Essays in Corporate Finance, Labour Economics, and Political Economy

by

Sheng-Jun Xu

B.Math, University of Waterloo, 2008
B.B.A., Wilfrid Laurier University, 2008

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

in

THE FACULTY OF GRADUATE AND POSTDOCTORAL STUDIES

(Business Administration)

THE UNIVERSITY OF BRITISH COLUMBIA

(Vancouver)

July 2017

Abstract

This thesis presents a collection of essays on the intersection of finance, labour, and political economy. In Chapter 2, I exploit the 2003 reduction in the legislative cap for the H-1B visa program to show that a firm's ability to hire skilled workers affects corporate investment. U.S. firms use the H-1B program to recruit foreign skilled (college-educated) workers, and I find that the reduction in the cap caused a significant decrease in investment for firms that were more reliant on H-1B workers as a source of skilled labour. The effect persists for several years, and is more pronounced for firms hiring workers in "industrial" occupations compared with firms hiring workers in "knowledge" occupations.

The remaining essays examine how political incentives affect the policies of U.S. public-sector defined benefit pension plans. In Chapter 3, I present novel empirical evidence that "pension deficits"—the difference between liability accrual rates and asset accumulation rates—are systematically higher in gubernatorial election years. This electoral cycle pattern is explained by systematic dips in governmental contributions, and plans that exhibit larger electoral cycles tend to experience deteriorating funding levels and lower economic growth. Falsification tests, including analysis of private-sector DB pension plans and unexpected Governor transitions, indicate that non-political factors are unlikely to explain the documented electoral cycles.

In Chapter 4, I present a theoretical model detailing how electoral incentives induce incumbent politicians to borrow from public pension plans in a short-sighted manner at the expense of taxpayers. Using a career concerns model framework, I show this conflict is rooted in (1) moral hazard stemming from protections that insulate employees from the costs of unfunded pension liabilities, and (2) information asymmetry stemming from the opacity of public pension plans. The model generates predictions consistent with empirical findings from Chapter 3. Specifically, electoral cycles in pension deficits are more pronounced for states that place the burden of funding unfunded pension liabilities on taxpayers, and for states with less transparent public pension systems. Furthermore, pension deficits are larger during elections that are more closely contested and during gubernatorial terms in which the incumbent remains eligible to run for reelection.

Lay Summary

This thesis constitutes a collection of essays on finance, labour, and political economy. In Chapter 2, I study a U.S. policy shift in 2003 that limited the ability for firms to hire foreign skilled (college-educated) workers through the H-1B visa program, and show that corporate investment is negatively affected by regulations that restrict firms' ability to hire skilled workers.

The remaining essays examine how electoral politics affect how governments fund public sector defined benefit (DB) pension plans. In Chapter 3, I show that U.S. states tend to reduce public pension contributions immediately prior to elections for state Governors. In Chapter 4, I present a theoretical model that explains the incentives that lead politicians to reduce public pension funding in an election year. The model formalizes the idea that incumbent politicians conduct "hidden" borrowing through public pension plans in order to temporarily inflate their performance.

Preface

This dissertation, including the formulation of research questions, construction of theoretical models, and execution of empirical investigations, is an original intellectual product of the author, Sheng-Jun Xu. The author received valuable advice and feedback from his dissertation committee members on both the theoretical modelling and empirical execution components of his research.

Table of Contents

List of Tables

List of Figures

Acknowledgements

Dedication

I dedicate this work to my parents, Hongqi and Chen-Wei.

Chapter 1

Introduction

Financial markets, labour markets, and the political system are inextricably linked in the modern economy. Issues that that affect one area likely have implications for the others. In recent years, U.S. corporations have issued frequent complaints about a shortage of skilled workers, pointing to regulatory restrictions on the free movement of workers across borders as a factor in hampering economic growth. At the same time, public pension plans, which provide promises of future retirement benefits to public sector workers, have grown increasingly underfunded. This has eroded the financial health of state and local governments, and prompted media commentators to speculate that the insolvency of public pension plans may lead to the next financial crisis.

In the collection of essays presented in this thesis, I describe how regulatory constraints in the U.S. labour market affect corporate decisions, and how institutional frictions in the U.S. political system affect public pension funding decisions. In Chapter 2, the first essay, I ask whether restrictions on the ability for firms to hire skilled workers negatively impact corporate investment. To this end, I exploit a 2003 regulatory change that dramatically lowered the number of foreign skilled workers that domestic firms in the U.S. are allowed to hire through the H-1B visa program. I compare the investment policies of firms that were differently affected by the quota reduction, and find that firms that were more reliant on H-1B workers experienced a relative decline in their capital expenditure rates. This decline persisted for several years past the regulatory change date, and was especially pronounced for firms hiring workers in "industrial occupations" related to science and engineering fields.

In the remaining essays, I study the political economy of public sector defined benefit (DB) pension plan policies. In Chapter 3, the second essay, I ask whether political incentives influence how governments fund public DB pension plans. I empirically document an electoral cycle in which state pension deficits—the difference between the rate at which pension liabilities accrue and pension assets accumulate—are systematically higher in the year preceding a gubernatorial election. Results from follow-up empirical tests support the notion that incumbent Governors attempt to bolster their reelection chances through a form of "hidden borrowing" conducted through the state pension system.

In Chapter 4, the final essay, I present a theoretical model that clarifies how electoral politics distort government decisions over public pension policies. The stylized model illustrates that reelection incentives can induce incumbent politicians to behave in a short-sighted manner when rational voters are responsible for financing unfunded pension plans but cannot perfectly monitor the government's policies. By constructing a model of politically-motivated pension borrowing, I

am able to provide a theoretical basis for the empirical results presented in Chapter 3.

The three essays in this thesis explore common themes relating to how financial and corporate decisions are affected by labour market frictions and the democratic political process. Chapter 2 is self-contained, while Chapters 3 and 4 are closely interrelated and reference one another. More comprehensive discussions regarding research questions, motivations, methodologies, and contributions to the literature are left to the introduction sections within each individual chapter.

Chapter 2

Skilled Labour and Corporate Investment: Evidence from the H-1B Visa Program

> *"In other businesses the capacity constraint is buildings, plant or equipment. In our business... it's people."*

—Jeff Owens, CEO of Advanced Technology Services, Inc.[1]

2.1. Introduction

Complaints about skill shortages have become a common mantra among business leaders. A global survey conducted in 2012 found that one in four CEOs claimed they were unable to pursue a market opportunity or had to cancel or delay a strategic initiative due to "talent constraints".[2] Laments about the difficulties in hiring workers are especially ubiquitous concerning skilled occupations in specialized fields. For example, a 2013 industry report estimates that a shortage of skilled workers in the oil and gas sector put $100-billion worth of industrial investment projects at risk,[3] while a separate industry survey found that 47% of Fortune 1000 firms reported business growth being impeded by unfilled jobs in technical occupations.[4] These examples suggest that difficulties in hiring skilled workers can meaningfully inhibit demand for capital. Considering the fundamental roles of capital and labour in economic production, it is surprising how little is known about how constraints on firms' access to skilled labour affect corporate investment.

Corporate finance is largely concerned with how imperfect financial markets affect firms' ability to pursue attractive business opportunities. However without also considering the imperfections of labour markets, one cannot gain a complete picture of how firms make decisions. Zingales (2000) encouraged finance researchers to investigate the increasingly important interplay between human and physical capital to better understand the decisions of modern human-capital-intensive firms. In this essay, I study how labour market frictions affect demand for physical capital, with the broader

---

[1] Weitzman, Hal "Skills gap hobbles US employers" *Financial Times* 13, Dec. 2011.
[2] "15th Annual Global CEO Survey 2012" *PWC Report.* Web. `www.pwc.com/ceo`
[3] Hirtenstein, Anna and Shankleman, Jess "Skilled worker shortage threatens US$100-billion in U.S. energy projects" *Bloomberg News* 7 Mar. 2013.
[4] Bayer Corporation. "The Bayer Facts of Science Education XVI: US STEM Workforce Shortage—Myth or Reality? Fortune 1000 Talent Recruiters on the Debate." *Journal of Science Education and Technology* 23 (2014): 617-623.

goal of advancing our understanding of how capital and labour markets interact.

I study how restrictions on firms' ability to hire skilled labour (defined as college-educated workers) impacts corporate investment decisions. It is not immediately obvious whether firms should increase or decrease investment in response to an adverse skilled labour supply shock. In line with the anecdotal accounts of hiring difficulties creating a drag on investment, there is a long literature, starting with Griliches (1969), that explores the idea that skilled labour, relative to unskilled labour, is more complementary to capital. In contrast, Autor (2003) argues that the boundary between labour and capital generally moves in the direction of capital taking over tasks formerly performed by labour, even in traditionally skilled occupations. For instance, recent advances in automation and artificial intelligence may displace skilled workers in the modern economy, just as factories and assembly lines once displaced skilled artisan workers in the distant past.

My empirical tests are designed to shed light on whether an adverse shock to the supply of skilled labour induces firms to cut investments (i.e. the complementarity hypothesis), as widely claimed by business leaders, or whether firms opt instead to increase capital investment in order to mitigate the shock through substituting one factor of production for another (i.e. the substitution hypothesis). It is also possible that such shocks have no detectable effects on firms' investment decision, especially if the shocks are small and thresholds for capital investments are high. Under the null hypothesis, capital investment should remain unchanged after a shock to the supply of skilled workers.

While my research aims to improve our understanding of the fundamental relationship between labour and capital, it also has practical implications from a policy perspective. The economic impact of employment-based immigration has long been a politically contentious subject, with protectionist advocates arguing that the inflow of foreign workers negatively impacts the job opportunities and wages for domestic workers, while immigration reform advocates argue that restrictions on foreign workers hurt the competitiveness of domestic businesses and limit their growth potential. However, the effect of immigration policy on capital investment is often overlooked by policymakers and labour economists who are primarily concerned with employment and wage outcomes. My empirical work uncovers evidence that restrictions on skilled immigration do in fact impact capital growth at the firm level, with accompanying estimates that quantify the economic significance of this impact.

To establish the causal impact of changes to skilled labour supply on firm investment, one faces the classic identification challenge of disentangling supply shocks from shifts in demand. To overcome this challenge, I exploit an arguably exogenous change in skilled labour supply created by a change to the regulatory limit on the total number of foreign college-educated workers allowed to be hired in the United States under the H-1B visa program. Specifically, the nation-wide number of visas issued each year is limited by a regulatory cap, and a significant reduction in the cap took effect in 2003. The president of the American Immigration Lawyers Association predicted at the time that *"[the] immediate impact of not being able to obtain an H-1B approval... is that projects are put on hold, capital expenditures are deferred and lives are thrown into chaos."*[5]

---

[5] Gamboa, Suzanne "Limit reached for applications for skilled worker visas" *Associated Press*, 17 Feb. 2004.

The H-1B visa cap drop provides an ideal setting for my empirical investigation. As argued by Borjas (2001), immigrants constitute a relatively elastic supply of labour that serves to "grease the wheels" of the domestic labour market in large part due to their high intrinsic degree of mobility. This means that the relatively inelastic supply of domestic skilled workers often does not provide a sufficient source of substitute labour, especially given the secular trend over the past several decades, as documented by Molloy et al. (2014), of declining mobility amongst domestic workers with college educations. Therefore, an artificial restriction on the elastic supply of skilled immigrant workers should be acutely felt by domestic firms facing an inelastic supply of domestic workers.

My empirical approach is to compare changes in corporate investment between firms that were differentially affected by the 2003 cap drop. Firms which relied more heavily on H-1B workers ex-ante as a source of skilled labour were more exposed to H-1B policy shocks and therefore should have been more intensely affected by the cap drop. Accordingly, I set up a difference-in-differences (DD) estimation approach in which the 2003 H-1B cap drop forms the "treatment" event, and the intensity of firm's exposure to H-1B policy is measured based on firms' ex-ante hiring rates of H-1B workers during 2001. I compare quarterly investment rates for firms with differing levels of H-1B exposure from one year prior to the cap drop (2002) and one year following the cap drop (2004). Under the complementarity hypothesis, firms more exposed to H-1B policy shocks should experience declines in investment relative to firms less exposed to H-1B policy shocks, while the reverse should hold under the substitution hypothesis.

In line with the complementarity hypothesis, the results show that the 2003 H-1B cap drop caused more intense employers of H-1B workers to reduce capital expenditures relative to less intense employers of H-1B workers. The results are both statistically and economically significant, implying that a firm in the 75th percentile of H-1B usage experienced a 10.1 percentage point drop in their quarterly investment rate relative to a firm in the 25th percentile of H-1B usage. This corresponds to a 7 percent decline relative to the sample mean for the investment rate. I find that this result is robust to a variety of alternative definitions of firms' H-1B usage rates.

Crucially for identification, I find strong evidence in support of parallel trends, the key assumption behind the validity of my DD estimation approach, in that firms with differing exposures to H-1B policy did not experience diverging or converging trends in investment policy prior to the 2003 event. This suggests that my results are not driven by pre-existing differences in investment opportunity trends, and also that the event was not anticipated by firms prior to 2003. I also find that the dynamics of quarterly investment from 2002 to 2004 generally conform to the timeline of political events surrounding the H-1B cap drop.

Next, I examine whether the declines in investment for firms more reliant on H-1B workers persists beyond the immediate one-year window used in my benchmark analysis. It is possible that complementarity holds in the short run, while over longer horizons, firms can substitute for the restricted foreign H-1B workers using domestic workers—in which case the adverse effect on investment should attenuate over time—or to alter their production technology in substituting capital for labour—in which case the reverse substitution effect may occur. However, I find that

the impact on investment strongly persists for at least four years following the 2003 event, which suggests that it is difficult for firms to substitute for this elastic supply of skilled foreign labour.

A potential concern regarding my empirical approach is that the 2003 H-1B cap drop came about due to declining lobbying efforts from firms suffering declining investment opportunities. I mitigate this concern by showing that the documented effect on investment was not confined to the high-tech sector, which was strongly associated with political lobbying on H-1B policy issues. I find no significant differences between industries inside and outside of the high-tech sectors. Furthermore, I find no significant differences between large firms, which tend to be more politically active in lobbying, and small firms, which tend to be less politically active.

I also explore how the complementarity between skilled labour and capital investment depends on the specific occupational role of the labour and the specific industrial application of the capital. I find capital to be complementarity to workers in traditional "industrial" roles such as scientists and engineers, who are closely associated with working with physical capital, but not to workers in pure "knowledge" occupations such as computer programmers and accountants, who are more closely associated with working with ideas rather than physical machines.[6] With respect to industries, I find limited evidence that the complementarity effect is stronger for manufacturing firms, in which capital expenditures tend to be directed towards more variable inputs such as equipment and machinery, and weaker for service sector firms, in which capital expenditures tend to be directed towards fixed overhead items such as buildings and offices.

The literature on corporate investment is extensive. Research has shown investment to be impacted by agency frictions (Panousi and Papanikolaou, 2012), information constraints (Foucault and Fresard, 2014), behavioural biases (Malmendier and Tate, 2005), and real options (Carlson et al. (2004), Bloom et al. (2006)). One of the most important areas of the investment literature focuses on the role of financial constraints. Starting with Fazzari et al. (1988) and revitalized by Kaplan and Zingales (1997), researchers have long searched for evidence that financial constraints limit the ability of firms to respond to investment opportunities. Recent works by Lemmon and Roberts (2010), Duchin et al. (2010), and Almeida et al. (2012) have empirically documented the adverse impact of financial sector shocks on corporate investment. My contribution to this literature is to document how constraints on the supply of human capital, rather than financial capital, can affect investment policy.

My work also relates to the emerging body of finance research related to labour and employment. Previous works have explored both how labour market considerations affect financial and governance outcomes (Atanassov and Kim (2009), Chen et al. (2011), Simintzi et al. (2015), Matsa (2010), Agrawal and Matsa (2013)), as well as how financial factors affect employment outcomes (Benmelech et al. (2011), Mian and Sufi (2014)). While much of this literature looks at the impacts of unions, which is often associated with less-educated blue collar workers, I explicitly focus on highly-educated workers and their relationship to capital.

---

[6] For instance, software developers are tasked with the implementation of concepts and models, rather than the construction of physical machines.

My focus on skilled labour is motivated by the literature, starting with Griliches (1969), that explores the premise that skilled labour is relatively complementary to capital when compared to unskilled labour. Much of the evidence in this literature is descriptive and uses aggregate data, with no strong identification of causation at the micro level (DiNardo and Pischke, 1997). Lewis (2011) provides the most closely-related work to this essay, finding evidence that automation technology is more complementary to medium-skilled workers relative to low-skilled workers. While his work examines how low-skilled immigrants affect the technological mix used by manufacturing plants, I focus instead on high-skilled immigrants and their effect on total capital expenditures for firms across a broader set of industries. Furthermore, my dataset allows me to explore cross-sectional differences with respect to occupations and industries, and my quasi-experimental setting allows me to investigate the time horizon of the effect on investment.

The H-1B visa program itself is increasingly attracting attention from academic researchers. Most research in this area focus on the effects of the program on the employment and wages of domestic workers (Lofstrom and Hayes (2011), Kerr et al. (2015b), Peri et al. (2014), Doran et al. (2014)), while others study the effect on patenting and innovation (Lewis et al. (2015), Kerr and Lincoln (2010)). Rather than investigate the effect on domestic workers, I focus on the outcome of capital investment, which is often neglected by labour and policy researchers working in the field. In addition, I provide evidence on the horizon of the effect on investment, which may be an important consideration for policymakers.

Ghosh et al. (2014) and Ashraf and Ray (2016), who study the impact of skilled immigrant workers on innovation and productivity, also use the 2003 H-1B cap reduction as a quasi-experimental setting. However, they use data on labour condition applications (LCAs), which are noisy measures of H-1B usage.[7] In contrast, I use data on firms' actual petitions to hire H-1B workers, which provides additional detailed data on workers' occupations and educational backgrounds. In addition, both Ghosh et al. (2014) and Ashraf and Ray (2016) use annual firm data, while I use quarterly data in order to better isolate the timing of the policy shock. Nevertheless, my finding of a negative effect on firm investment is consistent with the negative effect on innovation and productivity that they document.

The remainder of the essay is organized as follows. Section 2.2 provides a description of the 2003 regulatory change in the H-1B visa program and how I exploit this quasi-experimental event as part of my identification strategy. Section 2.3 describes the data and accompanying summary statistics. Section 2.4 reports my main results as well as follow-up findings. Section 2.5 concludes.

2.2. Empirical Strategy

I base my identification strategy on the sharp 2003 drop in the legislative cap of the H-1B visa program. In this section, I explain the importance of the H-1B visa program as a source of skilled workers for U.S. firms. I then briefly describe the history of the annual cap restricting the number

---

[7] Filing an LCA is a necessary step towards hiring an H-1B worker, but does not necessarily lead to a H-1B hire.

of foreign workers that can be hired through the program. Finally, I describe the sharp drop in the annual cap drop that occurred in 2003, and how I exploit this event as part of my identification strategy.

2.2.1. Overview of the H-1B Program

Established by Congress through the Immigration Act of 1990, the H-1B visa program allows employers to hire skilled foreign workers to legally work in the U.S. on a temporary basis. Visas are issued for a period of up to three years, with the possibility of a one-time extension for an additional three years. According to the U.S. government's website, the program's stated intent is to allow employers to fill vacant positions for which *"the nature of the specific duties is so specialized and complex that the knowledge required to perform the duties is usually associated with the attainment of a bachelor's or higher degree"*.[8] Since the late 1990s, H-1B workers have largely consisted of workers in technical occupations related to science and technology fields.[9]

The H-1B visa program provides an economically significant source of skilled workers for U.S. firms. In 2003, U.S. employers hired 130,497 new H-1B workers, a substantial number when compared against the 442,755 new domestic bachelor's degree holders in science and technology disciplines.[10] The H-1B program is also comparable in magnitude to that of employment-based legal permanent residents (LPRs); LPRs are capped at 140,000 per year, and each foreign country is further limited to a maximum 7% of total worldwide admissions. Since the H-1B program places no such per-country limit, it is often the only channel for firms to hire workers from countries with large emigrant populations such as India and China.[11]

There is a legislative cap placed on the total number of H-1B visas issued per year, which applies to new H-1B hires and not to extensions of existing visas. This cap has fluctuated throughout the history of the H-1B program, starting with 65,000 in 1992 and reaching as high as 195,000 during the early 2000s. The cap was first raised to 115,000 through the American Competitive and Workforce Improvement Act (ACWIA) in 1998, and then raised again to 195,000 in 2000 by the American Competitiveness in the Twenty-First Century Act (AC21). The sharpest change came in 2003, when the cap reverted from 195,000 to 65,000 upon the expiration of the AC21.[12] This last event forms the quasi-experimental event behind my identification strategy.

---

[8] More than 98% of all approved applicants in 2004 possessed at least a bachelor's degree, with the remaining 2% coming from special exempt occupation such as fashion modelling.

[9] In 2003, the top five most common occupations for H-1B workers were found in systems analysis and programming (33.5%), college and university education (7.8%), accountants and auditors (4.8%), electrical/electrical engineering (3.9%), and computer-related occupations (3.1%), according to the *USCIS Characteristics of Specialty Occupation Workers (H-1B): Fiscal Year 2004*.

[10] See Appendix Table 2-18 for "Science and Engineering Indicators 2012" by the National Science Foundation, available online at https://www.nsf.gov/statistics/seind12/appendix.htm.

[11] A 2015 *National Foundation for American Policy* policy brief reports that skilled workers from high-population countries face expected wait times of 6-10 years in obtaining permanent residency. Unsurprisingly, India overwhelmingly supplied the largest share of new H-1B workers in 2003 at 46%, with China coming in at second at 8.7%.

[12] All changes to the H-1B cap up to this point focused exclusively on skilled immigration were not accompanied by policy changes relating to low-skilled immigration (Kerr et al., 2015a).

2.2.2. Identification based on the 2003 H-1B Cap Drop

As shown in Figure 2.1, the 2003 H-1B cap drop from 195,000 to 65,000 resulted in a binding constraint on H-1B hires. Before the drop, employers were effectively assured of securing visas, as the 105,185 initial petitions submitted in 2002 fell well below the higher cap. In 2004, the newly-lowered cap of 65,000 was well above the 116,927 initial petitions submitted by employers. Consequently, employers found themselves rationed in their ability to hire H-1B workers due to the newly binding cap.

The main idea behind my empirical strategy is that the H-1B cap drop resulted in more severe hiring constraints for firms that were ex-ante more reliant on H-1B workers as a source of skilled labour. Accordingly, I employ a difference-in-differences (DD) estimation framework in which the 2003 H-1B cap drop marks the onset of the treatment, and the intensity of treatment is determined by the intensity at which firms employed H-1B workers in 2001. This follows the standard DD specification in which treatment is continuous rather than binary as in Card (1992):

$$CapEx_{it} = \alpha_i + \lambda_t + \delta \cdot H1B\ use_i \cdot Post_t + X_{it-1}\beta + \epsilon_{it} \tag{2.2.1}$$

where i indexes firms and t indexes time periods. $CapEx$ represents capital expenditures, α represents a firm-specific dummy, λ denotes a time-specific dummy, $Post$ represents a dummy for the "post-treatment" period, X represents a vector of lagged firm-level control variables, ϵ represents the error term, and $H1B\ use$ represents the intensity at which firms hired H-1B workers in 2001. The coefficient of interest is δ, which should be zero under the null hypothesis, negative under the complementarity hypothesis, and positive under the substitution hypothesis. This standard DD specification controls for any time-invariant firm-level factors affecting investment, as well as for any time-specific shocks common to all firms.

I define the post-treatment period to consist of the four quarters in 2004, as illustrated in Figure 2.2. Although the lower cap officially took effect in October 2003, firms were able to continue filing petitions for hiring new H-1B employees until several months later. It was not until February of 2004 that the United States Citizenship and Immigration Services (USCIS) announced that it would no longer accept new H-1B petitions for the coming fiscal year, marking the point at which firms were first subject to hiring restrictions due to saturation of the cap.[13] Therefore, the impact of the cap drop should have been fully felt by the beginning of 2004.

Next, I define the pre-treatment period to consist of the four calendar quarters in 2002, also shown in Figure 2.2. Although the AC21 initially set the cap at 195,000 for a temporary period of three years, the previous trend of a rising cap created a reasonable expectation of permanence (Kato and Sparber, 2013).[14] Media reports suggest that the business community had expectations of a continued higher cap in early 2003, as the trade publication CIO Magazine reported in January that

---

[13] The government's fiscal year starts in October and ends in September. The petition "window" never closed for two years preceding the 2003 cap drop.

[14] Consider that the previous cap increase from the ACWIA was also originally set to expire after three years before being extended and raised by the AC21 in 2001.

"most expect the introduction of a bill that will either keep the cap high or eliminate it altogether".[15] It was not until February 2003 that the congressional chairman of the House Judiciary Committee indicated that the cap would revert back to 65,000 the following year.[16] Therefore, the sharp H-1B cap drop remained largely unanticipated by firms during the 2002 pre-treatment interval.

In my main regression analysis, I restrict the sample to the pre-treatment and post-treatment periods, while dropping the 2003 calendar year—i.e. the "legislative shift" period. This is so that δ captures the full extent of the effect of the H-1B cap drop on investment, and does not reflect any partial effects as expectations about the pending H-1B cap drop gradually built up throughout 2003. In later tests, I include the full time series, including the legislative shift period, in order to examine the quarter-by-quarter dynamics of investment around the event to verify that they align with the political timeline.

As is the case with all natural experiments involving legislative action, there is the concern that the 2003 H-1B cap drop arose endogenously due to shifts in forward-looking economic demand. In particular, one must be wary of the possibility that declining expectations about future investment opportunities resulted in reduced lobbying by firms looking to maintain a higher cap. In particular, the 2003 H-1B cap drop has been partly attributed to reduced lobbying efforts by information technology firms following the dot-com crash that occurred in 2000-2001.

Figure 2.3(a) reveals that the 2003 H-1B cap drop came at a time of growing rather than declining aggregate investment.[17] Figure 2.3(b), which displays the same data series at quarterly intervals, shows the same upward trajectory and also uncovers a sharp dip in aggregate investment during the latter parts of 2003 and early parts of 2004, precisely when the H-1B cap drop began to take effect. To mitigate concerns that H-1B dependent firms faced declining investment opportunities following the dot-com crash, I check to make sure investment rates between high *H1B use* and low *H1B use* firms did not diverge in the 2002 pre-treatment period.

I further address concerns about political endogeneity by investigating whether the effects on investment are confined to sectors most closely associated with political lobbying on H-1B policy. As noted by the press around the time of the cap drop, firms in the high-tech sector were the most significant political lobbyists on the issue of H-1B policy.[18] If my results are driven by the declining investment opportunities of politically-active firms, for instance, then one would expect the relative investment declines to be stronger in firms in the high-tech sector. I show this not to be the case, using various definitions of high-tech industries.

Finally, plausibly exogenous political factors played a large role in influencing the regulatory shift towards to a lower cap. In particular, the September 11, 2001 terrorist attacks created a fear of foreigners being admitted into the country. This created a political climate in which proponents of more open immigration policies found it more difficult to influence politicians.[19] In fact, the

---

[15] Overby, Stephanie "Cap on H-1B Visas Brought to Congress" *CIO Maganize* 1 Jan. 2003.

[16] "U.S. to tighten H1B visa norms" *The Hindu Business Line* 21 Feb. 2003.

[17] Note this series is taken from Bureau of Economic Analysis data, and represents aggregate investment activity across all sectors, not just Compustat firms in my sample.

[18] Sickinger, Ted "Congress Lowers Visa Cap for Foreign Tech Workers" *The Oregonian*, 29 Sep. 2003.

[19] In its September 2003 10-K filing, telecommunications company Wireless Facilities Inc. noted that *"[immigration]*

Department of Homeland Security, specifically formed in response to the 9/11 attacks, assumed direct oversight of approving H-1B petition in March of 2003, taking over the mantle from the newly-defunct Immigration and Naturalization Services agency. Combined with the non-declining trend in investments, the circumstances during this period make a strong case for the exogeneity of the H-1B cap drop with respect to firms' changing investment opportunities.

2.3. Data

2.3.1. Sample Construction

My sample consists of firm-quarter observations from industrial firms, excluding utility firms (SIC code between 4900 and 4900), financial firms (SIC code between 6000 and 6999), and public sector firms (SIC code over 9000). All accounting and financial data come from the merged CRSP-Compustat Fundamentals Quarterly file. For my main results, I limit my sample to four quarters in the pre-treatment period (2002Q1-2002Q4) and four quarters of data in the post-event period (2004Q1-2004Q4).

I employ data selection criteria standard in the investment literature (Almeida et al. (2004), Duchin et al. (2010), Almeida et al. (2012)) by discarding firms for which the total market capitalization is less than $50 million as of the last quarter in the pre-treatment period (2002Q4). This serves to exclude the smallest firms with volatile accounting data and skewed investment patterns, resulting in a sample of 23,644 firm-quarter observations corresponding to 3,600 distinct firms.

I further restrict the sample to firms that have submitted at least one H-1B petition during the 2001 calendar year (i.e. "H-1B firms"), which results in a sample of 9,921 firm-quarter observations corresponding to 1,395 distinct firms that make up 36.24% of the total market capitalization for all publicly-listed companies listed on the Compustat quarterly database as of 2002Q4. Having H-1B petition-level data for all firms in the sample allows me to conduct cross-sectional heterogeneity tests based on the observed characteristics of H-1B workers across firms. Furthermore, this restriction ensures that all firms in the sample have domestic operations in the U.S. and are potentially affected by H-1B policy.

Data on H-1B usage comes via a Freedom of Information Act (FOIA) request filed with the USCIS. The data contains information from petitions submitted by firms to the USCIS during the final step of the H-1B approval process, and includes details about the sponsoring employer, prospective H-1B employee, and job position, including employee age, education level, job wage, and occupational category. I match the USCIS data to Compustat firms via company names. Due to spelling mistakes and alternate variations of firm names in the USCIS data, I employ a matching procedure that incorporates fuzzy string matching as well as manual inspection of matches.[20]

_____

policies are subject to rapid change, and these policies have become more stringent since the terrorist attacks on September 11, 2001."

[20] Specifically, I first standardize the firm names found in both the Compustat and FOIA files, and employ a fuzzy string matching algorithm to arrive at a list of potential matches. I then inspect the list of potential matches to filter out the false positives.

By restricting the sample to only H-1B firms, my benchmark results are potentially subject to selection bias. In order to address this, I include tests based on the expanded sample of firms including "non-H-1B firms"—i.e. firms that did not submit a petition to hire H-1B workers in 2001. In particular, I show that non-H-1B firms experienced similar investment patterns to those of H-1B firms with marginally low exposure to H-1B policy, which suggests that the investment opportunity trends of H-1B firms are similar to the investment patterns of non-H1B firms absent the effect of the H-1B cap restriction. The expanded sample includes an additional 13,723 firm-quarter observations corresponding to 2,205 non-H1B firms.

2.3.2. Key Variables and Descriptive Statistics

My primary measure of H-1B usage intensity, *H1B use*, is defined as the total number of initial H-1B petitions filed during the 2001 calendar year by a given firm, scaled by the average number of employees employed by the firm during the same interval. I use applications filed in 2001 in order to create an ex-ante measure with respect to my sample period, as shown in Figure 2.2. This mitigates the possibility of *H1B use* being correlated with changing investment opportunities surrounding 2003. The distribution for *H1B use* exhibits a sizable degree of positive skewness, and therefore it is winsorized at the 2% level at the upper tail.[21]

The dependent variable in my analysis is *CapEx*, which is defined as the ratio of quarterly capital expenditures to lagged total assets following the conventions of Baker et al. (2003) and Rauh (2006).[22] I include lagged control variables commonly found in the investment literature. These include $Tobin's\ Q$, defined as the ratio between the market value and book value of assets, $ln(Size)$, defined as the natural log of total assets, *Cash Flow*, defined as the ratio between quarterly net income before depreciation and total assets, *Cash Holdings*, defined as the ratio between cash holdings and total assets, and *Leverage*, defined as the ratio between long-term debt and total assets. A detailed definition of these variables can be found in Appendix B.1. To mitigate the effects of outliers, I winsorize each variable listed above at the 1% level at both tails. I further bound $Tobin's\ Q$ to be no larger than 10, following Baker et al. (2003).

Table 2.1 presents the descriptive statistics for the variables defined above. Panel A displays the descriptive statistics for H-1B firms, while Panel B displays the descriptive statistics for non-H-1B firms. Note that in Panel A, *H1B use* exhibits positive skewness even after winsorization. In later robustness checks, I employ alternative measures of firm-level H-1B usage, including non-parametric measures in order to address potential concerns regarding skewness.

In comparing Panel A and Panel B, it is apparent that H-1B firms are on average larger than non-H1B firms, with lower average investment rates and leverage ratios but higher average Tobin's Q, profitability, and cash holdings.[23] This is consistent with anecdotes of large firms in high-growth

---

[21] The main results remain qualitatively unchanged if I winsorize by 1% at both tails like the other variables.

[22] Because capital expenditure is reported on a year-to-date basis in quarterly financial statements, the previous quarter's capital expenditure is subtracted from the current quarter's capital expenditure (*capxy*) for fiscal quarters 2, 3, and 4 to arrive at the quarterly figure.

[23] The differences in means are significant for all variables.

technology industries being major employers of H-1B workers.[24] Panel A in Table 2.2 shows a list of the top 10 H-1B employers (in terms of total petitions submitted to the USCIS) found in my sample; the list includes large technology companies such as Microsoft, Oracle, and Intel. Panel B in Table 2.2 shows that the firms most dependent on H-1B workers are not quite as large, but are also found in high-growth sectors such as telecommunications and high-tech manufacturing. In later tests, I include both H-1B and non-H1B firms in order to address concerns about selection bias stemming from focusing only on H-1B firms.

Table 2.3 presents statistics about the characteristics of the H-1B workers hired by firms in the sample during 2001. These characteristics include *Wage*, the listed wage of the H-1B employee, *Occ Wage*, the national average wage corresponding to the H-1B employee's occupations according to BLS data, *Occ Wage Growth*, the national average wage net growth rate corresponding to the H-1B employee's occupation, *Age*, the age of the H-1B employee, *Grad*, a dummy variable for whether the H-1B employee possesses a graduate-level education, and *HQ State*, a dummy variable for whether the H-1B employee works in the same geographic state as firm headquarters. Detailed definitions for all worker characteristic variables can be found in Appendix B.1. All variables are constructed using USCIS petition-level data, with the exception for *HQ State*, which uses additional data that is publicly-available on the Department of Labor website.[25]

Table 2.3 presents descriptive statistics about the characteristics of the top occupational groups found across the H-1B petitions in the sample. The occupational categories are taken directly from the USCIS Dictionary of Occupational Codes, and a listing of more detailed occupational subcategories can be found in Appendix C.1.[26] Panel A displays the mean values for the various worker characteristic variables across occupational categories, while Panel B presents correlations between the same set of variables. The results reveal that *Computer* workers constitute the youngest group of workers and are amongst the highest paid in terms of actual wages as well as being in the highest-paid and highest wage growth occupations. Meanwhile, *Science* workers are among the least well-paid workers with the lowest rate of occupational wage growth, but also constitute the most well-educated category of workers. *Science* workers are also the most likely to be working in close proximity to firm headquarters compared to the other occupations. Panel B from Table 2.3 show high correlations between wage and age as well as between occupational wage and occupational wage growth.

Table 2.4 presents a breakdown of H-1B petitions by occupational and industry group.[27] The vast majority of H-1B employees are found in *Computer*, *Engineer*, *Science*, *Admin*, and *Manage-*

---

[24] This could be due to the fact that large firms are better able to afford overhead costs associated with immigration lawyer fees and overcoming regulatory hurdles in the H-1B hiring process.

[25] Before submitting petitions to the USCIS, firms must first submit a Labor Condition Application (LCA) to the Department of Labor attesting that the positions for prospective H-1B workers meet certain regulatory requirements. LCA data is are available online, and contain information on the geographic location of the prospective H-1B workers' work locations. I match application-level LCA data to firms in a similar manner as the petition-level USCIS data.

[26] The occupational codes are available online at `http://www.uscis.gov/files/form/m-746.pdf`. The physical sciences (Mathematics And Physical Sciences) and life sciences (Life Sciences) subgroups have been combined under a single "Sciences" group.

[27] Industry is defined at the SIC Division level. See note on next page for more details on this classification.

ment occupations, with *Computer* occupations accounting for the largest group by a wide margin. In terms of a breakdown by industry, the vast majority of firms operate within the *Service* and *Manufacturing* industries. *Manufacturing* firms tend to employ the largest share of H-1B workers across the different occupational categories, with the exception of *Computer* workers, who are more than twice as likely to be found in the *Service* rather than *Manufacturing* sector. Overall, the top H-1B occupations are found across all industries, with the exception of *Construction* and *Agriculture, Forestry*, which contain relatively few firms.

The descriptive statistics are generally consistent with anecdotes of the H-1B program being an important source of young IT workers from India in the software and other IT-related service industries. However, the summary tables also show that manufacturing firms hire a significant number of H-1B workers, particularly in more traditional technical fields related to science and engineering. I later investigate heterogeneity across worker-level occupational characteristics as well as across industry classifications. This is done in order to investigate how complementarity or substitutability between skilled labour and capital depends on the nature of the production function, as well as to address various concerns about omitted variables driving my results.

