified overinvestment following a tax increase. Meanwhile, we also observe the impact of neighbouring state's tax changes

have no impact on firms' investment efficiency, as all coefficients of neighbouring state tax changes keep insignificant across column (3) and (4). These evidence rule out the possibility that the tax reforms and investment efficiency changes are caused simultaneously by unobservable local economic conditions, and supports a causal interpretation of the home-state tax treatment effect.

Table 4.3 Tax changes and investment efficiency: unobservable local economic confounding factors
This table report the regression result of the falsification test. In column (1) and (2), we use the neighbouring state tax changes as our independent variable to see whether firms respond to tax changes that occur in a neighbouring state when there is no tax changes in their home state. Column (3) and (4), we include both tax changes which occur in home state and neighbouring state. Firm-clustered robust standard errors are reported in parentheses. *,** and*** indicate significance level at 10%, 5% and 1%, respectively. The definition of variables are reported in Appendix A.

	(1)	(2)	(3)	(4)
	Underinvestment	Overinvestment	Underinvestment	Overinvestment
Neighbouring state tax increase	0.002	-0.008	0.002	-0.007
	(0.001)	(0.007)	(0.001)	(0.007)
Neighbouring state tax decrease	0.002	0.004	0.002	0.001
	(0.001)	(0.008)	(0.001)	(0.008)
Tax Increase			0.001	0.019*
			(0.002)	(0.010)
Tax Decrease			-0.004***	-0.011
			(0.002)	(0.008)
Control Variables	Yes	Yes	Yes	Yes
Year Fixed effect	Yes	Yes	Yes	Yes
Firm Fixed effect	Yes	Yes	Yes	Yes
adj. R-sq	0.106	0.101	0.106	0.102

4.4.5 Tax Changes and Investment Efficiency: Tax sensitivity

In the previous section, we proved that firms adjust their investment strategy to cope with the potential outcomes brought by the tax changes. In this section, we provide further evidence by employing triple difference-in-differences test that the effect of tax changes on investment efficiency is differ on their tax sensitivity. To capture the tax sensitivity, we focus on two aspects of firms: the aggressive level of tax planning and the capability of tax avoidance.

4.4.5.1 Tax Planning

Intuitively, firms differ in terms of their exposure to tax changes relying on their tax sensitivity. For firms who emphasis their tax positions and engage in aggressive tax planning activities should be more sensitive to tax rate changes. If the effect of tax on investment efficiency is motivated by the tax changes, the effect should be more pronounced for firms which engage in aggressive tax planning. To test this conjecture, we follow previous studies and use three different measures to capture tax planning: the *Deferral*, Book-tax difference (*BTD*) and permanent Book-Tax Difference (*Perm_BTD*) (Edwards, Schwab, and Shevlin 2016; Khurana and Moser 2013). We calculate the *Deferral* as the negative value of the ratio of deferred tax expense to pre-tax income adjusted for special items, *BTD* as the annual total book-tax differences and the *Perm_BTD* is the annual permanent book difference. Greater value indicates more aggressive in tax planning. The detailed measure and definition can be found in Appendix A. The deferral-based tax planning can produce temporary cash tax saving in the current period, but increase cash taxes in future period. Edwards (2016) find that firms intend to use deferral-based strategies to increase cash tax saving to response to increased financial constraints. While deferral-based tax planning is a temporary strategy, managers are also looking for permanent tax planning strategies which produce both cash flow and financial reporting benefit. To capture this tax planning strategy, we adopt total Book-Tax Difference (*BTD*) and permanent Book-Tax Difference (*Perm_BTD*) as alternative measure of tax planning level (Frank, Lynch, and Rego 2009; Khurana and Moser 2013; Rego and Wilson 2012). We then reestimate our baseline regression, and let the tax changes dummy interact with tax planning measures. Specifically, we employ the specification below:

$$
\begin{aligned}
Investment\ Efficiency\ _{i,s,t+1} &= \alpha + \beta_{I,bottom} * Tax\ Increase_{s,t} * \text{Bottom } 33 \\
&+ \beta_{I,top} * Tax\ Increase_{s,t} * \text{Top } 67 + \beta_{D,bottom} \\
&* Tax\ Decrease_{s,t} * \text{Bottom } 33 + \beta_{D,top} * Tax\ Decrease_{s,top} \\
&* \text{Top67} + \gamma Control\ _{i,t} + Firm_i + Year_t + \epsilon_{i,s,t+1} \qquad (4.4)
\end{aligned}
$$

We partition sample firms into those with tax planning measures fall in the bottom 33 and top 67 percentiles, respectively. Bottom 33 (Top67) is a dummy variable that equals one if $Firm_i$ falls in the bottom 33 (top 67) percentiles. This specification allows us to observe the effect of tax changes separately for these groups with different level of tax planning by estimating interactions between tax changes and those tax planning dummies. We predict the impact of tax changes on investment efficiency in the top 67 groups ($\beta_{I,top}\ and\ \beta_{D,top}$) should be more salient than the bottom 33 groups ($\beta_{I,bottom}\ and\ \beta_{D,bottom}$). The results are reported in Table 4.4 Panel A.

Overall, we can see that firms in the top 67 percentiles are more likely response to a tax cut and consequently mitigate underinvestment inefficiency and also response to a tax increase and consequently experience intensified overinvestment inefficiency. This is consistent with our prediction that firms who engage more in tax planning should be more sensitive to the tax rate changes. Interestingly, In column (4), we see that firms lie in bottom 33 percentiles intend to reduce their overinvestment activities if they experience a tax cut. This result somehow supports our hypothesis of tax incentive of using tax shelter. When the tax increase, firms will engage more inefficiency investment activities to take advantage of the tax benefits. While when the tax rate falls, the incentive in taking advantage of tax benefits reduced, higher after-tax return also incentive managers to make more efforts in investment selection, consequently reduce overinvestment efficiency.

Table 4.4 Tax changes and Investment Efficiency: Tax sensitivity

This table provides the estimation results of the impact of tax changes on investment efficiency in terms of firms' tax sensitivity. In Panel A, we use three different measures of tax planning in period *t* to split sample firms into group which fall into bottom 33 percentile and top 67 percentile based on their tax pressure level, respectively. We include the tax pressure measures to control for the level effect of tax pressure. The three measures are Deferral, Book-Tax difference (BTD) and Permanent Book-Tax Difference. In Panel B, we partition firms based on whether their state mandate combined income reporting. Combined (Non-Combined) is a dummy set to one if the firm headquartered is located in a state requires combined income reporting or zero otherwise. All regressions include control variables used in our baseline specification, and firm and year fixed effects. Firm-clustered robust standard errors are reported in parentheses. *,** and*** indicate significance level at 10%, 5% and 1%, respectively. The definition of variables are reported in Appendix A.

Panel A: Tax Planning

	Deferral		Book-Tax Difference		Permanent Book-Tax Difference	
	(1)	(2)	(3)	(4)	(5)	(6)
	Underinvestment	Overinvestment	Underinvestment	Overinvestment	Underinvestment	Overinvestment
Tax Increase*Bottom 33	0.001	0.004	-0.003	0.022	-0.002	0.029
	(0.003)	(0.013)	(0.006)	(0.020)	(0.006)	(0.022)
Tax Increase* Top 67	0.002	0.034***	0.001	0.031***	0.001	0.028**
	(0.003)	(0.013)	(0.002)	(0.012)	(0.002)	(0.011)
Tax Decrease*Bottom 33	-0.003	0.003	-0.006	-0.040**	-0.007	-0.022
	(0.002)	(0.011)	(0.004)	(0.018)	(0.004)	(0.018)
Tax Decrease* Top 67	-0.005**	-0.018	-0.004**	-0.000	-0.004**	-0.006
	(0.002)	(0.009)	(0.002)	(0.010)	(0.002)	(0.009)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
_cons	0.033***	0.507***	0.028**	0.530***	0.027**	0.532***
	(0.011)	(0.048)	(0.013)	(0.051)	(0.013)	(0.051)
N	25733	12312	20241	9271	20130	9209
adj. R-sq	0.104	0.104	0.102	0.114	0.103	0.113

Panel B: Tax Sheltering

	(1) Underinvestment	(2) Overinvestment
Tax Increase*Non-Combined	0.002	0.009
	(0.002)	(0.014)
Tax Increase* Combined	0.000	0.031**
	(0.003)	(0.013)
Tax Decrease* Non-Combined	-0.003*	-0.024**
	(0.002)	(0.012)
Tax Decrease* Combined	-0.006**	0.001
	(0.003)	(0.010)
Control Variables	Yes	Yes
Year Fixed effect	Yes	Yes
Firm Fixed effect	Yes	Yes
_cons	0.031***	0.497***
	(0.010)	(0.045)
N	27269	13082
adj. R-sq	0.106	0.102

4.4.5.2 Tax sheltering

Next, we examine the tax sensitivity in the aspect of their ability to shelter taxes. Firms can arbitrate through different tax rules across border. The difference of state tax policies provides firms opportunities to take the regulatory arbitrate through shifting income from a high-tax jurisdiction to a low tax jurisdiction. For example, a common state tax avoidance strategy is known as a Passive Investment Company (PIC) or Delaware Holding Company. The PIC strategy allows firms to shift income to their subsidiary corporation located in states, e.g. Delaware or Nevada, to convert taxable income into tax-exempt income. Combined reporting essentially treats the parent and most subsidiaries as one corporation for state income tax purpose, and corporates' national profits are combined and the state then taxes a share of the combined income. Since 1990, a growing number of states are adopting the combined reporting rules (Mazerov 2009). The combined reporting states tend to limit, especially for large multistate corporations, the tax planning strategy of firms which are more likely to manipulate their tax by transferring across states, from where they earned to which they will be taxed at a lower rate. Therefore, for firms who headquartered in combined reporting states, the impact of home state tax changes should be more pronounced compared with their counterparties who are located in non-combined reporting states. In order to test this prediction, we first collect implementation date of combined reporting states from Dyreng et al. (2013) and Mazerov (2009) from 1990 to 2009, and we manually collect the effective date of combined reporting until 2015. In our sample period, we identify 26 states implement the combined reporting requirements. Specifically, we employ the specification below:

$$
\begin{aligned}
Investment\ Efficiency\ _{i,s,t+1} &= \alpha + \beta_{I,noncombine} * Tax\ Increase_{s,t} * Non\text{-}Combined_s \\
&+ \beta_{I,combine} * Tax\ Increase_{s,t} * Combined_s + \beta_{D,noncombine} \\
&* Tax\ Decrease_{s,t} * Non\text{-}Combined_s + \beta_{D,combine} \\
&* Tax\ Decrease_{s,t} * Combined_s + \gamma Control\ _{i,t} + Firm_i \\
&+ Year_t + \epsilon_{i,s,t+1} \qquad (4.5)
\end{aligned}
$$

We partition firms base on whether their state adopts combined tax reporting. $Combined_s$ ($Non\text{-}Combined_s$) is a dummy variable set to one if the firm headquartered in a state enact combined reporting requirement or zero otherwise. The results are reported in Table 4.4 Panel B.

Similar to the results in Panel A, firms located in states with a combined reporting requirement are more likely to mitigate their underinvestment inefficiency after the tax cut compares to the one located in non-combined reporting state. In terms of overinvestment, firms located in combined reporting states response strongly to the tax increase and aggravate overinvestment inefficiency compare to firms in non-combined reporting state. Also, the coefficient $\beta_{I,combine}$ is significant at 95% confidence level with a larger magnitude than $\beta_{I,noncombine}$. These results are consistent with our argument and predictions. Interestingly, we see that firms located in non-combined states intend to reduce their overinvestment after the tax cut. The potential reason can be that firms located in non-combined states can take more tax benefit through regulatory arbitrage across states. Once the tax rate cut, they do not hold the same incentive to explore the tax shelter and therefore mitigate overinvestment.

4.5 Mechanism

As we discussed in previous sections, suboptimal investment can result from different incentives. Our previous results show an asymmetric impact of tax changes on investment efficiency: the tax cut tends to mitigate underinvestment while tax increase can intensify overinvestment. According to results, we predict that tax changes impact underinvestment and overinvestment through different channels. In this section, we provide further evidence to prove the potential mechanism through which tax changes affect investment efficiency.

4.5.1 The financial constraints channel

The tax cut actually reduces firms' cash tax payment and create a cash windfall in a short-term time period. The sudden increased internal cash flow provides firms with additional funding which is an important source for investment. Specifically, for

financially constrained firms, they better benefit from the cash windfall and thereby engage in the investment which they have to forego without the cash tax saving (Blouin et al., 2020; Faulkender and Petersen, 2012; Fazzari et al., 1988). This suggests that tax policy may impact investment of the constrained firms, especially the quantity of internal funds available for investment is supported by the average tax on earnings from existing projects. Under this case, the tax rate faced by a firm affects its investment decision. To examine this prediction, we test whether tax cut has a more pronounced effect in mitigating underinvestment inefficiency among firms which experience greater financial constraints by employing the specification (4.4). We partition firms into top 67 and bottom 33 percentile of their financial constraints level which measured by three different financial constraints proxies: KZ index, WW index and SA index (Hadlock and Pierce 2010; Kaplan and Zingales 1997; Lamont, Polk, and Saá-Requejo 2001; Toni M Whited and Wu 2006). The detailed calculation is reported in Appendix A.3, greater value indicates more financial constraints. Bottom 33 (Top67) set to one if $Firm_i$ falls in the bottom 33 (top 67) percentiles based on the financial constraints measures. If the tax cut create the tax cash saving windfall and consequently provides additional investment source, we expect a significant and negative coefficient $\beta_{D,top} < 0$. The results are presented in Table 4.5.