2.4. Results

2.4.1. Effect of the 2003 H-1B Cap Drop

I run OLS regressions according to the Eq. 2.2.1 to estimate the impact of the 2003 H-1B cap drop on investment. Table 2.5 presents the results under various sub-specifications on the sample described in the previous section. The coefficient estimate for the variable of interest $H1B\ use \times Post$ is negative and statistically significant under all specifications, implying that the H-1B cap drop induced a relative investment decline in firms that were ex-ante more dependent on the program, in support of the complementarity hypothesis.

Column (1) starts off with the most basic specification. This specification does not include any control variables, but does include firm fixed effects, which control for time-invariant factors, and year-quarter fixed effects, which control for time-specific macro shocks. The inclusion of control variables *Tobin's Q* , *Cash Flow*, *ln(Size)*, *Leverage*, and *Cash Holdings* through columns (3)-(6) leaves estimates with slightly larger magnitudes and stronger statistical significance. The specifications represented in columns (2), (4), and (6) further include industry-year-quarter fixed effects, where industry is defined at the SIC Division level.[28] This addresses potential concerns that the main results are driven by time-varying industry-level demand shocks.

Column (6) presents the most robust specification, which includes the full set of control variables and firm and quarter fixed effects. The economic magnitude here is significant: the coefficient

---

[28] SIC Divisions consist of broad categories of economic activity identified in the SIC manual, corresponding to ranges of two-digit SIC codes (Kahle and Walkling, 1996). I use a coarse industry classification since finer industry definitions result in many industries for which my sample only contains a single firm, in which case all variation is subsumed by the industry-time fixed effects. In unreported tests, I use 2-digit, 3-digit, and 4-digit SIC classifications and the results remain virtually unchanged.

estimate of -0.101 implies a firm in the 75th percentile of *H1B use* suffers 10.1 percentage point drop in their quarterly investment rate relative to a firm in the 25th percentile of H-1B use. For a firm with the sample mean value for *CapEx*, this corresponds to a 7 percent relative decline in proportional terms. For a firm with the sample mean value for total assets, this corresponds to a $606,679 relative drop in capital expenditures in dollar terms.[29]

2.4.2. Investment Dynamics and Pre-Event Trends

The validity of my DD estimation approach hinges on the "parallel trends" assumption, in that firms' ex-ante H-1B exposure are not correlated with trends in investment policy in the lead up to the 2003 H-1B cap drop. I provide evidence in support of this by estimating the following OLS regression:

$$CapEx_{it} = \alpha_i + \lambda_t + \sum_{\tau < 2004Q1} \delta_\tau \cdot H1B\ use_i \cdot \tau_t + \delta \cdot H1B\ use_i \cdot Post_t + X_{it-1}\beta + \epsilon_{it} \qquad (2.4.1)$$

where τ_t represents a dummy variable that takes on a value of one when τ is equal to t, and τ takes on values from 2002Q2 to 2003Q4 inclusive.[30] The sample consists of all quarters between 2002Q1 and 2004Q4; data from 2003 is added back to the sample in order to analyze the full dynamics of firm investment, including the legislative shift period. For the parallel assumption to hold, the coefficients δ_τ should not exhibit any significance prior to 2003.

The results are presented in Table 2.6, and provide support for the parallel trends assumption. Both specifications contain the full set of control variables as found in column (6) of Table 2.5, while including different sets of fixed effects. Under both cases, δ_t is statistically insignificant for all $\tau < 2003Q3$, which means that, relative to the baseline period of 2002Q1, firms with differing levels of *H1B use* did not experience differing trends in investment during the pre-treatment period. This implies that my results are not driven by differing trends in investment opportunities already in place during the pre-treatment period, and that the pending cap drop was not anticipated by firms prior to 2003.

The timing of the detected effect also conforms to the legislative timeline outlined in Section 2.2. The first statistically significant coefficient in column (2) comes at the third quarter of 2003, meaning that it took two quarters following the February 2003 congressional announcement before firms implemented changes in investment policy. This is consistent with the political timeline of the legislative shift period: firms still had the opportunity to lobby for an extension of the higher cap following the congressional announcement, and therefore may have decided to refrain from major

---

[29] In a set of unreported tests, I estimate the same regression after collapsing the data along the time-series into a pre-treatment mean and a post-treatment mean for CapEx and all control variables. This is done, based on the recommendations from Bertrand et al. (2004), in order to overcome concerns of serially-correlated standard errors resulting in excessive rejection of the null hypothesis. The results are qualitatively similar when the data is collapsed, and remain statistically significant at the 1% level.

[30] The dummy variable for 2002Q1 is omitted since it is subsumed by the *H1B use* level term and intercept. Note that I do not extend my sample back beyond 2002, as the September 11, 2001 terrorist attacks also impacted immigration policy and therefore may confound the results.

shifts in investment policy until the lower cap became more certain. It was not until late September of 2003 that the lower cap was officially finalized following a final congressional hearing on the subject, which coincided with the first significant negative coefficient corresponding to 2003Q3.

2.4.3. Long Term Impact of the H-1B Cap Drop

While the 2003 H-1B cap drop was of a permanent nature, the baseline results presented in Table 2.5 are based on post-treatment investment policies at only a one year horizon.[31] However, it is possible that the effect on investment attenuated gradually over time, as the supply of potential domestic skilled worker substitutes becomes less inelastic in the long-run. The negative effect on investment may even eventually reverse if firms gradually adjust their production technology to replace labour with capital over longer horizons, as described by Autor (2003). Therefore, I extend the horizon past 2004 to investigate whether the effect of the H-1B cap drop persists beyond the initial year by expanding the sample to include data up to 2007.[32] I collapse the quarterly data along the time dimension by calendar year and run the following regression:

$$CapEx_{it} = \alpha_i + \lambda_t + \sum_{k=2004}^{2007} \delta_k \cdot H1B \ use_i \cdot Year \ k_t + X_{it-1}\beta + \epsilon_{it} \qquad (2.4.2)$$

where $Year \ k_t$ represents a dummy variable that takes on a value of one when k is equal to t. Here, k takes on values from 2002 to 2007 inclusive, which allows me to estimate the effect on investment for four years following the 2003 cap drop.

The results are presented in in Table 2.7, and reveal that the effect on investment is indeed persistent for all four years following the 2003 cap drop, as δ_k remains negative and statistically significant for all $k > 1$. Furthermore, they do not shrink in magnitude over time—in fact they seem to grow larger. This is consistent with the anecdotal evidence of the increasing difficulties that firms faced in securing H-1B visas for their workers in the years following the cap drop. Over all, the results suggests that persistent rationing of foreign skilled workers is not gradually mitigated by domestic replacements, and that firms are not able to adjust their production technology to directly replace workers with capital at the time scale examined here. Nevertheless, it is still possible that reversals can occur in the very long run.

2.4.4. Comparisons Between Occupations and Industries

Complementarity between capital and skilled labour is a general and abstract concept, and its manifestation depends greatly on the characteristics of the specific production technology that

---

[31] In 2005, there was a small increase in the allowance for an additional 20,000 workers under the cap, but this was a relatively insignificant change in the cap compared to the 2003 decrease, and only applied to applicants holding a Master's or PhD degree from an U.S. institution. Furthermore, prospective legislation on skilled immigration became increasingly bundled with that on unskilled immigration in the years following the cap drop (Kerr et al., 2015a), making it politically difficult to enact policy changes to re-expand the H-1B program.

[32] I stop at 2007 due to the onset of the credit crunch and financial crisis that significantly impacted firm investment in 2008 and 2009.

combines capital and labour to produce goods and services. In this section, I investigate how the main effect documented in this essay differ across firms with differing sets of worker and industry characteristics, in order to answer questions about how the complementarity between skilled labour and capital relates to occupational and industry characteristics.

To give some historical context, Goldin and Katz (1998) and others point out that the relative complementarity between capital and skilled labour is a fairly recent phenomenon. During the industrial revolution, for instance, physical capital in the form of factory systems, machinery, and mechanized equipment came to directly displace skilled artisans in occupations such as glassblower, shoemaker, and blacksmith. It is natural to expect that, in the modern economy, the degree of complementarity between labour and capital depends critically on the specific occupational role of labour as well as the specific industrial application of capital, and not necessarily on the abstract attribute of skill itself.

First, I investigate whether the benchmark effects on investment from Table 2.5 differ across occupational groups of H-1B workers in my sample. As shown in Table 2.4, the major occupational categories of worker found in the sample come from the fields of *Admin*, *Computer*, *Engineer*, *Management*, and *Science*. One can further classify these occupational groups into broader categories in terms of their fundamental roles in modern economic production. First, workers in *Science* and *Engineer* occupations can be placed in the category of traditional "industrial workers", with roles that are typically tied to physical production processes. Looking through the occupational sub-categories in Appendix C.1, employees in fields such as civil engineering, mechanical engineering, physics, chemistry, and biology typically work in close physical proximity to machinery, laboratories, and other physical hardware to produce physical products. Therefore, it is natural to expect that workers in such occupations would exhibit strong complementarities to physical capital.

Workers in *Computer* and *Admin* occupations, on the other hand, can be more appropriately placed in the category of modern "knowledge workers". Taking examples of computer programmers, computer technical support specialists, accountants, and public relations occupational subcategories from Appendix C.1, it is apparent that such workers are more closely associated with working with ideas and abstract models rather than heavy machinery and equipment, software rather than hardware, and digital rather than analogue technologies.[33] Rather than generating physically capital-intensive projects, the value of knowledge workers lies in the development of organizational capital, defined by Eisfeldt and Papanikolaou (2013) as intangible capital embodied in the firm's specialized labour inputs and distinct from physical capital. Furthermore, these workers often do not need to be in close physical proximity to their work, especially when augmented by modern telecommunication technology. Therefore, one should expect that workers in such occupations would exhibit weaker complementarities to physical capital.

Finally, workers in *Management* occupations can be placed in their own category, as managers, who have been the focus of much academic research (see Bloom and Van Reenen (2007) for instance),

---

[33] (Martin and Moldoveanu (2003) note that, late in the 20th century, physical and financial assets came to be supplanted in importance by knowledge assets, including the know-how and experience of knowledge workers.

provide oversight over all aspects of the firms' operations and strategic direction. Managers typically possess power over decisions on capital budgeting, but their decisions also depend on input from employees involved in day-to-day operations (Harris and Raviv, 2005). Therefore, it is not clear where *Management* workers fall on the occupational spectrum relative to industrial and knowledge workers, with respect to complementarity to physical capital.

To empirically determine whether the results on investment from Table 2.5 follow the occupational patterns described above, I break down the variable *H1B use* by occupational category and run the following regression:

$$CapEx_{it} = \alpha_i + \lambda_t + \sum_j \delta_j \cdot H1B\ use_{ij} \cdot Post_t + X_{it-1}\beta + \epsilon_{it} \tag{2.4.3}$$

where $H1B\ use_{ij}$ is defined as the total number of initial petitions submitted by firm i for workers in occupational category j scaled by the average number of employees during 2001, and j takes on the values of *Computer*, *Engineer*, *Science*, *Admin*, and *Management*, as described in Table 2.3, as well as the broader categories of *Industrial* and *Knowledge*, as defined above. The coefficients δ_j reveal whether the H-1B cap drop resulted in investment declines for firms that relied more intensely on H-1B workers in occupation j relative to firms that relied less intensely on H-1B workers in occupation j.

The results are presented in Table 2.8. While the coefficient estimates δ_j are negative across all specifications, they are not statistically significant for workers in *Knowledge*, *Computer* and *Admin* occupations (columns (4), (5), and (6)), which is consistent with knowledge workers not exhibiting strong complementarities to capital expenditures. On the other hand, the estimates are statistically significant with respect to *Industrial*, *Engineer*, and *Science* occupations (columns (1), (2), and (3)), which is consistent with industrial workers exhibiting strong complementarities with capital-intensive projects.[34] Finally, the coefficient estimate on *Management* is large, as seen in column (4).[35] However, the estimate is imprecisely measured with large standard errors, which may be attributed to the relatively few H-1B workers in management roles as seen in Table 2.4.

I further investigate how the benchmark effects on investment relate to other occupational and industry characteristics. First, I test whether capital is more complementary to higher-skilled workers who hold post-graduate degrees. Next, I investigate whether the geographic proximity of workers to firm headquarters has any bearings on the documented effects on investment, based on the idea that workers closer to headquarters are more complementary to capital due to their relative importance and/or advantages in monitoring and information acquisition. Finally, I test whether the documented complementarity effects are found to be stronger in manufacturing-sector firms or in service-sector firm.

---

[34] In terms of economic magnitude, a 1-standard deviation change in $H1B\ use_{ij}$ corresponds to a 4.39% and 9.41% decline in investment relative to the sample for $j = Engineer$ and $j = Science$, respectively.

[35] The results for which all occupational categories are omitted to conserve space. When all categories are included, the coefficient estimates on the industrial occupation interaction variables remain significant, the coefficient estimates on the knowledge occupation interaction variables remain insignificant. and the coefficient estimate on $H1B\ use_{i,Management}$ is no longer significant

I run the following triple-differences OLS regression, in which the DD interaction term $H1B\ use_i \cdot Post_t$ from my baseline specification is interacted with various dummy variables related to worker and industry characteristics:

$$CapEx_{it} = \alpha_i + \lambda_t + \delta \cdot H1B\ use_i \cdot Post_t + \theta \cdot W_i \cdot Post_t + \gamma \cdot H1B\ use_i \cdot W_i \cdot Post_t + X_{it-1}\beta + \epsilon_{it} \quad (2.4.4)$$

where W_i takes on the form of various dummy variables related to H-1B worker and industry characteristics. This test is used to determine whether the documented complementarity effects are stronger for more-educated vs. less-educated workers ($High\ Grad_i$ indicates firm i is above the sample median in terms of $Grad$), for older vs. younger workers ($High\ Age_i$ indicates whether firm i is above the sample median in terms of Age), for workers with higher vs. lower wages ($High\ Wage_i$ indicates whether firm i is above the sample median in terms of $Occ\ Wage$), for workers in close proximity vs. distant proximity to firm headquarters ($Near\ HQ_i$ indicates whether firm i is above the sample median in terms of $HQ\ State$), for manufacturing vs. non-manufacturing firms ($Manufacturing_i$ indicates whether firm i is in the manufacturing sector), and for service vs. non-service firms ($Services_i$ indicates whether firm i is in the services sector). The reported coefficient γ reveals whether the effect of the H-1B cap drop on investment is different across firms with different sets of worker and industry characteristics.

Results for the triple differences regressions are presented in Table 2.9. First, taking education, age, and occupational wage as proxies for worker skill and experience, one would expect γ to be negative in columns (1) to (3) if relatively more skilled workers are more complementarity to capital when compared to relatively less-skilled workers. However, the only significant result of the three is for the triple interaction involving $High\ Grad$. Furthermore, these results may be driven by differences in worker characteristics between knowledge and industrial workers—recall from Table 2.3 that $Science$ workers tended to be better-educated and less highly-paid, while $Computer$ workers tended to be younger and more highly-paid.[36] Therefore, there is limited evidence to suggest the abstract attribute of skill by itself has a strong bearing on the degree of complementarity between college-educated workers and capital.

Next, one may expect that workers in closer proximity to company headquarters to have a larger effect on firm decisions, in which case γ should be negative in column (5). This may be due to advantages in monitoring and information acquisition, as described by Giroud (2013), or due to the possibility that the roles of workers hired in close proximity to headquarters are less easily relocated and outsourced. The estimate from column (5) provides some evidence in support of either explanation, as the coefficient corresponding to $H1B\ use_i \cdot NearHQ_i \cdot Post_t$ is negative and significant at the 5% level. Again, this result cannot easily be disentangled from the fact that $Science$ and $Engineer$ workers tend to work closer to headquarters, as shown in Table 2.3.[37] Industrial

---

[36] When running the same triple-differences regression using $H1B\ use_{i,Industrial}$ instead of $H1B\ use_i$, the triple interaction term for $High\ Grad$ remains significant at the 1% level, suggesting the results are not totally driven by correlations between occupational categories and education levels.

[37] When running the same triple-differences regression using $H1B\ use_{i,Industrial}$ instead of $H1B\ use_i$, the triple interaction term for $Near\ HQ$ remains significant at the 10% level, suggesting the results are not totally driven by

workers need to be in close proximity to physical capital, while knowledge workers are more easily relocated as their productive activities can be more easily augmented by modern telecommunication technologies.

Finally, column (5) and (6) from Table 2.9 present evidence of a differential effect on service and manufacturing industries.[38] The coefficients corresponding to $H1B\,use \cdot Manufacturing \cdot Post$ and $H1B\,use \cdot Services \cdot Post$ are shown to be weakly significant in the negative and positive directions, respectively. Given data limitations that prevent direct tests on different types of capital expenditures, these tests provide an indirect way to compare industries with different expenditure patterns.[39] According to U.S. census data, manufacturing firms tend to spend a significantly greater proportion of their capital expenditures on equipment (e.g. computers, industrial machines, and communications equipment) relative to structures (e.g. offices, commercial buildings, and transportation facilities) when compared to firms in the service sector.[40] Therefore, the results are consistent with the notion that skilled workers do not necessarily spur investments in structures since they do not take up a lot of physical space, but rather tend to spur investment in machines and equipment, which is consistent with the findings from Lewis (2011). As seen in Table 2.4, workers in *Science* and *Engineer* occupational fields are largely concentrated in the manufacturing sector, while the services sector is dominated by workers in *Computer* occupations.[41]

2.4.5. Political Lobbying and Endogeneity of Investment

Firms in the high-tech industries, and in particular large firms in the information technology (IT) sector, were the most prominent corporate lobbyists for extending the H-1B cap at a higher level. If my results are driven by correlations between investment trends and lobbying efforts, then effects of the H-1B cap drop on investment should be more pronounced for firms in these politically-active industries. In order to address this concern, I demonstrate that the previously documented effects on investment are not concentrated in industries most involved in H-1B lobbying, which mitigates concerns regarding the endogeneity of the H-1B cap drop driving my results. To this end, I split the sample by industry characteristics and conduct a triple-differences regression similar to the one presented in the preceding section:

$$CapEx_{it} = \alpha_i + \lambda_t + \delta \cdot H1B\,use_i \cdot Post_t + \theta \cdot I_i \cdot Post_t + \kappa \cdot H1B\,use_i \cdot I_i \cdot Post_t + X_{it-1}\beta + \epsilon_{it} \quad (2.4.5)$$

correlations between occupational categories and worker proximity.

[38] As seen in Table 2.4, the vast majority of firms in the sample are found within these two major industry groups.

[39] Compustat does not break down capital expenditures in further detail.

[40] According to the U.S. Census 1998 Annual Capital Expenditures Survey, manufacturing sector firms spent $4.21 on equipment for every dollar spent on structures, while service sector firms only spent $1.66 on equipment for every dollar spent on structures. Note that 1998 was the last year that the survey results were broken down by SIC categories.

[41] Indeed, when running the same triple-differences regression using $H1B\,use_{i,Industrial}$ instead of $H1B\,use_i$, the triple interaction term for both *Manufacturing* and *Services* are no longer statistically significant.

where I_i takes on the form of the following dummy variables related industry characteristics: IT_i, which indicates whether firm i is in the information technology sector,[42] $New\ Econ_i$, which indicates whether firm i is in the "new economy" sector,[43] $High\ TQ_i$, which indicates whether firm i is in an industry with above-median average $Tobin's\ Q$, $High\ RD_i$, which indicates whether firm i is in an industry with above-median average R&D spending, and $High\ Size_i$, which indicates whether firm i is in an industry with above-median average total assets. All industry dummies are defined using data from the pre-treatment period, and more detailed definitions for these variables can be found in Appendix B.1.

Table 2.10 reveals the estimates for κ are not statistically significant across all specifications. Therefore, the documented complementarity effects on investment are consistently found across IT and non-IT sector firms, as well as across new economy and old economy firms. Splitting the sample by other industry-level characteristics associated with the high-tech sector—i.e. high-growth versus low-growth industries, high R&D versus low R&D industries—also reveals no significance differences. Finally, splitting the sample according to asset size, which is a strong predictor of immigration-related political lobbying according to Kerr et al. (2014), also reveals no significant differences. These results suggest that my main results are not driven by the correlation between investment demand and lobbying activity by the most politically-active firms. The findings also suggest that skilled workers play an important role in implementing a wide range of investment projects, and not only those based on R&D intensive technologies in high-tech sectors.

2.4.6. Including Non-H1B Firms in the Sample

All analysis presented so far is based on the sample restricted to firms that have submitted at least one petition during 2001 to hire H-1B workers. This gives rise to the potential for selection bias, due to the fact that selection into H-1B and non-H-1B firms is non-random—i.e. the ϵ_{it} error term in Eq. 2.2.1 may be correlated with $H1B\ use_i \cdot Post_t$, conditional on firm i being an H-1B firm. Therefore, I estimate Eq. 2.2.1 based on the expanded sample that includes both sets of H-1B and non-H-1B firms, where $H1B\ use_i$ is set at zero for all non-H1B firms.

The results are presented in column (1) from Table 2.11, and show the estimate for δ to be statistically significant at the 1% level and similar in economic magnitude to the benchmark results from Table 2.2.1. This suggests that my earlier results are not driven by selection effects. I also run the following regression:

$$CapEx_{it} = \alpha_i + \lambda_t + \eta \cdot H1B_i \cdot Post_t + \delta \cdot H1B\ use_i \cdot Post_t + X_{it-1}\beta + \epsilon_{it} \qquad (2.4.6)$$

where $H1B_i$ represents a dummy variable indicating whether firm i is an H-1B firm. The coefficient

---

[42] The IT sector is defined according to BEA classification, which is found online at http://www.bea.gov/industry/xls/GDPbyInd_VA_NAICS_1998-2011.xls.

[43] Defined to be any industry that *"involves acquisition, processing and transformation, and distribution of information"* as in Nordhaus (2002). This includes SIC code 35 (industrial machinery and equipment), 36 (electronic and other electric equipment), 48 (telephone and telegraph), and 873 (software).

η captures the differential effect of the 2003 H-1B cap drop on non-H-1B workers versus H-1B firms with marginal exposure to H-1B policy (i.e. the extensive margin),[44] while δ still captures the differences in investment rate changes between firms of varying ex-ante H-1B dependence (i.e. the intensive margin). If the status of being an H-1B firm has no bearing on investment policy changes around the 2003 event, then there is no reason to expect a significant difference between non-H-1B firms and firms that were marginal employers H-1B workers, in which case η should be zero.

The results are presented in column (3) of Table 2.11, and show the estimate for η to be both economically and statistically insignificant. Therefore, there is nothing about being in the category of H-1B firms that affects investment policy changes around the 2003 event, further mitigating concerns of selection bias. All results in Table 2.11 are based on the fully saturated specification including all fixed effects and control variables.

It is worth noting the question of whether to include non-H-1B firms in the sample depends on the specific economic question being asked. Since the impact of H-1B policies falls on H-1B firms rather than non-H-1B firms, it makes certain sense to focus on the former population. This frames the question as whether restrictions on the H-1B visa cap affects the investment policies of existing employers of H-1B workers—i.e. the firms most likely to be affected. The concern then becomes one of external validity, as we are limited in our ability to answer broader questions about how access to skilled labour affects investment more generally. The inclusion of non-H-1B firms in the sample does not completely address this issue, since the entire set of non-H-1B firms is unaffected by the policy and thus reveals no information about how such firms may be affected by skilled labour supply restrictions. Nevertheless, this is a common limitation facing any study that exploits an event that affects a limited cross-section of the population.

2.4.7. Alternative Definitions of *H1B use*

I check the robustness of my main results by using alternative definitions of *H1B use* within the regression framework from Eq. 2.2.1. This serves to mitigate concerns that my earlier results are driven by the skewed distribution of the *H1B use* variable. The results are presented Table 2.12, and show that the main results hold under a variety of alternative definitions. Column (1) present the baseline results using the original definition of *H1B use*, column (2) presents results using $ln(H1B\ use)$, the natural log of *H1B use*, and column (3) presents results using *High H1B use*, a dummy variable indicating whether *H1B use* is above the sample median. In all cases, the coefficient estimates remain statistically significant and similar in economic magnitude to the baseline results.

I also employ definitions of H-1B policy exposure based on the wages of H-1B workers, as these measures potentially capture additional information regarding firms' exposure to H-1B policy beyond those found in *H1B use*. Column (4) presents results based on *H1B wage*, which is defined as the sum of the wages listed across USCIS petitions submitted by a given firm in 2001, scaled

---

[44] This is because *H1B use* is equivalent to $H1B \cdot H1B\ use$ (since *H1B use* is set at zero for all non-H1B firms), so that Eq. 2.4.6 in effect forms a triple-differences specification, where the double interaction term $H1B \cdot Post$ captures the differences between non-H-1B and marginal H-1B firms, and the "triple interaction" term $H1B \cdot H1B\ use \cdot Post$ captures any additional differences between high H-1B users and low H-1B users.

by the total imputed wage bill for that firm during the same year.[45] Columns (5) and (6) present results based on $ln(H1B\,wage)$, the natural log of $H1B\,wage$, and $High\,H1B\,wage$, a dummy variable indicating whether $H1B\,wage$ is above the sample median, respectively. In all cases, the estimates remain statistically and similar in economic magnitude to the baseline results.

2.5. Conclusion

In this essay, I find evidence that firms' access to skilled workers is an important determinant of investment policy. The sharp 2003 drop in the regulatory cap for H-1B visas provided a quasi-experimental setting in which some firms were affected more than others due to differing rates of ex-ante reliance on the visa program. I find firms relying more heavily on H-1B workers experienced a sharper decline in their investment rates relative to firms relying less heavily on H-1B workers, which is consistent with the capital-skill complementarity hypothesis. The effect on investment persist for several years, and the evidence suggests that it is unlikely to be driven by pre-existing trends in investment opportunities, endogenous public policy related to H-1B lobbying, or selection effects specific to H-1B-employing firms.

I further find evidence suggesting the complementarity effect to be linked to the specific nature of the firm's worker characteristics, with the effect more pronounced for workers in "industrial" occupations and less pronounced for workers in "knowledge" occupations. I also find the effects to be more pronounced for firms hiring more highly-educated workers and workers in close proximity to company headquarters. Finally, there is limited evidence to suggest that the effects are more pronounced for manufacturing firms and less pronounced for service sector firms. These results imply that the complementarity between skilled labour and capital depends critically on the specific characteristics of the production technology combining capital with labour.

In addition to helping advance our basic understanding of the relationship between labour and capital, my research also provides policy implications relating to immigration policy. Specifically, my empirical findings suggest that, rather than focusing only on the immediate impacts on domestic employment and wage growth when evaluating immigration policy, policymakers should also consider the long-term impact on capital investment and subsequent implications for overall economic growth. My results further suggest that policymakers should bear in mind the mix of occupational roles likely to be affected by prospective legislation when evaluating policy, as restrictions on some occupations may have a large impact on businesses while restrictions on other occupations may simply result in the jobs relocating abroad.

---

[45] The imputed wage is calculated by multiplying the total number of firm-level employees by the national average wage for the industry for the firm according to data from the Bureau of Labor Statistics.

Figure 2.1: Trends in H-1B Petitions vs. Regulatory Cap

Source: United States Citizenship and Immigration Services
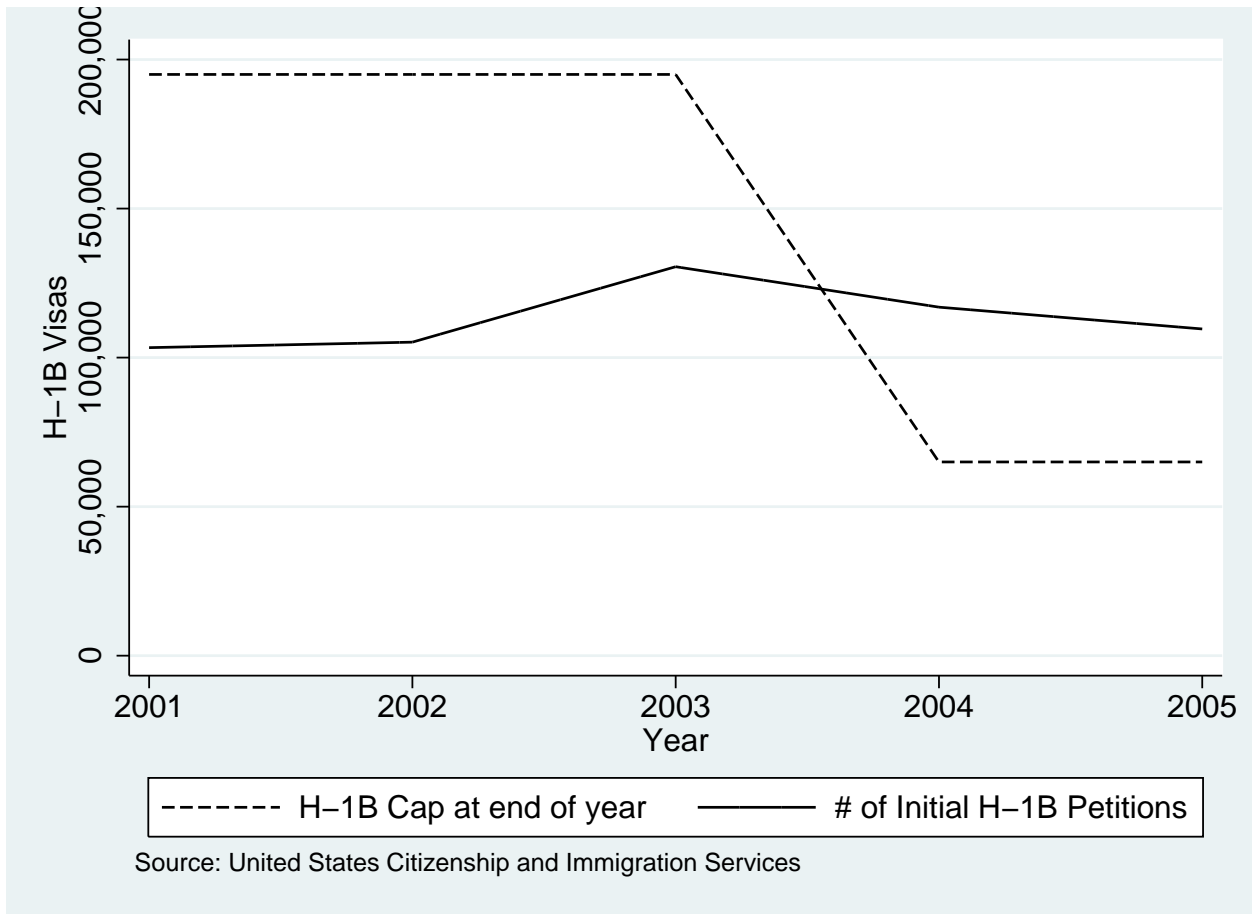
Figure 2.2: Timeline of H-1B Cap Drop

Feb 2003: Rep. Sensenbrenner comments that cap will revert in September

Oct 2004: Cap reverts to 65,000

Feb 2004: FY2004 petition window closed

| 2001 Q1 | 2001 Q2 | 2001 Q3 | 2001 Q4 | 2002 Q1 | 2002 Q2 | 2002 Q3 | 2002 Q4 | 2003 Q1 | 2003 Q2 | 2003 Q3 | 2003 Q4 | 2004 Q1 | 2004 Q2 | 2004 Q3 | 2004 Q4 |

H1B Usage Definition Period

Pre-Treatment Period

Legislative Shift Period

Post-Treatment Period
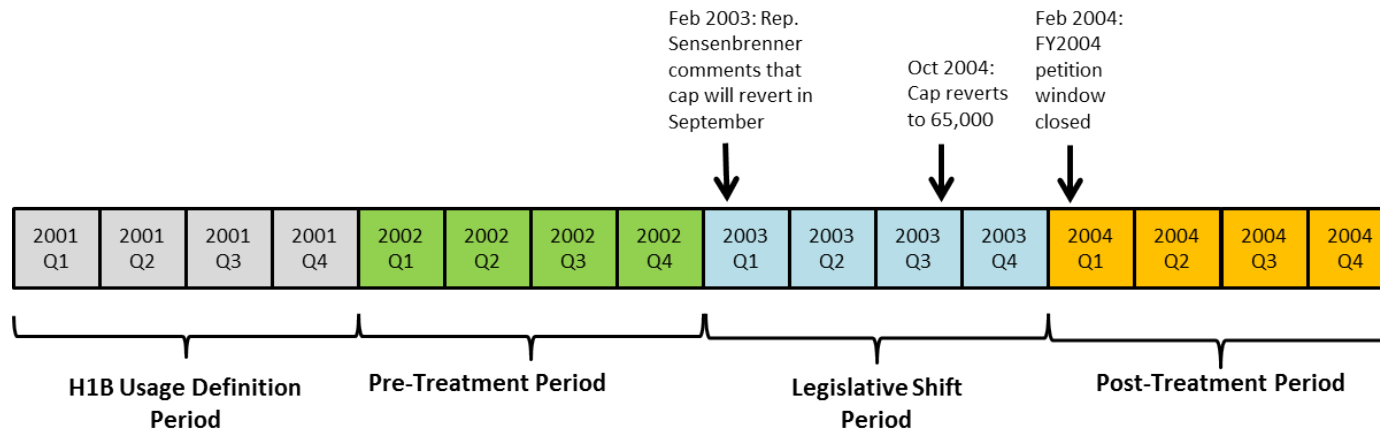
Note: Figure shows the timeline of the H-1B cap drop, which officially took effect on October 1, 2003. In February 2004, the United States Citizenship and Immigration Services (USCIS) announced that it was no longer accepting petitions for the upcoming fiscal year.

Figure 2.3: Aggregate U.S. Fixed Non-Residential Private Investment
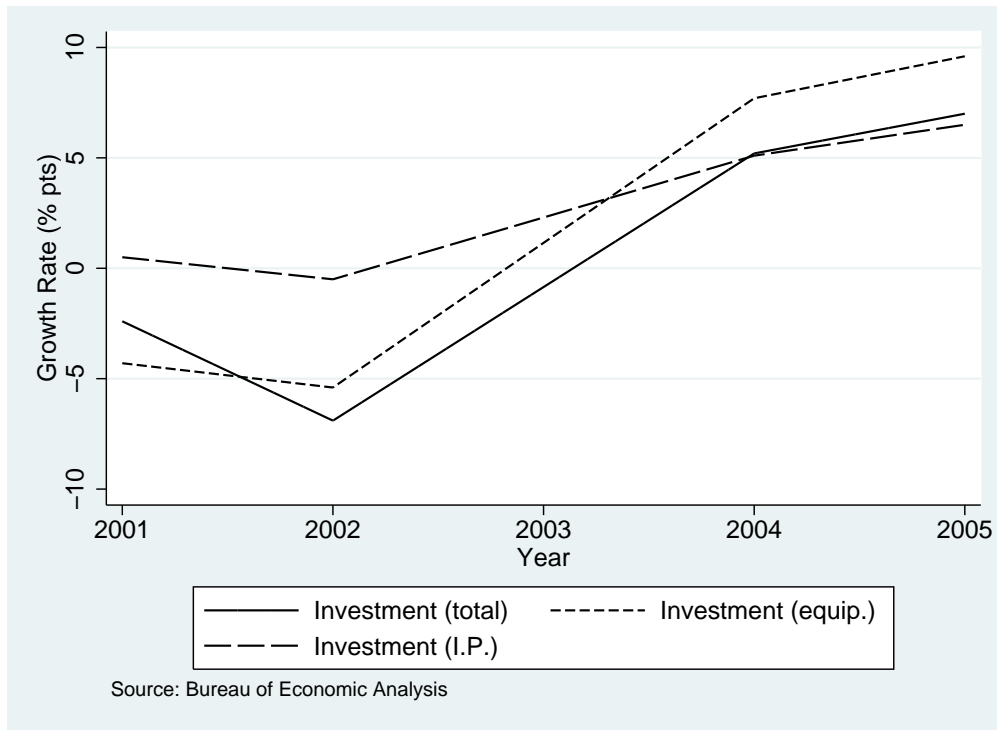
(a) Annual Aggregate Private Investment
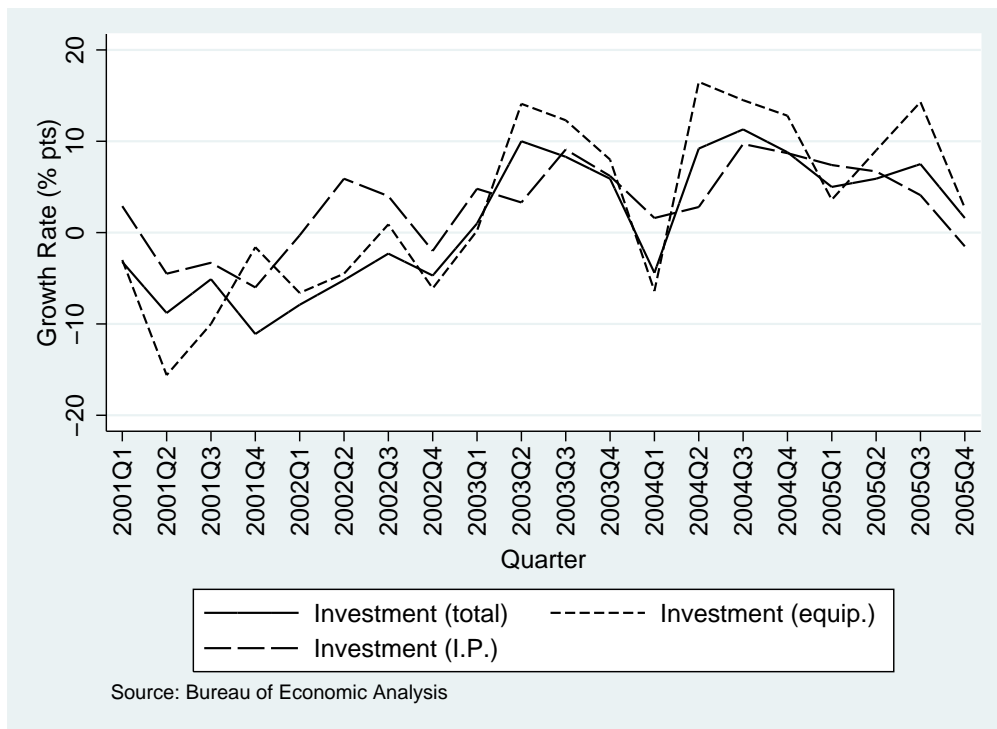
(b) Quarterly Aggregate Private Investment

Table 2.1: Descriptive Statistics

This table presents summary statistics for the main variables in my regression models. In Panel A, the sample consists of 1,395 industrial firms (excluding utilities, financials, and public-sector firms) over the 2002Q1-2002Q4 ("pre-treatment") and 2004Q1-2004Q4 ("post-treatment") periods, for firms submitting at least one H-1B application during 2001 (i.e. "H-1B Firms"). In Panel B, the sample consists of 2,205 industrial firms (excluding utilities, financials, and public-sector firms) over the same time interval as the sample from Panel A, for firms that did not submit any H-1B applications during 2001 (i.e. "Non-H-1B Firms"). *CapEx* is quarterly capital expenditures scaled by lagged quarter-end total book assets (atq), *Tobin's Q* is the quarter-end market value of total assets ($atq + prccq \times cshoq - ceqq - txditcq$) scaled by quarter-end book value of total assets (atq), $ln(Size)$ is the natural log of quarter-end total book assets (atq), *Cash Flow* is quarterly income before depreciation ($ibq + dpq$) scaled by lagged quarter-end total book assets (atq), *Cash Holdings* is quarter-end cash holdings ($cheq$) scaled by lagged quarter-end total assets (atq), and Leverage is quarter-end long-term debt ($dltt$) scaled by lagged quarter-end total book assets (atq). *H1B use* represents the total number of initial H-1B petitions filed during the 2001 calendar year, scaled by average number of employees (emp) during the same interval. Detailed definitions for all variables can also be found in Appendix B.1. All variables constructed using Compustat variables are winsorized at the 1% level at both tails, *Tobin's Q* is bounded to be no larger than 10, and *H1B use* is winsorized at the 2% level at the upper tail.