Overall, we find that the coefficients on the interaction between $Tax\ Decrease_{s,top}$ and $Top67$ are negative and significant across all three columns by using different financial constraints measures. Contrast to counterparties which lie in the bottom percentile of the financial constrained level, firms which are more financially constrained are more likely response to tax cut and mitigate underinvesting. Collectively, these results indicate that the effect of tax cut on alleviating underinvestment is more salient for firms that are financially constrained.

Table 4.5 Tax change and investment efficiency: Financial constraints Channel

This table reports the results of the effect of tax changes on investment efficiency for firms with different level of financial constraints, where we use three measures of financial constraints: KZ index, WW index and SA index. All regressions include control variables used in our baseline specification, and firm and year fixed effects. Firm-clustered robust standard errors are reported in parentheses. *,** and*** indicate significance level at 10%, 5% and 1%, respectively. The definition of variables are reported in Appendix A.

	KZ Index	WW Index	SA Index
	(1)	(2)	(3)
	Underinvestment	Underinvestment	Underinvestment
Tax Increase*Bottom 33	-0.000	0.001	0.003
	(0.003)	(0.003)	(0.004)
Tax Increase* Top 67	-0.000	0.001	0.000
	(0.003)	(0.003)	(0.002)
Tax Decrease*Bottom 33	-0.004	-0.004	-0.003
	(0.003)	(0.002)	(0.003)
Tax Decrease* Top 67	-0.005***	-0.005**	-0.005***
	(0.002)	(0.002)	(0.002)
Control Variables	Yes	Yes	Yes
Year Fixed effect	Yes	Yes	Yes
Firm Fixed effect	Yes	Yes	Yes
_cons	0.031**	0.036***	0.040***
	(0.012)	(0.011)	(0.013)
N	22837	26438	25988
adj. R-sq	0.103	0.107	0.109

4.5.2 The agent cost channel

On the other side, the tax increase actually provides managers incentives to take advantage of tax benefits which can distort investment efficiency in the end. Higher tax rate means more tax payment if the taxable income holds the same. At the meantime, higher tax rate also provides higher tax saving per dollars tax deduction. The tax increase provides managers incentives to take advantage of the tax shelter and such incentives can lead to the distort of investment decision and therefore depart from firms' optimal level. Also, managers may be more incentives to engage in agency-motivated investment, e.g. empire building, because of the reduced after-tax return. Specifically, when the positive projects are all undertaken, managers are induced to invest in projects which are less profitable and harm shareholder's value in the end. Existing studies document that agency cost can arise from higher cash flows as managers are more capable to engage in inefficiency investment decision or satisfy their own specific objective (Blanchard et al., 1994; Jensen, 1986). Richardson (2006) finds that overinvestment is concentred in firms with the highest levels of free cash flow which consistent with agency cost explanations. If the impact of a tax increase on overinvestment efficiency is through the agency cost channel, we should see firms which expose to a higher agency cost problem respond overinvestment efficiency strongly to a tax increase. To test the conjecture, we use the specification (4.4) and classify firms into Bottom 33 and Top 67 by using three measures: *overfirm*, *cash holding* and *Institutional ownership*. First, we follow Biddle et al. (2009) create the variable *overfirm*. The variable is a ranked variable based on the average of a ranked (deciles) measure of cash and leverage. The leverage is multiplied by minus one before ranking so that both variables are increasing in the likelihood of over-investment. Therefore, the *overfirm* captures the potential agency cost and the tendency for over investing. The second measure is the *cash holding* of firms which is measured as the ratio of cash and cash equivalents to PP&E. Higher value of *overfirm* and *cash holding* indicates greater agency cost. The third measure of agency cost we used is the share of institutional owners. The institutional investors represent a monitoring mechanism to curb managers' inefficiency investment decision (T. Chen et al. 2017; Ward et al. 2020). We expect that firms with greater share of institutional investors are better monitored and exposed to a lower agency problem. Lower value of *Institutional Ownership* indicates less monitoring and greater agency problem. Detailed definition of the variables can be found in Appendix A.3. The results are reported in Table 4.6.

Column (1) and (2) presents the results of agency cost proxied by *overfirm* and *cash holding*. We find that compared to firms which lie in the bottom of the agency cost, the coefficients on *Tax Increase* and *Top 67* are both positive and significant at 95% confidence level. These results suggest that firms which experience greater agency cost problems tend to intensify the positive impact of the tax increase and overinvestment. Column (3) shows the result by using the ratio of institutional ownership as the measure of agency cost. We find that firms with the lowest share of institutional ownership intend to amplify the impact of the tax increase on overinvestment. The coefficient of the interaction between *Tax Increase* and *Bottom33* is significant at 99% confidence level and also the magnitude is much larger compared to the coefficient on the interaction between *Tax Increase* and *Top 67*. This result suggests that firms with fewer institutional investors which are less monitored and exposed to greater agency problems, and these firms are more likely to intensify the positive impact of the tax increase on overinvestment efficiency. Collectively, all the results found in this section suggest that the tax increase exacerbate overinvestment inefficiency among firms with higher agency costs and less monitored.

Table 4.6 Tax change and investment efficiency: Agency Cost Channel

This table reports the results of the effect of tax changes on investment efficiency for firms with different level of agency costs, where we use two measures of agency cost: Over Firm, Cash holding and Share of Institutional Ownership. All regressions include control variables used in our baseline specification, and firm and year fixed effects. Firm-clustered robust standard errors are reported in parentheses. *,** and*** indicate significance level at 10%, 5% and 1%, respectively. The definition of variables are reported in Appendix A.

	Overfirm	Cash holding	Institutional Ownership
	(1)	(2)	(3)
	Overinvestment	Overinvestment	Overinvestment
Tax Increase*Bottom 33	-0.001	0.005	0.057***
	(0.017)	(0.016)	(0.020)
Tax Increase* Top 67	0.026**	0.027**	0.007
	(0.011)	(0.011)	(0.010)
Tax Decrease*Bottom 33	-0.008	0.004	-0.023
	(0.014)	(0.010)	(0.018)
Tax Decrease* Top 67	-0.010	-0.015	-0.005
	(0.008)	(0.009)	(0.007)
Control Variables	Yes	Yes	Yes
Year Fixed effect	Yes	Yes	Yes
Firm Fixed effect	Yes	Yes	Yes
_cons	0.475***	0.499***	0.498***
	(0.048)	(0.045)	(0.045)
N	13082	13082	13082
adj. R-sq	0.102	0.102	0.102

4.6 Robustness test

In this section we conduct a serial of robustness checks on our main findings. First, we examine whether our results are driven by the measure of investment efficiency. Therefore, we follow Chen et al. (2011) to construct the investment model and reestimate the investment efficiency. Different from Biddle et al. (2009), this model estimates expected investment as a function of revenue growth. Following Chen et al. (2011), we define firms as underinvestment if they negatively deviate from expected investment level or overinvestment if they positively deviate from the expected level. We take the absolute value of the residual of the model to measure the investment efficiency, greater value indicates less efficient. The results are reported in Column (1) and (2) in table 4.7, which is consistent with our baseline results. However, there is weak evidence shows that the tax cut will alleviate overinvestment, but such a result is not persistent across our empirical tests. As we discussed before, the potential reason can be that the reduced the tax rate also reduce managers' incentive of using tax benefits, and more effort from managers in investment decision making because of a higher after-tax return, consequently followed with alleviated overinvestment efficiency.

Another concern of our baseline results is that multinational corporations can adopt tax avoidance strategies through their overseas subsidiaries, as well as the tax rate charged by the overseas countries affect their capital decision (Faulkender and Smith 2016). Therefore, we exclude firms which have foreign income from our sample and run the baseline regression again. The results are reported in column (3) and (4). We continue to observe the results which we find in the baseline regression.

Last, we add additional state-level macroeconomic factors, including GDP growth rate, logarithm value of GDP and the state tax revenue to GDP. All these macroeconomic data are derived from the U.S. Bureau of Economic Analysis. The results are presented in column (5) and (6). We show that our main findings remain unchanged. We observe that the macroeconomic factors intend to affect underinvestment but less likely to affect overinvestment. The potential explanation

could be that the overall financial conditions tend to affect underinvestment but not the overinvestment. This somehow support our findings in section 4.5. that the different channels through which tax rate changes affect investment efficiency.

Taken together, the results from Table 4.7 indicate a robust impact of tax changes on investment efficiency.

Table 4.7 Robustness Test

This table provides further robustness checks to the baseline regression as presented in table 4.2. Column (1) and (2) report the regression estimation of baseline by using alternative measure of investment efficiency. Following Chen et al., (2011), we construct the investment efficiency and estimate the tax changes on underinvestment and overinvestment respectively. In Column (3) and (4), we report results only for domestic firms, which with zero foreign pre-tax income. Column (5) and (6) report the regression estimation of baseline with additional control of state level macroeconomic characters. All regressions include control variables used in our baseline specification, and firm and year fixed effects. Firm-clustered robust standard errors are reported in parentheses. *,** and*** indicate significance level at 10%, 5% and 1%, respectively. The definition of variables are reported in Appendix A.3.

	(1)	(2)	(3)	(4)	(5)	(6)
	Underinvestment	Overinvestment	Underinvestment	Overinvestment	Underinvestment	Overinvestment
Tax Increase	0.002	0.022**	0.000	0.026*	0.001	0.021**
	(0.002)	(0.009)	(0.003)	(0.014)	(0.002)	(0.009)
Tax Decrease	-0.004**	-0.013*	-0.006***	-0.005	-0.005***	-0.009
	(0.002)	(0.007)	(0.002)	(0.011)	(0.002)	(0.007)
GDP growth rate					0.001**	-0.000
					(0.000)	(0.001)
Log GDP					-0.033***	-0.040
					(0.012)	(0.054)
State Tax revenue to GDP					-0.281*	-0.653
					(0.151)	(0.762)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
_cons	0.024**	0.492***	0.047***	0.529***	0.462***	1.032
	(0.010)	(0.043)	(0.012)	(0.056)	(0.149)	(0.679)
N	26566	13785	17146	8379	27254	13079
adj. R-sq	0.086	0.094	0.105	0.126	0.107	0.101

4.7 Conclusion

As the most important fiscal instrument, tax has been employed by the government to accelerate firms' investment and stimulate the local economic growth and employment. Compare to federal corporate income tax policy reforms, adjusting state corporate income tax rate are employed frequently by the local government. In this paper, we use staggered changes in state corporate tax rate in the U.S. to examine the impact of tax policy on investment efficiency at firm level. We find evidence that the tax policy changes can affect firms investment efficiency asymmetrically, the tax rate increase aggravates overinvestment problem but a tax cut mitigate underinvestment. We further prove that this asymmetrical impacts of tax changes on investment efficiency are through different channels: the financial constraints channel and the agency cost channel. Different from existing researches on tax reform and firm investment decision, we provide new evidence to show the causal effect of general tax policy on investment from shareholders' perspective. Importantly, tax policy plays an essential role in corporate investment decision making. While increasing the tax rate can increase the revenue for the government, it may distort firms' investment efficiency at the cost of shareholders' value.

Chapter 5

Conclusion

This thesis studies the real effect and consequence of financial regulatory reform and development over the last decades, including three thorough studies examine the effects from different aspects. The results found in this thesis highlight the importance of proper regulation design and provide implications for future policy reform. This chapter begins with the summary of the key findings, contributions and implications, followed by the limitation and suggestion for future research.

5.1 Key findings, contributions and implications

The first study in Chapter 2 investigates how regulation and supervision affect individual bank's systemic risk exposure across countries. Using data for banks from 65 countries for the period 2001-2013, we find that bank activity restriction, initial capital stringency and prompt corrective action are all positively related to systemic risk as measure by *Marginal Expected Shortfall*. To address the potential endogeneity issue, we employ the staggered timing of the implementation of Basel II regulation across countries as an exogenous event and conduct a *Difference-in-Difference* estimation. We next employ country's latitude as the instrumental variable to conduct the two-step least square regression analysis. Our results also hold for a series of robustness tests. The further results show that the level of equity and diversification can alleviate such effect, while bank size is likely to enhance the effect. The study highlights the importance of banks capability of raising capital especially when the overall financial system is undercapitalized. However, our results do not argue against bank regulation, but rather focus on the design and implementation of the regulation.