Panel A: H-1B firms

	Observations	Mean	Std Dev	P25	Median	P75
CapEx	9,921	0.011	0.013	0.004	0.007	0.014
Tobin's Q	9,921	2.174	1.487	1.237	1.712	2.577
ln(Assets)	9,921	6.666	1.749	5.357	6.489	7.805
Cash Flow	9,921	0.004	0.065	-0.002	0.017	0.032
Cash Holdings	9,921	0.264	0.253	0.051	0.179	0.429
Leverage	9,921	0.165	0.200	0.000	0.104	0.267
H1B use	9,921	0.007	0.010	0.000	0.002	0.008

Panel B: Non-H-1B firms

	Observations	Mean	Std Dev	P25	Median	P75
CapEx	13,723	0.015	0.023	0.004	0.008	0.018
Tobin's Q	13,723	2.117	1.762	1.133	1.510	2.316
ln(Assets)	13,723	5.844	1.906	4.801	5.902	6.991
Cash Flow	13,723	-0.001	0.109	0.005	0.020	0.034
Cash Holdings	13,723	0.176	0.229	0.021	0.078	0.239
Leverage	13,723	0.189	0.243	0.002	0.137	0.300

Table 2.2: Top H-1B Employers in 2001

Panel A lists the top 10 firms in the sample in terms of total H-1B initial petitions submitted to the USCIS in 2001, according to data from the USCIS. Panel B lists the top 10 firms in the sample in terms of *H1B use* (defined in Appendix B.1), according to data from the USCIS and Compustat.

Panel A: Top 10 H-1B employers in 2001 (ranked by total petitions submitted)

Company Name	SIC Division	2-digit SIC
Infosys Ltd	Services	Business Services
Microsoft Corp	Services	Business Services
Intl Business Machines Corp	Services	Business Services
Cisco Systems Inc	Manufacturing	Industrial Machinery & Equipment
Oracle Corp	Services	Business Services
Intel Corp	Manufacturing	Electronic & Other Electric Equipment
Motorola Solutions Inc	Manufacturing	Electronic & Other Electric Equipment
Lucent Technologies Inc	Services	Business Services
Wipro Ltd	Services	Business Services
Compuware Corp	Services	Business Services

Panel B: Top 10 most H-1B-dependent firms in 2001 (ranked by *H1B use*)

Company Name	SIC Division	2-digit SIC
Telecommunication Sys Inc	Services	Business Services
Broadwing Corp	Manufacturing	Electronic & Other Electric Equipment
Pharmacyclics Inc	Manufacturing	Chemical & Allied Products
Array Biopharma Inc	Services	Health Services
Actuate Corp	Services	Business Services
Catapult Communications Corp	Manufacturing	Instruments & Related Products
Alliance Semiconductor Corp	Manufacturing	Electronic & Other Electric Equipment
Enzon Pharmaceuticals Inc	Manufacturing	Chemical & Allied Products
Maxygen Inc	Services	Engineering & Management Services
Wink Communications Inc	Services	Business Services

Table 2.3: H-1B Worker Characteristics

This table presents a breakdown of worker characteristics across H-1B applications from firms in the sample. Panel A lists the major occupational groups for H-1B workers hired by firms in the sample during the 2001 calendar year, and for each occupational group, the corresponding *Count* (i.e. the total number of applications) and mean values for the following set of worker-level characteristics: *Wage* (listed wage of H-1B employee), *Occ Wage* (the national average wage from BLS corresponding to H-1B employee's occupation), *Occ Wage Growth* (the national average wage growth rate from BLS corresponding to H-1B employee's occupation), *Age* (the age of H-1B employee), *Grad* (a dummy variable for whether H-1B employee possesses a graduate-level education), and *HQ State* (a dummy variable for whether H-1B employee works in the same geographic state as firm headquarters). Panel B presents a correlation table for the same set of variables for which occupational averages are reported in Panel A. Detailed definitions for all variables can be found in Appendix B.1 and detailed definitions for occupational categories can be found in Appendix C.1. In Panel B, *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Mean Characteristics by Occupation

	Wage	Occ Wage	Occ Wage Growth	Age	Grad	HQ State
Computers	72,989	72,393	0.061	29.85	0.660	0.436
Engineering	73,951	63,867	0.036	30.71	0.738	0.608
Admin	68,036	45,934	0.042	30.99	0.680	0.516
Management	92,639	63,776	0.027	34.30	0.704	0.500
Scientist	67,250	52,867	0.015	33.31	0.760	0.824
Other	67,234	61,461	0.029	31.60	0.661	0.405
Total	73,257	68,337	0.052	30.46	0.683	0.496

Panel B: Application Level Correlations of Worker Characteristics

	Wage	Occ Wage	Occ Wage Growth	Age	Grad	HQ State
Wage	1.000					
Occ Wage	0.013*	1.000				
Occ Wage Growth	0.006	0.473***	1.000			
Age	0.336***	-0.121***	-0.112***	1.000		
Grad	0.070***	-0.107***	-0.140***	0.068***	1.000	
HQ State	0.098***	-0.038***	-0.071***	0.026***	0.084***	1.000

Table 2.4: Number of Applications by Occupation and Industry Group

This table presents the number of H-1B worker applications submitted during the 2001 calendar year by firms in the sample, broken down across major industry and occupational groups. Industries are defined at the SIC Division level while occupations are defined at the 3-digit Dictionary of Occupational Code level , with "Occupations in Life Sciences" and "Occupations in Mathematics and Physical Sciences" combined under the "Science" category. Detailed definitions for occupational categories can be found in the Appendix C.1.

	Computers	Engineering	Admin	Management	Scientist	Other	Total
Agriculture	3	0	1	1	0	0	5
Construction	6	21	6	7	0	0	40
Manufacturing	6,570	6,129	822	667	1,398	443	16,029
Mining	15	24	20	7	20	2	88
Retail	327	11	49	68	9	242	706
Services	15,661	1,128	447	462	340	308	18,346
Transportation	315	261	100	81	2	32	791
Wholesale	97	15	24	14	9	14	173
Total	22,994	7,589	1,469	1,307	1,778	1,041	36,178

Table 2.5: Effect of the H-1B cap Drop on Investment

The tables below report the estimation results from the OLS regression $CapEx_{it} = \alpha_i + \lambda_t + \delta \cdot H1B\ use_i \cdot Post_t + X_{it-1}\beta + \epsilon_{it}$ in which δ captures how the 2003 H-1B cap drop affects the investment policy of firms with different levels of H-1B usage intensity. The sample is limited to four quarters prior to the H-1B cap drop (2002Q1-2002Q4) and four quarters following the H-1B cap drop (2004Q1-2004Q4), for firms submitting at least one H-1B application during 2001. $CapEx_{it}$ denotes firm i's investment rate during quarter t, $H1B\ use_i$ denotes firm i's H-1B usage intensity during 2001, and $Post_t$ represents a dummy variable that takes on a value of 1 if quarter t is in the post-treatment period 2004Q1-2004Q4. X_{it} denotes the set of quarterly firm-level control variables, which are all lagged by one quarter relative to the dependent variable $CapEx_{it}$. Detailed definitions for all variables can be found in Table 2.1 as well as Appendix B.1. F denotes firm fixed effects, T denotes year-quarter fixed effects, and $I \times T$ denotes industry-year-quarter fixed effects. Standard errors are corrected for heteroskedasticity and clustered at the firm level. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) CapEx	(2) CapEx	(3) CapEx	(4) CapEx	(5) CapEx	(6) CapEx
H1B use × Post	-0.059** [0.029]	-0.081*** [0.029]	-0.080*** [0.029]	-0.100*** [0.029]	-0.080*** [0.029]	-0.101*** [0.029]
Tobin's Q			0.002*** [0.000]	0.002*** [0.000]	0.002*** [0.000]	0.002*** [0.000]
Cash Flow			0.006* [0.003]	0.006* [0.003]	0.006* [0.004]	0.006* [0.004]
ln(Assets)			-0.000 [0.001]	-0.000 [0.001]	-0.000 [0.001]	-0.000 [0.001]
Leverage					-0.003 [0.002]	-0.003* [0.002]
Cash Holdings					-0.002 [0.002]	-0.002 [0.002]
Fixed Effects	F, T	F, I × T	F, T	F, I × T	F, T	F, I × T
Observations	9,921	9,921	9,921	9,921	9,921	9,921
Adjusted R-squared	0.007	0.012	0.024	0.029	0.025	0.030

Table 2.6: Quarterly Investment Dynamics

This table reports the estimation results from OLS regression $CapEx_{it} = \alpha_i + \gamma_t + \sum \delta_t \cdot H1B\ use_i \cdot \tau_t + \delta \cdot H1B\ use_i \cdot Post_t + X_{it-1}\beta + \epsilon_{it}$. The sample is limited to the 2002Q1-2004Q4 interval, which includes the pre-treatment period (2002Q1-2002Q4), the legislative shift period (2003Q1-2003Q4), and the post-treatment period (2004Q1-2004Q4), for firms submitting at least one H-1B application during 2001. $CapEx_{it}$ denotes firm i's investment rate during quarter t, $H1B\ use_i$ denotes firm i's H-1B usage intensity during 2001, and τ_t denotes a dummy variable for quarter τ, where τ takes on values from 2002Q1 to 2004Q4 inclusive. X_{it-1} denotes the set of quarterly firm-level control variables, which are lagged by one quarter relative to the dependent variable $CapEx_{it}$. Detailed definitions for all variables can be found in Table 2.1 as well as Appendix B.1. Only δ and δ_t are reported to conserve space. F denotes firm fixed effects, T denotes year-quarter fixed effects, and $I \times T$ denotes industry-year-quarter fixed effects. Standard errors are corrected for heteroskedasticity and clustered at the firm level. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) CapEx	(2) CapEx
H1B use × 2002Q2 (pre-treatment)	-0.011	-0.012
	[0.028]	[0.026]
H1B use × 2002Q3 (pre-treatment)	0.027	0.016
	[0.049]	[0.049]
H1B use × 2002Q4 (pre-treatment)	-0.032	-0.041
	[0.043]	[0.043]
H1B use × 2003Q1 (legislative shift)	0.003	-0.024
	[0.035]	[0.037]
H1B use × 2003Q2 (legislative shift)	-0.017	-0.049
	[0.040]	[0.041]
H1B use × 2003Q3 (legislative shift)	-0.056	-0.079**
	[0.040]	[0.039]
H1B use × 2003Q4 (legislative shift)	-0.090**	-0.107**
	[0.045]	[0.046]
H1B use × Post (post-treatment)	-0.080**	-0.103***
	[0.036]	[0.036]
Control Variables	Yes	Yes
Fixed Effects	F, T	F, I × T
Observations	14,811	14,811
Adjusted R-squared	0.023	0.025

Table 2.7: Long Run Effect of H-1B Cap Drop on Investment

This table reports the estimation results from OLS regression $CapEx_{it} = \alpha_i + \gamma_t + \sum_{k=-1}^{4} \delta_k \cdot H1B\ use_i \cdot Year\ k_t + X_{it}\beta + \epsilon_{it}$. The sample is limited to the 2001 to 2007 time interval, with $k = 0$ corresponding to the 2003 calendar year, for firms submitting at least one H-1B application during 2001. $CapEx_{it}$ denotes firm i's quarterly investment rate averaged over calendar year t, $H1B\ use_i$ denotes firm i's H-1B usage intensity during 2001, and $Year\ k_t$ denotes a year dummy variable for $k = 2003 + t$. X_{it} denotes the set of firm-level control variables, which are lagged by one quarter relative to the dependent variable $CapEx_{it}$ and then averaged over calendar year t. More detailed definitions for all variables can be found in Table 2.1 as well as Appendix B.1. Only coefficients δ_k are reported to conserve space. F denotes firm fixed effects, $Year$ denotes year fixed effects, and $I \times Year$ denotes industry-year fixed effects. Standard errors are corrected for heteroskedasticity and clustered at the firm level. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) CapEx	(2) CapEx
H1B use × Year -1	0.013	0.001
	[0.029]	[0.030]
H1B use × Year 0	-0.021	-0.049
	[0.032]	[0.034]
H1B use × Year 1	-0.071**	-0.102***
	[0.031]	[0.032]
H1B use × Year 2	-0.062**	-0.088***
	[0.031]	[0.032]
H1B use × Year 3	-0.111***	-0.131***
	[0.035]	[0.036]
H1B use × Year 4	-0.107***	-0.120***
	[0.038]	[0.039]
Control Variables	Yes	Yes
Fixed Effects	F, T	F, I × T
Observations	8,613	8,591
Adjusted R-squared	0.096	0.110

Table 2.8: Effect of the H-1B Cap Drop on Investment by Occupational Category

This table reports the estimation results from the OLS regression $CapEx_{it} = \alpha_i + \gamma_t + \sum \delta_j \cdot H1B\ use_{ij} \cdot Post_t + X_{it-1}\beta + \epsilon_{it}$. The sample is limited to four quarters prior to the H-1B cap drop (2002Q1-2002Q4) and four quarters following the H-1B cap drop (2004Q1-2004Q4), for firms submitting at least one H-1B application during 2001. Only coefficients δ_j are reported to conserve space. $CapEx_{it}$ denotes firm i's investment rate during quarter t, $H1B\ use_{ij}$ denotes firm i's H-1B usage intensity in hiring workers in occupation j (i.e. *Industrial*, *Engineer*, *Science*, *Knowledge*, *Computer*, *Admin*, or *Management*) during 2001, and $Post_t$ represents a dummy variable that takes on a value of 1 if quarter t is in the post-treatment period 2004Q1-2004Q4. X_{it-1} denotes the set of quarterly firm-level control variables, which are lagged by one quarter relative to the dependent variable $CapEx_{it}$: all specifications include *Tobin's Q*, *Cash Flow*, *ln(Size)*, *Cash Holdings*, and *Leverage* as controls. Detailed definitions for all variables can be found in Table 2.1 as well as Appendix B.1, and more detailed definitions for occupational categories can be found in Appendix C.1. F denotes firm fixed effects and $I \times T$ denotes industry-year-quarter fixed effects. Standard errors are corrected for heteroskedasticity and clustered at the firm level. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) CapEx	(2) CapEx	(3) CapEx	(4) CapEx	(5) CapEx	(6) CapEx	(7) CapEx
H1B use (Industrial) × Post	-0.493*** [0.120]						
H1B use (Engineer) × Post		-0.264** [0.120]					
H1B use (Science) × Post			-0.651*** [0.235]				
H1B use (Knowledge) × Post				-0.060 [0.046]			
H1B use (Computer) × Post					-0.055 [0.048]		
H1B use (Admin) × Post						-0.806 [0.491]	
H1B use (Management) × Post							-1.403* [0.724]
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	F, I × T	F, I × T	F, I × T	F, I × T	F, I × T	F, I × T	F, I × T
Observations	9,921	9,921	9,921	9,921	9,921	9,921	9,921
Adjusted R-squared	0.031	0.028	0.030	0.027	0.027	0.027	0.028

Table 2.9: Occupational and Industry Characteristics and the Effect of the H-1B Cap Drop on Investment

This table reports the estimation results from the OLS regression $CapEx_{it} = \alpha_i + \gamma_t + \delta \cdot H1B\ use_i \cdot Post_t + \theta \cdot W_i \cdot Post_t + \lambda \cdot H1B\ use_i \cdot W_i \cdot Post_i + X_{it}\beta + \epsilon_{it}$. Only coefficients δ and λ are reported in order to conserve space. The sample is limited to four quarters prior to the H-1B cap drop (2002Q1-2002Q4) and four quarters following the H-1B cap drop (2004Q1-2004Q4), for firms submitting at least one H-1B application during 2001. $CapEx_{it}$ denotes firm i's investment rate during quarter t, $H1B\ use_i$ denotes firm i's H-1B usage intensity during 2001, and $Post_t$ represents a dummy variable that takes on a value of 1 if quarter t is in the post-treatment period 2004Q1-2004Q4. In columns (1)-(4), W_i represents a dummy variable that take on a value of 1 if firm i is above the sample median in terms of the following variables listed and defined in Table 2.3: $Grad$ ($W_i = High\ Grad_i$), Age ($W_i = High\ Age_i$), $Occ\ Wage$ ($W_i = High\ Wage_i$), and $HQ\ State$ ($W_i = Near\ HQ_i$). In columns (5)-(6), W_i represents an indicator variable for whether firm i is in the manufacturing sector ($W_i = Manufacturing_i$ for SIC 2000-3999) or the services sector ($W_i = Services_i$ for SIC 7000-8999). X_{it-1} denotes the set of quarterly firm-level control variables which are lagged by one quarter relative to the dependent variable $CapEx_{it}$. All specifications include $Tobin's\ Q$, $Cash\ Flow$, $ln(Size)$, $Cash$, and $Leverage$ as controls. Detailed definitions for all variables can be found in Table 2.1 as well as Appendix B.1. F denotes firm fixed effects and $I \times T$ denotes industry-year-quarter fixed effects. Standard errors are corrected for heteroskedasticity and clustered at the firm level. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) CapEx	(2) CapEx	(3) CapEx	(4) CapEx	(5) CapEx	(6) CapEx
H1B use × Post	-0.006 [0.049]	-0.069** [0.034]	-0.126** [0.062]	-0.002 [0.048]	-0.040 [0.045]	-0.143*** [0.036]
H1B use × High Grad × Post	-0.123** [0.062]					
H1B use × High Age × Post		-0.052 [0.057]				
H1B use × High Wage × Post			0.034 [0.069]			
H1B use × Near HQ × Post				-0.146** [0.060]		
H1B use × Manufacturing × Post					-0.105* [0.058]	
H1B use × Services × Post						0.109* [0.060]
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	F, I × T	F, I × T	F, I × T	F, I × T	F, I × T	F, I × T
Observations	7,526	8,371	7,964	8,223	9,921	9,921
Adjusted R-squared	0.035	0.032	0.031	0.032	0.030	0.030

Table 2.10: Characteristics Associated with Political Lobbying and the Effect of the H-1B Cap Drop on Investment

This table reports the estimation results from the OLS regression $CapEx_{it} = \alpha_i + \gamma_t + \delta \cdot H1B\ use_i \cdot Post_t + \pi \cdot I_i \cdot Post_t = \kappa \cdot H1B\ use_i \cdot Post_t + X_{it}\beta + \epsilon_{it}$. Only coefficients δ and κ are reported in order to conserve space. The sample is limited to four quarters prior to the H-1B cap drop (2002Q1-2002Q4) and four quarters following the H-1B cap drop (2004Q1-2004Q4), for firms submitting at least one H-1B application in 2001. $CapEx_{it}$ denotes firm i's investment rate during quarter t, $H1B\ use_i$ denotes firm i's H-1B usage intensity during 2001, and $Post_t$ represents a dummy variable that takes on a value of 1 if quarter t is in the post-treatment period. In columns (1)-(2), I_i represents a dummy variable that take on a value of 1 if firm i is in the information technology sector ($I_i = IT_i$) and the "new economy" sector ($I_i = New\ Econ_i$). In columns (3)-(5), I_i represents a dummy variable that take on a value of 1 if firm i is in an above-median industry (2-digit SIC) in terms of average values for the following variables: $Tobin's\ Q$ ($I_i = High\ TQ_i$), R&D spending ($I_i = High\ RD_i$), and total assets ($I_i = High\ Size_i$). X_{it-1} denotes the set of quarterly firm-level control variables, which are lagged by one quarter relative to $CapEx_{it}$: all specifications include $Tobin's\ Q$, $Cash\ Flow$, $ln(Size)$, $Cash\ Holdings$, and $Leverage$ as controls. Detailed definitions for all variables can be found in Table 2.1 as well as Appendix B.1. F denotes firm fixed effects and $I \times T$ denotes industry-year-quarter fixed effects. Standard errors are corrected for heteroskedasticity and clustered at the firm level. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) CapEx	(2) CapEx	(3) CapEx	(4) CapEx	(5) CapEx
H1B use × Post	-0.125** [0.049]	-0.095** [0.038]	-0.124*** [0.041]	-0.096*** [0.037]	-0.099*** [0.030]
H1B use × IT × Post	0.031 [0.061]				
H1B use × New Econ × Post		-0.039 [0.059]			
H1B use × High TQ × Post			0.045 [0.054]		
H1B use × High RD × Post				0.008 [0.055]	
H1B use × High Size × Post					-0.017 [0.159]
Control Variables	Yes	Yes	Yes	Yes	Yes
Fixed Effects	F, I × T	F, I × T	F, I × T	F, I × T	F, I × T
Observations	9,921	9,921	9,921	9,921	9,921
Adjusted R-squared	0.030	0.031	0.032	0.031	0.030

Table 2.11: Effect of the H-1B Cap Drop on Investment Based on Unrestricted Sample of H-1B and Non-H-1B Firms

The tables below report the estimation results from the OLS regression $CapEx_{it} = \alpha_i + \gamma_t + \delta \cdot H1B\ use_i \cdot Post_t + X_{it-1}\beta + \epsilon_{it}$ in column (1), and $CapEx_{it} = \alpha_1 + \gamma_t + \eta \cdot H1B_i \cdot Post_t + \delta \cdot H1B\ use_i \cdot Post_t + X_{it-1}\beta + \epsilon_{it}$ in column (3). The sample is limited to four quarters prior to the H-1B cap drop (2002Q1-2002Q4) and four quarters following the H-1B cap drop (2004Q1-2004Q4) for all firms (including those that did not submit H-1B applications during 2001). $CapEx_{it}$ denotes firm i's investment rate during quarter t, $H1B_i$ denotes that firm i submitted at least one H-1B application during 2001, $H1B\ use_i$ denotes firm i's H-1B usage intensity during 2001, and $Post_t$ represents a dummy variable that takes on a value of 1 if quarter t is in the post-treatment period 2004Q1-2004Q4. X_{it} denotes the set of quarterly firm-level control variables, which are all lagged by one quarter relative to the dependent variable $CapEx_{it}$. Detailed definitions for all variables can be found in Table 2.1 as well as Appendix B.1. F denotes firm fixed effects, T denotes year-quarter fixed effects, and $I \times T$ denotes industry-year-quarter fixed effects. Standard errors are corrected for heteroskedasticity and clustered at the firm level. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) CapEx	(2) CapEx	(3) CapEx
H1B use × Post	-0.079*** [0.028]		-0.070** [0.030]
H1B × Post		-0.001* [0.000]	-0.000 [0.000]
Control Variables	Yes	Yes	Yes
Fixed Effects	F, I × T	F, I × T	F, I × T
Observations	23,644	23,644	23,644
Adjusted R-squared	0.028	0.028	0.028

Table 2.12: Effect of the H-1B Cap Drop on Investment Based on Alternative Definitions of H-1B Exposure

This table reports the estimation results from the OLS regression $CapEx_{it} = \alpha_i + \gamma_t + \delta \cdot H1B\ variable_i \cdot Post_t + X_{it-1}\beta + \epsilon_{it}$, where $H1B\ variable_i$ represents various alternative measures of firm i's H-1B usage intensity during 2001. The sample is limited to four quarters prior to the H-1B cap drop (2002Q1-2002Q4) and four quarters following the H-1B cap drop (2004Q1-2004Q4), for firms submitting at least one H-1B application during 2001. $CapEx_{it}$ denotes firm i's investment rate during quarter t and $Post_t$ represents a dummy variable that takes on a value of 1 if quarter t is in the post-treatment period 2004Q1-2004Q4. Column (1) uses the same definition of $H1B\ use_i$ as found in Table 2.5, column (2) uses the natural log of $H1B\ use_i$, and column (3) uses a non-parametric measure of whether $H1B\ use_i$ is above or below its cross-sectional sample median. Columns (4)-(6) apply analogous measures of H-1B usage intensity calculated based on the cumulative wages of H-1B workers per firm rather than the number of hires per firm. X_{it-1} denotes the set of quarterly firm-level control variables, which are lagged by one quarter relative to the dependent variable $CapEx_{it}$: all specifications include $Tobin's\ Q$, $Cash\ Flow$, $ln(Size)$, $Cash\ Holdings$, and $Leverage$ as controls. Detailed definitions for all variables can be found in Table 2.1 as well as Appendix B.1. F denotes firm fixed effects and $I \times T$ denotes industry-year-quarter fixed effects. Standard errors are corrected for heteroskedasticity and clustered at the firm level. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) CapEx	(2) CapEx	(3) CapEx	(4) CapEx	(5) CapEx	(6) CapEx
H1B use × Post	-0.101*** [0.029]					
ln(H1B usage) × Post		-0.103*** [0.029]				
High H1B usage × Post			-0.002*** [0.001]			
H1B wage × Post				-0.072*** [0.022]		
ln(H1B wage) × Post					-0.074*** [0.023]	
High H1B wage × Post						-0.002*** [0.001]
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	F, I × T	F, I × T	F, I × T	F, I × T	F, I × T	F, I × T
Observations	9,921	9,921	9,921	9,892	9,892	9,892
Adjusted R-squared	0.030	0.030	0.029	0.029	0.029	0.031

Chapter 3

Politics and Hidden Borrowing: Electoral Cycles and State Defined Benefit Pension Plans

3.1. Introduction

Public sector defined benefit (DB) pension plans allow governments to defer payment to their workers by offering guaranteed future retirement benefits. In the United States, the aggregate liability formed by state-level DB pension plan obligations is enormous, with Novy-Marx and Rauh (2011) estimating unfunded pension liabilities to be as high as $4.43 trillion as of 2009. Motivated by the idea that politicians undertake opportunistic actions for politically motivated purposes, I investigate how electoral incentives can motivate incumbent state Governors to shape public pension policies for their own benefit. Specifically, Governors may "borrow' on behalf of taxpayers using their discretionary power over how public pension assets accumulate and how public pension liabilities accrue.

On the asset side, Governors may divert governmental contributions intended to fund state pension plans towards more politically expedient uses, such as increasing public services, cutting taxes, or reducing the state budget deficit. Anecdotal accounts suggest this to be an attractive option. In the run-up to the 1990 gubernatorial election, New York Governor Mario Cuomo worked to lower contributions to state pension plans by $1.3 billion, using the funds to reduce the budget deficit instead. After Governor Cuomo secured his reelection bid, the New York State of Appeals ruled in 1993 that the state had illegally borrowed from state pension funds, and ordered the state to pay back the shortfall over the next 12 years.

On the liability side, DB pension benefits promised to public sector employees represent debt-like obligations for the government. Incumbent Governors may be tempted to raise benefits in order to gain political support from public sector labour unions. In the early 2000's, California Governor Gray Davis pushed through numerous bills to increase state pension benefits, winning strong support from public sector unions along the way at the expense of creating large unfunded pension liabilities for taxpayers. Pension benefits also provide employers with a potential bargaining chip that can be used to negotiate against wage increases. By raising promises of pension benefits for public sector employees, for instance, the incumbent administration can keep payroll growth in check in the short run, freeing up funds for more immediate uses.

Spurred by the idea that political incentives are strongest immediately prior to an election, I investigate whether the net amount of borrowing conducted through state pension plans is systematically different in election years versus non-election years. To this end, I construct a novel "pension deficit" flow variable by taking the difference between the rate at which pension plan liabilities accrue (benefit accruals) and the rate at which pension plan assets accumulate (contributions). My findings indicate that that state DB pension plan deficits (surpluses) are on average 11% higher (lower) in gubernatorial election years compared to in non-election years. I include a variety of state-level and plan-level control variables, as well as plan fixed effects and year fixed effects, to control for potential confounding factors.

Separating the pension deficit measure into its two components (contributions and benefit accruals), I find that the electoral cycles in pension deficits are largely explained by election year decreases in pension contribution rates, as the magnitude of election year "dips" in contributions are almost identical to those of election year "spikes" in pension deficits. The significant electoral cycle in contribution rates are made possible by Governors' significant powers over the state budget process through which contributions are approved. Accordingly, I find contribution cutbacks to be larger for election years that coincide with the passage of a state budget relative to election years that do not.

In contrast to contributions, I find that benefit accruals do not exhibit a significant electoral cycle pattern. This may be attributed to the inflexibility of pension benefit policy, which is typically set through multi-year labour contracts and/or special statutory provisions, as well as to the fact that benefit accruals are imprecisely measured due to discretionary actuarial assumptions. Nevertheless, I find states with higher rates of public sector union membership experience significantly larger election year increases in benefit accrual rates relative to states with lower union membership rates, which suggests a motive to grant higher pension benefits in exchange for election year political support from powerful labour unions.

To gain a deeper understanding of the Governor's incentive to increase election year pension deficits, one must first understand how taxpayers and public pension employees are affected by pension funding policy, and in particular which stakeholder group bears the future burden of underfunded public pension plans. Higher pension deficits today necessarily imply future cuts to government spending, future increases in taxes, or future cuts to pension benefits. The first two outcomes are at the expense of the wider taxpayer base, while the third outcome is at the expense of public sector employees.

If public sector employees bear the future burden of pension underfunding, then election year spikes in pension deficits effectively constitute funds appropriated from public employees by incumbent politicians to "buy" votes from the electorate. However, the empirical evidence contradicts this interpretation, as I exploit cross-sectional variation in legal frameworks across states and find electoral cycles in pension deficits to be concentrated in states in which public sector employees enjoy *stronger* legal protection over their future DB retirement benefits. This suggests that public pension plan participants with weak protection over their benefits have both the incentive and the

means to limit politically-motivated policies that devalue their future retirement benefits.[46]

The implication is that strong benefit protection creates a moral hazard for employees to ignore the consequences of pension borrowing, as taxpayers are left to bear the burden through higher future taxes or lower public services. This should not be an issue if rational and forward-looking voters can observe government pension policies and understand that higher pension deficits serve only to "kick the can down the road". Under such a scenario, election year spikes in pension deficits would be politically self-defeating for incumbent Governors if such policies were not in the best interests of voting taxpayers who ultimately determine election outcomes.

In reality, voters are unlikely to be able to perfectly monitor the government's public pension policies due to well established free rider problems inherent in political settings with diffuse voters,[47] as well as due to the inherent opacity of DB pensions plans that rely on complex actuarial methods to evaluate and report on funding levels. Previous research has shown information asymmetry to be an important factor in generating politically-motivated electoral cycles in fiscal deficits (Shi and Svensson (2006), Alt and Lassen (2006)), based on the idea that incumbent politicians attempt to "fool" voters with increased deficit spending only if voters cannot directly observe that the higher spending is financed through debt.

Following this logic, state pension plans provide incumbent Governors with a particularly opaque channel to finance politically-motivated expansionary activities in election years. Using an index measure of state pension opacity based on journalist surveys, I find that electoral year spikes in pension deficits are significantly more pronounced in states with more opaque pension systems relative to states with more transparent pension systems, which supports the notion of state DB pension plans constituting a channel for "hidden" deficit financing prone to politically-motivated manipulations.

I find additional evidence that election concerns drive pension borrowing decisions. First, the incentive to win additional votes should be stronger for closely contested elections that are near a "tipping point", and I find election year pension deficit spikes are indeed larger for close elections in comparison to lopsided ones. I also find that pension deficits are smaller when the incumbent Governor is ineligible to run for reelection due to term limits. Lastly, I find no significant difference in electoral cycle patterns in pension deficits between Republican and Democrat Governors, which suggests that my results are not driven by the ideological preferences of one particular party's partisan supporters.

Next, I investigate whether systematic election year pension deficit spikes have real consequences. I find that state DB pension plans exhibiting larger electoral cycles in pension deficits tend to experience larger increases in unfunded liabilities over the 2001-2015 sample period. On average, the electoral cycle in pension deficits can explain 6.65% of the average increase in pension underfunding, which suggests that election year pension deficit spikes are not totally offset by lower

---

[46] For example, employees can collectively exert political pressure through lobbying by their unions, exert economic pressure through collective bargaining, or directly influence pension policy through employee representation on state pension boards of trustees.

[47] See, for instance, Becker (1983).

rates of pension deficits during non-election years and play an economically significant role in explaining the deteriorating funding status of state DB pension plans in recent years. Furthermore, I find suggestive evidence that states containing plans that exhibit larger electoral pension deficit cycles are associated with lower economic growth over the sample period.

I run additional tests in order to rule out plausible alternative explanations for my findings. Most notably, I find no evidence of an electoral cycle pattern in pension deficits for private-sector DB pension plans. Since private sector plans should be immune from political incentives relating to gubernatorial elections, this finding supports the key assumption behind my main empirical test, in that pension policies unaffected by political incentives should exhibit no systematic election year effects. I also find no evidence of pension deficit increases during years in which states experience unexpected governor turnovers. This mitigate concerns that my findings are driven by leadership transition effects unrelated to reelection incentives.

At its root, my research is about how information frictions can lead to short-sighted decisions in the context of a principal-agent relationship. This relates to the broad literature on managerial myopia, including works by Stein (1988), Bebchuk and Stole (1993), and Nagarajan et al. (1995), who provide models of how hidden information problems can lead to myopic corporate decisions. In particular, Narayanan (1985) and Stein (1989) show myopic decisions can arise due to hidden action problems using reputation building models. However, the corporate finance literature has found mixed success in finding empirical evidence in support of such theories. For example, Meulbroek et al. (1990) reject the prediction from Stein (1988) that takeover threats induce myopic corporate polices.

In this essay, I turn to the public sector to search for evidence of short-sighted decisions stemming from distortionary career concerns. As noted by Tirole (1994), career concern incentives as described in Holmström (1999) should be especially strong in the public sector due to the lack of high powered incentive contracts. Furthermore, while large block shareholders are able to concentrate ownership and overcome agency-induced managerial myopia (Wahal and McConnell (2000), Edmans (2009)), diffuse taxpayers cannot accumulate votes in order to overcome the free rider problem. Therefore, political elections and public sector defined pension policies provide a particularly appropriate setting for an empirical investigation into distortionary incentives.

The idea that political agency problems are most pronounced in election years comes from the political cycles literature, which examines politicians' incentives to manipulate macroeconomic outcomes for reelection purposes.[48] My work delivers the insight that opaque public pension plans offer governments a "hidden" way to finance expansionary election year policies,[49] an interpretation that potentially reconciles the finding of Poterba (1994) and Rose (2006), who empirically document fiscal policies to be systematically more expansionary during gubernatorial election years, with the findings of Peltzman (1992), who find that voters in gubernatorial elections tend to punish

---

[48] See Nordhaus (1975), Rogoff and Sibert (1988), Rogoff (1990), Alesina et al. (1997), and Persson and Tabellini (2002) for the major theories on what generates political cycles.

[49] This relates to work by Shi and Svensson (2006) and Alt and Lassen (2006), who find the budgetary transparency helps to mitigate electoral cycles in budget deficits in OECD countries.

budget deficits and reward fiscal conservatism. This also relates to the recent literature on financial innovation regarding how the opacity of complex financial products can be exploited by politicians. For example, Pérignon and Vallée (2017) find that local governments in France tend to increase their use of complex structured loans ahead of closely-contested elections as a way to temporarily shroud deficits.

My work also relates to the literature that explores how political elections affect financial markets and firm behaviour. Prior research has identified political cycles in banking regulation (Brown and Dinc (2005), Cole (2009), Liu and Ngo (2014), Haselmann et al. (2015)), firm-level investment (Julio and Yook, 2012), discretionary accounting choices (Kido et al., 2012), and rates of job and plant creation (Bertrand et al., 2007). In the corporate governance literature on board elections, Fos et al. (2016) find temporal proximity to board election increases CEO turnover-to-performance sensitivity.

Surprising, little work has been done to examine the impact of political incentives on public pension funding decisions. The existing literature on this topic has identified various factors that affect public pension funding levels. These factors include taxpayer mobility (Inman, 1982), unionization rates (Mitchell and Smith, 1994), state demographics (Giertz and Papke (2007), Kelley (2014)), and state fiscal conditions (Chaney et al. (2003), Munnell et al. (2011b), Splinter (2015)). Elder et al. (2015) study how political polarization and electoral uncertainty can lead to greater pension underfunding, but their results are based on noisy measures of pension funding and political conditions, and lack a clear empirical strategy to distinguish political causes from confounding economic channels.[50] By exploiting the exogenous scheduling of gubernatorial elections, I am able to plausibly identify a strictly political motive behind how state governments fund their DB pension plans. My work also contributes to the literature by (1) constructing a novel flow measure of pension borrowing that accounts for the fact that pension deficits are jointly determined by contributions and benefits, (2) providing a testable conceptual framework relating to employee moral hazard and uninformed voters to explain the roots of political incentives regarding public pension borrowing, and (3) using falsification tests that rule out alternative explanations for documented electoral cycle patterns.

The remainder of this essay is organized as follows. Section 3.2 describes how the institutional setting of state DB pension plans gives rise to incentives for Governors to borrow through the pension system for politically-motivated purposes. Section 3.3 describes the empirical strategy that I employ to identify an electoral cycle pattern in pension deficits and the political incentives behind the pattern. Section 3.4 describes data used in the empirical analysis. Section 3.5 reports and interprets the empirical results and supplementary findings. Section 3.6 concludes.

---

[50] For instance, Epple and Schipper (1981) make the point that governments may borrow through the public pension system as a way to smooth taxes and public spending in response to economic shocks, to the benefit of taxpayers.

3.2. State Defined Benefit Pension Plans

In this section, I outline the institutional setting surrounding state DB pension plans and detail the institutional roots behind Governors' incentives to use public pensions for political purposes. First, I describe how the balance of of state pension assets and liabilities are determined by the flow of contribution and benefit policies over time. I then describe the Governor's discretionary power over contribution and benefit policies. Next, I explain how taxpayers and public employees are affected by public pension underfunding and what that implies for the Governor's political incentives. Last, I describe how the opacity of public pension plans can distort the Governor's incentives.

3.2.1. State Pension Assets and Liabilities

I focus my analysis on *defined benefits* (DB) pension plans, which comprise the majority of all U.S. public-sector plans at the state level. According to the 2015 BLS Employee Benefits Survey, 84% of all public-sector workers in state and local governments were eligible to participate in a DB pension plan, and 89% of those eligible workers were active participants in those plans. At its core, a DB pension plans consists of a collection of liabilities, which represent promises of future benefits to employees, and a collection of assets, which is accumulated in order to fund those promises before they become due.[51]

In contrast to defined contribution (DC) plans, which provide benefits that fluctuate with the market value of a plan's assets, DB benefits are predefined in advance. Typically, a participating employee's annual benefit is determined by the product of their average salary over the final 3-5 years of employment, the number of years of employment, and a plan-specific accrual rate. For example, an employee with an average ending salary of $100,000 and possessing 20 years of service would receive a base annuity of $60,000 under a plan with an accrual rate of 3%.[52]

As semi-fixed promises of future payment to employees, DB pension benefits constitute a debt-like liability for state retirement systems. Each year, state DB plans accrues new liabilities as active employees gain an additional year of service, and a portion of existing pension liabilities is retired as benefits are distributed to retiring employees. Conceptually, the evolution of a DB plan's liability from year t to year $t+1$ follows:

$$Liab_{t+1} = Liab_t(1 + r^{Liab}) + Acc_{t+1} - Benefits_{t+1}, \qquad (3.2.1)$$

where $Liab$ denotes the stock of pension liabilities, r^{Liab} denotes the discount rate used to calculate the present value of future obligations, Acc denotes the present value of new benefits accrued, and $Benefits$ denotes benefits paid.

While Eq. 3.2.1 provides a conceptual representation of how DB pension liabilities change over time, the practical process of accounting for DB pension liabilities is considerably more complicated.

---

[51] In this way public DB pension plans are *pre-funded*, which is in contrast to the *pay-as-you-go* funding scheme of U.S. Social Security, in which each generation takes on the full burden of paying for the previous generation's benefits.

[52] Most plans apply a cost-of-living adjustment (COLA) add-on to adjust for inflation.

In order to estimate the expected present value of future benefits, a DB plan must make assumptions about future wage growth, mortality rates, inflation, discount rates, etc. In practice, state plans hire specialized actuarial consultants to calculate DB pension liabilities via complicated actuarial methods. These practical considerations relating to actuarial assumptions are accounted for in my empirical analysis, but are omitted here in order to highlight Acc as a conceptual flow measure of pension liability accruals.

On the asset side, contributions are set aside every year to match the steady accrual of benefits. The contribution funds are invested in marketable securities and held in trust until they are distributed to plan beneficiaries. Conceptually, a DB plan's assets evolves according to

$$Assets_{t+1} = Assets_t(1 + r^{Assets}) + Contrib_{t+1} - Benefits_{t+1}, \tag{3.2.2}$$

where $Assets$ denotes the stock of pension assets, r^{Assets} reflects the rate of return on investment, $Contrib$ denotes the flow of contributions into pension assets, and $Benefits$ denotes benefits paid from pension assets.

When a plan's liabilities exceed its assets, the plan is considered to be *underfunded*, and the shortfall difference is termed the *unfunded liability*. Combining 3.2.1 and 3.2.2 allows us to express the evolution of a plan's unfunded liability as follows:

$$UnfLiab_{t+1} = UnfLiab_t(1 + r^{Liab}) + Acc_{t+1} - Contrib_{t+1} - (r^{Liab} - r^{Assets})Assets_t, \tag{3.2.3}$$

where $UnfLiab$ denotes the stock of unfunded liabilities.

Conceptually, $UnfLiab$ represents the the "net" indebtedness of a pension plan, in the sense that any accrued benefit obligations not covered by accumulated assets must be eventually be repaid. $UnfLiab$ can be negative, in which case a plan's assets are more than sufficient to cover its accrued liabilities and the plan is considered to be *overfunded*.

The policy variable of interest is the difference between the accrued liability and the contribution amount—i.e. the "pension deficit" ("pension surplus"):

$$PenDef_t = Acc_t - Contrib_t. \tag{3.2.4}$$

At its core, $PenDef$ represents the rate at which the government borrows through the state pension system. Eq. 3.2.3 shows that, assuming $r^{Liab} = r^{Assets}$, a DB pension plan grows more underfunded (or less overfunded) at a rate that is increasing in $PenDef$. In this essay, I focus on how Governors can manipulate $PenDef$ through their discretion over contributions and benefit accrual policies.

3.2.2. Governor Discretion over State Pension Policy

In practice, both government employers and employees are responsible for funding state DB pension plans. This means that Acc is split into two portions: the part for which government employers are responsible (denote this $AccGov$) and the part for which employee members them-

selves are responsible (denote this *AccMbrs*). Similarly, *Contrib* consists of contributions from the government employers (denote this *ContribGov*) and contributions from employee members (denote this *ContribMbrs*). This means that the total pension deficit can be decomposed into $PenDef = PenDefGov + PenDefMbrs$, where

$$PenDefGov_t = AccGov_t - ContribGov_t, \tag{3.2.5}$$

represents the government's share of the pension deficit, and

$$PenDefMbrs_t = AccMbrs_t - ContribMbrs_t, \tag{3.2.6}$$

represents the employees' share of the pension deficit.

As chief executive of the state government, the Governor has powers to shape *PenDefGov* on a year-to-year basis. While other policymakers, such as state legislators, also play a role in the formulation of public pension policy, I focus on Governors due to their prominent roles in shaping the state budget and their oversight over state administrative agencies. Furthermore, public officials with political interests aligned with the Governor's interests may also wield influence over pension policy. For instance, members of the Governor's cabinet, members of the Governor's party in the state legislature, and Governor-appointed members of the pension board all have incentives to keep the incumbent Governor in office.[53] In contrast to *PenDefGov*, *PenDefMbrs* tends to be relatively inflexible, as employee contribution rates are typically set through collective bargaining agreements and/or statutory provisions that require special legislative actions.

Governors have significant discretion over *ContribGov*, which are typically approved as part of the budgeting and legislative appropriations process. According to Novy-Marx and Rauh (2014), pension contributions will eventually reach 14.1% of state and local budget revenues, absent significant policy reforms. Historically, Governors have played a prominent role in the budget process, with the responsibility of submitting budget proposals and signing enacted budgets into law. In many states, Governors have the authority to veto line items and spend unanticipated funds without legislative approval. In certain instances, such as in Illinois in 2006 and 2007, Governors have cut special deals with legislators to implement "pension holidays" that drastically reduced budgetary contributions.

There is a clear temptation for politicians to temporarily divert contributions away from state pension plans towards more immediately pressing needs. In recent years, for example, the Governors of New Jersey[54] and Connecticut[55] both made cuts to state pension contributions, citing that the funds were needed for the more urgent purpose of preventing immediate budget cuts. In certain cases, it may indeed be in the public's best interest to use public pension plan funds as means to

---

[53] In 1993, New York State Comptroller H. Carl McCall was accused by his political opponents of giving an "election-year gift" to his mentor Gov. Mario Cuomo by proposing a short-term reduction in state pension contributions.

[54] Zernike, Kate "Christie Vetoes 2015 Pension-Paying Budget" *The New York Times* 30 Jun. 2014.

[55] De Avila, Joseph, "Connecticut Governor, Unions Reach Deal to Restructure Pension Payments" *The Wall Street Journal* 9 Dec. 2016.

prevent painful short-term budgetary cuts. The insight of this essay is that it is unclear why such stopgap measures should be more prevalent during election years.

Governors also play a role in determining pension benefits, albeit in a more limited capacity. Typically, pension benefits are set through long-term collective bargaining agreements or through special legislative approval, which renders benefit policy less discretionary and flexible in comparison to contribution policy. However, Governors can assert their influence over benefit policies through their ability to set the legislative agenda and veto bills. In 2001, for instance, California Governor Gray Davis approved legislation that significantly increased the benefits for state employees, after making public assurances that the increased benefits would put no additional pressures on the state budget.[56] By the time that it became clear that the higher pension obligations would impose significant fiscal burdens, Governor Davis had been re-elected to a second term in the 2002 election.

Raising public pension benefits provides a channel for politicians to win the support from politically-powerful labour unions. For example, New York State Comptroller H. Carl McCall pursued such a strategy for a 2002 gubernatorial election bid, as media accounts at the time noted that *"Mr. McCall, who is planning a run for governor in 2002, has called for automatic pension increases, cementing his standing as a favorite of state workers and retirees."*[57] Pension benefit increases also serve as a potential bargaining chip that state governments can use to negotiate against wage concessions during labour negotiations with their employees. In fact, the relative generosity of public sector retirement benefits has been used to explain the earning differential between public and private sector workers (Munnell et al., 2011a).

3.2.3. Who Bears the Costs of Underfunded Public Pension Plans?

As Eq 3.2.3 shows, unfunded liabilities are decreasing in *Contrib*, increasing in *Acc*, and decreasing in $r^{Assets} - r^{Liab}$. Therefore, a state DB plan looking to improve its funding situation must either raise contributions (which imposes a cost on taxpayers), lower benefits (which imposes a cost on employees), or realize asset returns in excess of assumed discount rates. Thus, the political economy of the Governor's decision regarding pension funding policies hinges crucially on how state pension debts are expected to be repaid.

First, it is important to establish that reliance on excess realized returns to make up for unfunded liabilities tends to be a naive and unsustainable solution. The vast majority of state DB plans discount their liabilities at the expected rate of return on invested assets, usually in the 7-9% per annum range in accordance to equity-heavy portfolios. As Novy-Marx and Rauh (2011) and Brown and Wilcox (2009) point out, this severely undervalues pension liabilities, as DB liabilities should be discounted at a lower rate that more appropriately reflects the underlying risk of quasi-fixed pension obligations.[58] Even if one disregards the inappropriate discount rate, it is unrealistic for

---

[56] Crane, David "Dow 28,000,000: The Unbelievable Expectations of California's Pension System" *The Wall Street Journal* 19 May 2010.

[57] Perez-Pena "Legislators Back Pension Rises For Retired Public Employees" *The New York Times* 14 Jun. 2000.

[58] The mismatch of risk between a plan's assets and its liabilities implies that taxpayers implicitly bear the cost of the risk premium (Bader and Gold, 2007).

state plans to expect to earn consistently above-market returns over the long run. Rauh et al. (2010) estimates that 20 states will run out of pension funds by 2025 given their current funding policies, assuming average returns of 8%.

Therefore, underfunded plans must eventually raise contributions or reduce benefits. With respect to benefits, it is generally difficult for state DB plans to cut state pension benefits that have already accrued to employees (i.e. $Liab_t$ in Eq. 3.2.3), as accrued benefits represent debt-like obligations with strong legal protection in most states. With few exceptions, such as the 2013 Detroit bankruptcy, public sector DB pension plans rarely "default" on their promises to pay benefits already accrued by employees.

In certain states, government employers have more leeway to cut benefits that have yet to accrue (i.e. reducing Acc going forward).[59] At the extreme, some states operate under a "gratuity" principle, which allows employers to reduce public DB pension benefits at will. At the other extreme, some states have constitutional provisions that prevent the state from reducing pension benefits that employees expect to earn over their employment tenures. According to Munnell and Quinby (2012), it is practically impossible to cut benefit accruals in such states without amending the state constitution.

When benefit protection is weak, state employees have the incentive to monitor the government and prevent them from taking actions that would increase unfunded liabilities, as this would put the employees' retirement savings at risk. In comparison to diffuse voters who face the classic free rider problem, employee members of state DB plans have more concentrated interests and are in a better position to take on a monitoring role through various institutional channels, including employee representatives on pension boards of trustees and lobbying through public sector labour unions. When benefit protection is weak, however, employees are largely insulated from the consequences of pension underfunding, and the burden falls upon taxpayers through future contribution increases.

As noted in the previous section, state pension contributions come from both the government ($ContribGov$) and from employees ($ContribMbrs$). However, the employee's share of contributions tends to be inflexible, as it is typically set through long-term labour contracts and/or requires special legislative approval in a manner similar to benefit policies. Furthermore, just as employees can pose legal challenges to attempts by state employers to cut pension benefits, they can also turn to the courts to prevent employers from raising employee contribution rates. For example, in 2012 the Superior Court of Arizona ruled against S.B. 1614, a bill introduced in 2011 to reform the state pension system by increasing employee contributions, because it violated the pension protection clause of the Arizona Constitution.

In the end, increasing governmental contributions is the most plausible course of action for plans facing large unfunded liabilities. The unfunded liability for most state DB pension plans is either implicitly or explicitly the obligation of the state government (Giertz and Papke, 2007), and since governments are financed through tax revenue, taxpayers bear the ultimate burden of funding

---

[59] Since federal laws regulating pension benefits do not apply to state pension plans, individual states are responsible for the level of legal protection afforded to employees' rights to state pension benefits.

these contributions. This sets up a potential agency conflict between incumbent politicians and taxpayers, in that the government may borrow on behalf of taxpayers through the state pension system in a manner that taxpayers would not choose for themselves. This conflict is discussed in more detail in the following section.

3.2.4. State Pension Policy Opacity

When unfunded state pension liabilities represent a debt burden for taxpayers, the Governor's pension policy decisions should in theory be disciplined by forward-looking taxpaying voters who anticipate that higher pension deficits incurred today necessarily imply future tax increases or spending cuts. Under the principle of Ricardian equivalence, voters with rational foresight will discount any current expansionary fiscal activity funded through pension deficits, and may even punish Governors for exhibiting fiscal imprudence (Brender and Drazen, 2008).

However, state DB pension plans present a vulnerable target for political interference due to their inherent opacity. This is because politicians have the incentive to manipulate voters' perceptions of their governing abilities through "hidden" forms of borrowing that are not directly observable to the public. The existing literature has highlighted the importance of this information asymmetry as the key friction in rationalizing the occurrence of political cycles in fiscal deficits (Alt and Lassen (2006), Shi and Svensson (2006)). Furthermore, Coate and Morris (1995) argue that welfare transfers to political special interests tend to be funneled through non-transparent channels.

Voters pay limited attention to state pension finances due to free rider problems that arise when the future tax burden of current unfunded pension liabilities is dispersed across a large population base. For an individual voting taxpayer, it may not be worth the effort to delve into the details of public pension plan reports and individual line items on the state budget in order to understand the long run fiscal implications of pension contribution and benefit policies. For example, when Governor Cuomo raided New York state pensions in the early 1990's, the New York Times reported that *"there is no mystery in why politicians find the pension funds, which are worth more than $700 billion nationally, such attractive targets. Reducing the amount a state gives to the funds is likely to generate less protest from the voters than raising taxes."*[60]

There are also various institutional reasons why public pension plans tend to be opaque to the public. For instance, the complexity of actuarial methods used to report pension liabilities and determine contribution rates makes it difficult for the average voter to evaluate the long-term consequences of pension policies. In order to estimate the expected present value of future benefits, a DB plan must make assumptions about future wage growth, mortality rates, inflation rates, discount rates, among a host of other economic and demographic factors. This makes it easy for government employers to manipulate actuarial assumptions in order to "cover up" pension costs.[61]

---

[60] Verhovek, Sam Howe "The Region; States Are Finding Pension Funds Can Be a Bonanza Hard to Resist" *The New York Times* 22 Apr. 1990.

[61] Kido et al. (2012) find that state DB pension plans tend to underreport their unfunded liabilities in election years relative to non-election years, and attribute their findings to politically motivated actuarial manipulations. Pension

Even if one takes the government's financial reports at face value, institutional features of the state budget process make it difficult for voters to observe the impact of pension policies in a timely manner. In particular, the protracted nature of the state budget and legislative appropriations process makes it difficult for the public to appreciate the long-term implications of state pension contributions in the short run. This implies that incumbent Governors have an especially strong incentive to borrow through the state pension system right before an election, with the understanding that voters will likely not be able to fully appreciate the impact until after the election is over. In the stylized model presented in Chapter 4, a temporary lag in voters' ability to observe the impact of pension policies is sufficient to generate election year spikes in pension deficits.

Figure 3.1 presents an example of a typical state budget cycle based on information provided by the National Association of State Budget Officers (NASBO). Before the start of a given fiscal year, the Governor's office adopts or amends a recommended contribution rate suggested by the pension board of trustees. After consulting with other governmental agencies, the Governor submits a proposed budget to the legislature, which is eventually finalized and signed into law just before the start of the fiscal year. It is not until after the end of the fiscal year that a plan releases its audited end-of-year financial statements.

As Figure 3.1 shows, there is a one-year delay between when state governments set their pension contribution rates and when the impact on unfunded pension liabilities is reported. In addition, the impact on unfunded liabilities is generally not reported directly in the general fund budget—which covers the majority of state appropriation, expenditure and receipt transactions and is the primary focus of public attention—but released separately via financial reports provided by the state pension plans themselves. For instance, a 2010 New York Times report described how New York State officials regularly concealed costs by excluding expenses from the general fund, leading the State Comptroller Thomas DiNapoli to declare the state's balance sheet to be unreliable.[62]

In comparison to changes in pension contribution rates buried in the state budget, changes to state pension benefits are more likely to receive public scrutiny. However, the complexity of the actuarial valuation process may nevertheless serve to obfuscate the funding impact of benefit policy.[63] For example, Senate Bill 400, the legislation that significantly increased benefits for California Public Employees' Retirement System (CALPERS) participants in 2001, met with little opposition in the state legislature after actuaries provided estimates that the investment earnings on pension assets would be sufficient to cover the increased pension costs.

To sum up, the information asymmetry problem stemming from the opaqueness of public pension policy, combined with the moral hazard problem relating to employees being insulated from the consequences of underfunding, create the incentives for Governors to use state pension borrowing

---

reporting manipulations have also been documented in the private sector by Bergstresser et al. (2006) and Stefanescu et al. (2015).

[62] Confessore, Nicholas "Grab Bag of Gimmickry Hides State Deficit" *The New York Times (City Room Blog)* 6 Apr. 2010. Web. https://cityroom.blogs.nytimes.com/2010/04/06/albany-accounting-hides-deficit-size-comptroller-says/?src=mv.

[63] Glaeser and Ponzetto (2014) argue that "shrouded" public pension packages are better understood by public-sector workers than by than ordinary taxpayers.

for politically self-interested purposes at the expense of taxpayers. This intuition is formalized in a stylized model presented in Chapter 4, which applies the career concerns framework of Holmström (1999) in a political setting. In the following section, I describe empirical tests used to determine whether such distortionary reelection incentives play a significant role in driving state pension policy.

3.3. Empirical Strategy

In this section, I describe the empirical tests I use to evaluate how Governors' reelection incentives affect governmental borrowing conducted through state DB pension plans. First, I look for an electoral cycle in pension deficits to check whether governments increase their rates of borrowing through state pension plans in election years. To this end, I estimate the following OLS specification:

$$PenDef_{it} = \alpha + \kappa_i + \lambda_t + \delta_0 \cdot Election_{it} + X_{it}\beta + \epsilon_{it} \tag{3.3.1}$$

in which $PenDef$ denotes the pension deficit, α denotes a constant intercept, κ_i denotes a plan-specific indicator, λ_t denotes a year-specific indicator variable, X_{it} denotes a column vector of control variables, $Election_{it}$ denotes a dummy variable indicating whether an election occurs in period t in plan i's state, and ϵ_{it} denotes an unobservable mean-zero error term.

We expect δ_0 to be positive if pension deficits are higher in election years relative to non-election years. The null hypothesis is there should be no systematic electoral cycle patterns in pension deficits in the absence of political distortions. The credibility of this assumption is supported by the fact that gubernatorial elections occur at pre-determined and fixed intervals and therefore should not be influenced by confounding factors. Furthermore,, the inclusion of year and plan fixed effects implies that 3.3.1 essentially forms a repeated difference-in-difference estimation framework in which plans from states with offsetting electoral cycles serve as control groups for one another. In particular, plan-level fixed effects account for time-invariant differences between different plans, while the year fixed effects account for time-specific shocks that commonly affect all plans.

I also estimate Eq. 3.3.1 using $PenDefGov$, the government's share of the pension deficit, and $PenDefMbrs$, the employee share of the pension deficit, as the dependent variable. We expect politically-motivated pension borrowing to be reflected through election year increases in $PenDefGov$, but Governors may also be tempted to increase $PenDefMbrs$ as a form of election year wealth transfer to public employees. For instance, a Governor may grant a special contribution holiday to employees in exchange for political support from unions or as a bargaining chip during election year wage negotiations. However, $PenDefMbrs$ is relatively inflexible due to long-term labour contracts and statutory contribution rates, as described in Section 3.2.

While my baseline specification in Eq. 3.3.1 places the focus on the difference between election years and non-election years, it is not immediately obvious whether one should expect a sharp election year spike in pension deficits or a more gradual increase in pension deficits throughout the electoral cycle. The dynamics depend on whether the incumbent's incentive to inflate performance

rises gradually as election year draws near, or whether the increased media scrutiny and voter attention in election years produce a sharp surge in the incumbent's desire to inflate performance for political purposes.[64]

To investigate the full electoral cycle dynamics, I include dummy variables indicating one year before the election ($Election_{t+1}$) and two years before the election ($Election_{t+2}$) in estimating Eq. 3.3.1. Positive coefficient estimates on these additional dummy variables would indicate that increases in pension deficits occur earlier in the electoral cycle. Note that the coefficient for the dummy variable for three years before the election ($Election_{t+3}$) is not included since it is absorbed by the intercept term, as each electoral cycle is at most four years long.

Next, I separate $PenDef$ into contributions ($Contrib$) and benefit accruals (Acc) and check whether the two components exhibit electoral cycle patterns by estimating Eq. 3.3.1 using $Contrib$ and Acc, respectively, as the dependent variable. On the contribution side, we expect the Governor's budgetary discretion to drive election year reductions to contributions, particularly in the government's share ($ContribGov$). Thus, I further include an interaction term between $Election_{it}$ and a dummy variable indicating the passage of a state budget ($Budget\ Year_{it}$) to check whether election year reductions in $ContribGov$ are more pronounced during budget years.

On the benefits side, we expect Acc to be higher in election years relative to non-election years. However, the relative inflexibility of benefit policy makes it less likely for benefit accruals to exhibit systematic electoral cycle patterns. Nevertheless, the incentive to grant higher benefits in exchange for political support should be stronger in states with relatively powerful public sector labour unions. To test this empirically, I include an additional interaction term between $Election_{it}$ and the state-level public sector union membership rate ($Pub\ Union\ Mbrshp_{it}$) in estimating Eq. 3.3.1 with $AccGov$ as the dependent variable.

I conduct several follow-up tests to determine whether electoral cycles in pension deficits stem from a politically-motivated agency conflict between politicians and taxpayers. First, I exploit variation in the strength of public pension benefit legal protection across states, and include interaction terms between $Election_{it}$ and various measures of benefit protection strength in estimating Eq. 3.3.1. We should expect states that provide stronger benefit protection to exhibit more pronounced electoral cycles in pension deficits, as benefit protection insulates employees from the consequences of underfunded pension plans and reduces their incentives to monitor the government's pension funding policies.

To highlight the importance of information asymmetry between Governors and taxpayers, I include interaction terms between $Election_{it}$ and measures of state pension transparency in estimating Eq. 3.3.1. We expect to find election year spikes in pension deficits to be larger for plans in states with more opaque pension systems, as the incentive to finance expansionary activities through pension borrowing depends on the incumbent's ability to temporarily hide the pension borrowing from taxpayers.

---

[64] In a theoretical context, a sharp election year spike may arise if the opacity of the incumbent's actions with respect to public pension policy is only temporary, or if the signal of the incumbent's fiscal performance regarding his underlying ability is only informative for one period. This is discussed in greater detail in Chapter 4.

I investigate several political factors involving Governors' reelection motives. First, I interact $Election_{it}$ with the electoral margin of victory ($VicMargin_{it}$) and include the term in estimating Eq. 3.3.1. Following the logic that electoral incentives are stronger for more competitive elections, we expect pension deficits to be higher for elections that are more closely contested. Next, I exploit the existence of gubernatorial term limits by including $Lame\ Duck_{it}$, a dummy variable indicating reelection ineligibility, in estimating Eq. 3.3.1. If reelection incentives drive pension borrowing, then pension deficits should be higher during terms in which the incumbent Governor is reelection-eligible. Lastly, I include interaction terms between $Election_{it}$ and a dummy variable indicating the incumbent Governor belongs to the Republican party ($Republican_{it}$), in order to check whether election year spikes in pension deficits can be explained by differences in partisan preferences between Democrat and Republican voters.

I perform several tests to evaluate the economic consequences of electoral cycles in pension borrowing. First, I check whether election year spikes in pension deficits are associated with deteriorating pension funding levels by estimating the following OLS specification:

$$\Delta UnfundedLiab_i = \alpha + \delta \cdot PenDefCyc_i + \bar{X}\beta + \epsilon_i \qquad (3.3.2)$$

where $\Delta UnfundedLiab_i$ denotes the time series average for the annual change in the level of unfunded liabilities (scaled by payroll), $PenDefCyc_i$ denotes the average time-series difference between election year and non-election year pension deficits, $\bar{X}_i$ denotes a set of control variables which have been averaged along the time series for plan i, and ϵ_i denotes the residual error term.

We expect the coefficient on $PenDefCyc_i$ to be positive if larger electoral cycles in $PenDef$ are associated with larger increases in unfunded liabilities over the sample period. This would indicate that state governments do not create sufficient buffers in non-election years to offset higher election year pension deficits, leading to steadily deteriorating funding levels over time.

Note that estimating Eq. 3.3.1 with $UnfundedLiab_{it}$ as the dependent variable constitutes an alternative way to test the impact of electoral cycles on the level of unfunded liabilities. However, as mentioned earlier, unfunded liabilities are self-reported and calculated using actuarial assumptions and methodologies that can be manipulated, leading to under-reporting of unfunded liabilities in election years (Kido et al., 2012).[65] By taking the time-series average over the sample period in estimating Eq. 3.3.2, I circumvent this concern to a large extent, as it is much more difficult to hide funding deterioration over a 15-year period.

Ultimately, we are interested in whether electoral cycles in pension deficits lead to real economic consequences. There is fierce debate in both policy and academic circles over how public debt impacts economic growth. Our empirical setting allows me to ask a more specific question of whether "debts" incurred through the public pension system can have adverse effects on economic

---

[65] In unreported results, I find suggestive evidence that state plans overstate the value of plan assets in election years. Public pension plans use actuarial methods to smooth over fluctuations in asset values, and I find that the difference between the actuarial value and market value of plan assets is systematically larger in election years.

growth. To this end, I estimate the OLS following specification:

$$\ln(GDP\ Growth)_j = \alpha + \delta \cdot PenDefCyc_j + \epsilon_j \qquad (3.3.3)$$

where $ln(GDP\ Growth)_j$ denotes the average GDP log growth rate for state j over the sample period, and $PenDefCyc_j$ denotes the average $PenDefCyc_i$ across sample plans in state j, weighted by plan liabilities. We expect a negative coefficient estimate on $PenDefCyc_j$ if systematic election year spikes in state pension borrowing are associated with lower economic growth.

I also estimate Eq 3.3.3 using $ln(HPI\ Growth)_j$, the average log growth rate in house prices for state j over the sample period, as the dependent variable. This test is motivated by Epple and Schipper (1981), who show that public pension underfunding can be capitalized in house prices through the market's expectation of higher future property taxes. We should expect a negative coefficient on $PenDefCyc_j$ if systematic election year pension borrowing is capitalized through falling house prices.

Lastly, I run several robustness tests to rule out alternative explanations for my main findings. Most importantly, I estimate 3.3.1 using a sample of *private sector* DB pension plans that should be unaffected by Governors' reelection incentives. This falsification test serves to address concerns that, in the absence political incentives, electoral cycle patterns in DB pension plan policies may still occur due to political cycles in economic conditions. For example, private firms may reduce DB pension contributions in election years due to systematic economic downturns that correlate with the electoral cycle.[66] I also address concerns that my results are driven by increased uncertainty surrounding transition of political leadership[67] by checking whether state pension deficits exhibit systematic patterns following unexpected changes in the Governorship due to death, resignation, or impeachment.

3.4. Data

3.4.1. State Pension Data

I investigate the annual pension deficit policies of state-administered defined benefits pension plans over the period 2001-2015. The primary source of public pension data comes from the Public Plans Database (PPD) maintained by the Center for Retirement Research. The PPD maintains data starting in 2001 from 150 public pension plans, consisting of 115 plans administered at the state level and 35 administered at the local level, which covers 90% of public pension membership and assets in the United States.

---

[66] The existence of electoral cycles in aggregate output and employment at the national level is rejected by Alesina and Roubini (1992) who examine a sample of OECD countries. The authors find evidence of an electoral cycle pattern in inflation, but their findings indicate that inflation tends to occur immediate after elections rather than before elections. I control for inflation assumptions in my empirical specifications.

[67] This is motivated by Julio and Yook (2012), who find that corporate investment tends to be lower during election years due to higher levels of political uncertainty.

The PPD data includes information on public pension contributions broken down by originating source. Using the PPD contribution measures, I construct $ContribGov_{it}$, a measure of contributions from the government, by aggregating regular contributions from employers ($contrib\_ER\_regular$) and contributions directly from the state ($contrib\_ER\_state$), and scaling by total covered payroll.[68] This represents the total discretionary governmental spending directed towards funding pension plan i in year t, as a percentage of payroll. Scaling by payroll makes contribution rates comparable between plans of differing sizes, and follows public pension accounting conventions that express pension costs as a fraction of payroll. I multiple these fractions by 100 in order to express them in percentage terms for clearer exposition in tables.

Next, I construct $ContribMbrs_{it}$, a measure of contributions from participating employee members, by aggregating regular contributions from employees ($contrib\_EE\_regular$), contributions used to purchase service credits ($contrib\_EE\_PurchaseService$),[69] and other uncategorized contributions coming from employees ($contrib\_EE\_other$), and scaling by total covered payroll. The aggregate contribution rate $Contrib_{it}$ is defined as the sum of $ContribMbrs_{it}$ and $ContribGov_{it}$.

I construct measures of benefit accruals based on *normal cost rates*, which are self-reported figures that represent the present value of benefits accrued by plan i in year t as a percentage of payroll. The normal cost rate is calculated by apportioning the total present value of an employee's expected benefits in retirement to each year of an employee's work life, based on a specific actuarial cost method, and is reported in annual actuarial valuation reports. The PPD data provides both the employer's share of the normal cost rate ($NormCostRate\_ER_{it}$), which I use as my measure of the government's share of the normal cost rate, denoted $AccGov_{it}$, as well as employees' share of the normal cost rate ($NormCostRate\_EE_{it}$), which I use as my measure of the employees' share of the normal cost rate, denoted $AccMbrs_{it}$. The total rate of benefit accruals, denoted Acc_{it}, is the sum of $AccGov_{it}$ and $AccMbrs_{it}$.

I define $PenDef_{it}$, the pension deficit, as the difference between Acc_{it} and $Contrib_{it}$. This measure represents the rate at which that the government effectively borrows from the state pension plan, as described in Eq. 3.2.4 from Section 3.2. I further define $PenDefGov_{it}$, the government share of $PenDef_{it}$, as the difference between $AccGov_{it}$ and $ContribGov_{it}$, and define $PenDefMbrs_{it}$, the employee share of $PenDef_{it}$, as the difference between $AccMbrs_{it}$ and $ContribMbrs_{it}$.

Since normal costs are actuarially-determined figures, I include observable actuarial assumptions as control variables in order to account for changes in benefit accruals that come from actuarial assumptions and not from changes in the underlying benefits. In particular, I control for contemporaneous values of *Discount Rate*, the reported rate used to discount future benefit obligations, *Inflation Rate*, the assumed inflation rate used in the actuarial valuation of liabilities, and *CostMthd EAN*, a dummy variable that indicates whether the plan uses the Entry Age Normal (EAN) actuarial cost method in order to value its liabilities. The EAN method is the most common

---

[68] Covered payroll represents the total pensionable earnings among participants. Normalizing by payroll is standard in public pension accounting in order to make plans of different sizes comparable.

[69] Service credit contributions represents contributions made by employees to directly purchase accrued pension benefits as a means to increase their accrued pension savings.

cost method, and also the most conservative one in terms of liability recognition. A more detailed explanation of actuarial valuation methods can be found in Appendix C.2.

In addition to contemporaneous actuarial control variables, I also include several plan-level control variables constructed from the PPD data. This includes lagged values of $ln(Payroll)$, defined as the natural log of total payroll among plan participants, $ln(Avg\ Salary)$, defined as the natural log of average salary among plan participants, and $Income$, defined as the total non-contribution income (including investment income) scaled by payroll. In particular, $ln(Payroll)$ and $ln(Avg\ Salary)$ control for variation in plan size and employee wage levels, while $Income$ controls for changes to pension funding levels due to changes in investment returns.

I keep observations which contain non-missing variables for my benchmark regression specifications. This results in an unbalanced panel of 114 plans corresponding to 1,318 observations over 15 years from all 50 states. I winsorize all continuous variables at the 1% level at both tails. A detailed list of variable descriptions can be found in Appendix B.2.

Table 3.1 presents the descriptive statistics for the variables used in my main regression specifications. The table shows that on average, contribution rates are larger than benefit accrual rates, with the average $Contrib$ at 17.979% of payroll and the average Acc at 12.5% of payroll. This results in an average $PenDef$ of -5.39% of payroll, indicating an average surplus. This surplus can be attributed to the persistent underfunding of plans in my sample, which results in plans contributing more funds on average than accruing new liabilities in order to service the amortized costs of their unfunded liabilities. We see that the surplus is largely driven by the difference between $ContribGov$ and $AccGov$ rather than the difference between $ContribMbrs$ and $AccMbrs$. This is consistent with the fact that employee shares of benefit accruals and contributions are usually set, either by contract or statute, to the same rate, while the burden of unfunded pension liabilities falls upon the government.