The study contributes to the existing argument on the regulatory and supervisory environment in which banks operate has significant impacts on their systemic risk, contributing to the understanding of the association between bank regulation and systemic stability, providing important implications to governments and policymakers. Specifically, we tend to address the increasing concerns on whether

regulatory mechanisms designed are effective in enhancing the stability of the whole financial system. This study also related to Ponce and Rennert (2015) which highlight the role and responsibility of central bank, to be the lender of last resort for banks in a larger range of its liquidity shortfall. Matousek et al. (2020) also emphasise the importance of policymakers and politicians' timely and decisive response during a severe market decline. Our results provide policy implications that assisting banks in raising capital to smooth their capital shortfall in difficult time can mitigate the systemic risk they expose, which can be considered in future policy design. Our results echo the argument in Aikman et al. (2018) that implementation of qualitative elements of Basel III to avoid capital shortfall, e.g. counter-cyclical capital buffer.

The second study in Chapter 3 examines the regulation reform in banking and its spillover effect on firms. Specifically, we study how firms CSR response to external credit market development by exploiting the Riegle-Neal Interstate Banking and Branching Efficiency Act (IBBEA). The IBBEA passes in 1994 which allows unrestricted interstate banking significantly increase competition among banks within states, consequently expands the availability of credit and lowers the cost of capital. We find that the deregulation leads to a significant and persistent decrease in firm CSR, indicating firms show "doing good" for the access to finance when they are captured by the uncompetitive credit market. The results continue to hold after the endogenous tests and robustness tests. We rule out the alternative explanation to our results that the banking relationship change from relationship lending to transaction basis caused by the deregulation. In the end, we provide further evidence to show that the negative impact of bank deregulation on CSR is through the financial constraints channel.

In this study, we provide a clean setting on the exogenous increase in banking competition caused by regulations, contributing to the recent literature on the determinants of firms CSR activities. We first link firm CSR with external financial environment development, provide evidence that firms more susceptible to capture by banks exhibit a more pronounced decrease in CSR when such capture is dismantled by IBBEA. The exogenous event with IBBEA in the lending market allows us to reveal that banks with market monopolistic power may cause firms to invest excessively in CSR. Once banks' market monopoly power disappears, firms will make the optimal decision in CSR by suppressing excessive investment. The evidence suggests that CSR is socially inefficient in uncompetitive markets as firms can be captured by lending

groups' interest. We also highlight that a competitive credit market is important, especially for firms that rely heavily on external financing.

This study also has important implication for policy towards CSR. As suggested in Dharmapala and Khanna (2018), the overall CSR activity increased when firms subject to a mandatory requirement of the minimum spending threshold on CSR. however, for firms who initially spend more than the threshold tend to reduce their CSR expenditure after the policy implemented. Similarly, Manchiraju and Rajgopal (2017) also suggest the mandatory CSR policy will reduce shareholder value. Firms voluntarily choose CSR to maximize shareholder value. Forcing firms to investment on CSR is likely to be sub-optimal for firms as it can impose social burdens on business activities at the cost of shareholders, consequently negative impact on shareholder value. These evidence suggest that firms which are allowed to choose their optimal level of CSR tend to maximize their firm value. For policymakers and regulators, understanding the original motivation of CSR is important. The joint effects of institutional development and financial market frictions should be taken into consideration if they would like to see more socially responsible activities from firms. Similar to mandatory CSR requirement, stakeholder's pressure can also drive firms to engage in involuntary CSR activity, while once such pressure has been removed, their CSR will drop consequently. Therefore, future policy design can also consider to give firms private returns from CSR activities, which can motivate firm to voluntarily engage more in CSR.

In the previous two studies, we first examined the regulation development in banking and its impact on banks themselves. Next, we focus on the regulatory reform which happens in banking but its spillover effect on industry firms. In the last study of this thesis, we extend our study scope by investigating how general tax regulation change can affect corporate investment efficiency. By exploiting staggered changes in the state-level corporate income tax rate, we find that the tax rate changes tend to affect firms' investment efficiency asymmetrically: the tax increases aggravates overinvestment while tax cut mitigates underinvestment. Moreover, the impact of tax changes on investment efficiency would be more significant for firms who are aggressive in tax planning or less capable in tax avoidance activities. We further provide evidence to show that the asymmetrical effects of tax changes through

financing channel and agency cost channel respectively. The results keep unchanged after the endogeneity tests and a series of robustness tests.

This study adds new evidence to literature on the determinates of firm-level investment efficiency. Although existing studies on how tax can accelerate investment have been well established, we investigate the tax induced investment from shareholders perspective by examining the investment efficiency. In addition, we document that the underlying channels for the asymmetrical effects on investment efficiency, i.e. the financing channel and the agency channel. This study is also related to recent tax changes in the U.S., the Tax Cuts and Jobs Act (TCJA) signed in 2017 which reduces the corporate income tax from 35% to 21% since 2018. Compare to country level tax reform which are rare and far between, state level tax rate changes are more frequent and are most employ by the local government. Existing studies in state tax rate that find tax increase can hinder innovation, increase firm long-term leverage and reduce risk taking (Heider and Ljungqvist 2015; Ljungqvist et al. 2017; Mukherjee et al. 2017), and tax decrease can foster firm's innovation (Atanassov and Liu 2019). Our findings add new evidence to existing literature of state level tax rate changes and provide policy implications related to tax changes at the state level. As the most used fiscal policy, the general corporate tax rate changes may accelerate the overall investment but it may at the cost of shareholders' value.

5.2 Limitation and future research

The Global Financial Crisis in 2007 highlights the importance of the appropriate design of financial regulations, as the impact may not only on the target institutions but can also spillover to industry firms and the real economy. By conducting these three thorough studies which investigate the impact of regulation reforms from different aspects, we provide new evidence to show how regulations can affect financial institutions, industry firms and common welfare. The thesis shows that regulation reforms sometimes may cause unintended consequence which is mismatched to policymakers original purpose. Understand the potential channels of regulations work through are also important. We provide evidence to show the potential mechanism how the regulation can cause the results we found in the studies. These evidence can be useful to policymakers in future regulation design.

In the first chapter, we highlight the importance of the capability of banks' capital raising, especially when the whole system is under distress. Our findings suggest that the increasing similarity in the banking system due to the restriction on bank activities will impede banks stability through the capital shortfall channel. There are still several limitations for this study. First, in the empirical analysis, as suggested in recent literature, an alternative measure of systemic risk namely ΔCoVaR, which measures conditions on the distress of a single financial institution. However, due to the data availability of ΔCoVaR, we fail to perform the analysis by using ΔCoVaR but only use MES as the main measure of systemic risk[11]. Second, we argue that restrict regulation and supervision can lead to higher systemic risk, but we do not argue the direct impact of regulation on bank systemic risk. Therefore, one potential future research could be how the regulation and supervision stringency can affect banks assets allocation as well as their risk appetite. Both the assets allocation and the risk taking behaviours can affect bank's systemic risk in the end.

In the second chapter, our results provide new evidence to controversial views of why firms engage in CSR activities. Although we provide a cleaner setting by exploiting the staggered bank branch deregulation as a quasi-natural experiment, there are still several limitations. First, our empirical results are based on a relatively small sample of large firms due to data availability. The KLD data begins in 1991 only covers firms in S&P 500 and Domini 400 Social Index. We also require firms that have existed both before and after deregulation, therefore, the sample includes in 364 firms throughout the whole sample period. Also, due to the nature of the KLD data, it covers large firms only in the early 1990s. Therefore, for small firms, their responses to increased external financing access could be different from these large firms (Mcwilliams and Siegel 2001). We encourage future research to examine the potential difference between large and small firms in their CSR response to external credit shock.

[11] In the ΔCoVaR measure, it is required to measure the normal status of the market by using a set of macroeconomic condition variables, including the VIX, liquidity spread (the three-month repo rate the three-month bill rate), change in the three-month Treasury bill rate, change in the slope of the yield curve (the yield-spread between the ten-year Treasure rate and the three-month bill rate), change in credit spread (spread between BAA rated bonds and the Treasure rate) weekly equity market return, and one year cumulative real estate sector return (the return of real estate companies). We fail to use this measure for two reasons. First, the original proposal of CoVaR is under US market background, and the required macroeconomic condition variables are also based on the availability of US market. Therefore, we need to find same macroeconomic conditional variables to benchmark US proxies. Second, in our sample, we also cover a cluster of developing countries. For these countries, many of the macroeconomic condition variables are usually unavailable. Based on these two reasons, we only use MES as the measure of systemic risk.

Nevertheless, this study expands the current CSR researches by examining the external development of the financial market, and linking the literature with firms CSR performance as an unintended consequence of the deregulation. One caveat of our study is that our analysis does not argue the bank deregulation will negatively affect the social welfare. Instead, we would like to explore how the regulation reform can affect firm's CSR behaviours.

Last, in the third study, we exploit the corporate income tax change at state level and the impact on investment efficiency. We rely on the information in Compustat of firm's headquarter as the identification of whether firms expose to state-level tax change. While under the U.S. tax system, a multistate firm's federal taxable income is apportioned to each nexus state using a formula based on an average of the fractions of the firm's total payroll, sales, and property located in that state. Therefore, the extent to which a multistate firm is exposed to a give state income tax change depends on the extent of its nexus to that state. Due to the data limitation, we have no further information on firms plants' location. This potential issue may lead to an underestimation of the coefficient magnitude of tax changes on investment efficiency. For future studies, add the firm's plant-level information will enhance the credit of estimating the impact of the state level policy changes.

Reference

Abel, Andrew B. 1983. “Optimal Investment under Uncertainty.” *American Economic Review* 73(1):228–33.

Abeysekera, Amal P., and Chitru S. Fernando. 2020. “Corporate Social Responsibility versus Corporate Shareholder Responsibility: A Family Firm Perspective.” *Journal of Corporate Finance* 61(May). doi: 10.1016/j.jcorpfin.2018.05.003.

Acemoglu, Daron, Simon Johnson, and James A. Robinson. 2001. “The Colonial Origins of Comparative Development: An Empirical Investigation.” *American Economic Review* 91(5):1369–1401. doi: 10.1257/aer.91.5.1369.

Acemoglu, Daron, Asuman Ozdaglar, and Alireza Tahbaz-Salehi. 2015. “Systemic Risk and Stability in Financial Networks.” *American Economic Review* 105(2):564–608. doi: 10.1257/aer.20130456.

Acharya, Viral, Robert Engle, and Matthew Richardson. 2012. “Capital Shortfall: A New Approach to Ranking and Regulating Systemic Risks.” Pp. 59–64 in *American Economic Review*. Vol. 102.

Acharya, Viral V. 2009. “A Theory of Systemic Risk and Design of Prudential Bank Regulation.” *Journal of Financial Stability* 5(3):224–55. doi: 10.1016/j.jfs.2009.02.001.

Acharya, Viral V., Lasse H. Pedersen, Thomas Philippon, and Matthew Richardson. 2017. “Measuring Systemic Risk.” *Review of Financial Studies* 30(1):2–47. doi: 10.1093/rfs/hhw088.

Adhikari, Binay K. 2016. “Causal Effect of Analyst Following on Corporate Social Responsibility.” *Journal of Corporate Finance* 41:201–16. doi: 10.1016/j.jcorpfin.2016.08.010.

Adrian, Tobias, and Markus K. Brunnermeier. 2016. “CoVaR.” *American Economic Review* 106(7):1705–41. doi: 10.1257/aer.20120555.

Agoraki, Maria Eleni K., Manthos D. Delis, and Fotios Pasiouras. 2011. “Regulations, Competition and Bank Risk-Taking in Transition Countries.” *Journal of Financial Stability* 7(1):38–48. doi: 10.1016/j.jfs.2009.08.002.

Aikman, David, Andrew G. Haldane, Marc Hinterschweiger, and Sujit Kapadia. 2018. *Staff Working Paper No. 712 Rethinking Financial Stability*.

Ajello, Andrea. 2016. “Financial Intermediation, Investment Dynamics, and Business Cycle Fluctuations.” *American Economic Review* 106(8):2256–2303. doi: 10.1257/aer.20120079.

Allen, Franklin, and Douglas Gale. 2007. “Systemic Risk and Regulation.” Pp. 341–76 in *The risks of financial institutions*. University of Chicago Press.

Allen, Linda, Turan G. Bali, and Yi Tang. 2012. “Does Systemic Risk in the Financial

Sector Predict Future Economic Downturns?" *Review of Financial Studies* 25(10):3000–3036.

Almeida, Heitor, and Murillo Campello. 2007. "Financial Constraints, Asset Tangibility, and Corporate Investment." *Review of Financial Studies* 20(5):1429–60. doi: 10.1093/rfs/hhm019.

Amore, Mario Daniele, Cédric Schneider, and Alminas Žaldokas. 2013. "Credit Supply and Corporate Innovation." *Journal of Financial Economics* 109(3):835–55. doi: 10.1016/j.jfineco.2013.04.006.

Anginer, Deniz, Ata Can Bertay, Robert Cull, Asli Demirgüç-Kunt, and Davide S. Mare. 2019. "Bank Regulation and Supervision Ten Years after the Global Financial Crisis." *Policy Research Working Paper, World Bank* 9044.

Anginer, Deniz, and Asli Demirgüç-Kunt. 2019. "Bank Runs and Moral Hazard: A Review of Deposit Insurance." *The Oxford Handbook of Banking* (December):684–706. doi: 10.1093/oxfordhb/9780198824633.013.22.

Anginer, Deniz, Asli Demirguc-Kunt, and Min Zhu. 2014a. "How Does Competition Affect Bank Systemic Risk?" *Journal of Financial Intermediation* 23(1):1–26. doi: 10.1016/j.jfi.2013.11.001.

Anginer, Deniz, Asli Demirguc-Kunt, and Min Zhu. 2014b. "How Does Deposit Insurance Affect Bank Risk? Evidence from the Recent Crisis." *Journal of Banking and Finance* 48:312–21. doi: 10.1016/j.jbankfin.2013.09.013.

Arnold, Bruce, Claudio Borio, Luci Ellis, and Fariborz Moshirian. 2012. “Systemic Risk, Macroprudential Policy Frameworks, Monitoring Financial Systems and the Evolution of Capital Adequacy.” *Journal of Banking and Finance* 36(12):3125–32. doi: 10.1016/j.jbankfin.2012.07.023.

Atanassov, Julian, and Xiaoding Liu. 2019. “Can Corporate Income Tax Cuts Stimulate Innovation?” *Journal of Financial and Quantitative Analysis* 55(5):1–51. doi: 10.1017/s0022109019000152.

Atanassov, Julian, and Xiaoding Liu. 2020. “Can Corporate Income Tax Cuts Stimulate Innovation?” *JOURNAL OF FINANCIAL AND QUANTITATIVE ANALYSIS* 55(5):1415–65. doi: 10.1017/S0022109019000152.

Bachmann, Rüdiger, and Christian Bayer. 2014. “Investment Dispersion and the Business Cycle.” *American Economic Review* 104(4):1392–1416. doi: 10.1257/aer.104.4.1392.

Baele, Lieven, Olivier De Jonghe, and Rudi Vander Vennet. 2007. “Does the Stock Market Value Bank Diversification?” *Journal of Banking and Finance* 31(7):1999–2023. doi: 10.1016/j.jbankfin.2006.08.003.

BAHAJ, SALEEM, FREDERIC MALHERBE, and FREDERIC Malherebe. 2020. “The Forced Safety Effect: How Higher Capital Requirements Can Increase Bank Lending.” *The Journal of Finance* 13(3):jofi.12958. doi: 10.1111/jofi.12958.

Barigozzi, Francesca, and Piero Tedeschi. 2015. “Credit Markets with Ethical Banks

and Motivated Borrowers." *Review of Finance* 19(3):1281–1313. doi: 10.1093/rof/rfu030.

Barnea, Amir, and Amir Rubin. 2010. "Corporate Social Responsibility as a Conflict Between Shareholders." *Journal of Business Ethics* 97(1):71–86. doi: 10.1007/s10551-010-0496-z.

Barrot, Jean Noël. 2016. "Trade Credit and Industry Dynamics: Evidence from Trucking Firms." *Journal of Finance* 71(5):1975–2016. doi: 10.1111/jofi.12371.

Barth, James R., Gerard Caprio, and Ross Levine. 2004. "Bank Regulation and Supervision: What Works Best?" *Journal of Financial Intermediation* 13(2):205–48. doi: 10.1016/j.jfi.2003.06.002.

Barth, James R., Gerard Caprio, and Ross Levine. 2008. *Rethinking Bank Regulation: Till Angels Govern*. Cambridge University Press.

Barth, James R., Gerard Caprio, and Ross Levine. 2013. "Bank Regulation and Supervision in 180 Countries from 1999 to 2011." *Journal of Financial Economic Policy* 5(2):111–219. doi: 10.1108/17576381311329661.

Barth, James R., Chen Lin, Ping Lin, and Frank M. Song. 2009. "Corruption in Bank Lending to Firms: Cross-Country Micro Evidence on the Beneficial Role of Competition and Information Sharing." *Journal of Financial Economics* 91(3):361–88. doi: 10.1016/j.jfineco.2008.04.003.

Barth, James R., Chen Lin, Yue Ma, Jesús Seade, and Frank M. Song. 2013. “Do Bank Regulation, Supervision and Monitoring Enhance or Impede Bank Efficiency?” *Journal of Banking and Finance* 37(8):2879–92. doi: 10.1016/j.jbankfin.2013.04.030.

Beck, Thorsten, Asli Demirgüç-Kunt, and Ross Levine. 2003. “Law, Endowments, and Finance.” *Journal of Financial Economics* 70(2):137–81. doi: 10.1016/S0304-405X(03)00144-2.

Beck, Thorsten, Asli Demirgüç-Kunt, and Ross Levine. 2006. “Bank Supervision and Corruption in Lending.” *Journal of Monetary Economics* 53(8):2131–63. doi: 10.1016/j.jmoneco.2005.10.014.

Beck, Thorsten, Olivier De Jonghe, and Glenn Schepens. 2013. “Bank Competition and Stability: Cross-Country Heterogeneity.” *Journal of Financial Intermediation* 22(2):218–44. doi: 10.1016/j.jfi.2012.07.001.

Beck, Thorsten, Ross Levine, and Alexey Levkov. 2010. “Big Bad Banks? The Winners and Losers from Bank Deregulation in the United States.” *Journal of Finance* 65(5):1637–67. doi: 10.1111/j.1540-6261.2010.01589.x.

Benabou, Roland, and Jean Tirole. 2010. “Individual and Corporate Social Responsibility.” *Economica* 77(305):1–19. doi: 10.1111/j.1468-0335.2009.00843.x.

Bennett, Benjamin, Anjan V. Thakor, and Zexi Wang. 2019. “Stock Repurchases and

the 2017 Tax Cuts and Jobs Act." *SSRN Electronic Journal*. doi: 10.2139/ssrn.3443656.

Berger, Allen N., Raluca A. Roman, and John Sedunov. 2019. "Did TARP Reduce or Increase Systemic Risk? The Effects of Government Aid on Financial System Stability." *Journal of Financial Intermediation*. doi: 10.1016/j.jfi.2019.01.002.

Berger, Allen N., and Gregory F. Udell. 2002. "Small Business Credit Availability and Relationship Lending: The Importance of Bank Organisational Structure." *Economic Journal* 112(477):F32–53. doi: 10.1111/1468-0297.00682.

von Beschwitz, Bastian. 2018. "Cash Windfalls and Acquisitions." *Journal of Financial Economics* 128(2):287–319. doi: 10.1016/j.jfineco.2018.02.009.

Bhandari, Avishek, and David Javakhadze. 2017. "Corporate Social Responsibility and Capital Allocation Efficiency." *Journal of Corporate Finance* 43:354–77. doi: 10.1016/j.jcorpfin.2017.01.012.

Biddle, Gary C., and Gilles Hilary. 2006. *Accounting Quality and Firm-Level Capital Investment*. Vol. 81.

Biddle, Gary C., Gilles Hilary, and Rodrigo S. Verdi. 2009. "How Does Financial Reporting Quality Relate to Investment Efficiency?" *Journal of Accounting and Economics* 48(2–3):112–31. doi: 10.1016/j.jacceco.2009.09.001.

Billio, Monica, Mila Getmansky, Andrew W. Lo, and Loriana Pelizzon. 2012.

"Econometric Measures of Connectedness and Systemic Risk in the Finance and Insurance Sectors." *Journal of Financial Economics* 104(3):535–59. doi: 10.1016/j.jfineco.2011.12.010.

Bisias, Dimitrios, Mark Flood, Andrew W. Lo, and Stavros Valavanis. 2012. "A Survey of Systemic Risk Analytics." *Annual Review of Financial Economics* 4(1):255–96. doi: 10.1146/annurev-financial-110311-101754.

Black, Sandra E., and Philip E. Strahan. 2002. "Entrepreneurship and Bank Credit Availability." *Journal of Finance* 57(6):2807–33. doi: 10.1111/1540-6261.00513.

Blanchard, Olivier Jean, Florencio Lopez-de-Silanes, and Andrei Shleifer. 1994. "What Do Firms Do with Cash Windfalls?" *Journal of Financial Economics* 36(3):337–60. doi: 10.1016/0304-405X(94)90009-4.

Blouin, Jennifer L., Eliezer M. Fich, Edward M. Rice, and Anh L. Tran. 2020a. "Corporate Tax Cuts, Merger Activity, and Shareholder Wealth." *Journal of Accounting and Economics* 101315. doi: 10.1016/j.jacceco.2020.101315.

Blouin, Jennifer L., Eliezer M. Fich, Edward M. Rice, and Anh L. Tran. 2020b. "Corporate Tax Cuts, Merger Activity, and Shareholder Wealth." *Journal of Accounting and Economics* 101315. doi: 10.1016/j.jacceco.2020.101315.

Bolton, Patrick, Hui Chen, and Neng Wang. 2011. "A Unified Theory of Tobin'sq, Corporate Investment, Financing, and Risk Management." *Journal of Finance* 66(5):1545–78. doi: 10.1111/j.1540-6261.2011.01681.x.

Boyd, John H., Chun Chang, and Bruce D. Smith. 1998. “Moral Hazard under Commercial and Universal Banking.” *Journal of Money, Credit and Banking* 30(3):426. doi: 10.2307/2601249.

Brammer, Stephen J., and Stephen Pavelin. 2006. “Corporate Reputation and Social Performance: The Importance of Fit.” *Journal of Management Studies* 43(3):435–55. doi: 10.1111/j.1467-6486.2006.00597.x.

Brown, Edgar Cary. 1962. “Tax Incentives for Investment.” *The American Economic Review* 52(2):335–45.

Brownlees, Christian, and Robert F. Engle. 2017. “SRISK: A Conditional Capital Shortfall Measure of Systemic Risk.” *Review of Financial Studies* 30(1):48–79. doi: 10.1093/rfs/hhw060.

Brunnermeier, Markus Konrad, Gang Nathan Dong, and Darius Palia. 2019. “Banks’ Non-Interest Income and Systemic Risk.” *SSRN Electronic Journal*. doi: 10.2139/ssrn.3328890.

Buchanan, Bonnie, Cathy Xuying Cao, and Chongyang Chen. 2018. “Corporate Social Responsibility, Firm Value, and Influential Institutional Ownership.” *Journal of Corporate Finance* 52(June):73–95. doi: 10.1016/j.jcorpfin.2018.07.004.

Burgstahler, David, and Ilia Dichev. 1997. “Earnings Management to Avoid Earnings Decreases and Losses.” *Journal of Accounting and Economics* 24(1):99–126. doi: 10.1016/S0165-4101(97)00017-7.

Bushman, Robert M., and Christopher D. Williams. 2012. “Accounting Discretion, Loan Loss Provisioning, and Discipline of Banks’ Risk-Taking.” *Journal of Accounting and Economics* 54(1):1–18. doi: 10.1016/j.jacceco.2012.04.002.

Cai, Ye, Hoje Jo, and Carrie Pan. 2012. “Doing Well While Doing Bad? CSR in Controversial Industry Sectors.” *Journal of Business Ethics* 108(4):467–80. doi: 10.1007/s10551-011-1103-7.

Campbell, John L. 2007. “Why Would Corporations Behave in Socially Responsible Ways? An Institutional Theory of Corporate Social Responsibility.” *Academy of Management Review* 32(3):946–67. doi: 10.5465/AMR.2007.25275684.

Cao, Jie, Hao Liang, and Xintong Zhan. 2019. “Peer Effects of Corporate Social Responsibility.” *Management Science* 65(12):5487–5503. doi: 10.1287/mnsc.2018.3100.

Caprio, Gerard, A. Demirguc-Kunt, and Edward J. Kane. 2010. “The 2007 Meltdown in Structured Securitization: Searching for Lessons, Not Scapegoats.” *The World Bank Research Observer* 25(1):125–55. doi: 10.1093/wbro/lkp029.

Carroll, Robert J., David M. Primo, and Brian K. Richter. 2016. “Using Item Response Theory to Improve Measurement in Strategic Management Research: An Application to Corporate Social Responsibility.” *Strategic Management Journal* 37(1):66–85. doi: 10.1002/smj.2463.

Cespa, Giovanni, and Giacinta Cestone. 2007. “Corporate Social Responsibility and

Managerial Entrenchment." *Journal of Economics and Management Strategy* 16(3):741–71. doi: 10.1111/j.1530-9134.2007.00156.x.

Cetorelli, Nicola, and Phillip E. Philip E. Strahan. 2006. "Finance as a Barrier to Entry: Bank Competition and Industry Structure in Local U.S. Markets." *Journal of Finance* 61(1):437–61. doi: 10.1111/j.1540-6261.2006.00841.x.