Table 3.2 presents a breakdown of pension plans by state. The number of plans in each state ranges from 1 to 5, with the average state containing 2.76 state-administered DB pension plans. Table 3.2 also includes summaries of the average size of pension plans in the sample in terms of payroll, as well as averages for $Contrib$, Acc, and $PenDef$. The table reveals there is substantial cross-state variation in terms of plan size as well as pension contribution and benefit policies.

3.4.2. State Politics Data

I obtain data on gubernatorial elections from Carl Klarner's website (www.klarnerpolitics.com).[70] I supplement and verify Klarner's Governors data set against information extracted from Book of the States provided by the Council of State Government Knowledge Center. From these data sources, I also obtain data on gubernatorial election voting results, gubernatorial term limits, party affiliations of incumbent Governors, and Governors' prior political experience. Data regarding institutional budgetary rules comes from the National Conference of State Legislatures website.

---

[70] I thank Carl Klarner for making early updates of his datasets available for use.

The schedule of U.S. gubernatorial elections is exogenous and set by law. Governors are elected to four-year terms in all states except for New Hampshire and Vermont, where each term is two years. Gubernatorial elections are held in early November in all states except for Louisiana, which holds its elections in October. Figure 3.2 shows that gubernatorial elections are staggered over my sample period, with the majority of elections occurring two years offset from presidential elections. Figure 3.3(a) provides an illustrated map of how gubernatorial electoral cycles vary across states.

I define $Election_{it}$ as a dummy variable that indicates whether plan i is located in state that holds an election in fiscal year t. Specifically, a plan-year observation is associated with $Election_{it} = 1$ if and only if an election occurs between the start and end of fiscal year t. For example, a plan-year observation with fiscal year beginning in July 2006 is counted as an election year only if an election takes place in November 2006. This timing convention conforms to the timing of pension policy choices and election dates as illustrated in Figure 3.1, in the sense that the pension policy decision occurs prior to the election, and the impact on the pension plan's funding status is revealed in audited financial reports only after the election.

I define $VicMargin_{it}$ as the margin of victory in percentage points between the winning gubernatorial candidate and the runner-up in year t for the state in which plan i is located. If no election takes place in year t, then $VicMargin_{it}$ is set to equal zero. I define $Lame\ Duck_{it}$ as a dummy variable that indicates whether an incumbent Governor faces binding term limits in their current term.[71] Figure 3.3(b) provides an illustrated map of states which impose gubernatorial term limits.

I define $Republican_{it}$ as a dummy variable that indicates whether the incumbent Governor belongs to the Republic party,[72] $Budget\ Year_{it}$ as a dummy variable that indicates whether a the state passed a budget in year t, $BalBudget_i$ as a dummy variable that indicates the state is subject to balanced budget restrictions, and $LegisExp_{it}$ as a dummy variable that indicates whether the incumbent Governor possesses prior experience as a member of the state legislature. Figure 3.4(a) provides a map illustrating the geographic distribution of states with biennial versus annual budgets, and Figure 3.4(b) provides a map of states with balanced budget restrictions.

3.4.3. Other Data

In order to control for state-specific economic factors, I include lagged state-level control variables in my empirical specifications. These include $Deficit\ Shock_{it-1}$, which measures the unexpected per capita deficit for a given state in year $t-1$. This measure is constructed using data obtained from NASBO's *Fiscal Survey of States* following the methodology from Poterba (1994). In particular, Splinter (2015) documents that states tend to reduce contributions towards public DB pension plans when they experience negative budgetary shocks. I also include $State\ Unemp_{it-1}$, the state unemployment rate taken from the Bureau of Labor Statistics Local Area Unemployment Statistics, and $Pub\ Union\ Mbrshp_{it-1}$, the state-level public sector unionization rate taken from

---

[71] The majority of states maintain term limits for their Governors, although the exact nature of the term limit can differ from state to state.

[72] Republicans hold the Governor's office in 52.35% of the plan-year observations in my sample.

Barry Hirsch and David Macpherson's website www.unionstats.com, as additional lagged control variables. Descriptive statistics for these variables are included in Table 3.1, and a more detailed description of variable definitions is found in Appendix B.2.

Data on legal protection for state employees' pension benefits comes from Munnell and Quinby (2012). I define the *Weak Protect$_i$* and *Strong Protect$_i$* as dummy variables that indicate whether plan i is located in a state that protects benefits under the gratuity principle and the constitutional protection principle, respectively. Some states offer benefit protection only to public sector employees that meet a certain threshold of employment tenure. For example, benefit protection may be offered only after a certain vesting period or after the employee is eligible for retirement. Accordingly, I define *Unconditional Protect$_i$* as a dummy variable that indicates whether plan i is located in a state that offers unconditional benefit legal protection.

Figure 3.5(a) and Figure 3.5(b) provide illustrated geographic breakdowns of benefit protection legal regimes across states. Figure 3.5(a) shows several intermediate forms of benefit protection regimes; some states protect benefits as explicit contractual arrangements (contract principle), some states offer protection of benefits even where no contract has been explicitly stated (promissory estoppel), and some states considers public pension benefits to be property that cannot be taken away without due process (property principle). A comparison of Figure 3.5(a) and Figure 3.5(b) reveals the existence of states that provide unconditional but weak protection of state pension benefits (such as Texas), as well as states that provide strong protection of state pension benefits that are conditional on vesting or retirement eligibility (such as Michigan).

I obtain data on institutional transparency from the *State Integrity Investigation* (SII), a joint data project conducted by nonpartisan investigative news and open data organizations.[73] The SII provides index measures based on surveys of experienced journalists that reflects the degree of state government transparency and accountability across 13 different categories. I focus on the particular indices that fall under the categories of (1) state pension fund transparency and (2) state budget process transparency.

The SII pension transparency index is based on journalists' survey responses to questions such as whether *"citizens can access information on state pension funds within a reasonable time period and at no cost,"* and whether *"state pension funds information is made available in open data format."* The score is on a scale from 0 to 100 and a higher score indicates a greater level of transparency in state pension fund management. The similarly-constructed budget transparency index is based on journalists' responses to questions such as whether *"the state budgetary debate process is conducted in a transparent manner,"* and whether *"citizens can access itemized budget allocations within a reasonable time period and at no cost."* Illustrated breakdowns of the geographic variation in state pension transparency and in budget process transparency scores are presented in Figure 3.6(a) and Figure 3.6(b), respectively.

---

[73] The State Integrity Investigation is a collaboration between the Center for Public Integrity, Global Integrity and Public Radio International. The project was first carried out in 2011, and was updated in 2015 using more rigorous methods that required reports to supply more specificity. I base my measure based on the 2015 scores. See `https://www.publicintegrity.org/accountability/state-integrity-investigation/` for details.

I obtain data on state budgetary revenues and expenditures from the U.S. Census Bureau's Annual Survey of State Government Finances in order to check for electoral cycle patterns in several variables related to state fiscal policy. In particular, I construct per capita measures of tax revenues ($Taxes_{it}$), general fund expenditures ($Spend_{it}$), education expenditures ($Edu\ Spend_{it}$), capital outlay expenditures ($Cap\ Spend_{it}$), and police expenditures ($Police\ Spend_{it}$). The final three expenditure variables listed represent items that are especially likely to be targeted for politically-motivated purposes.

Lastly, I obtain data on state economic growth from the Bureau of Economic Analysis, and data on state housing prices from the Federal Housing Finance Agency. Specifically, I construct $ln(GDP\ Growth)_j$ as the time-series mean of the annual log growth rate of real GDP for state j over the sample period, and $ln(HPI\ Growth)_j$ as the time-series mean of the quarterly log growth rate of seasonally-adjusted house price index values (based on purchases only) for state j over the sample period. These variables allow me to check whether electoral cycles in pension deficits impact real economic outcomes.

3.5. Results

In this section, I present the results from estimating the empirical specifications outlined in Section 3.3 in order to show that political incentives distort how state governments borrow from state DB pension plans. I also present supplementary tests and robustness checks to understand whether these findings are driven by contributions or benefit accruals, as well as to rule out alternative explanations for the documented electoral cycle patterns.

3.5.1. Main Results

To estimate how pension deficits in election years differ from non-election years, I estimate 3.3.1 using $PenDef$, $PenDefMbrs$, and $PenDefGov$, respectively, as the dependent variable, and present the results in Table 3.3. Columns (1), (3), and (5) do not include any control variables, while columns (2), (4), and (6) include the full set of control variables described in the previous section.[74] The signs on the coefficients on the control variables lack statistical significance for the most part and are therefore difficult to interpret. All specifications presented contain year fixed effects and plan fixed effects. Standard errors are robust to heteroskedasticity and clustered at the state level.

The estimates from columns (1) and (2) reveal a statistically-significant and positive relationship between $Election_{it}$ and $PenDef_{it}$. The magnitude of the estimate is economically significant, as the coefficient estimate in column (2) implies that governmental pension deficits as a percentage of payroll are on average 0.603 percentage points higher in election years relate to non-election years. Relative to the sample mean 5.392 percentage point surplus, this represents a 11.2% increase

---

[74] Note that the number of observations reported is less than than the full 1,316 sample size. This is due to the dropping of singleton groups (i.e. states with only one observation) during the estimation process. According to Correia (2015), maintaining singleton groups when fixed effects (in this case plan fixed effects) are nested within clusters (in this case states) can overstate statistical significance and lead to incorrect inference.

(decrease) in pension deficits (surplus). With the sample average payroll at \$4.67 billion per plan, this represents a difference of \$28.15 million between election and non-election years in dollar terms.

Columns (3) to (6) show that the electoral cycle pattern in $PenDef$ is driven by the government share of the pension deficit and not the employee share. The coefficient estimate on $Election_t$ when $PenDefMbrs$ is the dependent variable is small and statistically insignificant, while the same estimate when $PenDefGov$ is the dependent variable is significant and similar in magnitude to the estimates on $PenDef$ in columns (1) and (2). This is consistent with expectations, as the Governor has significantly greater discretion over the government's share than over employees' share of the pension deficit, as described in Section 3.2.

Next, I estimate the same specifications as in Table 3.3 and include additional indicator variables for the other years in the electoral cycle. The results are presented in Table 3.4, which shows the full dynamics of how $PenDef$, $PenDefMbrs$, and $PenDefGov$, respectively, vary over the electoral cycle. Column (1) shows that the pension deficit spike is confined to the final year of the electoral cycle as the coefficient on $Election_t$ is significant while the coefficients on $Election_{t+1}$ and $Election_{t+2}$ are not. Estimates from columns (2) and (3) reinforce the evidence provided by Table 3.3 in that the election year effect is driven by discretionary governmental pension policies rather than by inflexible employee contribution and benefit accrual rates. The magnitudes of the coefficient estimates on $Election_t$ are similar to those found in Table 3.3, while the coefficients on $Election_{t+1}$ and $Election_{t+2}$ are statistically insignificant and close to zero for all specifications.

Given the increased voter engagement and media scrutiny of state politics in the lead-up to an election, it is unsurprising that pension deficits experience a sharp increase in election years. The sharp election year effect supports the temporary nature of the information asymmetry regarding pension policy, which renders policies undertaken in earlier years in the electoral cycle ineffective in influencing voters' perceptions by the time the election occurs. It is also consistent with the idea that the most recent fiscal performance is most predictive of an incumbent politician's future performance, in which case voters rationally weigh the most recent fiscal year more heavily in evaluating the incumbent candidate. Chapter 4 provides a more detailed discussion of the theoretical basis behind a sharp election year effect.

3.5.2. Electoral Cycles in State Pension Contributions

Since pension deficits reflects the difference between benefit accruals and contributions, the documented electoral cycles in $PenDef$ can be explained by election year spikes in Acc, election year dips in $Contrib$, or a combination of both. We begin by looking at contributions, as it constitutes the more discretionary policy choice facing Governors. To this end, I estimate 3.3.1 using various contribution measures as the dependent variable and report the results in Table 3.5.

Column (1) shows that $Contrib$ experiences a statistically significant election year drop, which is about equal in magnitude to the 0.603 percentage point increase in $PenDef$ reported in Table 3.3. We see from columns (2) and (3) that the election year dips in $Contrib$ are entirely explained by election year dips in $ContribGov$. The evidence suggests that governments cut back on their

own share of pension contributions in election years, but do not provide election year contribution breaks to employees. This is consistent with our earlier findings on pension deficits, and also in our line with expectations relating to the Governor's greater discretion over the government's share of pension contributions.

I conduct additional tests to check whether larger election year contribution reductions are associated with cases where the Governor possesses greater budgetary discretion. To this end, I exploit the fact that 19 out of 50 U.S. states pass a state budget on a biennial rather than on annual basis. In general, annual budget cycles allow for more flexibility and responsiveness, while biennial budget cycles provide more opportunity for oversight.[75] This means that Governors have less discretion to influence election year pension contributions when the election coincides with an off-budget year.

I interact $Election_{it}$ with $Budget\ Year_{it}$, a dummy variable indicating a budget year, and include the interaction term in Eq. 3.3.1. The estimation results are reported in column (4) of Table 3.5, which reveal a positive and significant coefficient estimate on $Election_{it} \times Budget\ Year_{it}$, and a coefficient estimate of zero on $Election_{it}$. This indicates that election year dips in governmental contributions are confined to budget years, thereby reinforcing the notion that budgetary discretion plays an important role in the Governor's ability to borrow through state pension plans.

I also exploit the fact that state budgets are passed via an appropriations process through the state legislature. I interact $Election_{it}$ with $LegisExp_{it}$, a dummy variable that indicates whether the Governor has prior experience as a member of the legislature, and include the interaction term in estimating Eq. (4.1). The results from column (5) of Table 3.5 reveal that the coefficient estimate on $Election_{it} \times LegisExp_{it}$ is positive and statistically significant, which implies that Governors who possess prior legislative experience leverage their experience to reduce contribution rates in election years. Column (6) of Table 3.5 shows that the coefficients on $Election_{it} \times Budget\ Year_{it}$ and $Election_{it} \times LegisExp_{it}$ remain negative and statistically significant when both are included in the empirical specification.

If Governors cut back on state pension contributions in election years, what do they do with the redirected funds? While we cannot directly track the redirected contribution funds dollar for dollar, we can look at overall electoral cycle patterns in state spending. The previous literature has documented the occurrence of expansionary spending policies in election year, and I corroborate those findings here by regressing various budgetary variables at the state level, including per capita spending ($Spend$) and per capita tax revenue ($Taxes$), on the election year dummy variable and a host of control variables.[76]

The results are presented in Table 3.6, and while column (1) shows that an election year decrease in taxes is not statistically significant, column (2) shows that state spending tends to increase in

---

[75] See The Hon. Leon Panetta's testimony before the House of Representatives Rules Committee (March 16, 2000), at `http://archives.democrats.rules.house.gov/archives/rules_hear09.htm`.

[76] I also include the interaction term $Election_{it} \times BalBudget_i$ to compare states that allow budget deficits to be carried over from year to year versus states that do not in order to account for the findings of Rose (2006), who show that expansionary spending in election years is attenuated by the presence of balanced budget requirements.

election year. These findings suggest that Governors look to expand budgetary expenditures during election years without raising taxes. I also examine budgetary expenditures on particularly visible items in columns (4)-(6) in Table 3.6. In particular, I find election year increases in particularly visible items, including per capita spending on education (*Edu Spend*), capital outlay projects (*Cap Spend*), and police (*Police Spend*).[77]

3.5.3. Electoral Cycles in State Pension Benefit Accruals

Turning to the liability side of the balance sheet, I estimate 3.3.1 using various measures of benefit accruals as the dependent variable and present the results in Table 3.7. The positive coefficient estimate from column (1) shows that *Acc* tends to be higher in election years relative to non-election years, but the effect is not statistically significant. Results reported in column (2) and column (3) show similar findings if we use *AccMbrs* or *AccGov* as the dependent variable in the specification.

The lack of significant election year effects in benefit accruals is consistent with the fact that pension benefits are relatively inflexible as they are typically set according to multi-year labour agreements and/or require special legislative approval. Moreover, the normal cost is a noisy measure of benefit accrual rates as it is determined via actuarial methods that incorporate many assumptions about future economic and demographic conditions. Election-year increases in benefits may further be concealed by unobservable actuarial manipulations that understate election year election unfunded liabilities, as documented by Kido et al. (2012). Therefore, the coefficients reported in Table 3.7 likely underestimate systematic election year increases in benefit accrual rates.

Next, I examine instances in which we should expect to see larger and more significant election year increases in benefit accruals. In particular, we should expect larger election year benefit increases in states with higher rates of public sector union membership if raising pension benefits provides a way for Governors to gain political support from labour unions in election years. Furthermore, we focus on *AccGov* rather than *AccMbrs* since it is self-defeating to make employees themselves responsible for paying for a benefit increase if the objective is to generate a welfare transfer to workers.

I interact the $Election_{it}$ with $Pub\ Union\ Mbrshp_{it}$ and include the interaction term in estimating 3.3.1 with *AccGov* as the dependent variable. The results are reported in column (4) of Table 3.7, and the positive and statistically significant coefficient estimate on $Election_{it} \times Pub\ Union\ Mbrshp_{it}$ indicates that election year increases in state pension benefit accruals are indeed larger for plans in states with stronger public sector unions. In terms of economic magnitude, a plan in a state in the 75th percentile of public sector union membership experiences a relative 0.33 percentage point election year in *AccGov* increase relative to a plan in a state in the 25th percentile of public sector union membership. Note that the negative coefficient on $Election_{it}$ in column (4) suggests that the government may even lower its share of pension benefit accruals when public sector unions are especially weak.

---

[77] Prior literature has found election year increases in police hiring (Levitt et al., 1997) and decreases in college tuition rates (Reynolds, 2014).

These finding suggest an alternative interpretation to the results from Mitchell and Smith (1994), who find that higher state unionization rates are associated with lower levels of state pension funding. The authors speculate that this is due the government reducing contributions in response to upward pressures on salaries stemming from collective bargaining. Our results suggest that the underfunding may also stem from public sector labour unions' ability to increase benefits for their constituents by exploiting politicians' reelection incentives, without bothering to consider how those benefits will be funded.

Since significant changes to state pension policies usually require legislative approval, I check whether Governors who possess legislative experience are more likely to increase benefit accrual rates in election years. To this end, I interact $Election_{it}$ with $LegisExp_{it}$ and include it in estimating 3.3.1 with $AccGov$ as the dependent variable. The results in column (5) of Table 3.7 shows a positive and significant coefficient on the interaction term. This suggests that legislative experience not only provides Governors with more budgetary discretion over pension contributions, but also increases their ability to influence benefit policies. Column (6) of Table 3.7 shows that the coefficients on $Election_{it} \times Pub\ Union\ Mbrshp_{it}$ and $Election_{it} \times LegisExp_{it}$ remain positive and significant when both are included in the empirical specification.

Overall, Tables 3.5 and 3.7 show that electoral cycles in pension deficits are primarily driven by lower contributions in election years, but that in certain scenarios, the Governor may also face election year pressures to raise benefits. As expected, the pattern is found only in the government share of contributions and benefit accruals, since these are the items over which the Governor has discretion. Therefore, I focus on $PenDefGov$ as the policy variable of interest in the following sections.

3.5.4. Electoral Cycles and Employee Benefit Protection

In order to understand the the political economy behind the electoral cycles documented thus far, we turn to an examination of the institutional factors that distort the incentives of incumbent Governors. First, we investigate the idea that opportunistic borrowing through state pension systems hinges on taxpayers rather than employees bearing the consequences of pension underfunding.

Exploiting variation in state-level legal regimes, I interact $Election_{it}$ with various indicators of benefit protection strength as described in Section 3.4 and include the interaction terms in Eq. 3.3.1. The results are reported in Table 3.8, and show that election year spikes in pension deficits are significantly larger for states offering stronger legal protection as well as for states offering unconditional legal protection for state pension benefits. Note that the level effects for the legal protection variables are not reported since they are time-invariant and thus absorbed by plan fixed effects.

The coefficient estimates on the interaction terms are economically significant. The coefficient estimate on $Election_{it} \times Strong\ Protect_i$ in column (1) implies that state pension plans from states that provide constitutional protection of employee pension benefits experience a 1.817 percentage point (35.3% relative to the sample mean) election year increase in pension deficits relative to states

that do not. Similarly, states that operate under the gratuity principle experience a 1.679 percentage point (33.3% relative to the sample mean) election year decrease in pension deficits relative to states that provide stronger forms of protection. States that provide unconditional protection of state pension deficits experience a 1.009 percentage point (19.6% relative to the sample mean) election year increase in pension deficits relative to states that places tenure requirements on legal protection of state pension benefits.

These findings suggest that strong benefit protection which insulate employees from the future costs of underfunded pension plans creates a moral hazard them to ignore opportunistic election year pension borrowing. This creates the necessary conditions for an agency conflict between Governors and taxpayers, in which the Governor borrows through the state pension system in a manner in which taxpayers may not choose for themselves.

3.5.5. Electoral Cycles and Pension Plan Opacity

If taxpayers can perfectly observe governmental pension policies, then any pension policy decisions not in the best interests of taxpaying voters should be self-defeating from the incumbent Governor's perspective. Thus, I investigate the idea that information asymmetry plays an important role in generating the distortionary reelection incentives that drive electoral cycles in pension deficits.

I interact $Election_{it}$ with measures of pension plan opacity and include the interaction terms in estimating Eq. 3.3.1. First, I interact $Election_{it}$ with $Opaque\ Pensions_i$, a dummy variable indicating if the SII state pension transparency index measure (as described in Section 3.4) is in the bottom decile of the sample, and with $Transparent\ Pensions_i$, a dummy variable indicating the same index measure is in the top decile.

Column (1) of Table 3.9 shows that the estimate on $Election_{it} \times Opaque\ Pensions_i$ to be positive and the estimate on $Election_{it} \times Transparent\ Pensions_i$ to be negative. The point estimates are statistically significant and indicate that pension plans in the bottom decile of pension transparency experience a 1.081 percentage point (21.5% relative to the sample mean) election year pension deficits increase relative to plans in the middle 80 percentile, while pension plans in the top decile of pension transparency experience a 1.228 percentage point (23.5% relative to the sample mean) election year pension deficit decrease. The economic magnitudes and significance of the estimates do not change much when both interaction terms are included together in one specification, as reported in column (4).

Since, the state budget process ultimately determines pension contributions, I conduct a similar test using the SII indicator for the transparency of the state budget process. I interact $Election_{it}$ with $Opaque\ Budget_i$, a dummy variable indicating whether the SII budget transparency index measure is in the bottom decile of the sample, as well as $Transparent\ Budget_i$, a dummy variable indicating whether the same index measure is in the top decile.

Column (2) of Table 3.9 reveals that the estimate on $Election_{it} \times Opaque\ Budget_i$ to be positive but insignificant, while the estimate on $Election_{it} \times Transparent\ Budget_i$ is negative and significant. The point estimate on the latter term indicates that states in the top decile of budget transparency

experience a 0.794 percentage point (15.6% relative to the sample mean) lower election year pension deficit spike relative to plans in the middle 80 percentile.

Overall, the results reported in Table 3.9 support the idea that information asymmetry forms a key friction in generating the incentive distortions that drive election year spikes in pension deficits, and further suggest that pension transparency is more important than budgetary transparency. When all interaction terms are included in column (3), the coefficient estimates on the budget transparency interaction terms are no longer significant while the estimates on the pension transparency interaction terms remain largely unchanged. A possible explanation is that nontransparent budgetary process provide incumbent Governors with alternative channels to fund opportunistic election year activities, such as delaying infrastructure investment.

3.5.6. Electoral Cycles and Political Factors

I investigate various political factors to determine whether Governors' reelection concerns drive their incentives to borrow opportunistically through state pension plans. First, I test whether electoral cycles in pension deficits are stronger for elections that are more closely contested. To this end, I include $VicMargin_{it}$, an inverse measure of election closeness, in estimating Eq. 3.3.1.[78].

The results are presented in Table 3.10, and column (1) shows that the coefficient estimate on $Election_{it} \times VicMargin_{it}$ is indeed negative and statistically significant. The point estimate of -2.232 implies that a close election in which the winning candidate barely edges out the runner-up candidate is associated with an election year spike in pension deficits that is 0.446 percentage points (8.8% relative to the sample mean) higher than an election in which the winning candidate prevails by a margin of 20 percentage points.

Next, I include $Lame\ Duck_{it}$, a dummy variable indicating whether binding term limits apply to the incumbent Governor, in estimating Eq. 3.3.1. The results are presented in column (3) of Table 3.10 and the negative estimate on $Lame\ Duck_{it}$ reveal that lame duck (i.e. reelection-ineligible) Governors incur lower pension deficits on average, which is consistent with the idea that politicians who are unable to seek reelection have a weaker incentive to inflate their performance through concealed pension borrowing. Interesting, Besley and Case (1995) and Alt et al. (2011) find that taxes and spending are higher under lame duck Governors, which the authors attribute to reduced fiscal prudence stemming from a lack of electoral accountability. My findings suggests a silver lining to the lower accountability associated with lame duck terms, as it may serve to limit distortionary actions motivated by reelection ambitions.

Surprisingly, the estimated coefficient on interaction term $Election_{it} \times Lame\ Duck_{it}$ is positive, which implies that reelection-ineligible Governors incur higher pension deficits in election years. However, this result is potentially confounded by electoral competitiveness, as reelection-eligible incumbent Governors tend to enjoy a significant electoral advantage (Ansolabehere and Snyder Jr,

---

[78] Since voting occurs only during election years, $VicMargin_{it}$ is set to zero for non-election years. This means that we do not need to include the interaction term between $VicMargin_{it}$ and $Election_{it}$, since the coefficient on $VicMargin_{it}$ directly captures the marginal effect of election closeness conditional on the occurrence of an election year

2002).[79] Indeed, the statistical significance of the interaction term is statistically weak and disappears when the terms involving $VicMargin_{it}$ are included in the specification, as reported in column (5).

Lastly, we check whether party affiliation have any effects on a Governor's propensity to raise pension deficits during election years. U.S. politics is dominated by a two party system, and each party may wish to cater to its core constituency, with Democratic voters preferring higher spending and Republican voters preferring lower taxes.[80] Therefore, we must consider the possibility that electoral cycles in pension deficits, rather than being a sign of distorted political agency, simply reflect the policy preferences of a partisan electorate.

I interact $Election_{it}$ with $Republican_{it}$, and include the interaction term in Eq. 3.3.1. The estimation results are reported in column (3) of Table 3.10, and show that there is no statistically significant effect of having an incumbent Republican Governor relative to having an incumbent Democrat Governor. The estimate remains insignificant when interaction terms relating to other political variables are included in column (4). These results suggest that electoral cycles in pension deficits are not driven by policies catered to the political preferences of one particular party's partisan base.

3.5.7. Consequences of Electoral Cycles in Pension Deficits

Thus far, we have shown that pension deficits tend to be higher in election years *relative* to in non-election years. The natural follow-up is to determine whether such electoral cycles lead to increases in the *level* of unfunded liabilities over time. The more benign possibility is that governments accumulate sufficient pension surpluses in non-election years to offset the increased election year pension borrowing.[81] The other possibility is that each successive incumbent chooses to "kick the can down the road" by not accumulating sufficient buffers during non-election years.

Following steps outlined in Section 3.3, I collapse my sample along the time series and estimate Eq. 3.3.2 where the variable of interset is $PenDefCyc_i$, the average difference in election year pension deficits and non-election year pension deficits, and the dependent variable is $\Delta\,UnfundedLiab_i$, the average change in unfunded liabilities over the sample period. The estimation results are reported in Panel A of Table 3.11, and show that the point estimate is positive across all specification and statistically significant at the 1% level, even when state fixed effects are included in columns (2), (4), and (6). This indicates that a greater degree of electoral cyclicality in $PenDef$ is associated

---

[79] Another possibility is that the incumbent's party exerts greater influence towards the end of the incumbent's lame duck term, and the party is strongly motivated to secure the election for the successor candidate, whose chances of victory are helped by burnishing in the incumbent party's perceived performance.

[80] The previous literature has found mixed results in identifying partisan differences in opportunistic fiscal activities by the two major U.S. political parties. Poterba (1994) finds no difference in electoral cycles in fiscal policy at state level. Alesina et al. (1997) find Democrats tend to be associate with more expansionary monetary policy, but only in first half of electoral cycle. Cunha et al. (2016) find that Democrats are more likely to exploit exogenous reductions to credit constraints.

[81] Note that artificial cycles in pension borrowing may still be welfare-destroying in this scenario if taxpayers prefer smooth policy paths with respect to fiscal policy—in effect, politicians may be gambling with taxpayer dollars by putting the state balance sheet in a vulnerable state following every election.

with a larger increase in the level of unfunded pension liabilities over time, which implies that state governments do not "save up" in non-election years to sufficiently offset higher election year pension deficits.

Columns (1) and (2) report results using the baseline definition of $PenDefCyc_i$, which is the difference, for each plan i, between the time series average of $PenDef_{it}$ conditional on t being an election year and the time series average of $PenDef_{it}$ conditional on t being a non-election year. The point estimate of 1.306 in column (2) indicates that the average plan, which experiences a 0.603 percentage point difference between election year and non-election year $PenDef$ according to Table 3.3, experiences a 0.788 percentage point higher $\Delta UnfundedLiab_i$ over the sample period. This accounts for 6.65% of the sample mean of $\Delta UnfundedLiab_i$ (11.02 percentage points), which implies that the electoral cyclicality of pension deficits can explain an economically significant portion of the increasing level of unfunded pension liability over the sample period.

Columns (3) and (4) report the same estimation results using a measure of pension deficit cyclicality that has been adjusted for aggregate time trends. Specifically, $PenDefCycD_i$ is defined in the same manner as $PenDefCyc_i$, but uses the estimated residual terms from the OLS regression $PenDef_{it} = \alpha + \delta \cdot t + \epsilon_{it}$ instead of the raw $PenDef_{it}$ when computing conditional time series averages. The point of removing the linear time trend component is to ensure that the measure of cyclicality is not influenced by some plans having their electoral cycles starting later in the sample period relative to other plans. The coefficient estimates on $PenDefCycD_i$ are similar in magnitude to those for $PenDefCyc_i$ and remain statistically significant.

Similarly, Columns (5) and (6) report the same estimation results using a measure of pension deficit cyclicality that has been adjusted for control variables, plan fixed effects, and time fixed effects. Specifically, $PenDefCycR_i$ is defined in the same manner as $PenDefCyc_i$, but uses the estimated residuals from the OLS regression $PenDef_{it} = \alpha + \kappa_i + \lambda_t + X_{it}\beta + \epsilon_{it}$ instead of using the raw $PenDef_{it}$ when computing conditional time series averages. Again, the coefficient estimates on $PenDefCycR_i$ are similar in magnitude to those for $PenDefCyc_i$ and remain statistically significant.

There is heated debate about whether government debt affects economic growth.[82] Thus, it is natural to ask whether large unfunded liabilities affects state economic growth. For example, expectations of future tax increases may imply lower expected firm profits and individual incomes in the future, leading to lower investment and consumption. Large unfunded liabilities may also drive profitable businesses and high-income individuals to relocate in order to escape local tax regimes. Lastly, states such as Illinois have struggled with indecision over what policies to use to address large pension shortfalls, and policy uncertainty is also negatively associated with investment and growth (Gulen and Ion, 2015).

I test whether electoral cycles in pension deficits are associated with changes in real economic outcomes—in particular, growth rates in state GDP. I compute state-level measures of pension deficit cyclicality, following steps described in Section 3.3, and estimate Eq. 3.3.3. Panel B of

---

[82] For example, Rogoff and Reinhart (2010) find a negative relationship between national public debt and GDP growth at high levels of debt-to-GDP ratios, but their findings have been questions and debated over.

Table 3.11 reports the estimation results from using $ln(GDP\ Growth)$, the state GDP log growth rate, as the dependent variable in columns (1)-(3). The negative coefficients in columns (1)-(3) suggest that larger electoral cycles in state pension deficits are associated with lower economic growth, although only two of the coefficient estimates are (weakly) significant and the sample size of 50 states is limited.

Another real consequence of pension underfunding is the possibility of lower house prices. As Epple and Schipper (1981) show, unfunded pension liabilities can be capitalized through house prices if the housing market rationally impounds expectations of higher future taxes into current prices. The negative coefficients in columns (4)-(6) of Panel B in Table 3.11, in which the house price index log growth rate $ln(HPI\ Growth)$ is the dependent variable, are consistent with this interpretation, but the estimates are not statistically significant. One potential explanation for the weakness of this result (aside from the small sample size) is provided by Brinkman et al. (2016), who show that downpayment constraints in the housing market can dampen the capitalization of underfunded liabilities into house prices.

We note that the evidence presented regarding real outcomes is only suggestive and does not necessarily imply causal connections. In particular, reverse causality is a major concern when examining the relationship between unfunded pension liabilities and growth. However, it is less clear why slower growth would lead to more pronounced *electoral cycles* in pension deficits. In addition, the described mechanisms behind how large public pension debts cause slower economic growth operate through the channel of rational taxpayer expectations, which may at first appear at odds with the underlying opaqueness of public pension systems expounded in this paper. However, it is reasonable for rational expectations to form over longer time horizons, and the 15 years that is incorporated into the cyclicality measure is much longer than the one year disclosure delay described in Section 3.2.

3.5.8. Falsification Tests

My benchmark empirical tests rely on the identifying assumption that, in the absence of political distortions, pension policies should not exhibit any systematic electoral cycle patterns. A natural way to test this assumption is to examine corporate DB pension plans in the private sector, which should be immune from political incentives relating to state gubernatorial elections. Therefore, running my benchmark tests on a sample of corporate DB plans provides a natural placebo test on my main findings.

I construct a sample of corporate DB pension plan policies using data from the Compustat Pension Annual database (ACO_PNFNDA). I construct the dependent variables and control variables using the same method as in the public plan sample, with $PenDefFirm$, $ContribFirm$, and $AccFirm$ as the dependent variables. Corporate plans face different reporting and regulatory standards relative to public sector plans, so many variables may not be perfectly comparable between the corporate sample and public plan sample.[83] Compustat does not report the inflation assump-

---

[83] I scale the private pension deficit, contribution, and accrual variables by the payroll variable XLR in order to match

tions and the actuarial cost method made by corporate plans. However, it does include the wage growth assumption, which I include as an additional control variable.[84] I assign each corporate plan to the state of its headquarters in order to match it to the gubernatorial election data.

The results from estimating 3.3.1 on the sample of corporate DB plans are presented in Table 3.12. The results show no election year effect for any of the specifications, as all coefficient estimates for election year dummy variables are statistically insignificant. This result provides evidence in support for the assumption that pension policies unaffected by political incentives do not exhibit electoral cycle patterns, which implies that the electoral cycle patterns that I identify in public sector DB pension plans are driven by political incentives.

I also exploit occurrences of sudden Governor changes due to death, resignation, or impeachment in order to address the concerns that my results are driven by leadership transition effects unrelated to reelection considerations. In particular, I address the concern that additional uncertainty associated with election years may affect public pension policies. For instance, the government may choose to finance expansionary policies through pension borrowing in order to stimulate the economy in response to uncertainty-induced economic slowdowns.

Following this logic, sudden and unexpected changes in Governors due to exogenous causes should also be associated with periods of high political uncertainty. Therefore, I estimate the following OLS specification

$$PenDef_{it} = \alpha + \kappa_i + \lambda_t + \nu_0 \cdot Gov\ Change_{it} + X_{it}\beta + \epsilon_{it} \tag{3.5.1}$$

in which $Gov\ Change_{it}$ represents a dummy variable that indicates whether there was an unexpected change in the state Governorship in year t due to death, impeachment, or resignation.

The estimation results are reported in Table 3.13, and show that sudden Governor changes do not have detectable effects on $PenDef$, $PenDefMbrs$, or $PenDefGov$. The same is true if one includes a lagged value of $Gov\ Change$ in the specification, as reported in columns (2), (4), and (6), in order to account for the possibility that political uncertainty over unexpected Governor changes persists for more than one year. These results suggest that it is anticipation of reelection prospects, rather than leadership transitions per se, that drives election year spikes in pension deficits. Note that there are few occurrence of unexpected Governor changes in my sample (60 out of 1,318 plan-year observations in sample). This leads to large estimated errors that limit the statistical power of the test.

3.5.9. Other Robustness Checks

As a final robustness check, I address concerns that my main results are driven by regional shocks that affect a small number of states that share the same gubernatorial election schedules. As seen

---

the variable construction of their public plan counterparts. However, XLR is missing for the majority of firms and thereby significantly limits the sample size. If I scale by total employment (EMP), which has significantly fewer missing observations, I obtain qualitatively similar results.

[84] The PPD data also includes wage growth assumptions but it is missing for most of the sample.

in Figure 3.2, the majority of states hold their elections in years that are two years offset from presidential elections (i.e. in 2002, 2006, 2010, etc.). The concern is that regional shocks that affect the small number of states that are "off-cycle" from this dominant schedule drive my main findings. Due to the potential clustering of state election schedules, there is also the concern that correlated pension policies across states could lead to correlated standard errors that understate standard error estimates in my benchmark tests.