Chaney, Thomas, David Sraer, and David Thesmar. 2012. "The Collateral Channel: How Real Estate Shocks Affect Corporate Investment." *American Economic Review* 102(6):2381–2409.

Chava, Sudheer, Alexander Oettl, Ajay Subramanian, and Krishnamurthy V. Subramanian. 2013. "Banking Deregulation and Innovation." *Journal of Financial Economics* 109(3):759–74. doi: 10.1016/j.jfineco.2013.03.015.

Chen, Feng, Ole Kristian Hope, Qingyuan Li, and Xin Wang. 2011. "Financial Reporting Quality and Investment Efficiency of Private Firms in Emerging Markets." *Accounting Review* 86(4):1255–88. doi: 10.2308/accr-10040.

Chen, Ruiyuan, Sadok El Ghoul, Omrane Guedhami, and He Wang. 2017. "Do State and Foreign Ownership Affect Investment Efficiency? Evidence from Privatizations." *Journal of Corporate Finance* 42:408–21. doi: 10.1016/J.JCORPFIN.2014.09.001.

Chen, Shimin, Zheng Sun, Song Tang, and Donghui Wu. 2011. "Government Intervention and Investment Efficiency: Evidence from China." *Journal of*

Corporate Finance 17(2):259–71. doi: 10.1016/j.jcorpfin.2010.08.004.

Chen, Tao, Lingmin Xie, and Yuanyuan Zhang. 2017. "How Does Analysts' Forecast Quality Relate to Corporate Investment Efficiency?" *Journal of Corporate Finance* 43:217–40. doi: 10.1016/j.jcorpfin.2016.12.010.

Cheng, Beiting, Ioannis Ioannou, and George Serafeim. 2014. "Corporate Social Responsibility and Access to Finance." *Strategic Management Journal* 35(1):1–23. doi: 10.1002/smj.2131.

Cheng, Ing-Haw, Harrison Hong, and Kelly Shue. 2013. "Do Managers Do Good with Other People's Money?" *National Bureau of Economic Research*. doi: 10.3386/w19432.

Cheng, Mei, Dan Dhaliwal, and Yuan Zhang. 2013. "Does Investment Efficiency Improve after the Disclosure of Material Weaknesses in Internal Control over Financial Reporting?" *Journal of Accounting and Economics* 56(1):1–18. doi: 10.1016/j.jacceco.2013.03.001.

Cheung, Adrian Wai Kong. 2016. "Corporate Social Responsibility and Corporate Cash Holdings." *Journal of Corporate Finance* 37:412–30. doi: 10.1016/j.jcorpfin.2016.01.008.

Cho, Seong Y., Cheol Lee, and Ray J. Pfeiffer. 2013. "Corporate Social Responsibility Performance and Information Asymmetry." *Journal of Accounting and Public Policy* 32(1):71–83. doi: 10.1016/j.jaccpubpol.2012.10.005.

Choi, Jin Kyung, Rebecca N. Hann, Musa Subasi, and Yue Zheng. 2020. "An Empirical Analysis of Analysts' Capital Expenditure Forecasts: Evidence from Corporate Investment Efficiency." *Contemporary Accounting Research* 1911-3846.12597. doi: 10.1111/1911-3846.12597.

Chortareas, Georgios E., Claudia Girardone, and Alexia Ventouri. 2012. "Bank Supervision, Regulation, and Efficiency: Evidence from the European Union." *Journal of Financial Stability* 8(4):292–302. doi: 10.1016/j.jfs.2011.12.001.

Cole, Rebel A., Lawrence G. Goldberg, and Lawrence J. White. 2004. "Cookie Cutter vs. Character: The Micro Structure of Small Business Lending by Large and Small Banks." *Journal of Financial and Quantitative Analysis* 39(2):227–51.

Committee on Banking Supervision, Basel. 2004. *Basel Committee on Banking Supervision International Convergence of Capital Measurement and Capital Standards*.

Cook, Kirsten A., Andrea M. Romi, Daniela Sánchez, and Juan Manuel Sánchez. 2019. "The Influence of Corporate Social Responsibility on Investment Efficiency and Innovation." *Journal of Business Finance and Accounting* 46(3–4):494–537. doi: 10.1111/jbfa.12360.

Cornaggia, Jess, Yifei Mao, Xuan Tian, and Brian Wolfe. 2015. "Does Banking Competition Affect Innovation?" *Journal of Financial Economics* 115(1):189–209. doi: 10.1016/j.jfineco.2014.09.001.

Cornett, Marcia Millon, Otgontsetseg Erhemjamts, and Hassan Tehranian. 2016. "Greed or Good Deeds: An Examination of the Relation between Corporate Social Responsibility and the Financial Performance of U.S. Commercial Banks around the Financial Crisis." *Journal of Banking and Finance* 70:137–59. doi: 10.1016/j.jbankfin.2016.04.024.

Cull, Robert, Lemma W. Senbet, and Marco Sorge. 2002. "The Effect of Deposit Insurance on Financial Depth: A Cross-Country Analysis." *Quarterly Review of Economics and Finance* 42(4):673–94. doi: 10.1016/S1062-9769(02)00120-5.

Deli, Yota D., and Iftekhar Hasan. 2017. "Real Effects of Bank Capital Regulations: Global Evidence." *Journal of Banking and Finance* 82:217–28. doi: 10.1016/j.jbankfin.2016.11.022.

Delis, Manthos D., Philip Molyneux, and Fotios Pasiouras. 2011. "Regulations and Productivity Growth in Banking." *Business* 44(4):1–29.

Demirgüç-Kunt, Asli, and Enrica Detragiache. 2011. "Basel Core Principles and Bank Soundness: Does Compliance Matter?" *Journal of Financial Stability* 7(4):179–90. doi: 10.1016/j.jfs.2010.03.003.

Demirgüç-Kunt, Asli, and Edward J. Kane. 2002. "Deposit Insurance around the Globe: Where Does It Work?" *Journal of Economic Perspectives* 16(2):175–95.

Demirgüç-Kunt, Asli, and Tolga Sobaci. 2001. "A New Development Database. Deposit Insurance around the World." *World Bank Economic Review* 15(3):481–

90. doi: 10.1093/wber/15.3.481.

Deng, Lu, Ping Jiang, Sifei Li, and Mingqing Liao. 2017. “Government Intervention and Firm Investment.” *Journal of Corporate Finance*. doi: 10.1016/j.jcorpfin.2017.07.002.

Dewatripont, Mathias, and Jean Tirole. 1993. *Efficient Governance Structure: Implications for Banking Regulation*. Vol. 1235. Cambridge University Press, Cambridge.

DeYoung, Robert, William C. Hunter, and Gregory F. Udell. 2004. “The Past, Present, and Probable Future for Community Banks.” *Journal of Financial Services Research* 25(2/3):85–133. doi: 10.1023/B:FINA.0000020656.65653.79.

Dharmapala, Dhammika, C. Fritz Foley, and Kristin J. Forbes. 2011. “Watch What I Do, Not What I Say: The Unintended Consequences of the Homeland Investment Act.” *Journal of Finance* 66(3):753–87. doi: 10.1111/j.1540-6261.2011.01651.x.

Dharmapala, Dhammika, and Vikramaditya Khanna. 2018. “The Impact of Mandated Corporate Social Responsibility: Evidence from India’s Companies Act of 2013.” *International Review of Law and Economics* 56:92–104. doi: 10.1016/j.irle.2018.09.001.

Dobbins, Laura, and Martin Jacob. 2016. “Do Corporate Tax Cuts Increase Investments?” *Accounting and Business Research* 46(7):731–59. doi: 10.1080/00014788.2016.1192985.

Dyreng, Scott D., Bradley P. Lindsey, and Jacob R. Thornock. 2013. “Exploring the Role Delaware Plays as a Domestic Tax Haven.” *Journal of Financial Economics* 108(3):751–72. doi: 10.1016/j.jfineco.2013.01.004.

Edwards, Alexander, Casey Schwab, and Terry Shevlin. 2016. “Financial Constraints and Cash Tax Savings.” *Accounting Review* 91(3):859–81. doi: 10.2308/accr-51282.

Eisdorfer, Assaf, Carmelo Giaccotto, and Reilly White. 2013. “Capital Structure, Executive Compensation, and Investment Efficiency.” *Journal of Banking & Finance* 37(2):549–62. doi: 10.1016/J.JBANKFIN.2012.09.011.

Elfenbein, D. W., R. Fisman, and B. Mcmanus. 2012. “Charity as a Substitute for Reputation: Evidence from an Online Marketplace.” *The Review of Economic Studies* 79(4):1441–68. doi: 10.1093/restud/rds012.

Elliott, W. Brooke, Kevin E. Jackson, Mark E. Peecher, and Brian J. White. 2014. “The Unintended Effect of Corporate Social Responsibility Performance on Investors’ Estimates of Fundamental Value.” *The Accounting Review* 89(1):275–302. doi: 10.2308/accr-50577.

Ellis, Luci, Andy Haldane, and Fariborz Moshirian. 2014. “Systemic Risk, Governance and Global Financial Stability.” *Journal of Banking and Finance* 45(1):175–81. doi: 10.1016/j.jbankfin.2014.04.012.

Elyasiani, Elyas, and Lawrence G. Goldberg. 2004. “Relationship Lending: A Survey

of the Literature." *Journal of Economics and Business* 56(4):315–30. doi: 10.1016/j.jeconbus.2004.03.003.

Engle, Robert. 2018. "Systemic Risk 10 Years Later." *Annual Review of Financial Economics* 10(1):125–52. doi: 10.1146/annurev-financial-110217-023056.

Entine, Jon. 2003. "The Myth of Social Investing: A Critique of Its Practice and Consequences for Corporate Social Performance Research." *Organization and Environment* 16(3):352–68. doi: 10.1177/1086026603256283.

Faulkender, Michael, and Mitchell Petersen. 2012. "Investment and Capital Constraints: Repatriations under the American Jobs Creation Act." *Review of Financial Studies* 25(11):3351–88.

Faulkender, Michael, and Jason M. Smith. 2016. "Taxes and Leverage at Multinational Corporations." *Journal of Financial Economics* 122(1):1–20. doi: 10.1016/j.jfineco.2016.05.011.

Fazzari, Steven, R. Glen. Hubbard, and Bruce Petersen. 1988. "Investment, Financing Decisions, and Tax Policy." *American Economic Review* 78(2):200–205.

Feldstein, M. S., and J. S. Flemming. 1971. "Tax Policy, Corporate Saving and Investment Behaviour in Britain." *The Review of Economic Studies* 38(4):415. doi: 10.2307/2296687.

Flammer, Caroline. 2015a. "Does Product Market Competition Foster Corporate

Social Responsibility? Evidence from Trade Liberalization." *Strategic Management Journal* 36(10):1469–85. doi: 10.1002/smj.2307.

Flammer, Caroline. 2015b. "Does Product Market Competition Foster Corporate Social Responsibility? Evidence from Trade Liberalization." *Strategic Management Journal* 36(10):1469–85. doi: 10.1002/smj.2307.

Frank, Mary Margaret, Luann J. Lynch, and Sonja Olhoft Rego. 2009. "Tax Reporting Aggressiveness and Its Relation to Aggressive Financial Reporting." Pp. 467–96 in *Accounting Review*. Vol. 84.

Friedman, Milton. 1962. *CAPITALISM AND FREEDOM*.

Fu, Xiaoqing (Maggie), Yongjia (Rebecca) Lin, and Philip Molyneux. 2014. "Bank Competition and Financial Stability in Asia Pacific." *Journal of Banking and Finance* 38(1):64–77. doi: 10.1016/j.jbankfin.2013.09.012.

Gaertner, Fabio B., Daniel P. Lynch, and Mary E. Vernon. 2020. "The Effects of the Tax Cuts & Jobs Act of 2017 on Defined Benefit Pension Contributions." *Contemporary Accounting Research*. doi: 10.1111/1911-3846.12604.

García Lara, Juan Manuel, Beatriz García Osma, and Fernando Penalva. 2016. "Accounting Conservatism and Firm Investment Efficiency." *Journal of Accounting and Economics* 61(1):221–38. doi: 10.1016/j.jacceco.2015.07.003.

Gauthier, Céline, Alfred Lehar, and Moez Souissi. 2012. "Macroprudential Capital

Requirements and Systemic Risk." *Journal of Financial Intermediation* 21(4):594–618. doi: 10.1016/j.jfi.2012.01.005.

Godfrey, Paul C., Craig B. Merrill, and Jared M. Hansen. 2009. "The Relationship between Corporate Social Responsibility and Shareholder Value: An Empirical Test of the Risk Management Hypothesis." *Strategic Management Journal* 30(4):425–45. doi: 10.1002/smj.750.

Goetz, Martin R., Luc Laeven, and Ross Levine. 2013. "Identifying the Valuation Effects and Agency Costs of Corporate Diversification: Evidence from the Geographic Diversification of U.S. Banks." *Review of Financial Studies* 26(7):1787–1823. doi: 10.1093/rfs/hht021.

Goodhart, C. A. E., and Miguel A. Segoviano Basurto. 2009. "Banking Stability Measures." *IMF Working Papers* 09(4):1. doi: 10.5089/9781451871517.001.

Goodhart, Charles. 2008. "The Boundary Problem in Financial Regulation." *National Institute Economic Review* 206(1):48–55. doi: 10.1177/0027950108099842.

Goodman, Theodore H., Monica Neamtiu, Nemit Shroff, and Hal D. White. 2014. "Management Forecast Quality and Capital Investment Decisions." *Accounting Review* 89(1):331–65. doi: 10.2308/accr-50575.

Goss, Allen, and Gordon S. Roberts. 2011. "The Impact of Corporate Social Responsibility on the Cost of Bank Loans." *Journal of Banking and Finance* 35(7):1794–1810. doi: 10.1016/j.jbankfin.2010.12.002.

Graham, John R., Michelle Hanlon, and Terry Shevlin. 2011. “Real Effects of Accounting Rules: Evidence from Multinational Firms’ Investment Location and Profit Repatriation Decisions.” *Journal of Accounting Research* 49(1):137–85. doi: 10.1111/j.1475-679X.2010.00395.x.

Graham, John R., Campbell R. Harvey, and Shiva Rajgopal. 2005. “The Economic Implications of Corporate Financial Reporting.” *Journal of Accounting and Economics* 40(1–3):3–73. doi: 10.1016/j.jacceco.2005.01.002.

Gravelle, Toni, and Fuchun Li. 2013. “Measuring Systemic Importance of Financial Institutions: An Extreme Value Theory Approach.” *Journal of Banking and Finance* 37(7):2196–2209. doi: 10.1016/j.jbankfin.2013.01.007.

Gropp, Reint, and Jukka Vesala. 2004. “Deposit Insurance, Moral Hazard and Market Monitoring*.” *Review of Finance* 8(4):571–602. doi: 10.1093/rof/8.4.571.

Hadlock, Charles J., and Joshua R. Pierce. 2010. “New Evidence on Measuring Financial Constraints: Moving beyond the KZ Index.” *Review of Financial Studies* 23(5):1909–40. doi: 10.1093/rfs/hhq009.

Hakenes, Hendrik, and Isabel Schnabel. 2011. “Capital Regulation, Bank Competition, and Financial Stability.” *Economics Letters* 113(3):256–58. doi: 10.1016/j.econlet.2011.07.008.

Hall, Robert E., and Dale W. Jorgenson. 1967. “Tax Policy and Investment Behavior.” *The American Economic Review* 57(3):391–414. doi: 10.2307/1812110.

Hanlon, Michelle, and Shane Heitzman. 2010. “A Review of Tax Research.” *Journal of Accounting and Economics* 50(2–3):127–78. doi: 10.1016/j.jacceco.2010.09.002.

Hayashi, Fumio. 1982. “Tobin’s Marginal q and Average q: A Neoclassical Interpretation.” *Econometrica* 50(1):213. doi: 10.2307/1912538.

Heider, Florian, and Alexander Ljungqvist. 2015. “As Certain as Debt and Taxes: Estimating the Tax Sensitivity of Leverage from State Tax Changes.” *Journal of Financial Economics* 118(3):684–712. doi: 10.1016/j.jfineco.2015.01.004.

Hombert, Johan, and Adrien Matray. 2017. “The Real Effects of Lending Relationships on Innovative Firms and Inventor Mobility.” *Review of Financial Studies* 30(7):2413–45. doi: 10.1093/rfs/hhw069.

Hong, Harrison, and Marcin Kacperczyk. 2009. “The Price of Sin: The Effects of Social Norms on Markets.” *Journal of Financial Economics* 93(1):15–36. doi: 10.1016/j.jfineco.2008.09.001.

Hong, Harrison, Jeffrey Kubik, and Jose Scheinkman. 2012. *Financial Constraints on Corporate Goodness*. Cambridge, MA.

Hope, Ole Kristian, and Wayne B. Thomas. 2008. “Managerial Empire Building and Firm Disclosure.” *Journal of Accounting Research* 46(3):591–626. doi: 10.1111/j.1475-679X.2008.00289.x.

Hoque, Hafiz, Dimitris Andriosopoulos, Kostas Andriosopoulos, and Raphael Douady. 2015. “Bank Regulation, Risk and Return: Evidence from the Credit and Sovereign Debt Crises.” *Journal of Banking and Finance* 50:455–74. doi: 10.1016/j.jbankfin.2014.06.003.

Hoshi, T., A. Kashyap, and D. Scharfstein. 1991. “Corporate Structure, Liquidity, and Investment: Evidence from Japanese Industrial Groups.” *The Quarterly Journal of Economics* 106(1):33–60. doi: 10.2307/2937905.

House, Christopher L., and Matthew D. Shapiro. 2008. “Temporary Investment Tax Incentives: Theory with Evidence from Bonus Depreciation.” *American Economic Review* 98(3):737–68. doi: 10.1257/aer.98.3.737.

Houston, Joel F., Chen Lin, and Yue Ma. 2011. “Media Ownership, Concentration and Corruption in Bank Lending.” *Journal of Financial Economics* 100(2):326–50. doi: 10.1016/j.jfineco.2010.12.003.

Hovakimian, Gayané. 2011. “Financial Constraints and Investment Efficiency: Internal Capital Allocation across the Business Cycle.” *Journal of Financial Intermediation* 20(2):264–83. doi: 10.1016/j.jfi.2010.07.001.

Hryckiewicz, Aneta. 2014. “What Do We Know about the Impact of Government Interventions in the Banking Sector? An Assessment of Various Bailout Programs on Bank Behavior.” *Journal of Banking and Finance* 46(1):246–65. doi: 10.1016/j.jbankfin.2014.05.009.

Huang, Xin, Hao Zhou, and Haibin Zhu. 2009. “A Framework for Assessing the Systemic Risk of Major Financial Institutions.” *Journal of Banking and Finance* 33(11):2036–49. doi: 10.1016/j.jbankfin.2009.05.017.

Huang, Xin, Hao Zhou, and Haibin Zhu. 2012. “Systemic Risk Contributions.” *Journal of Financial Services Research* 42(1–2):55–83. doi: 10.1007/s10693-011-0117-8.

Jayaratne, Jith, and Philip E. Strahan. 1996. “The Finance-Growth Nexus: Evidence from Bank Branch Deregulation.” *Quarterly Journal of Economics* 111(3):639–70. doi: 10.2307/2946668.

Jayaratne, Jith, and Philip E. Strahan. 1998. “Entry Restrictions, Industry Evolution, and Dynamic Efficiency: Evidence From Commercial Banking.” *The Journal of Law and Economics* 41(1):239–74. doi: 10.1086/467390.

Jensen, Michael. 2001. “Value Maximisation, Stakeholder Theory, and the Corporate Objective Function.” *European Financial Management* 7(3):297–317. doi: 10.1111/1468-036X.00158.

Jensen, Michael C. 1986a. “Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers.” *The American Economic Review* 76(2):323–29. doi: https://www-jstor-org.ezproxy.lib.gla.ac.uk/stable/1818789.

Jensen, Michael C. 1986b. “Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers.” *The American Economic Review* 76(2):323–29. doi: https://www-

jstor-org.ezproxy.lib.gla.ac.uk/stable/1818789.

Jensen, Michael C., and William H. Meckling. 1976. “Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure.” *Journal of Financial Economics* 3:305–60. doi: 10.2139/ssrn.94043.

Jiang, Liangliang, Ross Levine, and Chen Lin. 2019. “Competition and Bank Liquidity Creation.” *Journal of Financial and Quantitative Analysis* 54(2):513–38. doi: 10.1017/S0022109018000820.

Jiang, Tianjiao, Ross Levine, Chen Lin, and Lai Wei. 2020. “Bank Deregulation and Corporate Risk.” *Journal of Corporate Finance* 60:101520. doi: 10.1016/j.jcorpfin.2019.101520.

Jo, Hoje, and Haejung Na. 2012. “Does CSR Reduce Firm Risk? Evidence from Controversial Industry Sectors.” *Journal of Business Ethics* 110(4):441–56. doi: 10.1007/s10551-012-1492-2.

Johnson, Christian A., and Tara Rice. 2008. “Assessing a Decade of Interstate Bank Branching.” *Wash. & Lee L. Rev.* 65:73. doi: 10.2139/ssrn.981214.

Johnson, Richard A., and Daniel W. Greening. 1999. “The Effects of Corporate Governance and Institutional Ownership Types on Corporate Social Performance.” *Academy of Management Journal* 42(5):564–76. doi: 10.5465/256977.

Jones, Thomas M. 1995. “Instrumental Stakeholder Theory: A Synthesis of Ethics and Economics.” *Academy of Management Review* 20(2):404–37. doi: 10.5465/amr.1995.9507312924.

Kane, Edward J. 1980. “Politics and Fed Policymaking. The More Things Change the More They Remain the Same.” *Journal of Monetary Economics* 6(2):199–211. doi: 10.1016/0304-3932(80)90027-6.

Kaplan, Steven N., and Luigi Zingales. 1997. “Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints?” *The Quarterly Journal of Economics* 112(1):169–215. doi: 10.1162/003355397555163.

Kerr, William R., Ramana Nanda, William R. Kerr Ã, and Ramana Nanda. 2009. “Democratizing Entry: Banking Deregulations, Financing Constraints, and Entrepreneurship.” *Journal of Financial Economics* 94(1):124–49. doi: 10.1016/j.jfineco.2008.12.003.

Khurana, Inder K., and William J. Moser. 2013. “Institutional Shareholders’ Investment Horizons and Tax Avoidance.” *Journal of the American Taxation Association* 35(1):111–34. doi: 10.2308/atax-50315.

Kim, Jaehyeon, Yongtae Kim, and Jian Zhou. 2020. *Time Encoding in Languages and Investment Efficiency*.

Kim, Yongtae, Myung Seok Park, and Benson Wier. 2012. “Is Earnings Quality Associated with Corporate Social Responsibility?” *Accounting Review*

87(3):761–96. doi: 10.2308/accr-10209.

King, Mervyn. 1986. *The Cash Flow Corporate Income Tax*. Vol. I. Cambridge, MA.

Kraus, Alan, and Robert H. Litzenberger. 1973. *A State-Preference Model of Optimal Financial Leverage*. Vol. 28.

Krishnan, Karthik, Debarshi K. Nandy, and Manju Puri. 2015. "Does Financing Spur Small Business Productivity? Evidence from a Natural Experiment." *Review of Financial Studies* 28(6):1768–1809. doi: 10.1093/rfs/hhu087.

Kroszner, Randall S., and Philip E. Strahan. 1999. "What Drives Deregulation? Economics and Politics of the Relaxation of Bank Branching Restrictions." *Quarterly Journal of Economics* 114(4):1437–67. doi: 10.1162/003355399556223.

Kupiec, Paul, and Levent Güntay. 2016. "Testing for Systemic Risk Using Stock Returns." *Journal of Financial Services Research* 49(2–3):203–27. doi: 10.1007/s10693-016-0254-1.

Kupiec, Paul H., and Carlos D. Ramirez. 2013. "Bank Failures and the Cost of Systemic Risk: Evidence from 1900 to 1930." *Journal of Financial Intermediation* 22(3):285–307. doi: 10.1016/j.jfi.2012.09.005.

Kwan, SH, and ES Laderman. 1999. "On the Portfolio Effects of Financial Convergence--A Review of the Literature." *Economic Review-Federal Reserve*

Number 2:18–31.

Laeven, Luc, and Ross Levine. 2007. “Is There a Diversification Discount in Financial Conglomerates?” *Journal of Financial Economics* 85(2):331–67. doi: 10.1016/j.jfineco.2005.06.001.

Laeven, Luc, and Ross Levine. 2009. “Bank Governance, Regulation and Risk Taking.” *Journal of Financial Economics* 93(2):259–75. doi: 10.1016/j.jfineco.2008.09.003.

Laeven, Luc, Lev Ratnovski, and Hui Tong. 2016. “Bank Size, Capital, and Systemic Risk: Some International Evidence.” *Journal of Banking and Finance* 69:S25–34. doi: 10.1016/j.jbankfin.2015.06.022.

Lamont, Owen, Christopher Polk, and Jesús Saá-Requejo. 2001. “Financial Constraints and Stock Returns.” *Review of Financial Studies* 14(2):529–54. doi: 10.1093/rfs/14.2.529.

Laux, Volker. 2020. “Effects of Accounting Conservatism on Investment Efficiency and Innovation.” *Journal of Accounting and Economics* 101319. doi: 10.1016/J.JACCECO.2020.101319.

Lester, Rebecca. 2019. “Made in the U.S.A.? A Study of Firm Responses to Domestic Production Incentives.” *Journal of Accounting Research* 57(4):1059–1114. doi: 10.1111/1475-679X.12269.