To address these concern, I estimate my benchmark test following 3.3.1, but add *region × year* fixed effects as well as cluster standard errors by year in addition to by state.[85] The inclusion of *region × year* fixed effects controls for time-varying shocks at the census region level,[86] while clustering by standard errors by year accounts by correlation of standard errors across states within a given year. The results are reported in Table 3.14, and show that my main estimation results remain largely unchanged whether one includes *region × year* fixed effects, clusters by year and by state, or does both. Figure 3.3(a) illustrates that on-cycle states and off-cycle states do not follow obvious patterns of geographic clustering, which should further mitigate concerns that my results are driven by correlated pension policies across states that cluster together geographically.

3.6. Conclusion

In this essay, I investigate an electoral cycle in the borrowing state governments conduct through public DB pension plans. The premise is that state Governors, who possess discretion over public pension policy, face incentives to increase "pension deficits" for politically motivated purposes. The result is a systematic pattern in which pension borrowing is higher during election years relative to non-election years. I present empirical evidence that state DB pension plans increase their rate of borrowing during election years, and that this pattern is driven by election year reductions in governmental contributions. I run additional tests in order to rule out alternative explanations for the documented electoral cycle patterns.

I find strong empirical support that electoral cycles in pension deficits are rooted in an agency conflict between politicians and taxpayers. In particular, election year spikes in pension deficits are larger in states which place the burden of unfunded public pension liabilities on taxpayers rather than state employees, and which contain less transparent public pension system. I also find that Governors' reelection incentives drive pension funding policy, as pension deficits are higher during more closely contested elections and during the terms of reelection-eligible incumbents.

My work offers implications regarding potential policy remedies to address the distortionary incentives underlying electoral cycles in pension deficits. One possibility is to place stricter restrictions that limit governmental discretion over contributions. For example, Kentucky passed legislation in 2013 that required state governments to follow up on their contribution promises.

---

[85] Clustering by year be problematic as the number of years in my sample is not large. This can lead to a downward bias in the cluster-robust variance matrix estimate and consequently over-rejection of the null hypothesis. Therefore, I follow the suggestions of Cameron and Miller (2015) and use bootstrap clustering methods in order to estimate standard errors when clustering by year.

[86] The U.S. consists of four census regions: Northeast, Midwest, South, and West.

Another potential solution is to address the underlying opacity of public pension plans. For example, the Governmental Accounting and Standards Board (GASB) recently passed new disclosure rules that placed stricter restrictions on the use of discount rates and actuarial smoothing methodologies. Reforming pension systems by loosening protection over state pension benefits presents another option to mitigate the conflict between politicians and taxpayers. However, reducing benefit protection may have unintended effects on the labour supply decisions of for public sector employees, and therefore should be approached with great care.

Lastly, my results suggest that electoral cycles in state pension borrowing have real consequences. In particular, I find that plans that exhibit larger election year spikes in pension deficits also experience larger increases in total unfunded liabilities over the sample period. This suggests that state governments do not accumulate sufficient buffers during non-election years to offset the higher election year pension borrowing. I also find suggestive evidence that states that contain plans that exhibit larger electoral cycles in pension borrowing also experience lower economic growth. However, much more work is needed to improve our understanding of how public pension underfunding affects the real economy.

Figure 3.1: Illustrative Example of Institutional Timeline
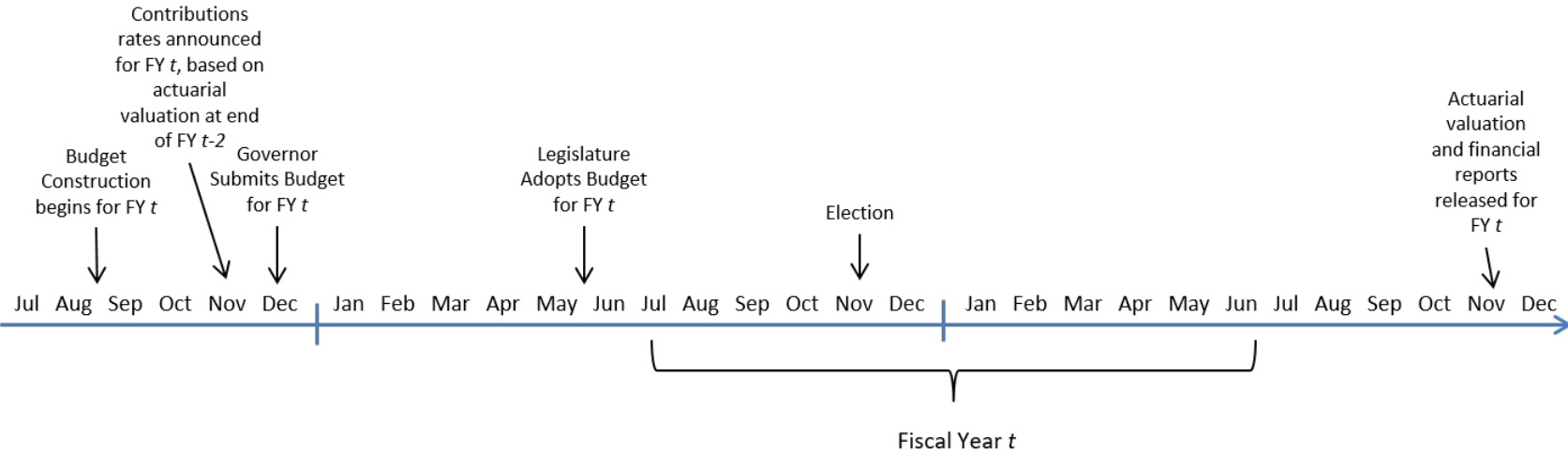
Figure 3.2: Frequency of Gubernatorial Elections (2001 to 2015)
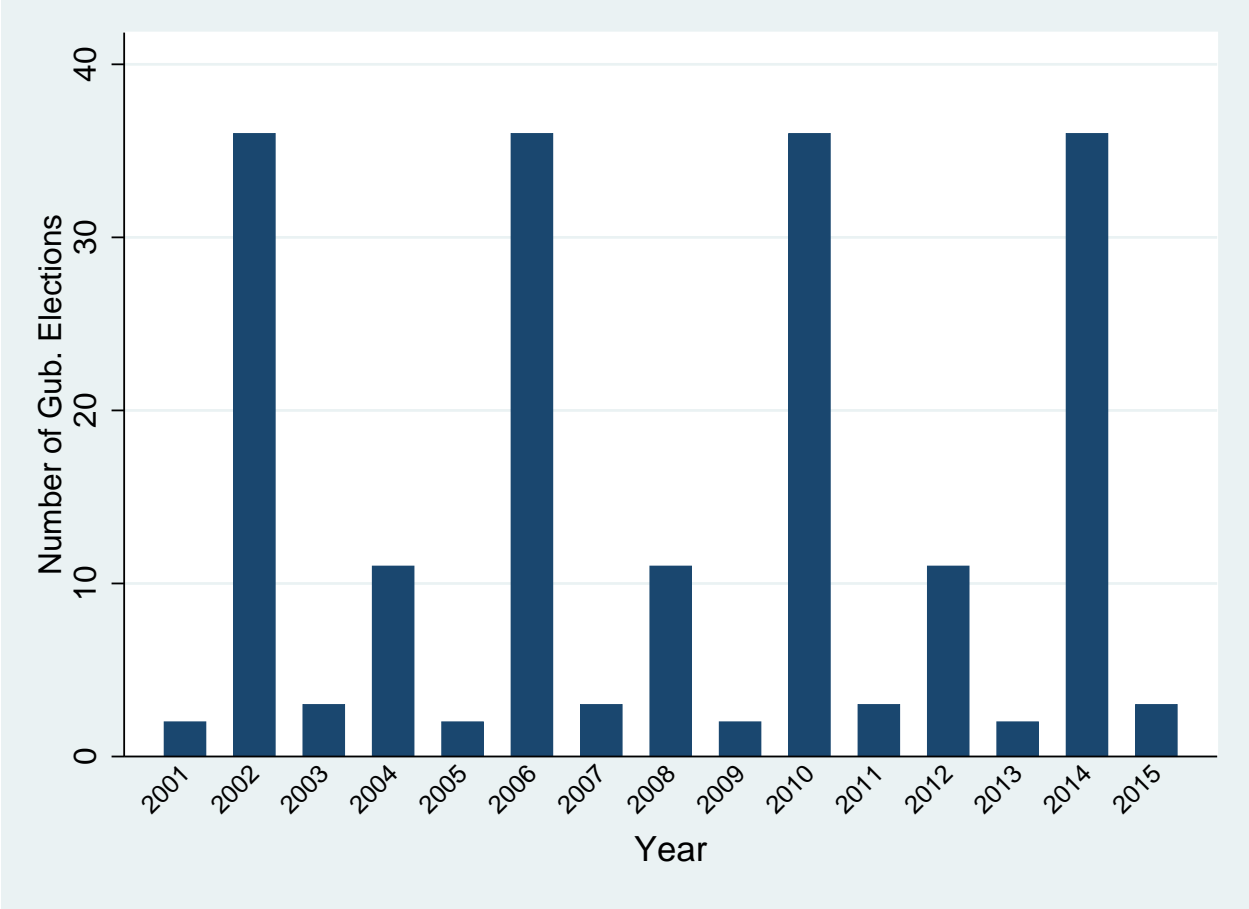
Figure 3.3: Geographic Variation in Political Institutions
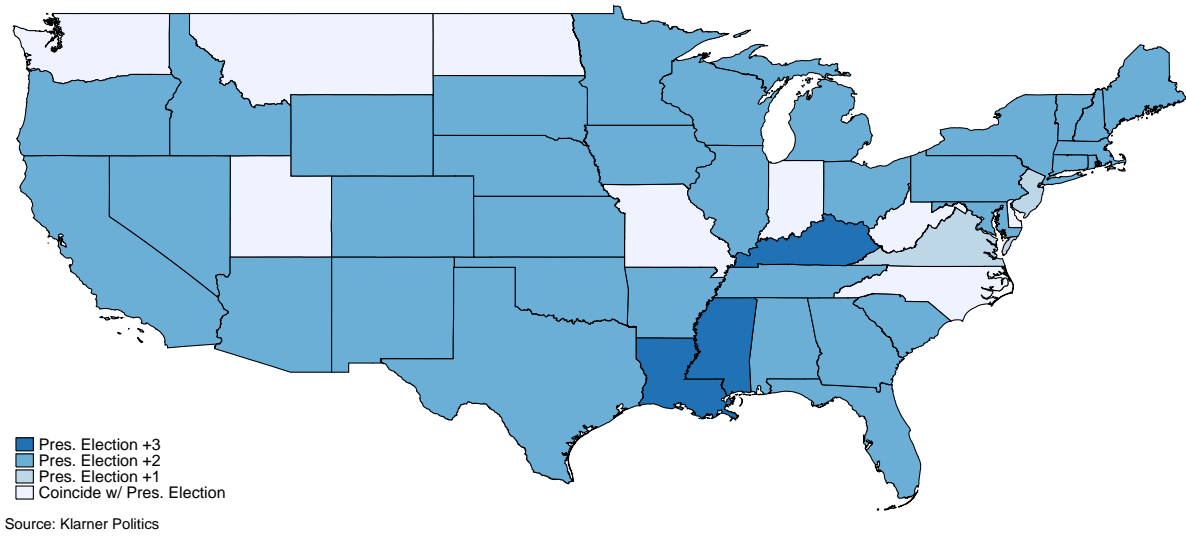
(a) Gubernatorial Electoral Cycles (as of 2015)
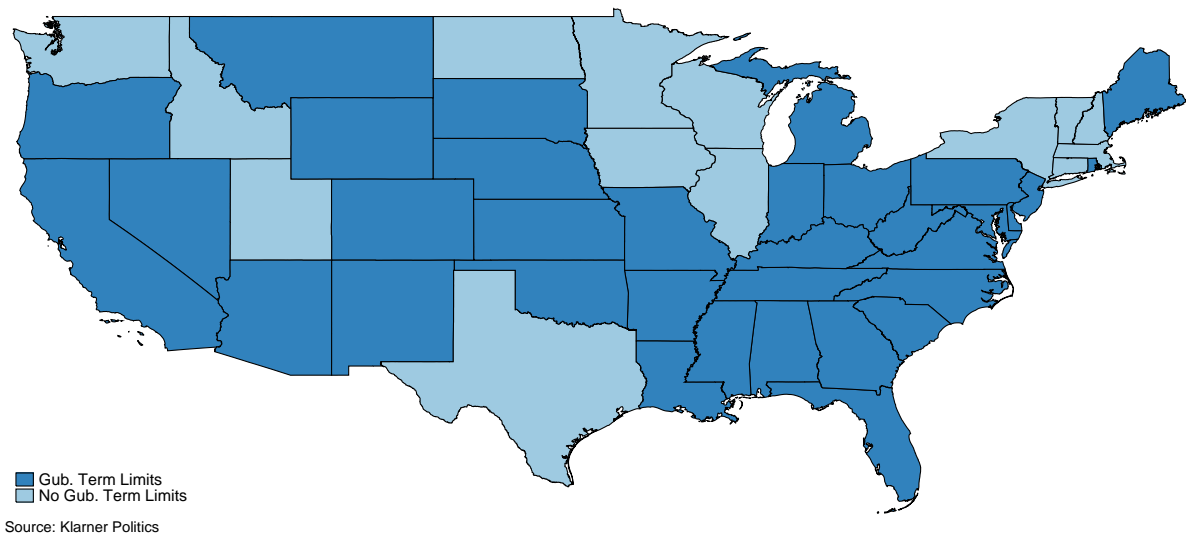
(b) Gubernatorial Term Limits (as of 2015)

Figure 3.4: Geographic Variation in Budgetary Institutions

Biennial Budget
Annual Budget

Source: National Conference of State Legislatures
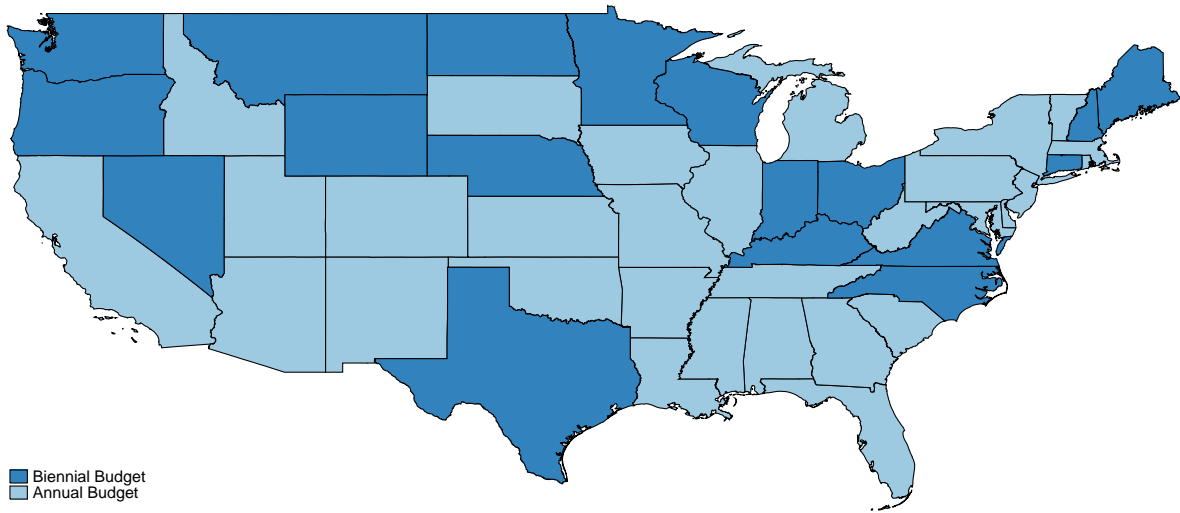
(a) Annual vs. Biennial Budget Cycles (as of 2015)

Can carry over deficit
Cannot carry over deficit

Source: National Conference of State Legislatures
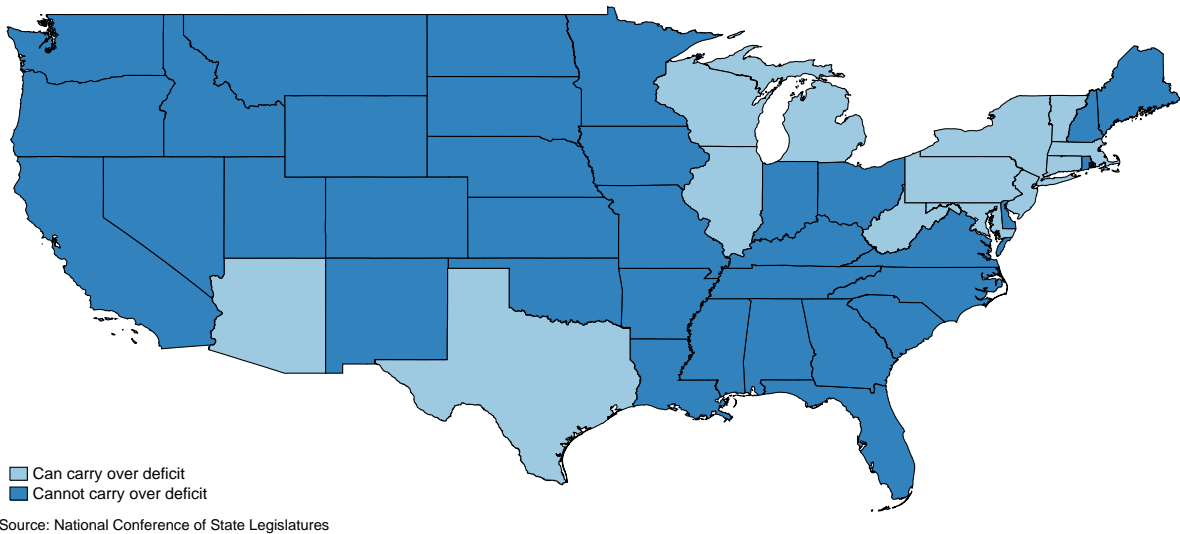
(b) State Balanced Budget (No-Carry-Over Rule) Restrictions

Figure 3.5: Geographic Variation in Public Pension Benefit Protection Legal Regimes

Constitutional Protection
Contract Principle
Promestory Estoppel
Property Principle
Gratuity Principle

Source: Munnell & Quinby (2012)
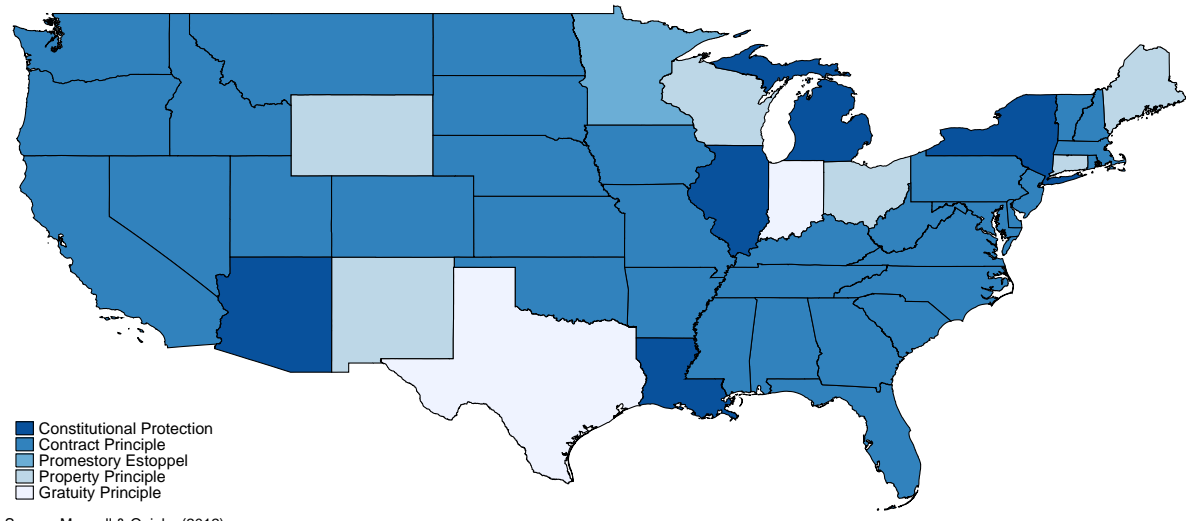
(a) State Pension Benefit Legal Protection Regimes

Conditional Protection
Unconditional Protection

Source: Munnell & Quinby (2012)
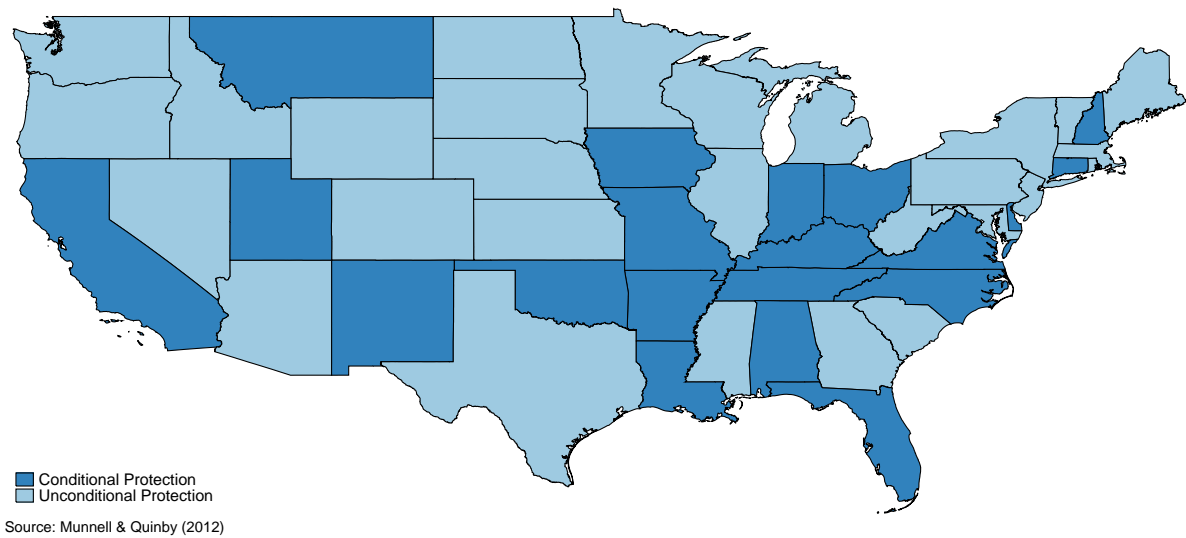
(b) State Pension Benefit Legal Protection Conditions

Figure 3.6: Geographic Variation in Transparency Indicators
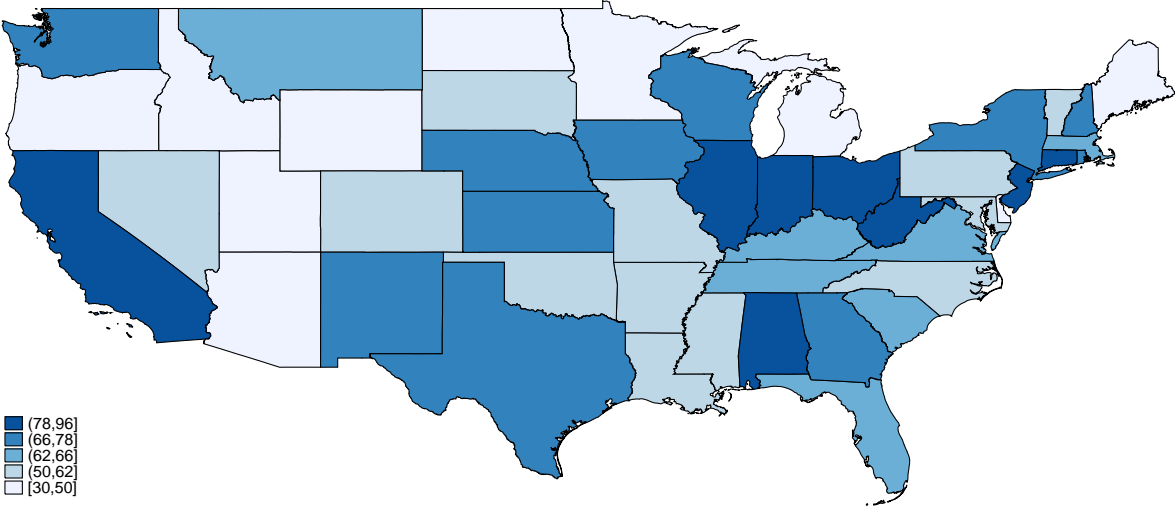
(a) State Integrity Investigation Transparency Score for State Pension Fund Management
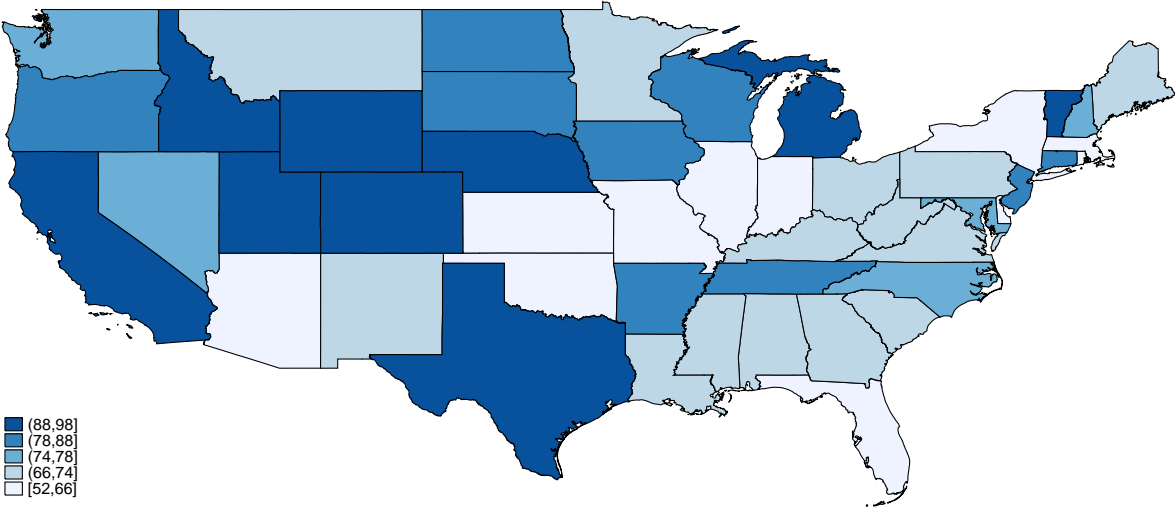
(b) State Integrity Investigation Transparency Score for State Budget Process

77

Table 3.1: Descriptive Statistics

This table presents summary statistics for the variables in my benchmark regression specifications. The sample consists of 114 state-administered public pension plans (covering all 50 states) over the period 2001 to 2015. *Contrib* denotes the total pension contribution scaled by payroll, *ContribMbrs* denotes the employee pension contribution scaled by payroll, *ContribGov* denotes the governmental pension contribution scaled by payroll, *Acc* denotes the total benefit accrual scaled by payroll, *AccMbrs* denotes the employee benefit accrual scaled by payroll, *AccGov* denotes the governmental benefit accrual scaled by payroll, *PenDef* denotes the pension deficit scaled by payroll, *PenDefMbrs* denotes the employee pension deficit scaled by payroll, *PenDefGov* denotes the governmental pension deficit scaled by payroll, Election denotes a dummy variable for a gubernatorial election year, $ln(Payroll)$ denotes the natural log of total payroll among plan participants, $ln(Avg\ Salary)$ denotes the natural log of average salary among plan participants, *Income* denotes non-contribution income scaled by payroll, *Discount Rate* denotes the assumed discount rate reported by the plan, Inflation Rate denotes the inflation rate assumed by the plan, *CostMthd EAN* denotes a dummy variable for Entry Age Normal being the actuarial cost method, Deficit denotes the per capita unexpected state deficit, *State Unemp* denotes the state unemployment rate, and *Pub Union Mbrshp* denotes the state unionization rate among public-sector workers. Detailed definitions for all variables can also be found in Appendix B.2. All variables except for Election are winsorized at the 1% level at both tails. Missing variables account for differences in number of observations.

	Observations	Mean	Std Dev	P25	Median	P75
Pension Contributions						
Contrib	1,316	17.979	9.469	11.866	16.667	22.428
ContribMbrs	1,316	6.052	3.560	3.625	6.408	8.234
ContribGov	1,318	11.911	8.604	6.493	10.200	14.290
Pension Accruals						
Acc	1,318	12.500	4.270	9.870	11.529	14.480
AccMbrs	1,318	5.710	2.832	3.990	6.000	7.689
AccGov	1,318	6.852	4.113	4.170	6.030	8.250
Pension Deficits						
PenDef	1,316	-5.392	8.258	-8.236	-3.938	-0.796
PenDefMbrs	1,316	-0.319	1.848	-0.633	-0.139	0.126
PenDefGov	1,318	-5.065	7.967	-7.966	-3.619	-0.429
Electoral Cycle						
Election	1,318	0.262	0.440	0.000	0.000	1.000
Plan-Level Control Variables						
ln(Payroll)	1,318	7.851	1.107	7.190	7.902	8.564
ln(Salary)	1,318	3.746	0.273	3.568	3.734	3.912
Income	1,318	0.219	0.485	-0.048	0.296	0.525
Discount Rate	1,318	0.079	0.004	0.075	0.080	0.080
Inflation Rate	1,318	0.034	0.006	0.030	0.032	0.035
CostMthd EAN	1,318	0.804	0.397	1.000	1.000	1.000
State-Level Control Variables						
Deficit Shock	1,318	-0.018	0.108	-0.069	-0.011	0.033
State Unemp	1,318	0.063	0.020	0.048	0.059	0.075
Pub Union Mbrshp	1,318	0.333	0.177	0.175	0.282	0.509

Table 3.2: Average Payroll and Pension Policies by State

This table presents a state-by-state summary, including the number of plans for each state, as well as the average Payroll, average *Contrib*, average *Acc*, and average *PenDef* for each state. Detailed definitions for all variables can be found in Table 3.1 as well as Appendix B.2.

	Number of Plans	Payroll	Contrib	Acc	PenDef
AK	2	1021.927	26.387	13.881	-12.656
AL	2	4520.158	14.695	9.917	-4.778
AR	2	1441.067	13.712	11.391	-2.329
AZ	3	3458.666	19.558	15.492	-4.067
CA	3	21108.221	16.731	18.415	0.378
CO	3	2568.761	22.707	12.953	-9.754
CT	3	3160.995	26.223	10.294	-15.191
DE	1	1670.206	8.641	9.776	1.136
FL	1	24803.133	10.635	10.084	-0.550
GA	2	5944.057	14.492	10.742	-3.750
HI	1	3504.771	15.822	10.391	-5.474
IA	2	4544.873	17.596	14.508	-3.088
ID	1	2469.950	17.345	14.204	-3.141
IL	4	5418.373	26.020	16.094	-9.827
IN	2	4302.572	14.900	8.882	-5.839
KS	1	5815.819	12.321	8.345	-3.976
KY	3	2474.669	18.614	11.087	-7.526
LA	5	2153.382	30.756	15.132	-15.627
MA	2	4868.025	23.433	11.528	-11.903
MD	2	4772.687	14.643	10.924	-3.719
ME	2	937.685	18.887	14.073	-4.814
MI	3	4292.982	21.670	9.700	-11.499
MN	4	3085.265	14.641	11.105	-3.381
MO	5	1795.267	21.466	12.715	-8.747
MS	1	5319.257	20.737	10.561	-10.176
MT	2	851.190	16.865	10.967	-5.898
NC	2	8071.481	11.771	12.003	0.232
ND	2	569.737	13.559	9.584	-3.539
NE	1	1436.878	17.937	11.438	-6.500
NH	1	2431.064	17.213	10.520	-6.693
NJ	3	9382.403	15.950	9.340	-6.612
NM	2	2116.240	22.768	16.577	-6.191
NV	2	2591.627	26.258	21.507	-4.749
NY	3	12400.116	10.369	12.063	1.575
OH	4	5428.947	22.380	15.106	-6.258
OK	3	2042.291	22.326	14.089	-8.231
OR	1	8281.775	8.409	8.120	-0.286
PA	3	6382.234	13.381	14.296	0.914
RI	2	931.877	20.295	11.878	-8.418
SC	2	4047.379	18.680	11.277	-6.637
SD	1	1346.206	13.401	11.771	-1.629
TN	2	3902.333	12.996	9.611	-3.384
TX	5	9267.403	12.331	10.346	-1.693
UT	2	2139.902	20.159	16.843	-3.301
VA	1	13771.987	8.664	9.330	0.666
VT	2	441.174	12.471	8.978	-3.493
WA	4	3392.746	7.137	10.897	3.715
WI	1	11890.885	11.458	12.908	1.450
WV	2	1203.019	29.414	9.673	-18.710
WY	1	1473.984	11.922	11.161	-0.761
Total	3	4667.729	17.979	12.500	-5.392

Table 3.3: Electoral Cycles in Pension Deficits

This table reports the estimation results from the OLS regression $PenDef_{it} = \alpha + \kappa_i + \lambda_t + \delta_0 \cdot Election_{it} + X_{it}\beta + \epsilon_{it}$ in columns (1) and (2). In column (3) and (4), $PenDef$ is replaced by $PenDefMbrs$ as the dependent variable, and in columns (5) and (6), $PenDef$ is replaced by $PenDefGov$ as the dependent variable. The variables of interest is $Election_{it}$ and coefficient δ_0 captures the relative difference in the outcome variable between election years and non-election years. X_{it} denotes the set of control variables, and is included in columns (2), (4), and (6). Control variables included lagged values of $ln(Payroll)$, $ln(Avg\ Salary)$, $Income$, $Deficit\ Shock$, $State\ Unemp$, and $Pub\ UnionMbrshp$, as well as contemporaneous values of $Discount\ Rate$, $Inflation\ Rate$, and $CostMthdEAN$. Detailed definitions for all variables can be found in Table 3.1 as well as Appendix B.2. All specifications include both plan and year fixed effects. Standard errors are corrected for heteroskedasticity and clustered at the state level. The sample consists of 114 state-administered public pension plans for the period 2001 to 2015 described in Table 3.1. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) PenDef	(2) PenDef	(3) PenDefMbrs	(4) PenDefMbrs	(5) PenDefGov	(6) PenDefGov
Election	0.581**	0.603***	-0.021	-0.012	0.605**	0.613***
	[0.218]	[0.211]	[0.091]	[0.089]	[0.231]	[0.199]
ln(Payroll)		12.704		-2.879**		15.560*
		[9.134]		[1.353]		[8.090]
ln(Salary)		-15.472*		-1.986		-13.467
		[8.795]		[1.679]		[8.641]
Income		-0.843*		0.073		-0.904**
		[0.450]		[0.122]		[0.420]
Deficit Shock		0.631		-0.208		0.827
		[2.863]		[0.383]		[2.761]
State Unemp		-30.748		-2.701		-28.202
		[29.112]		[10.717]		[24.828]
Pub Union Mbrshp		-6.051		-1.564		-4.493
		[8.992]		[1.864]		[8.012]
Discount Rate		63.339		-0.198		63.692
		[101.704]		[34.699]		[111.216]
Inflation Rate		-53.375		11.455		-64.960
		[46.087]		[21.108]		[44.761]
CostMthd EAN		-2.899		-0.186		-2.713
		[2.873]		[0.298]		[2.603]
Fixed Effects	Plan, Year	Plan, Year	Plan, Year	Plan, Year	Plan, Year	Plan, Year
Observations	1,312	1,312	1,312	1,312	1,314	1,314
Adjusted R-squared	0.649	0.677	0.565	0.589	0.632	0.672

Table 3.4: Dynamics of Electoral Cycles in Pension Deficits

This table reports the estimation results from the OLS regression $Y_{it} = \alpha + \kappa_i + \lambda_t + \sum_{j=0}^{2} \delta_j \cdot Election_{it+j} + X_{it}\beta + \epsilon_{it}$, where the outcome variable Y_{it} is $PenDef_{it}$ in column (1), $PenDefMbrs_{it}$ in column (2), and $PenDefGov_{it}$ in column (3). The coefficients δ_j's captures how contribution rates are affected by proximity to gubernatorial elections on a year-to-year basis over the electoral cycle. All specification include the set of control variables X_{it}, including lagged values of $ln(Payroll)$, $ln(Avg\ Salary)$, $Income$, $Deficit\ Shock$, $State\ Unemp$, and $Pub\ Union\ Mbrshp$, as well as contemporaneous values of $Discount\ Rate$, $Inflation\ Rate$, and $CostMthd\ EAN$. Detailed definitions for all variables can also be found in Table 3.1 as well as Appendix B.2. All specifications include both plan and year fixed effects. Standard errors are corrected for heteroskedasticity and clustered at the state level. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) PenDef	(2) PenDefMbrs	(3) PenDefGov
Election	0.759***	0.074	0.686***
	[0.272]	[0.139]	[0.242]
Election(t+1)	-0.005	0.006	-0.008
	[0.398]	[0.087]	[0.373]
Election(t+2)	0.368	0.198	0.176
	[0.323]	[0.149]	[0.274]
ln(Payroll)	12.715	-2.873**	15.566*
	[9.131]	[1.348]	[8.092]
ln(Salary)	-15.559*	-2.027	-13.513
	[8.712]	[1.690]	[8.558]
Income	-0.867*	0.062	-0.917**
	[0.455]	[0.119]	[0.430]
Deficit Shock	0.690	-0.176	0.856
	[2.854]	[0.390]	[2.741]
State Unemp	-31.484	-3.088	-28.554
	[29.330]	[10.866]	[24.943]
Pub Union Mbrshp	-5.949	-1.514	-4.442
	[9.041]	[1.871]	[8.057]
Discount Rate	61.416	-1.189	62.745
	[101.847]	[35.326]	[110.901]
Inflation Rate	-53.079	11.616	-64.809
	[46.011]	[20.933]	[44.827]
CostMthd EAN	-2.913	-0.194	-2.720
	[2.875]	[0.300]	[2.606]
Fixed Effects	Plan, Year	Plan, Year	Plan, Year
Observations	1,312	1,312	1,314
Adjusted R-squared	0.677	0.590	0.672