Li, Hui, Hong Liu, and Chris Veld. 2019. “The Effects of Bank Regulation Stringency on Seasoned Equity Offering Announcements.” *Journal of International Money and Finance* 91:71–85. doi: 10.1016/j.jimonfin.2018.11.001.

Lins, Karl V., Henri Servaes, and Ane Tamayo. 2017. “Social Capital, Trust, and Firm Performance: The Value of Corporate Social Responsibility during the Financial Crisis.” *Journal of Finance* 72(4):1785–1824. doi: 10.1111/jofi.12505.

Liu, Michelle, and Peter D. Wysocki. 2011. “Cross-Sectional Determinants of Information Quality Proxies and Cost of Capital Measures.” *SSRN Electronic Journal*. doi: 10.2139/ssrn.1013652.

Ljungqvist, Alexander, and Michael Smolyansky. 2018. *To Cut or Not to Cut? On the Impact of Corporate Taxes on Employment and Income*. Cambridge, MA.

Ljungqvist, Alexander, Liandong Zhang, and Luo Zuo. 2017. “Sharing Risk with the Government: How Taxes Affect Corporate Risk Taking.” *Journal of Accounting Research* 55(3):669–707. doi: 10.1111/1475-679X.12157.

López-Espinosa, Germán, Antonio Moreno, Antonio Rubia, and Laura Valderrama. 2012. “Short-Term Wholesale Funding and Systemic Risk: A Global CoVaR Approach.” *Journal of Banking and Finance* 36(12):3150–62. doi: 10.1016/j.jbankfin.2012.04.020.

Manchiraju, Hariom, and Shivaram Rajgopal. 2017. “Does Corporate Social Responsibility (CSR) Create Shareholder Value? Evidence from the Indian

Companies Act 2013." *Journal of Accounting Research* 55(5):1257–1300. doi: 10.1111/1475-679X.12174.

Matousek, Roman, Ekaterini Panopoulou, and Andromachi Papachristopoulou. 2020. "Policy Uncertainty and the Capital Shortfall of Global Financial Firms." *Journal of Corporate Finance* 62. doi: 10.1016/j.jcorpfin.2020.101558.

Mattingly, James E., and Shawn L. Berman. 2006. "Measurement of Corporate Social Action Discovering Taxonomy in the Kinder Lydenburg Domini Ratings Data." *Journals.Sagepub.Com* 45(1):20–46. doi: 10.1177/0007650305281939.

Mazerov, Michael. 2009. "A Majority of States Have Now Adopted a Key Corporate Tax Reform—"Combined Reporting." *Center on Budget and Policy Priorities. Revised April* 3:2009.

Mcwilliams, Abagail, and Donald Siegel. 2001. "Corporate Social Responsibility: A Theory of the Firm Perspective." *Academy of Management Review* 117–27.

McWilliams, Abagail, and Donald Siegel. 2000. "Corporate Social Responsibility and Financial Performance: Correlation or Misspecification?" *Strategic Management Journal* 21(5):603–9. doi: 10.1002/(SICI)1097-0266(200005)21:5<603::AID-SMJ101>3.0.CO;2-3.

Merton, Robert C. 1974. "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates." *The Journal of Finance* 29(2):449. doi: 10.2307/2978814.

Modigliani, Franco, and Merton H. Miller. 1958. “The Cost of Capital, Corporation Finance and the Theory of Investment.” *The American Economic Review* 48(3):261–97.

Modigliani, Franco, and Merton H. MH Miller. 1963. “American Economic Association Corporate Income Taxes and the Cost of Capital : A Correction.” *American Economic Review* 53(3):433–43. doi: 10.1126/science.151.3712.867-a.

Morgan, Donald P., Bertrand Rime, and Philip E. Strahan. 2004. “Bank Integration and State Business Cycles.” *Quarterly Journal of Economics* 119(4):1555–84. doi: 10.1162/0033553042476161.

Mukherjee, Abhiroop, Manpreet Singh, and Alminas Žaldokas. 2017. “Do Corporate Taxes Hinder Innovation?” *Journal of Financial Economics* 124(1):195–221. doi: 10.1016/j.jfineco.2017.01.004.

Myers, Stewart C. 1977. “Determinants of Corporate Borrowing.” *Journal of Financial Economics* 5(2):147–75. doi: 10.1253/circj.CJ-16-0846.

Myers, Stewart C., and Nicholas S. Majluf. 1984. “Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have.” *Journal of Financial Economics* 13(2):187–221. doi: 10.1016/0304-405X(84)90023-0.

Nan, Lin, and Xiaoyan Wen. 2014. “Financing and Investment Efficiency, Information Quality,and Accounting Biases.” *Management Science* 60(9):2308–23. doi:

10.1287/mnsc.2013.1864.

Nijskens, Rob, and Wolf Wagner. 2011. “Credit Risk Transfer Activities and Systemic Risk: How Banks Became Less Risky Individually but Posed Greater Risks to the Financial System at the Same Time.” *Journal of Banking and Finance* 35(6):1391–98. doi: 10.1016/j.jbankfin.2010.10.001.

Ohrn, Eric. 2018. “The Effect of Corporate Taxation on Investment and Financial Policy: Evidence from the DPAD.” *American Economic Journal: Economic Policy* 10(2):272–301. doi: 10.1257/pol.20150378.

Padgett, Robert C., and Jose I. Galan. 2010. “The Effect of R&D Intensity on Corporate Social Responsibility.” *Journal of Business Ethics* 93(3):407–18. doi: 10.1007/s10551-009-0230-x.

Ponce, Jorge, and Marc Rennert. 2015. “Systemic Banks and the Lender of Last Resort.” *Journal of Banking and Finance* 50:286–97. doi: 10.1016/j.jbankfin.2014.01.002.

La Porta, R., Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert Vishny. 1999. “The Quality of Government.” *Journal of Law, Economics, and Organization* 15(1):222–79. doi: 10.1093/jleo/15.1.222.

Poterba, James. 2004. “Taxation and Corporate Payout Policy.” Pp. 171–75 in *American Economic Review*. Vol. 94.

Rego, Sonja Olhoft, and Ryan Wilson. 2012. “Equity Risk Incentives and Corporate Tax Aggressiveness.” *Journal of Accounting Research* 50(3):775–810. doi: 10.1111/j.1475-679X.2012.00438.x.

Repullo, Rafael. 2004. “Capital Requirements, Market Power, and Risk-Taking in Banking.” *Journal of Financial Intermediation* 13(2):156–82. doi: 10.1016/j.jfi.2003.08.005.

Rice, Tara, and Philip E. Strahan. 2010. “Does Credit Competition Affect Small-Firm Finance?” *Journal of Finance* 65(3):861–89. doi: 10.1111/j.1540-6261.2010.01555.x.

Richardson, Scott. 2006. “Over-Investment of Free Cash Flow.” Pp. 159–89 in *Review of Accounting Studies*. Vol. 11.

Sacconi, L., and G. Antoni. 2010. *Social Capital, Corporate Social Responsibility, Economic Behaviour and Performance*.

Sandmo, Agnar. 1974. “Investment Incentives and the Corporate Income Tax.” *Journal of Political Economy* 82(2, Part 1):287–302. doi: 10.1086/260192.

Santos, Joao A. C. 2001. “Bank Capital Regulation in Contemporary Banking Theory: A Review of the Literature.” *Financial Markets, Institutions and Instruments* 10(2):41–84. doi: 10.1111/1468-0416.00042.

Schandlbauer, Alexander. 2017. “How Do Financial Institutions React to a Tax

Increase?" *Journal of Financial Intermediation* 30:86–106. doi: 10.1016/j.jfi.2016.08.002.

Schwarcz, Steven L. 2008. "Systemic Risk." *Geo. LJ* 97:193.

Scott, James H. 1976. *A Theory of Optimal Capital Structure*. Vol. 7.

SHARPE, STEVEN A. 1990. "Asymmetric Information, Bank Lending, and Implicit Contracts: A Stylized Model of Customer Relationships." *The Journal of Finance* 45(4):1069–87. doi: 10.1111/j.1540-6261.1990.tb02427.x.

Spence, Michael. 1973. *Job Market Signaling*. Vol. 87.

Stoughton, Neal M., Kit Pong Wong, and Long Yi. 2017. "Investment Efficiency and Product Market Competition." *Journal of Financial and Quantitative Analysis* 52(6):2611–42. doi: 10.1017/S0022109017000746.

Sufi, Amir. 2007. "Information Asymmetry and Financing Arrangements: Evidence from Syndicated Loans." *Journal of Finance* 62(2):629–68. doi: 10.1111/j.1540-6261.2007.01219.x.

Summers, Lawrence H., Barry P. Bosworth, James Tobin, and Philip M. White. 1981. "Taxation and Corporate Investment: A q-Theory Approach." *Source: Brookings Papers on Economic Activity* 1981(1):67–140.

Sun, Xian, and Brian C. Gunia. 2018. “Economic Resources and Corporate Social Responsibility.” *Journal of Corporate Finance* 51(April):332–51. doi: 10.1016/j.jcorpfin.2018.06.009.

The World Bank. 2013. *Rethinking the Role of the State in Finance*.

Tobin, James. 1969. “A General Equilibrium Approach To Monetary Theory.” *Journal of Money, Credit and Banking* 1(1):15. doi: 10.2307/1991374.

Uchida, Hirofumi, Gregory F. Udell, and Nobuyoshi Yamori. 2012. “Loan Officers and Relationship Lending to SMEs.” *Journal of Financial Intermediation* 21(1):97–122. doi: 10.1016/j.jfi.2011.06.002.

Waddock, Sandra A., and Samuel B. Graves. 1997. “The Corporate Social Performance-Financial Performance Link.” *Strategic Management Journal* 18(4):303–19. doi: 10.1002/(SICI)1097-0266(199704)18:4<303::AID-SMJ869>3.0.CO;2-G.

Wagner, Alexander F., Richard J. Zeckhauser, and Alexandre Ziegler. 2018. “Unequal Rewards to Firms: Stock Market Responses to the Trump Election and the 2017 Corporate Tax Reform.” *AEA Papers and Proceedings* 108:590–96. doi: 10.1257/pandp.20181091.

Wagner, Wolf. 2010. “Diversification at Financial Institutions and Systemic Crises.” *Journal of Financial Intermediation* 19(3):373–86. doi: 10.1016/j.jfi.2009.07.002.

Wagner, Wolf. 2011. “Systemic Liquidation Risk and the Diversity-Diversification Trade-Off.” *Journal of Finance* 66(4):1141–75. doi: 10.1111/j.1540-6261.2011.01666.x.

Waldman, David A., Donald S. Siegel, and Mansour Javidan. 2006. “Components of CEO Transformational Leadership and Corporate Social Responsibility.” *Journal of Management Studies* 43(8):1703–25. doi: 10.1111/j.1467-6486.2006.00642.x.

Ward, Charles, Chao Yin, and Yeqin Zeng. 2020. “Motivated Monitoring by Institutional Investors and Firm Investment Efficiency.” *European Financial Management* 26(2):348–85. doi: 10.1111/eufm.12232.

Weiß, Gregor N. F., Sascha Neumann, and Denefa Bostandzic. 2014. “Systemic Risk and Bank Consolidation: International Evidence.” *Journal of Banking and Finance* 40(1):165–81. doi: 10.1016/j.jbankfin.2013.11.032.

Whited, Toni M, and Guojun Wu. 2006. “Financial Constraints Risk.” *Review of Financial Studies* 19(2):531–59. doi: 10.1093/rfs/hhj012.

Whited, Toni M., and Guojun Wu. 2006. “Financial Constraints Risk.” *Review of Financial Studies* 19(2):531–59. doi: 10.1093/rfs/hhj012.

Yoshikawa, Hiroshi. 1980. “On the ‘q’ Theory of Investment.” *American Economic Review* 70(4):739–43. doi: 10.2307/1803570.

Zarutskie, Rebecca. 2006. “Evidence on the Effects of Bank Competition on Firm

Borrowing and Investment." *Journal of Financial Economics* 81(3):503–37. doi: 10.1016/j.jfineco.2005.07.008.

Appendix

A. Main Variable Definitions

A.1. Definition of variables

Variable name	Description
MES	Average return on sample banks conditioned on 5% worse returns on the market.
Activity Restriction	A measure of a bank's ability to engage in the businesses of securities underwriting, insurance, and real estate and of the regulatory restrictiveness of banks to own shares in non-financial firms. The level of regulatory restrictiveness can be defined as "unrestricted" and coded as a score of 1. If the full range of activities can be conducted, but some or all must be conducted in subsidiaries, then it can be defined as "permitted" and coded as a score of 2. If less than a full range of activities can be conducted in a bank or subsidiaries, then it can be defined as "restricted" and counted as a score of 3. If the activity cannot be conducted in either the bank or subsidiaries, then it is defined as "prohibited" and counted as a score of 4. Activity restriction is calculated by the sum of the answers to these questions divided by 12. Greater values signify more restrictions. (Barth et al., 2004; Barth et al., 2013b)
Initial Capital Stringency	Whether the source of funds that count as regulatory capital can include assets other than cash or government securities and borrowed funds and whether the regulatory supervisory authorities verify the sources of capital. This index is based on the following question (for question (1), Yes=1 No=0; for question (2) and (3), Yes=0 No=1): (1) Are the sources of funds to be used as capital verified by the regulatory/supervisory authorities? (2) Can the initial disbursement or subsequent injections of capital be performed with assets other than cash or government securities? (3) Can the initial disbursement of capital be performed with borrowed funds? Initial capital stringency is calculated by the sum of the answers to these questions divided by 3. Higher values indicate greater stringency. (Barth et al., 2004; Barth et al., 2013b) .
Prompt Corrective Action	Prompt corrective action measures the extent to which the law establishes pre-determined levels of bank solvency deterioration that force automatic enforcement actions, such as intervention, and the extent to which supervisors have the requisite, suitable powers to do so. This variable is based on several questions (Yes=1, No=0): (1) Can the supervisory authority force a bank to change its internal organizational structure? (2) Are there any mechanisms of cease and desist-type orders, whose infraction leads to the automatic imposition of civil and penal sanctions against the bank's directors and managers? (3) Can the supervisory agency order the bank's directors or management to constitute provisions to cover actual or potential losses? (4) Can the supervisory agency suspend the director's decision to distribute dividends? (5) Can the

	supervisory agency suspend the director's decision to distribute bonuses? (6) Can the supervisory agency suspend the director's decision to distribute management fees? Prompt corrective action is calculated as the sum of the score for each question and divided by 6. A higher value indicates greater supervisory power. (Barth et al., 2004; Barth et al., 2013b) .
Deposit Insurer Power	The deposit insurer power scheme is an index of the deposit insurer power to measure each country's deposit insurance regime and to trace its evolution from 1999 to 2011. This index is based on the answer to the following questions (Yes=1, No=0): (1) Does the deposit insurance authority make the decision to intervene in a bank? (2)Can the deposit insurance agency/fund take legal action for violations of laws, regulations, and bylaws (of the deposit insurance agency) against bank directors or other bank officials? (3)Has the deposit insurance agency/fund ever taken legal action for violations of laws, regulations, and bylaws (of the deposit insurance agency) against bank directors or other bank officials? (4)Were any deposits not explicitly covered by the deposit insurance at the time of the failure compensated when the bank failed (excluding funds later paid out in liquidation procedures)? Deposit insurer power is equal to {[(1)+(2)+(3)]/3 + (4)}/2. This variable ranges from 0 to 1, where higher values indicate more power. (Barth et al., 2004; Barth et al., 2013b) .
Total Regulation	We collapse the four regulation measures into a single measure of bank regulation using factor analysis. We estimate the following equation: $Y_{i,s,t}=\beta_i$ $Regulation_{s,s,t}+\varepsilon_{i,t}$, where the subscripts i, s, and t correspond to the country, the four regulation measures (Activity Restriction, Initial Capital Stringency, Deposit Insurer Power, and Prompt Corrective Action), and years, respectively. The left-hand-side variables are the four regulation measures, all of which are stacked into a single factor, whereas regulation is not observed and estimated along with the factor loadings β. We follow the standard practice of normalizing the proxy measures included on the left-hand side to have a mean of zero and a variance of one before we conduct the factor analysis. We focus on the single factor that has the greatest explanatory power. It turns out that our data are well described by a one-factor model, which captures approximately 55% of the variation in the four regulation measures. We take this factor as our final measure of overall bank regulation.
LgTA	A natural logarithm of total assets denominated in US dollars
ROA	Return on asset. Net income/ Total assets in %
MTBV	Market-to-book value, measured as Market value of equity / Book value of equity
LLP	Loan loss provision ratio, measured as total loan loss provision/net loan in %
GDP Growth	The annual growth rate of GDP.
Inflation	The percentage change of GDP deflator.
Basel II Dummy	A dummy variable which equals to one for the time after the country adopted Basel II and 0 otherwise.
SRISK	An individual financial institution's contribution to the systemic risk, measured in billion dollar value.
Economic Freedom	Proxy for the overall level of economic freedom from Heritage Foundation. It is a composite index that including business freedom, trade freedom, fiscal freedom, government spending, monetary freedom, investment freedom, financial freedom. property rights, labour freedom.
Equity/Assets	Total equity to total assets ratio
Diversification	Non-interest income divided by total operating income in %

A.2 Definition of variables

Variable	Definition
CSR	The *D-SOCIAL-KLD* index (Carroll et al., 2016) proxies firm's CSR performance at the year *t*..
Deregulation	Four minus Rice-Strahan index of interstate banking deregulation based on Rice and Strahan (2010). The deregulation index ranges from 0 (least deregulated,) to 4 (most deregulated) based on regulation changes at a state level.t
Log Total assets	Natural logarithm value of total assets measured at the year *t*.
Leverage	The leverage ratio measured as the book value of debt divided by book value of total assets at the year *t*.
Cash ratio	The cash holding of company scaled by the book value of total assets at the year *t*.
MV ratio	The ratio of the market value of equity to the book value of equity at the year *t*.
ROE	Return-on-equity ratio defined as the net income scaled by book value of equity at the year *t*.
Age	The natural logarithm value of years the corporation has existed since the founding year plus one. The funding year obtain from Loughran and Ritter (2004) data set.
WW index	WW index is based on Whited and Wu (2006), defined as $(-0.091 * \mathrm{CF}) - (0.062 * \mathrm{DIVPOS}) + (0.021 * \mathrm{TLTD}) - (0.044 * \mathrm{LNTA}) + (0.102 * \mathrm{ISG}) - (0.035 * \mathrm{SG})$, where the CF is the ratio of cash flow to assets; DIVPOS is an indicator that takes the value of 1 if the firm pays cash dividends; TLTD is the ratio of long-term debt to total assets; LNTA is the natural logarithm of total assets; ISG is the firm's three-digital industry sale growth; and SG is firm sales growth.
SA Index	SA index is based on Hadlock and Pierce (2010), $SA\ Index = -0.737 * Ln(assets) + 0.043 * Ln(assets)^2 - 0.04 * Age$.
Relationship Lending	The sum of all bank assets held by banks with total assets below $100 million divided by the sum of all bank assets in the state-year.
Sales Growth	The sales growth is the percentage change in sales from year *t-1* to year *t*
R&D	The R&D investment measured by the R&D expenses scaled by sales

A.3 Definition of variables

Variable Name	Descriptions
Dependent variable	
Investment efficiency	A firm-level measure of total investment inefficiency, which is the absolute value of the residuals from the regression (Biddle et at., 2009): $$Investment_{i,t+1} = \alpha + \beta * Sales\ Growth_{i,t} + \epsilon_{i,t+1}$$ Where the $Investment_{i,t+1}$ is the total investment and $Sales\ Growth_i$ is the percentage change in sales from year $t-1$ to t. The model is estimated for each industry-year based on the Fama and French 48-industry classification for all industries with at least 20 observations in a given year. Specifically, we classify firms as underinvestment if the residual is negative, and take the absolute value of the residual as the measure of investment efficiency. In the same manner, we classify firms as overinvestment if the residual is positive and take the value of residual as the measure of investment efficiency. a higher value of investment efficiency indicate less efficiently invest.
Independent variable	
Tax increase	A dummy variables set to one if state s increase corporate income tax at year t or zero otherwise.
Tax decrease	A dummy variables set to one if state s decrease corporate income tax at year t or zero otherwise.
Control Variable	
Size	Natural logarithm of total assets
Leverage	The ratio of long-term debt to sum of long-term debt to the market value of equity
M/B	The ratio of the market value of total assets to book value of total assets
ROA	The return on assets
Z-score	A measure of bankruptcy risk, calculated as 3.3*pretax income + sales + 0.25*retained earnings + 0.5*(current assets-current liabilities), scaled by total assets
Tangibility	The ratio of plant, property and equipment (PP&E) to total assets
Ind. K-structure	The mean leverage for firms in the same SIC 3-digit industry
Dividend	An indicator variable which set to one if the firm paid a dividend and zero otherwise
Slack	The ratio of cash and cash equivalents to PP&E
CFOsale	Cash flow from operations scaled by sales
sd_Cash	Cash flow volatility which measured as the standard deviation of cash flow from operations scaled by average total assets from year t-5 to t-1
sd_Sales	Sale volatility which measured as the standard deviation of sales deflated by average total assets from year t-5 to t-1
sd_Investment	Investment volatility which measured as the standard deviation of investment from year t-5 to t-1

Age	Natural logarithm of number of firm age which is the difference between the first year when the firm appears in CRSP and the current year.
Cycle	The log of receivables to sales plus investor to cost of goods sold multiplied by 360
Loss	An indicator variable that equals one if income before extraordinary items is negative and zero otherwise
Analyst	The number of analyst following the firms
Institutions	The percentage of firm shares held by institutional investors
Deferral	-1 times the ratio of deferred tax expense (Federal and Foreign) to pre-tax income adjusted for special items
BTD	Pre-tax book income – (current federal tax expense + current foreign tax expense)/the highest marginal U.S. corporate statutory tax rate, scaled by lagged total assets
Perm_BTD	Pre-tax book income – (current federal tax expense + current foreign tax expense + deferred tax expenses)/the highest marginal U.S. corporate statutory tax rate, scaled by lagged total assets
KZ Index	KZ index is based on Lamont et al. (2001) calculated as $-1.001909 * [(ib + dp)/\ lagged\ ppent] + 0.2826389 * [(at + prcc\_f * csho - ceq - txdb)/at] + 3.139193 * [(dltt + dlc)/(dltt + dlc + seq)] - 39.3678 * [(dvc + dvp)/l.ppent] - 1.314759 * [che/lagged\ ppent]$, where all variables in italics are Compustat data items
WW Index	WW index is based on Whited and Wu (2006), defined as $(-0.091 * \text{CF}) - (0.062 * \text{DIVPOS}) + (0.021 * \text{TLTD}) - (0.044 * \text{LNTA}) + (0.102 * \text{ISG}) - (0.035 * \text{SG})$, where the CF is the ratio of cash flow to assets; DIVPOS is an indicator that takes the value of 1 if the firm pays cash dividends; TLTD is the ratio of long-term debt to total assets; LNTA is the natural logarithm of total assets; ISG is the firm's three-digital industry sale growth; and SG is firm sales growth.
SA Index	SA index is based on Hadlock and Pierce (2010), $SA\ Index = -0.737 * Ln(assets) + 0.043 * Ln(assets)^2 - 0.04 * Age$.
Overfirm	Following Biddle et al. (2009), overfirm is a ranked variable based on the average of a ranked measure of cash and leverage. Leverage is multiplied by minus one.

B. Regulation and supervision and systemic risk: includes US and UK banks

Table B.1 Robustness test: includes US and UK banks

This table reports the panel regression results of the estimation of different regulations and systemic risk from 67 countries, including US and UK banks for the period from 2001 to 2013. The dependent variable is the systemic risk measure by MES. Control variables include MTBV, lgTA, LLP, ROAA, GDP Growth, Inflation and Economic Freedom. Detailed definitions of the variables can be found in Appendix A.1. Bank fixed effect and year fixed effects are both included. The standard errors for the regressions are estimated as heteroskedasticity-robust standard errors clustered for banks and are presented in brackets *, **, and *** represent statistical significance at the 10%, 5%, and 1% significance level, respectively.

	(1)	(2)	(3)	(4)	(5)
	Activity Restriction	Initial Capital Stringency	Prompt Corrective Action	Depositor	Regulation Total
Regulation	0.843***	1.027***	0.696***	-0.024	0.200***
	(0.109)	(0.096)	(0.094)	(0.050)	(0.022)
MTBV	0.143**	0.142**	0.146**	0.146**	0.145**
	(0.070)	(0.069)	(0.071)	(0.071)	(0.071)
lgTA	-0.151**	-0.227***	-0.142**	-0.180***	-0.082
	(0.065)	(0.064)	(0.064)	(0.068)	(0.067)
LLP	-0.007	-0.009	-0.008	-0.008	-0.006
	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)
ROA	-0.025***	-0.023***	-0.026***	-0.026***	-0.027***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
GDP Growth	0.059***	0.054***	0.058***	0.056***	0.057***
	(0.008)	(0.007)	(0.008)	(0.008)	(0.008)
Inflation	0.021***	0.023***	0.022***	0.019***	0.021***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Economic Freedom	-0.000	-0.016**	-0.002	0.000	0.008
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
_cons	1.289	2.961***	1.162	1.909**	0.287
	(0.839)	(0.829)	(0.842)	(0.922)	(0.858)
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes
Time-fixed effect	Yes	Yes	Yes	Yes	Yes
N	9559	9559	9559	9559	9559
adj. R-sq	0.089	0.094	0.088	0.084	0.091