Table 3.5: Electoral Cycles in Pension Contribution Rates

This table reports the estimation results from the OLS regression $Y_{it} = \alpha + \kappa_i + \lambda_t + \delta_0 \cdot Election_{it} + X_{it}\beta + \epsilon_{it}$ in columns (1) to (3), $ContribGov_{it} = \alpha + \kappa_i + \lambda_t + \delta_0 \cdot Election_{it} + \rho \cdot Budget\ Year_{it} \cdot Election_{it} + \pi \cdot Budget\ Year_{it} + X_{it}\beta + \epsilon_{it}$ in column (4), and $ContribGov_{it} = \alpha + \kappa_i + \lambda_t + \delta_0 \cdot Election_{it} + \rho \cdot LegixExp_{it} \cdot Election_{it} + \pi \cdot LegixExp_{it} + X_{it}\beta + \epsilon_{it}$ in column (5), where Y_{it} represents various measures of pension contribution rates, $BudgetYear_{it}$ is a dummy variable indicating whether there a state budget passed in year t, and $LegisExp_{it}$ is a dummy variable indicating whether the incumbent Governor has prior experience in the state legislature. Column (6) reports the results from including all terms from columns (4) and (5). All specification include the set of control variables X_{it}, including lagged values of $ln(Payroll)$, $ln(Avg\ Salary)$, $Income$, $Deficit\ Shock$, $State\ Unemp$, and $Pub\ Union\ Mbrshp$, as well as contemporaneous values of $Discount\ Rate$, $Inflation\ Rate$, and $CostMthd\ EAN$. Detailed definitions for all variables can also be found in Table 3.1 as well as Appendix B.2. All specifications include both plan and year fixed effects. Standard errors are corrected for heteroskedasticity and clustered at the state level. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) Contrib	(2) ContribMbrs	(3) ContribGov	(4) ContribGov	(5) ContribGov	(6) ContribGov
Election	-0.618** [0.234]	0.011 [0.086]	-0.628*** [0.219]	0.200 [0.218]	-0.328 [0.232]	0.466 [0.280]
Election × Budget Year				-1.179*** [0.366]		-1.141*** [0.365]
Budget Year				0.574*** [0.176]		0.553*** [0.162]
Election × LegisExp					-1.830** [0.893]	-1.789** [0.871]
LegisExp					1.460* [0.812]	1.454* [0.811]
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Plan, Year	Plan, Year	Plan, Year	Plan, Year	Plan, Year	Plan, Year
Observations	1,312	1,312	1,314	1,314	1,314	1,314
Adjusted R-squared	0.726	0.871	0.692	0.692	0.694	0.694

Table 3.6: Electoral Cycles in State Fiscal Outcomes

This table reports the estimation results from the OLS regression $Y_{it} = \alpha + \kappa_i + \lambda_t + \delta_0 \cdot Election_{it} + \rho_0 \cdot BalBudget_i \cdot Election_{it} + X_{it}\beta + \epsilon_{it}$, where $BalBudget_i$ takes on a value of one if state i does not allow deficits to be carried over from one year to the next. In The outcome variable Y_{it} is $Taxes_{it}$ (per capita tax revenue) in column (1), $Spend_{it}$ (per capita general fund expenditure) in column (2), $Edu\ Spend_{it}$ (per capita expenditure on education) in column (3), $Cap\ Spend_{it}$ (per capita expenditure on capital outlays) in column (4), and $Police\ Spend_{it}$ (per capita expenditures on police) in column (5). X_{it} denotes the set of control variables, which include lagged values of *State Unemp*, *Pub Union Mbrshp*, *State GDP*, *Deficit Shock*, and *State Debt*. All specifications include both state and year fixed effects. Standard errors are corrected for heteroskedasticity and clustered at the state level. The sample consists of 50 states for the period 2001 to 2015. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) Taxes	(2) Spend	(3) Edu Spend	(4) Cap Spend	(5) Police Spend
Election	-0.006	0.063***	0.034**	0.014*	0.002**
	[0.024]	[0.022]	[0.013]	[0.008]	[0.001]
Election × BalBudget	0.022	-0.026	-0.024*	-0.005	-0.001
	[0.028]	[0.025]	[0.013]	[0.008]	[0.001]
State Unemp	0.027	-0.051	-0.021*	-0.007	-0.001
	[0.026]	[0.034]	[0.011]	[0.008]	[0.001]
Pub Union Mbrshp	0.011	-0.000	0.002	-0.002	0.000
	[0.010]	[0.008]	[0.003]	[0.001]	[0.000]
State GDP	0.111***	0.074***	0.020***	0.017***	0.000
	[0.025]	[0.016]	[0.005]	[0.006]	[0.000]
Deficit Shock	-0.367	0.272	0.047	0.024	-0.001
	[0.431]	[0.212]	[0.071]	[0.028]	[0.003]
State Debt	0.016	0.113*	0.003	-0.003	0.003
	[0.052]	[0.058]	[0.024]	[0.015]	[0.002]
Fixed Effects	State, Year	State, Year	State, Year	State, Year	State, Year
Observations	647	647	647	647	647
Adjusted R-squared	0.888	0.968	0.946	0.890	0.915

Table 3.7: Electoral Cycles in Pension Benefit Accrual Rates

This table reports the estimation results from the OLS regression $Y_{it} = \alpha + \kappa_i + \lambda_t + \delta_0 \cdot Election_{it} + X_{it}\beta + \epsilon_{it}$ in columns (1) to (3), $AccGov_{it} = \alpha + \kappa_i + \lambda_t + \delta_0 \cdot Election_{it} + \rho \cdot Pub\ Union\ Mbrshp_{it} \cdot Election_{it} + \pi \cdot Pub\ Union\ Mbrshp_{it} + X_{it}\beta + \epsilon_{it}$ in column (4), and $AccGov_{it} = \alpha + \kappa_i + \lambda_t + \delta_0 \cdot Election_{it} + \rho \cdot LegixExp_{it} \cdot Election_{it} + \pi \cdot LegixExp_{it} + X_{it}\beta + \epsilon_{it}$ in column (5), where Y_{it} represents various measures of pension accrual rates, $Pub\ Union\ Mbrshp_{it}$ is the state-level public sector unionization membership rate in year t, and $LegisExp_{it}$ is a dummy variable indicating whether the incumbent Governor has prior experience in the state legislature. Column (6) reports the results from including all terms from columns (4) and (5). All specification include the set of control variables X_{it}, including lagged values of $ln(Payroll)$, $ln(Avg\ Salary)$, $Income$, $Deficit\ Shock$, $State\ Unemp$, and $Pub\ Union\ Mbrshp$, as well as contemporaneous values of $Discount\ Rate$, $Inflation\ Rate$, and $CostMthd\ EAN$. Detailed definitions for all variables can also be found in Table 3.1 as well as Appendix B.2. All specifications include both plan and year fixed effects. Standard errors are corrected for heteroskedasticity and clustered at the state level. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) Acc	(2) AccMbrs	(3) AccGov	(4) AccGov	(5) AccGov	(6) AccGov
Election	0.063	0.001	0.062	-0.271*	-0.011	-0.330**
	[0.080]	[0.043]	[0.067]	[0.157]	[0.078]	[0.144]
Election × Pub Union Mbrshp				1.058**		1.022**
				[0.489]		[0.451]
Pub Union Mbrshp				2.077		1.905
				[3.098]		[2.969]
Election × LegisExp					0.444**	0.435**
					[0.175]	[0.182]
LegisExp					-0.421	-0.414
					[0.344]	[0.338]
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Plan, Year	Plan, Year	Plan, Year	Plan, Year	Plan, Year	Plan, Year
Observations	1,314	1,314	1,314	1,314	1,314	1,314
Adjusted R-squared	0.860	0.917	0.863	0.864	0.864	0.864

Table 3.8: Benefit Protection Strength and Electoral Cycles in Pension Deficits

This table reports the estimation results from the OLS regression $PenDefGov_{it} = \alpha + \kappa_i + \lambda_t + \delta_0 \cdot Election_{it} + \rho \cdot W_i \cdot Election_{it} + X_{it}\beta + \epsilon_{it}$ in columns 1, 2, and 3, where W_i represents *Strong Protect$_i$* (a dummy variable indicating whether a plan's state provides constitutional protection of public pension plan members' benefits) in column (1), *Weak Protect$_i$* (a dummy variable indicating whether a plan's state provides protection of public pension plan members' benefits under the gratuity principal) in column (2), and *Unconditional Protect$_i$* (a dummy variable indicating whether a plan's state provides unconditional protection of public pension plan members' benefits) in column (3). Column (4) reports the estimation results from including all terms from columns (1), (2), and (3). All specification include the set of control variables X_{it}, including lagged values of *ln(Payroll)*, *ln(Avg Salary)*, *Income*, *Deficit Shock*, *State Unemp*, and *Pub Union Mbrshp*, as well as contemporaneous values of *Discount Rate*, *Inflation Rate*, and *CostMthd EAN*. Detailed definitions for all variables can also be found in Table 3.1 as well as Appendix B.2. All specifications include both plan and year fixed effects. Standard errors are corrected for heteroskedasticity and clustered at the state level. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) PenDefGov	(2) PenDefGov	(3) PenDefGov	(4) PenDefGov
Election	0.320 [0.214]	0.731*** [0.200]	0.039 [0.238]	-0.014 [0.166]
Election × Strong Protect	1.817*** [0.334]			1.525*** [0.336]
Election × Weak Protect		-1.679** [0.687]		-1.502*** [0.515]
Election × Unconditional Protect			1.009*** [0.327]	0.857*** [0.302]
Control Variables	Yes	Yes	Yes	Yes
Fixed Effects	Plan, Year	Plan, Year	Plan, Year	Plan, Year
Observations	1,314	1,314	1,314	1,314
Adjusted R-squared	0.673	0.672	0.672	0.673

Table 3.9: Pension Plan Opacity and Electoral Cycles in Pension Deficits

This table reports the estimation results from the OLS regression $PenDefGov_{it} = \alpha + \kappa_I + \lambda_t + \delta_0 \cdot Election_{it} + \pi \cdot Opaque\ Pensions_i \cdot Election_{it} + \rho \cdot Transparent\ Pensions_i \cdot Election_{it} + X_{it}\beta + \epsilon_{it}$ in column (1), and $PenDefGov_{it} = \alpha + \kappa_I + \lambda_t + \delta_0 \cdot Election_{it} + \pi \cdot Opaque\ Budget_i \cdot Election_{it} + \rho \cdot Transparent\ Budget_i \cdot Election_{it} + X_{it}\beta + \epsilon_{it}$ in column (2), where $Opaque\ Pensions_i$ is a dummy variable indicating whether a state is in the bottom decile in terms of state pension SII transparency score, $Transparent\ Pensions_i$ is a dummy variable indicating whether a state is in the top decile in terms of state pension SII transparency score, $Opaque\ Budget_i$ is a dummy variable indicating whether a state is in the bottom decile in terms of state budget SII transparency score, $Tranpsarent\ Budget_i$ is a dummy variable indicating whether a state is in the top decile in terms of state budget SII transparency score. Column (3) reports the estimation results from including all LHS terms from columns (1) and (2). All specification include the set of control variables X_{it}, including lagged values of $ln(Payroll)$, $ln(Avg\ Salary)$, $Income$, $Deficit\ Shock$, $State\ Unemp$, and $Pub\ Union\ Mbrshp$, as well as contemporaneous values of $Discount\ Rate$, $Inflation\ Rate$, and $CostMthd\ EAN$. Detailed definitions for all variables can also be found in Table 3.1 as well as Appendix B.2. All specifications include both plan and year fixed effects. Standard errors are corrected for heteroskedasticity and clustered at the state level. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) PenDefGov	(2) PenDefGov	(3) PenDefGov
Election	0.509**	0.681***	0.518**
	[0.212]	[0.236]	[0.243]
Election × Opaque Pensions	1.081**		1.123**
	[0.474]		[0.466]
Election × Transparent Pensions	-1.228***		-0.782**
	[0.431]		[0.327]
Election × Opaque Budget		0.299	0.470
		[1.077]	[1.096]
Election × Transparent Budget		-0.794**	-0.556
		[0.392]	[0.332]
Control Variables	Yes	Yes	Yes
Fixed Effects	Plan, Year	Plan, Year	Plan, Year
Observations	1,314	1,314	1,314
Adjusted R-squared	0.672	0.672	0.672

Table 3.10: Political Factors and and Electoral Cycles in Pension Deficits

This table reports the estimation results from the OLS regression $PenDefGov_{it} = \alpha + \kappa_i + \lambda_t + \delta_0 \cdot Election_{it} + \rho \cdot VicMargin_{it} + X_{it}\beta + \epsilon_{it}$ in column (1), $PenDefGov_{it} = \alpha + \kappa_i + \lambda_t + \delta_0 \cdot Election_{it} + \rho \cdot VicMargin_{it} + \pi \cdot VicMargin_{it} \cdot IncumbLoses_{it} + X_{it}\beta + \epsilon_{it}$ in column (2), $PenDefGov_{it} = \alpha + \kappa_i + \lambda_t + \delta_0 \cdot Election_{it} + \rho \cdot Lame\ Duck_{it} + \pi \cdot Lame\ Duck_{it} \cdot Election_{it} + X_{it}\beta + \epsilon_{it}$ in column (3), and $PenDefGov_{it} = \alpha + \kappa_i + \lambda_t + \delta_0 \cdot Election_{it} + \rho \cdot Republican_{it} + \pi \cdot Republican_{it} \cdot Election_{it} + X_{it}\beta + \epsilon_{it}$ in column (4). $VicMargin_{it}$ is the margin of victory between the winning candidate and the runner-up in the gubernatorial election in year t if an election occurred and zero otherwise, $IncumbLoses_{it}$ is a dummy variable that indicates if the incumbent Governor loses reelection in year t, $Lame\ Duck_{it}$ indicates whether the Governor faces binding term limits, and $Republican_{it}$ indicates whether the Governor is a member of the Republican party. Column (5) reports the results from including all terms from columns (1), (2), (3), and (4). All specification include the set of control variables X_{it}, including lagged values of $ln(Payroll)$, $ln(Avg\ Salary)$, $Income$, $Deficit\ Shock$, $State\ Unemp$, and $Pub\ Union\ Mbrshp$, as well as contemporaneous values of $Discount\ Rate$, $Inflation\ Rate$, and $CostMthd\ EAN$. Detailed definitions for all variables can also be found in Table 3.1 as well as Appendix B.2. All specifications include both plan and year fixed effects. Standard errors are corrected for heteroskedasticity and clustered at the state level. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) PenDefGov	(2) PenDefGov	(3) PenDefGov	(4) PenDefGov	(5) PenDefGov
Election	1.043***	0.746**	0.373*	0.747***	0.680*
	[0.303]	[0.338]	[0.208]	[0.268]	[0.381]
VicMargin	-2.232**	-2.198**			-2.384**
	[0.976]	[1.018]			[1.098]
Lame Duck			-0.913**		-0.834**
			[0.391]		[0.384]
Election × Lame Duck			0.861*		0.764
			[0.464]		[0.481]
Election × Republican				-0.218	-0.122
				[0.515]	[0.500]
Republican				-0.556	-0.665
				[0.635]	[0.631]
gub_election_legCtrl		0.517			0.467
		[0.463]			[0.459]
Control Variables	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Plan, Year	Plan, Year	Plan, Year	Plan, Year	Plan, Year
Observations	1,280	1,280	1,318	1,318	1,280
Adjusted R-squared	0.681	0.681	0.675	0.674	0.683

Table 3.11: Consequences of Electoral Cycles in Pension Deficits

Panel A reports plan-level cross-sectional regression estimation results from $\Delta UnfundedLiab_i = \alpha + \delta \cdot Z_i + \bar{X}_i\beta + \epsilon_i$, where Z_i represents $PenDefCyc_i$ (the plan-level time series average of $PenDef$ conditional on election year minus the plan-level time series average of $PenDef$ conditional on non-election year) in columns (1) and (2), $PenDefCycD_i$ ($PenDefCyc_i$ adjusted for time trends) in columns (3) and (4), and Residual $PenDefCycR_i$ ($PenDefCyc_i$ adjusted for time-varying covariates, plan fixed effects, and time fixed effects) in columns (5) and (6). $\Delta UnfundedLiab_i$ denotes the plan-level time series average for annual changes in unfunded liabilities scaled by payroll. $\bar{X}_i$ denotes the plan-level time-series averages for the set of control variables, which includes lagged values of $ln(Payroll)$, $ln(Avg\ Salary)$, $Income$, $Deficit\ Shock$, $State\ Unemp$, and $Pub\ Union\ Mbrshp$, as well as contemporaneous values of $Discount\ Rate$, $InflationRate$, and $CostMthd\ EAN$. Panel B reports state-level cross-sectional regression estimation results from $Y_j = \alpha + \delta \cdot Z_j + \epsilon_j$, where j indexes states, Y_j represents the time-series average of log growth rates in state GDP in columns (1)-(3) and in house price index values in columns (4)-(6), and Z_j represents the weighted averages of $PenDefCyc_i$, $PenDefCycD_i$, and $PenDefCycR_i$, respectively (weighted by plan liabilities). Detailed definitions for all variables can be found in Table 3.1 as well as Appendix B.2. State level fixed effects are included in columns (2), (4), and (6). Standard errors are corrected for heteroskedasticity and clustered at the state level in Panel A. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

Panel A: Changes in Unfunded Liabilities

	(1) Δ UnfundedLiab	(2) Δ UnfundedLiab	(3) Δ UnfundedLiab	(4) Δ UnfundedLiab	(5) Δ UnfundedLiab	(6) Δ UnfundedLiab
PenDefCyc	1.338*** [0.487]	1.306*** [0.396]				
PenDefCycD			1.361** [0.523]	1.384*** [0.438]		
PenDefCycR					1.228*** [0.425]	0.867*** [0.273]
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects		State		State		State
Observations	106	106	106	106	103	103
Adjusted R-squared	0.330	0.614	0.324	0.620	0.348	0.591

Panel B: State-Level Economic Outcomes

	ln(GDP Growth)	ln(GDP Growth)	ln(GDP Growth)	ln(HPI Growth)	ln(HPI Growth)	ln(HPI Growth)
PenDefCyc	-0.142* [0.076]			-0.031 [0.026]		
PenDefCycD		-0.153* [0.077]			-0.031 [0.027]	
PenDefCycR			-0.071 [0.065]			-0.016 [0.022]
Observations	50	50	48	50	50	48
Adjusted R-squared	0.048	0.056	0.004	0.010	0.007	-0.010

Table 3.12: Electoral Cycles in Private-Sector DB Pension Policies

This table reports the estimation results from the OLS regression $Y_{it} = \alpha + \kappa_i + \lambda_t + \delta_0 \cdot Election_{it} + X_{it}\beta + \epsilon_{it}$, where Y_{it} is $DefFirm_{it}$ in column (1), $ContribFirm_{it}$ in column (2), and $AccFirm_{it}$ in column (3). All specification include the set of control variables X_{it}, including lagged values of $ln(Payroll)$, $ln(Avg\ Salary)$, $Income$, $Deficit\ Shock$, $State\ Unemp$, and $Pub\ Union\ Mbrshp$, as well as contemporaneous values of $Discount\ Rate$, and $Wage\ Growth$. Control variable coefficient estimates are not reported in order to conserve space. All specifications include both plan and year fixed effects. Standard errors are corrected for heteroskedasticity and clustered at the state level. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) DefFirm	(2) ContribFirm	(3) AccFirm
Election	0.135	-0.352	-0.316
	[0.492]	[0.299]	[0.600]
ln(Payroll)	18.500***	-1.946**	16.030**
	[6.467]	[0.791]	[6.439]
ln(Avg Salary)	-15.292**	2.453***	-12.179
	[7.167]	[0.869]	[7.651]
Income	-0.365***	-0.007	-0.377***
	[0.112]	[0.031]	[0.117]
Deficit Shock	1.696	-1.863	0.631
	[6.569]	[2.132]	[5.955]
State Unemp	0.719	-0.340	0.571
	[0.889]	[0.257]	[0.894]
Pub Union Mbrshp	-0.346	-0.014	-0.332
	[0.237]	[0.059]	[0.211]
Discount Rate	-1.479	0.134	-1.445
	[1.028]	[0.181]	[0.964]
Wage Growth	-0.429	0.129	-0.175
	[0.587]	[0.178]	[0.593]
Fixed Effects	Plan, Year	Plan, Year	Plan, Year
Observations	2,430	2,431	2,439
Adjusted R-squared	0.671	0.317	0.670

Table 3.13: Unexpected Governor Changes and Pension Deficits

This table reports report the estimation results from the OLS regression $Y_{it} = \alpha + \kappa_i + \lambda_t + \omega_0 \cdot Gov\ Change_{it} + X_{it}\beta + \epsilon_{it}$ where Y_{it} represents the outcome variable $PenDef_{it}$ in columns (1) and (2), $PenDefMbrs_{it}$ in columns (3) and (4), and $PenDefGov_{it}$ in columns (5) and (6). A lagged $Gov\ Change_{it-1}$ is added to the specification in columns (2), (4), and (6). All specification include the set of control variables X_{it}, including lagged values of $ln(Payroll)$, $ln(Avg\ Salary)$, $Income$, $Deficit\ Shock$, $State\ Unemp$, and $Pub\ Union\ Mbrshp$, as well as contemporaneous values of $Discount\ Rate$, $Inflation\ Rate$, and $CostMthd\ EAN$. Detailed definitions for all variables can also be found in Table 3.1 as well as Appendix B.2. All specifications include both plan and year fixed effects. Standard errors are corrected for heteroskedasticity and clustered at the state level. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) PenDef	(2) PenDef	(3) PenDefMbrs	(4) PenDefMbrs	(5) PenDefGov	(6) PenDefGov
Gov Change	0.257	0.300	0.067	-0.005	0.188	0.303
	[0.888]	[0.835]	[0.132]	[0.138]	[0.887]	[0.848]
Gov Change(t-1)		-0.133		0.222		-0.352
		[1.198]		[0.179]		[1.222]
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Plan, Year	Plan, Year	Plan, Year	Plan, Year	Plan, Year	Plan, Year
Observations	1,312	1,312	1,312	1,312	1,314	1,314
Adjusted R-squared	0.676	0.676	0.589	0.589	0.671	0.671

Table 3.14: Accounting for Geographic Clustering of State Electoral Cycles

This table reports the estimation results from the OLS regression $Y_{it} = \alpha + \kappa_i + \lambda_t + \delta_0 \cdot Election_{it} + X_{it}\beta + \epsilon_{it}$, where the outcome variable Y_{it} is *PenDef* in columns (1) and (2), *PenDefMbrs* in columns (3) and (4), and *PenDefGov* in columns (5) and (6). All specification include the set of control variables X_{it}, including lagged values of *ln(Payroll)*, *ln(Avg Salary)*, *Income*, *Deficit Shock*, *State Unemp*, and *Pub Union Mbrshp*, as well as contemporaneous values of *Discount Rate*, *Inflation Rate*, and *CostMthd EAN*. Detailed definitions for all variables can also be found in Table 3.1 as well as Appendix B.2. Standard errors are corrected for heteroskedasticity and double clustered at the state and year level. Bootstrap clustering is applied due to the small number of years in the panel. Plan-level and year-level fixed effects are included in columns (1), (3), and (5), while plan-level and region-year fixed effects are included in the remaining columns, where region represents the U.S. Census geographic grouping of U.S. states into *Northeast*, *Midwest*, *South*, and *West* regions. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% level, respectively.

	(1) PenDef	(2) PenDef	(3) PenDefMbrs	(4) PenDefMbrs	(5) PenDefGov	(6) PenDefGov
Election	0.603**	0.524***	-0.012	0.026	0.613***	0.499***
	[0.214]	[0.107]	[0.099]	[0.089]	[0.173]	[0.162]
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Plan, Year	Plan, Year × Region	Plan, Year	Plan, Year × Region	Plan, Year	Plan, Year × Region
Cluster by	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year
Boostrap Cluster	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,312	1,312	1,312	1,312	1,314	1,314
Adjusted R-squared	0.677	0.685	0.589	0.594	0.672	0.683

Chapter 4

Distortionary Reelection Incentives and Public Defined Benefit Pension Plans

4.1. Introduction

Public sector defined benefit (DB) pension plans require policymakers to make major financial decisions over the use of public funds. These decisions include the granting of retirement benefits to public sector employees, which represents a form of public borrowing, and the funneling of contributions into plan funds, which represents a form of public saving. Recent cases of severe underfunding of U.S. state DB pension plans in Illinois, California, and Rhode Island show that mismanagement of public DB pension plans can lead to the financial destabilization of state and local governments. At the same time, public pension policies are at the discretion of elected politicians, who face political incentives to win elections. In particular, politicians are often accused of acting in a short-sighted manner by reducing funding for public pension plans and "kicking the can down the road" by placing the burden on future administrations.

In this essay, I develop a stylized model based on the framework of Holmström (1999) to show how reputational concerns can distort public DB pension policy decisions in a political setting. An incumbent politician makes public pension policy decisions on behalf of voting taxpayers, but is motivated by reelection concerns in addition to caring about voters' utility. Policy choices are not immediately transparent to all voters, which results in the incumbent agent taking hidden actions in an attempt to manipulate the election result.

I first consider a scenario in which an incumbent politician grants promises of pension benefits to public sector employees, but cannot prefund those promises with contribution savings. I show that when the benefit policy is not fully transparent to voters, the incumbent has the incentive to raise the benefit above the socially-optimal level in exchange for obtaining short-term wage concessions from public sector employees. This in turn allows the incumbent to temporarily boost the output of public goods in order to inflate his perceived economic performance in the eyes of uninformed voters before the election.

Next, I consider the scenario in which the incumbent agent chooses the amount of contributions that goes towards funding the pension benefit, which is exogenously set. Following the same reasoning as before, the incumbent has the incentive to reduce contributions prior to an election

in order to temporarily inflate his perceived performance, but only if pension policies are not fully transparent to all voters. In addition, if the employee does not enjoy protection over pension benefits, then lowering contributions will be offset by higher wages that the worker demands in exchange for unfunded benefits, preventing the incumbent from inflating his performance. Thus, both the opacity of public pension policy as well strength of legal protection for employee benefits are necessary conditions for reelection incentives to affect the incumbent's decisions.

In both scenarios, voters are rational and make the utility-maximizing choice between the incumbent and a challenger at election time. The incumbent agent, who cares about voter welfare but also derives private benefits from holding political office, holds a temporary informational advantage over voters regarding public pension policy. The result is a "signal-jamming" equilibrium, in which the incumbent attempts to boost the signal of his governing ability during election year by "borrowing" from the public pension plan to increase the provision of public goods, even though voters are rational and anticipate the incumbent's opportunistic behaviour in equilibrium.

My model delivers several empirical prediction. Specifically, pension deficits—defined as the difference between pension benefit accruals and contributions—should be higher in election years, and this pattern should be more pronounced in states with pension systems that are more opaque, for elections that are more closely contested, and for plans that provide stronger guarantees to employees over their future benefit payments. I find evidence in support of these predictions for a sample of U.S. state DB pension plans in a detailed empirical investigation presented in Chapter 3,.

My work extends a long literature on the phenomenon of political cycles in economic policies, which examines the tendency for governments to enact expansionary policies immediately before an election. Nordhaus (1975) first interpreted such cycles as the consequences of opportunistic politicians fooling irrational voters in order to win elections. Subsequent work by Rogoff and Sibert (1988) and Rogoff (1990) show that political cycles in fiscal policies may arise out of a signalling equilibrium in which incumbents signal their intrinsic competence to rational voters through incurring fiscal deficits. Alesina et al. (1997) later showed that political cycles in U.S. inflation rates can result from expansionary monetary policies enacted during the terms of Democratic presidential administrations.

Persson and Tabellini (2002), Alt and Lassen (2006), and Shi and Svensson (2006) provide the closest work to my research, as they show that election year spikes in fiscal deficits can be rationalized by models in which nontransparent fiscal policies allow politicians to undertake opportunistic "hidden borrowing" as a means to inflate their perceived performance. I apply the same basic intuition to the setting of public pension plan funds, and I further show that electoral cycle patterns in policy decisions can emerge when agents' innate qualities remain constant over time, given that that the information asymmetry over policy is temporary. This assumption provides a different mechanism for generating political cycles compared to the existing literature, and is motivated by the institutional features of the public pension system as described in Section 3.2 from Chapter 3. My model also generates novel testable predictions relating to the closeness of elections and the strength of legal protection over benefits.

The remainder of the essay is organized as follows. Section 4.2 describes a model of politically-motivated public pension benefit policies. Section 4.3 describes a model of politically-motivated public pension contribution policies. Section 4.4 describes the empirical implications of the models. Section 4.5 concludes.

4.2. Reelection Incentives and Pension Benefits

We first consider the case in which an incumbent political agent make decisions over public sector employee wages and pension benefits, but do not allow them to make contributions to prefund the pension plan.

4.2.1. Setup

I adopt a two-period setting in which a political agent makes decisions that affect the welfare of tax-paying voters. In the first period ($t = 1$), the incumbent agent, denoted I, is assumed to be the leader with authority over policy decisions regarding granting defined benefits to a governmental worker. An election occurs near the end of the period, in which voters decide whether to re-elect agent I or a political challenger, denoted C, to become the leader in the second period ($t = 2$).[87]

Voters and agents derive utility from consuming a public good in each period t. The public good, denoted g_t, is net of taxes, which allows us to abstract from taxation policy. Voter utility, denoted U_v, is determined by the sum of the public goods produced during the two periods—i.e. $U_v = g_1 + g_2$.

At t=1, the public good output is determined according to

$$g_1 \equiv \eta_I - w + \epsilon_1 \tag{4.2.1}$$

where η_I denotes I's fiscal competence, w denotes the employee wage bill, and ϵ_1 denotes a random shock.

Public sector employees are paid a wage w in wages period 1 and a pension benefit b in period 2. To abstract away from labour demand considerations, we assume public goods production requires the employment of a single worker. Furthermore, the incumbent is able to commit in period 1 to paying b in period 2. To employ the worker, the government must provide adequate compensation according to the worker's participation constraint:

$$u(w) + u(b) \geq \bar{u} \tag{4.2.2}$$

where $\bar{u}$ denotes the the the worker's reservation utility, and $u(\cdot)$ denotes a concave utility function such that $u'(\cdot) > 0$ and $u''(\cdot) \leq 0$. The concavity of $u(\cdot)$ implies that the employee prefers consumption to be smoothed over the two periods.

---

[87] One can think of the agents as individuals or political parties in this setup.

The incumbent agent sets w and b at the beginning of period 1. An election takes place at the end of period 1, at which point voters decide whether to elect I or C as the leader. At $t = 2$, public good output is determined according to

$$g_2 \equiv \theta\eta_I + (1 - \theta)\eta_C - b + \epsilon_2, \tag{4.2.3}$$

where $\theta \in \{0, 1\}$ takes on a value of 1 if the incumbent is re-elected and 0 otherwise, η_C denotes the challenger's fiscal competence, b denotes the promised pension benefit, and, ϵ_2 denotes a random shock term that is independent from ϵ_1.

We assume that political agents care about voters' utility, but also derive positive benefits from holding political office, such that the incumbent's utility is defined as $U_I = U_v + \theta x$, where x is assumed to be strictly positive and represents the "ego rents" of being in power, following Rogoff (1990).

The fiscal competence ("ability") parameter η captures the innate qualities of the political agent, such as how well he is able to eliminate wasteful spending or deal with unexpected fiscal shocks. As is standard in models of career concerns, ability is not directly observed, and voters and agents alike must make inferences about the incumbent's ability through observing g_1. We assume η_I and η_C to be invariant over time, with the following common prior distribution at the beginning of $t = 1$:

$$\eta_i \sim N(m_{i1}, \frac{1}{h_{i1}}), \tag{4.2.4}$$

for $i \in \{I, C\}$.

The random output shocks ϵ_t are also not directly observable, and are normally distributed according to

$$\epsilon_i \sim N(0, \frac{1}{h_{\epsilon1}}), \tag{4.2.5}$$

where η_I, η_C, ϵ_1 and ϵ_2, are independently distributed and unaffected by w and b.

At the beginning of $t = 1$, the incumbent decides on public pension policies b and w. Next, g_1 is realized and observed by everyone, followed by an election in which voters decide whether to vote for I or C. Crucially, we assume that the representative voter, who casts the decisive vote in the election, observes b and w before the election only with probability $1 - \rho$, while with probability ρ she does not observe b and w until after the election. The parameter ρ captures the degree of policy opacity. In the second period, the elected leader collects the ego rent x and repays the promised benefit b, but has no influence on public goods output g_2 except through his ability.

An illustrated timeline of the model is provided in Figure 4.1. The left column in the figure provides a mapping between the model timeline and the institutional timeline described in the 3.1 from the previous chapter. The decision point for b and w corresponds to the beginning of the state budget process in a given fiscal year. The realization of g_1 corresponds to the realization of actual revenues and expenditures as the budget takes effect. Finally, the post-election revelation of pension policies b and w represents the end of the fiscal year, at which point the state releases

its independently audited financial reports.

4.2.2. Inference

Voters form posteriors about the incumbent agent's ability from observing output and pension policies. Let m_{I2} and h_{I2} denote the mean and precision of the representative voter's posterior about η_I, conditional on having observed g_1 and w. If the representative voter observes w or b before the election, she will rationally form a posterior mean of m_{I2} at election time.[88] Since priors about ability and output shocks are jointly independent and normally distributed, we can apply Bayes' law to express m_{I2} as

$$m_{I2} = (1 - \mu)m_{I1} + \mu z, \tag{4.2.6}$$

where $z \equiv g_1 + w = \eta_I + \epsilon_1$ represent the period 1 signal of the I's ability conditional on observing g_1 and w, and

$$\mu \equiv \frac{h_\epsilon}{h_{I1} + h_\epsilon}, \tag{4.2.7}$$

represents the relative weight of the signal.

Let $\hat{m}_{I2}$ and $\hat{h}_{I2}$ denote the mean and precision of the representative voter's posterior about I's ability conditional on having observed g_1 but not w. Thus, if the representative voter does not observe w or b before the election, she will form a posterior mean of $\hat{m}_{I2}$ at election time. Applying Bayes' law, we express $\hat{m}_{I2}$ as

$$\hat{m}_{I2} = (1 - \mu)m_{I1} + \mu\hat{z} = m_{I2} + \mu(\bar{w} - w), \tag{4.2.8}$$

where $\bar{w}$ represent the representative voter's conjecture about w, and $\hat{z} \equiv g_1 + \bar{w} = z - w + \bar{w}$ denotes the period 1 signal of the incumbent's ability conditional on observing g_1 but not w.

The precision of the representative voter's posteriors about the incumbent's ability evolves deterministically—i.e. $h_{I2} = \hat{h}_{I2} = h_{I1} + h_\epsilon$—regardless of whether the she observes w or not. Since utility is linear in the incumbent agent's ability, voters and agents only care about the posterior mean. From this point forward, reputation refers to the posterior mean of an agent's ability, unless stated otherwise. Since C cannot influence g_1 in any way during the first two periods, there is no learning about the challenger's ability—i.e. $m_{C2} = \hat{m}_{C2} = m_{C1}$ and $h_{C2} = \hat{h}_{C2} = h_{C1}$. It is only through the incumbent's power to enhance his reputation by manipulating w and b that the possibility of a political agency conflict arises.

4.2.3. Equilibrium

We solve the optimization problems facing voters and the incumbent agent, given each other's optimal strategies. At election time, the representative voter understands that g_1 is already set

---

[88] Note that if she observes b, she can "back out" b as we assume that she understands that the employee's participation constraint will be binding in equilibrium.

and therefore chooses θ to maximize expected period 2 utility g_2:

$$\max_{\theta} \hat{E}_1[\eta_C + \theta(\eta_I - \eta_C) - b + \epsilon_2], \tag{4.2.9}$$

where $\hat{E}_1[\cdot]$ denotes the expectation function with respect to voters' information set at election time.

It follows that the representative voter's optimal strategy follows

$$\theta = \begin{cases} 1 & \text{if } m_{I2} - m_{C2} \geq 0 \\ 0 & \text{if } m_{I2} - m_{C2} < 0, \end{cases} \tag{4.2.10}$$

if she observes w or b before the election, and

$$\theta = \begin{cases} 1 & \text{if } \hat{m}_{I2} - \hat{m}_{C2} \geq 0 \\ 0 & \text{if } \hat{m}_{I2} - \hat{m}_{C2} < 0. \end{cases} \tag{4.2.11}$$

if she does not.

The intuition behind 4.2.10 and 4.2.11 is straightforward. The representative voter understands that b has already been set, and therefore bases her election decision entirely on comparing the reputations of I and C. The incumbent's ability to influence this voting decision hinges on whether the representative voter is able to observe w before the election.

Anticipating the voter's decision process, the incumbent chooses w and b at the beginning of period 1 according the following constrained optimization problem

$$\max_{b,w} \quad E_1[\eta_I - w + \epsilon_1 + \eta_C + \theta(\eta_I - \eta_C + x) - b + \epsilon_2]$$
$$\text{subject to} \quad u(w) + u(b) \geq \bar{u}, \tag{4.2.12}$$

where $E_1[\cdot]$ denotes the expectation function with respect to the incumbent's information set at the beginning of period 1.

If the representative voter observes w or b before the election, we see from 4.2.7 that she can "back out" the true signal of the incumbent's ability ($z = \eta_I + \epsilon_1$), in which case the incumbent's choices for w and b would have no effect on the election result. It follows from first order conditions that the incumbent's optimal policy under full transparency (i.e $\rho = 0$) is characterized by $w = b$.

It is immediately clear that $w = b$ also characterizes the first-best policy from voters' perspective.[89] Intuitively, the incumbent agent and voters face the same marginal benefits and marginal costs to adjust w and b when election results are exogenous to w and b. In the absence of reelection incentives, the incumbent minimizes spending on employee compensation on behalf of voting taxpayers by offering wages and benefits that perfectly smooth the employee's consumption over the two periods.

---

[89] This is trivially obtained by solving for the w and b that maximizes U_v subject to 4.2.2

If the representative voter does not observe w or b before the election, then we see from 4.2.8 that the incumbent can use w to influence the signal of the incumbent's ability ($\hat{z} = z - w + \bar{w}$). In effect, the incumbent boosts his reputation by inflating output through paying a lower period 1 wage. To see this, let us denote $\Omega = E_1[w(\eta_I - \eta_C + x)]$, and express the partial derivative of Ω with respect to w via the following lemma (see A.1 in Appendix A for proof).

Lemma 1. *Let $\Phi(v; \mu, \sigma^2)$ denote the probability density function for a normally distributed random variable V with mean μ and variance σ^2. It follows that*

$$\frac{\partial \Omega}{\partial w} = -\rho\mu\phi(\mu(w - \bar{w}); m_1^\Delta, \frac{\mu}{h_{I1}})(x + \mu(w - \bar{w})) \tag{4.2.13}$$

where $m_1^\Delta \equiv m_{I1} - m_{C1}$ denotes the difference between the common prior beliefs of I's and C's abilities, and $\frac{\mu}{h_{I1}}$ is the variance of $m_{I2} - m_{C2}$ given the incumbent's information set at the beginning of period 1.

Eq. 4.2.13 presents an intuitive representation of the incumbent's reelection incentive. The first term ρ captures the fact that w affects I's election-time reputation only if the representative voter does not observe w before the election, in which case the decrease in election probability is $-\mu\phi(\mu(w - \bar{w}); m_1^\Delta, \frac{\mu}{h_{I1}})$ and unambiguously negative. The $x + \mu(w - \bar{w})$ component can be further decomposed into an ego rents term, x, which is unambiguously positive, and an "election distortion" component, $\mu(w - \bar{w})$, which is ambiguously signed. This distortion component may be negative or positive, depending on the relative difference between w and $\bar{w}$. For example, by lowering w when $w < \bar{w}$, the incumbent creates additional states of the world in which he wins the election even when he believes C to have a higher ability. Following the same logic, the incumbent can eliminate such suboptimal states by lowering w when $w > \bar{w}$.

In equilibrium, voters conjecture correctly about w, which implies that $w = \bar{w}$ and

$$\omega^* \equiv \frac{\partial \Omega}{\partial w}\bigg|_{w=\bar{w}} = -\rho\mu\phi(\mu(0; m_1^\Delta, \frac{\mu}{h_{I1}})x, \tag{4.2.14}$$

where ω^* represents the equilibrium "election manipulation incentive" term.

When voters form the correct conjecture about w, there is no election distortion and the only marginal effect on agent I's utility is through the unambiguously positive expected ego rents channel. If ρ is positive, then $\omega^* < 0$ and the incumbent agent faces an additional benefit from lowering w. In equilibrium, the incumbent does not gain any advantage, but still lowers w in order to "protect" his reputation.

From Eq. 4.2.14, it is immediately obvious that ω^* is decreasing in ρ, which captures the idea that greater opacity leads to stronger election manipulation incentives. Moreover, ω^* is increasing in m_1^Δ if $m_1^\Delta < 0$ and decreasing in m_1^Δ if $m_1^\Delta > 0$.[90] This captures the idea that the election

---

[90] This stems from the characteristics of the normal probability density function. The same results should hold for similar distributions in which median is the same as the mode and the probability density function is strictly increasing to the left of the median and strictly decreasing to the right of the median. I thank Masahiro Watanabe for pointing this out.

manipulation incentive is greater when the election is "closer" in the sense that the difference between the prior reputations of the incumbent and the challenger is small.

We obtain the following proposition (see A.2 in Appendix A for proof):

Proposition 1. *The equilibrium pension benefit, b^*, satisfies the following conditions:*

(a) *Ceteris paribus, b^* is increasing in ρ,*

(b) *If $\rho > 0$, then ceteris paribus b^* is decreasing in m_1^Δ for $m_1^\Delta > 0$ and increasing in m_1^Δ for $m_1^\Delta < 0$, and*

(c) *If $\rho = 0$, then ceteris paribus b^* is unaffected by m_1^Δ.*

Part (a) of Proposition 1 formalizes the idea that a greater degree of opacity leads to a stronger incentive for the incumbent agent to increase pension benefits during election year. Part (b) formalizes the idea that the incentive to manipulate voters through election year pension borrowing is higher when the election is closer to a "tipping point" between the incumbent winning and the challenger winning, while part (c) captures the idea that the manipulation incentive exists only if the pension system is not fully transparent.

The general intuition behind Proposition 1 is that the incumbent wants to realize additional short term wage savings by providing higher pension benefits in order to inflate the signal of his period 1 performance. In the real world, short term wage savings constitute one of several potential channels motivating incumbent politicians to grant higher pension benefit. For example, the incumbent may wish to increase benefits to win direct political support from public sector labour unions. I focus on only the wage savings channel for the sake of model parsimony.

4.3. Reelection Incentives and Pension Contributions

We now consider the case in which unfunded benefits are not wholly guaranteed to employees, but the incumbent agent can make contributions into the public pension fund in period 1. To shift the attention to contribution policy rather than benefits policy, we assume b has been set and cannot be changed by the incumbent at the beginning of period 1. This assumption is justified by the relative inflexibility of pension benefit policy, which is explained in detail in Chapter 3.

4.3.1. Setup

The basic framework of remains the same as in Section 4.2. Voter utility is $U_v = g_1 + g_2$ and the incumbent agent's utility is $U_I = U_v + \theta x$. There are two periods and an election occurs in period 1. However, we modify the public goods output in the two periods to be

$$g_1 \equiv \eta_I - w - k + \epsilon_1 \tag{4.3.1}$$

$$g_2 \equiv \theta \eta_I + (1-\theta)\eta_C - \pi(b-k) + \epsilon_2, \tag{4.3.2}$$

where k denotes the pension contribution in period 1, π denotes the portion of the unfunded pension liability (i.e. $b - k$) that is paid out of g_2 to the employee in period 2, and the remaining variables are defined as before.

Due to the imperfect guarantee on the unfunded portion of the pension benefit, the worker's participation constraint is now

$$u(w) + u(k + \pi(b - k)) \geq \bar{u} \tag{4.3.3}$$

where $k + \pi(b - k)$ reflects that fact that the employee is paid the entirety of the funded contribution k plus a portion π of the unfunded benefit.[91]

Note we allow for the possibility that $b < k$, in which case the fund is overfunded and the employee receives a payment greater than b in the second period. This can be interpreted as pension beneficiaries "skimming" the surplus of overfunded public pension plan funds though benefit increases. We also allow for the possibility for $k < 0$, which is difficult to interpret. We may insert an additional constraint that $k \geq 0$, but the case of when this constraint binds is not economically interesting, so for the sake of simplicity we assume the equilibrium is characterized by an interior solution at which $k > 0$.

The timeline of the model again proceeds as illustrated in 4.1. The incumbent agent chooses w and k at the beginning of period 1. This is followed by the realization of g_1 and then an election between the incumbent and the challenger. The representative voter first observes w and k before the election with probability $1 - \rho$, and first observes w and k after the election with probability ρ.

4.3.2. Inference

The incumbent's ability and the random shock terms follow the same distributions as in Section 4.2, which means that the representative voter's inference of η_I is characterized by Eq. 4.2.6 if she first observes ρ prior to the election—i.e. $m_{I2} = (1 - \mu)m_{I1} + \mu z$ where $z = \eta_I + \epsilon_1$. However, if she first observes ρ after the election, then her inference of η_I is characterized by

$$\hat{m}_{I2} = (1 - \mu)m_{I1} + \mu\hat{z} = m_{I2} + \mu(\bar{w} - w + \bar{k} - k), \tag{4.3.4}$$

where $\bar{w}$ represent the representative voter's conjecture about w, $\bar{k}$ represent the representative voter's conjecture about k, and $\hat{z} \equiv g_1 + \bar{w} = z - w + \bar{w} + \bar{k} - k$ denotes the period 1 signal of the incumbent's ability conditional on observing g_1 but not w or k.

Eq. 4.3.4 indicates that the incumbent can manipulate w and k in order to inflate his reputation in the eyes of uninformed voters. As before, the precision of the representative voter's posteriors about the incumbent's ability evolves deterministically, and there is no learning about the challenger's ability.

---

[91] An alternative formulation is to make the benefit payment be b with probability π and k with probability $1 - \pi$. However, this introduces addition complications relating to employee risk aversion, which we abstract away from by making the benefit payment deterministic.

4.3.3. Equilibrium

As in Section 4.2, the representative voter understands that she cannot affect g_1, w, or k with her election choice and therefore makes her decision based on 4.2.10 if she first observes w and k before the election, and based on 4.2.11 if she first observes w and k after the election.

The incumbent agent anticipates the representative voter's decision rule and optimizes according to

$$\max_{k,w} \quad E_1[\eta_I - w - k + \epsilon_1 + \eta_C + \theta(\eta_I - \eta_C + x) - \pi(b - k) + \epsilon_2]$$

$$\text{subject to} \quad u(w) + u(k + \pi(b - k)) \geq \bar{u},$$

(4.3.5)

to determine his choices for w and k at the beginning of period 1.

Again, let $\Omega = E_1[w(\eta_I - \eta_C + x)]$ represent the incumbent's marginal utility bonus from winning the election. We can show that changing w and changing k have the same marginal effect on Ω, as stated in the following lemma (see A.3 in Appendix A for proof):

Lemma 2. *Let* $\Phi(v; \mu, \sigma^2)$ *denote the probability density function for a normally distributed random variable V with mean μ and variance σ^2. It follows that*

$$\frac{\partial \Omega}{\partial w} = \frac{\partial \Omega}{\partial k} = -\rho\mu\phi(\mu(w - \bar{w} + k - \bar{k}); m_1^\Delta, \frac{\mu}{h_{I1}})(x + \mu(w - \bar{w} + k - \bar{k}))$$

(4.3.6)

where $m_1^\Delta \equiv m_{I1} - m_{C1}$ denotes the difference between the prior beliefs of I's and C's abilities, and $\frac{\mu}{h_{I1}}$ is the variance of $m_{I2} - m_{C2}$ given the incumbent's information set at the beginning of period 1.

In equilibrium, voters correctly conjecture that $w = \bar{w}$ and $k = \bar{k}$, and so we can express the equilibrium election manipulation incentive ω^* as

$$\omega^* \equiv \frac{\partial \Omega}{\partial w}\bigg|_{w=\bar{w}, k=\bar{k}} = \frac{\partial \Omega}{\partial k}\bigg|_{w=\bar{w}, k=\bar{k}} = -\rho\mu\phi(\mu(0; m_1^\Delta, \frac{\mu}{h_{I1}})x.$$

(4.3.7)

As was the case in Section 4.2, the equilibrium election incentive ω^* is nonpositive, and is strictly negative if $\rho > 0$. This leads to the following proposition (see A.4 in Appendix A for proof).

Proposition 2. *The equilibrium pension contribution, k^*, satisfies the following conditions:*

(a) *If $\pi > 0$ then ceteris paribus k^* is decreasing in ρ,*

(b) *If $\pi > 0$ and $\rho > 0$, then ceteris paribus k^* is increasing in m_1^Δ for $m_1^\Delta > 0$ and decreasing in m_1^Δ for $m_1^\Delta < 0$, and*

(c) *If $\pi = 0$, then ceteris paribus k^* is not affected by ρ nor m_1^Δ.*

Proposition 2 closely parallels Proposition 1 from the previous section. Specifically, election year manipulation incentives are increasing in the degree of opacity and in the closeness of the election. However, Proposition 2 also illustrates that the incentive to reduce k depends on a nonzero portion

of the pension benefit b being guaranteed. Intuitively, if $\pi = 0$, then any reduction in k is perfectly offset by the worker demanding a higher w in period 1, which leaves the incumbent's reputation unchanged in the eyes of the uninformed voter.

The intuition underlying Proposition 2 mirrors the intuition underlying Proposition 1. The incumbent prefers to redirect pension contributions into increasing pre-election public goods output, but lowering contributions is immediately offset by the employing making higher wage demands in response. The more insulated the employee is against losses from unfunded benefits, the less the offsetting wage demands, and the greater the incentive to cut back on contributions.

Just as in the previous section, we use employee wages as a parsimonious modelling mechanism, but alternative mechanisms are possible For example, rather than demanding higher wages from underfunded pension plans, the incumbent may exert direct political pressure on the incumbent. Regardless of the mechanism, higher benefit protection in essence create a moral hazard for employees to abstain from disciplining the incumbent from cutting back on contributions.

4.4. Empirical Implications

The model delivers the insight that when pension plan policies are not fully transparent to voters, incumbent politicians have the incentive to borrow at a higher-than-optimal rate from public pension plans through increasing benefits or lowering contributions. This means that state DB pension deficits should be higher in election years relative to non-election years.

While the stylized model only includes one period before the election, it is easy to extrapolate backwards to show that the incentive to manipulate election results would not extend backwards if one were to include additional periods prior to the election period. This is due to the assumption that any potential information asymmetry between the incumbent and voters is resolved by the end of the period. Therefore, any opportunistic borrowing conducted through the pension plan during non-election years would be revealed by the time that the election occurs. This assumption is motivated by the one year gap between when pension benefit and contributions policies are set and when their impact on pension funding levels are disclosed to the public, which is explained in Section 3.2 from Chapter 3. An electoral year spike in pension deficits can also result if voters put more weight on the most recent performance during election time. This may arise from an irrational recency bias on the part of voters, or if voters are rational and understand that the most recent performance is more predictive of future performance.[92]

On the other hand, one can also imagine the existence of a gradual electoral cycle pattern in which the political incentive to manipulate pension deficits increases as election time nears. In the context of the model, such gradual cycles can arise if the probability that the representative voter discovers the actions taken by the incumbent is increasing in the amount of time between the

---

[92] For example, Persson and Tabellini (2002), Alt and Lassen (2006), and Shi and Svensson (2006) present models of electoral cycles in budget deficits based on the assumption that the politician's innate ability follows an MA(1) process. This means that only election-year activities are informative about the incumbent future performance, and voters rationally discard pre-election performance.

incumbent's action and the next election. However, in empirical results presented in Chapter 3, I find that there is a sharp election year decrease in pension contributions.

While Proposition 1 predicts an election year increase in pension benefits and Proposition 2 predicts an election year decrease in pension contribution, I find empirical evidence for the latter but not the former in results presented in Chapter 3. As discussed in Section 3.2 of Chapter 3, this is consistent with the institutional realities of the public pension system, in which the Governor has significant discretion to change contribution policy but not benefit policy on a yearly basis.

Proposition 1(a) and Proposition 1(b) also imply that election year spikes in pension deficits should be larger for state DB pension plans that are more opaque relative to state DB pension plans that are more transparent, following the insight that information asymmetry is a necessary ingredient in creating distortionary incentives. Indeed, empirical findings presented in Section 3.5 from Chapter 3 indicate electoral cycles are more pronounced for states with public pension systems that are more opaque, using empirical proxies for the opacity of state pension systems.

Next, Proposition 2(c) implies that the incentive to raise election year pension borrowing depends on employees enjoying a certain degree of protection over their benefits. The intuition is that contribution cutbacks are self-defeating as a means to reduce pre-election expenditures if they are offset by employees demanding higher wages in exchange for future losses from unfunded benefits. The empirical findings from Section 3.5 from Chapter 3 support this interpretation, as election year reductions in pension contributions are signficantly more pronounced in states that provide stronger legal protection over public pension benefits.
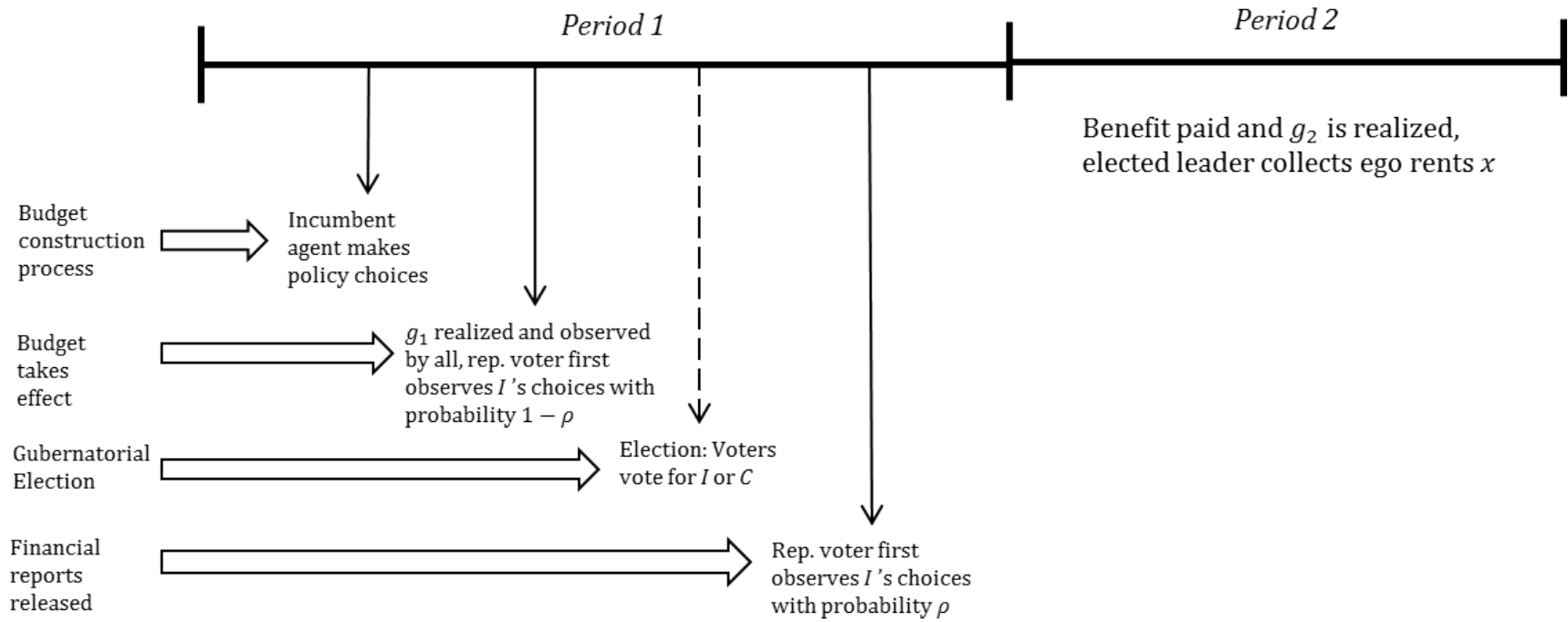
Lastly, Proposition 1(b) and Proposition 2(b) imply that election year spikes in pension deficits are larger for elections that are more closely contested, based on the idea that there is a greater incentive to manipulate elections that are close to a "tipping point" than in manipulating elections in which one candidate has a large lead and the election result is a foregone conclusion. This prediction receives robust empirical support from evidence presented in Section 3.5 from Chapter 3.

4.5. Conclusion

In this essay, I construct a stylized model to explain how reelection incentives distort policymakers' decisions over policies relating to public sector defined benefit plans. The model shows that, when voters are imperfectly informed about public policy, incumbent politicians can realize short-term savings by promising higher defined benefits to public sector employees or by cutting back on public pension contributions. In equilibrium, voters are not fooled by these actions, but the incumbent still has the incentive to follow through in order to protect his reputation.

The model generates several predictions of electoral cycles in public pension policies. In particular, one should expect benefits to spike and contributions to dip right before an election, and these effects should be larger for states with more opaque pension systems, stronger legal protection over pension benefits, and for elections that are more closely contested. These predictions are supported by the empirical findings presented in the essay from Chapter 3.

Figure 4.1: Model Timeline

Period 1

Period 2

Benefit paid and g_2 is realized,
elected leader collects ego rents x

Budget
construction
process

Incumbent
agent makes
policy choices

Budget
takes
effect

g_1 realized and observed
by all, rep. voter first
observes I's choices with
probability $1 - \rho$

Gubernatorial
Election

Election: Voters
vote for I or C

Financial
reports
released

Rep. voter first
observes I's choices
with probability ρ

Chapter 5

Conclusion

In this thesis, I present three essays on the interrelated topics of finance, labour, and political economy. Chapter 2 forms the first essay, in which I examine how regulatory constraints on firms' abilities to hire skilled workers can inhibit corporate investment. To this end, I exploit a 2003 reduction in the annual quota for H-1B visas, which are used by domestic firms in the U.S. to hire skilled foreign workers on a temporary basis. I find that the quota reduction resulted in relative decreases in capital expenditures for firms that were ex-ante more reliant on H-1B workers, and that this effect persisted for several years and was more pronounced for firms hiring workers in traditional industrial occupations, such as scientists and engineering. My findings suggest that human capital constraints, much like financial capital constraints, can hinder corporate investment.

The findings presented in Chapter 2 lay fertile groundwork for future research on related topics. One potential avenue would be to investigate whether the rents generated by barriers to hiring skilled workers are captured by firms or by domestic workers—i.e. whether more restrictive policies result in higher wages for domestic workers or whether the increased scarcity of foreign workers raises the values of existing workers and subsequently captured by the firm. Answering such questions will help clarify the welfare implications of labour market restrictions, as well as improve our understanding of the political economy surrounding immigration policy.

Chapter 3 forms the second essay, in which I document an electoral cycle in how states fund their public sector defined benefit pension plans. Specifically, systematic election year cuts to government contributions result in election year increases in the rate at which the government effectively borrows through public pension plans, and this pattern is more pronounced for states with less transparent public pension systems, for states that provide stronger benefit protection, and for elections that are more closely contested. These findings indicate that incumbent Governors have the incentive to undertake "hidden borrowing" in an attempt to inflate performance and secure reelection when the pension system is opaque and when employees bear the consequences of unfunded liabilities.

Chapter 4 forms the final essay, in which I present a theoretical model to rationalize the empirical findings from Chapter 3. The model illuminates an agency conflict between the incumbent politician and taxpayer, in which the incumbent borrows on behalf of taxpayers through the public pension system at a higher rate than taxpayers would choose if they could directly choose for themselves. The underlying friction driving this conflict is information asymmetry relating to the inability for voters to perfectly observe the incumbent's pension policy, which allows the incumbent to attempt to inflate his performance through higher benefits or lower contributions, although in equilibrium voters see through these actions.

Chapters 3 and 4 combine to illustrate how opaque borrowing channels provided by public entities like state DB pension plans are vulnerable to opportunistic actions taken by incumbent politicians. However, more work is needed to improve our understanding of the welfare implications of public pension policy manipulations. For example, meddling with public employees' pension benefits may have consequences for workers' labour supply decisions. There is also the difficult questions of whether large unfunded pension liabilities can act as a form of public debt overhang that reduces economic growth. Answering these questions presents a research agenda left for future work.

Bibliography

Agrawal, Ashwini K, and David A Matsa, 2013, Labor unemployment risk and corporate financing decisions, *Journal of Financial Economics* 108, 449–470.

Alesina, Alberto, and Nouriel Roubini, 1992, Political cycles in OECD economies, *The Review of Economic Studies* 59, 663–688.

Alesina, Alberto, Nouriel Roubini, and Gerald D Cohen, 1997, *Political cycles and the macroeconomy* (MIT press).

Almeida, Heitor, Murillo Campello, Bruno Laranjeira, Scott Weisbenner, et al., 2012, Corporate Debt Maturity and the Real Effects of the 2007 Credit Crisis, *Critical Finance Review* 1, 3–58.

Almeida, Heitor, Murillo Campello, and Michael S Weisbach, 2004, The cash flow sensitivity of cash, *The Journal of Finance* 59, 1777–1804.

Alt, James, Ethan Bueno De Mesquita, and Shanna Rose, 2011, Disentangling accountability and competence in elections: evidence from US term limits, *The Journal of Politics* 73, 171–186.

Alt, James E, and David Dreyer Lassen, 2006, Fiscal transparency, political parties, and debt in OECD countries, *European Economic Review* 50, 1403–1439.

Ansolabehere, Stephen, and James M Snyder Jr, 2002, The incumbency advantage in US elections: an analysis of state and federal offices, 1942–2000, *Election Law Journal* 1, 315–338.

Ashraf, Rasha, and Rina Ray, 2016, Human Capital, Skilled Immigrants, and Innovation, Working Paper. Available at SSRN: https://ssrn.com/abstract=2849089 or http://dx.doi.org/10.2139/ssrn.2849089.

Atanassov, Julian, and E Kim, 2009, Labor and corporate governance: International evidence from restructuring decisions, *The Journal of Finance* 64, 341–374.

Autor, David H, 2003, Outsourcing at will: The contribution of unjust dismissal doctrine to the growth of employment outsourcing, *Journal of Labor Economics* 21, 1–42.

Bader, Lawrence N, and Jeremy Gold, 2007, The case against stock in public pension funds, *Financial Analysts Journal* 63, 55–62.

Baker, Malcolm, Jeremy C Stein, and Jeffrey Wurgler, 2003, When does the market matter? Stock prices and the investment of equity-dependent firms, *The Quarterly Journal of Economics* 118, 969–1005.

Bebchuk, Lucian Arye, and Lars A Stole, 1993, Do Short-Term Objectives Lead to Under-or Over-investment in Long-Term Projects?, *The Journal of Finance* 48, 719–729.

Becker, Gary S, 1983, A theory of competition among pressure groups for political influence, *The Quarterly Journal of Economics* 98, 371–400.

Benmelech, Efraim, Nittai K Bergman, and Amit Seru, 2011, Financing Labor, NBER Working Paper No. 17144.

Bergstresser, Daniel, Mihir Desai, and Joshua Rauh, 2006, Earnings manipulation, pension assumptions, and managerial investment decisions, *The Quarterly Journal of Economics* 121, 157–195.

Bertrand, Marianne, Esther Duflo, Sendhil Mullainathan, et al., 2004, How Much Should We Trust Differences-In-Differences Estimates?, *The Quarterly Journal of Economics* 119, 249–275.

Bertrand, Marianne, Francis Kramarz, Antoinette Schoar, and David Thesmar, 2007, Politicians, Firms and the Political Business Cycle: Evidence from France, Unpublished Working Paper, University of Chicago.

Besley, Timothy, and Anne Case, 1995, Does Electoral Accountability Affect Economic Policy Choices? Evidence from Gubernatorial Term Limits, *The Quarterly Journal of Economics* 110, 769–98.

Bloom, Nicholas, and John Van Reenen, 2007, Measuring and Explaining Management Practices Across Firms and Countries, *The Quarterly Journal of Economics* 122, 1351–1408.

Bloom, Nick, Stephen Bond, and John Van Reenen, 2006, Uncertainty and investment dynamics, *The Review of Economic Studies* 74, 394–415.

Borjas, George J, 2001, Does immigration grease the wheels of the labor market?, *Brookings Papers on Economic Activity* 2001, 69–133.

Brender, Adi, and Allan Drazen, 2008, How do budget deficits and economic growth affect reelection prospects? Evidence from a large panel of countries, *The American Economic Review* 98, 2203–2220.

Brinkman, Jeffrey, Daniele Coen-Pirani, and Holger Sieg, 2016, The Political Economy of Under-funded Municipal Pension Plans, NBER Working Paper No. 22321.

Brown, Craig O, and I Serdar Dinc, 2005, The politics of bank failures: Evidence from emerging markets, *The Quarterly Journal of Economics* 120, 1413–1444.

Brown, Jeffrey R, and David W Wilcox, 2009, Discounting state and local pension liabilities, *The American Economic Review* 99, 538–542.

Cameron, A Colin, and Douglas L Miller, 2015, A practitioner's guide to cluster-robust inference, *Journal of Human Resources* 50, 317–372.

Card, David, 1992, Using regional variation in wages to measure the effects of the federal minimum wage, *ILR Review* 46, 22–37.

Carlson, Murray, Adlai Fisher, and Ron Giammarino, 2004, Corporate investment and asset price dynamics: implications for the cross-section of returns, *The Journal of Finance* 59, 2577–2603.

Chaney, Barbara A, Paul A Copley, and Mary S Stone, 2003, The effect of fiscal stress and balanced budget requirements on the funding and measurement of state pension obligations, *Journal of Accounting and Public Policy* 21, 287–313.

Chen, Huafeng Jason, Marcin Kacperczyk, and Hernan Ortiz-Molina, 2011, Labor unions, operating flexibility, and the cost of equity, *Journal of Financial and Quantitative Analysis* 46, 25–58.

Coate, Stephen, and Stephen Morris, 1995, On the Form of Transfers to Special Interests, *The Journal of Political Economy* 103, 1210–1235.

Cole, Shawn, 2009, Fixing market failures or fixing elections? Agricultural credit in India, *American Economic Journal: Applied Economics* 1, 219–250.

Correia, Sergio, 2015, Singletons, cluster-robust standard errors and fixed effects: A bad mix, Unpublished paper.

Cunha, Igor, Miguel A Ferreira, and Rui Silva, 2016, Can Credit Rating Agencies Affect Election Outcomes?, Working paper. Available at SSRN: https://ssrn.com/abstract=2748458 or http://dx.doi.org/10.2139/ssrn.2748458.

DiNardo, John E, and Jorn-Steffen Pischke, 1997, The Returns to Computer Use Revisited: Have Pencils Changed the Wage Structure Too?, *The Quarterly Journal of Economics* 112, 291–303.

Doran, Kirk, Alexander Gelber, and Adam Isen, 2014, The Effects of High-Skilled Immigration Policy on Firms: Evidence from H-1B Visa Lotteries, NBER Working Paper No. 20668.

Duchin, Ran, Oguzhan Ozbas, and Berk A Sensoy, 2010, Costly external finance, corporate investment, and the subprime mortgage credit crisis, *Journal of Financial Economics* 97, 418–435.

Edmans, Alex, 2009, Blockholder trading, market efficiency, and managerial myopia, *The Journal of Finance* 64, 2481–2513.

Eisfeldt, Andrea L, and Dimitris Papanikolaou, 2013, Organization Capital and the Cross-Section of Expected Returns, *The Journal of Finance* 68, 1365–1406.

Elder, Erick M, Gary A Wagner, et al., 2015, Political Effects on Pension Underfunding, *Economics and Politics* 27, 1–27.

Epple, Dennis, and Katherine Schipper, 1981, Municipal pension funding: A theory and some evidence, *Public Choice* 37, 141–178.

Fazzari, Steven M, R Glenn Hubbard, and Bruce C Petersen, 1988, Financing Constraints and Corporate Investment, *Brookings Papers on Economic Activity* 1988, 141–206.

Fos, Vyacheslav, Kai Li, and Margarita Tsoutsoura, 2016, Do Director Elections Matter?, Chicago Booth Research Paper No. 17-08. Available at SSRN: https://ssrn.com/abstract=2609815 or http://dx.doi.org/10.2139/ssrn.2609815.

Foucault, Thierry, and Laurent Fresard, 2014, Learning from peers' stock prices and corporate investment, *Journal of Financial Economics* 111, 554–577.

Ghosh, Anirban, Anna Maria Mayda, and Francesc Ortega, 2014, The impact of skilled foreign workers on firms: an investigation of publicly traded US firms, IZA Discussion Paper No. 8684. Available at SSRN: https://ssrn.com/abstract=2534712.

Giertz, J Fred, and Leslie E Papke, 2007, Public Pension Plans: Myths and Realities for State Budgets, *National Tax Journal* 60, 305–23.

Giroud, Xavier, 2013, Proximity and Investment: Evidence from Plant-Level Data, *The Quarterly Journal of Economics* 128, 861–915.

Glaeser, Edward L, and Giacomo AM Ponzetto, 2014, Shrouded costs of government: the political economy of state and local public pensions, *Journal of Public Economics* 116, 89–105.

Goldin, Claudia, and Lawrence F Katz, 1998, The origins of technology-skill complementarity, *The Quarterly Journal of Economics* 113, 693–732.

Griliches, Zvi, 1969, Capital-Skill Complementarity, *The Review of Economics and Statistics* 51, 465–68.

Gulen, Huseyin, and Mihai Ion, 2015, Policy uncertainty and corporate investment, *The Review of Financial Studies* 29, 523–564.

Harris, Milton, and Artur Raviv, 2005, Allocation of decision-making authority, *Review of Finance* 9, 353–383.

Haselmann, Rainer, Thomas Kick, Markus Behn, and Vikrant Vig, 2015, The Political Economy of Bank Bailouts, IMFS Working Paper Series 86.

Holmström, Bengt, 1999, Managerial incentive problems: A dynamic perspective, *The Review of Economic Studies* 66, 169–182.

Inman, Robert P, 1982, Public employee pensions and the local labor budget, *Journal of Public Economics* 19, 49–71.

Julio, Brandon, and Youngsuk Yook, 2012, Political uncertainty and corporate investment cycles, *The Journal of Finance* 67, 45–83.

Kahle, Kathleen M, and Ralph A Walkling, 1996, The impact of industry classifications on financial research, *Journal of Financial and Quantitative Analysis* 31, 309–335.

Kaplan, Steven N, and Luigi Zingales, 1997, Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints?, *The Quarterly Journal of Economics* 112, 169–215.

Kato, Takao, and Chad Sparber, 2013, Quotas and quality: The effect of H-1B visa restrictions on the pool of prospective undergraduate students from abroad, *Review of Economics and Statistics* 95, 109–126.

Kelley, Dashle G, 2014, The political economy of unfunded public pension liabilities, *Public Choice* 158, 21–38.

Kerr, Sari Pekkala, William R Kerr, and William F Lincoln, 2015a, Firms and the Economics of Skilled Immigration, *Innovation Policy and the Economy* 15, 115–152.

Kerr, Sari Pekkala, William R Kerr, and William F Lincoln, 2015b, Skilled immigration and the employment structures of US firms, *Journal of Labor Economics* 33, S147–S186.

Kerr, William R, and William F Lincoln, 2010, The supply side of innovation: H-1B visa reforms and US ethnic invention, *Journal of Labor Economics* 28, 473–508.

Kerr, William R, William F Lincoln, and Prachi Mishra, 2014, The dynamics of firm lobbying, *American Economic Journal: Economic Policy* 6, 343–379.

Kido, Nolan, Reining Petacchi, and Joseph Weber, 2012, The influence of elections on the accounting choices of governmental entities, *Journal of Accounting Research* 50, 443–476.

Lemmon, Michael, and Michael R Roberts, 2010, The Response of Corporate Financing and Investment to Changes in the Supply of Credit, *Journal of Financial and Quantitative Analysis* 45, 555–587.

Levitt, Steven D, et al., 1997, Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime, *American Economic Review* 87, 270–90.

Lewis, Ethan, 2011, Immigration, skill mix, and capital skill complementarity, *The Quarterly Journal of Economics* 126, 1029–1069.

Lewis, Ethan, Giovanni Peri, et al., 2015, Immigration and the Economy of Cities and Regions, *Handbook of Regional and Urban Economics* 5, 625–685.

Liu, Wai-Man, and Phong TH Ngo, 2014, Elections, political competition and bank failure, *Journal of Financial Economics* 112, 251–268.

Lofstrom, Magnus, and Joseph J Hayes, 2011, H-1Bs: How Do They Stack Up to US Born Workers?, IZA Discussion Paper No. 6259. Available at SSRN: https://ssrn.com/abstract=1981215.

Malmendier, Ulrike, and Geoffrey Tate, 2005, CEO overconfidence and corporate investment, *The Journal of Finance* 60, 2661–2700.

Martin, RL, and MC Moldoveanu, 2003, Capital versus talent. The battle that's reshaping business., *Harvard Business Review* 81, 36–41.

Matsa, David A, 2010, Capital structure as a strategic variable: Evidence from collective bargaining, *The Journal of Finance* 65, 1197–1232.

Meulbroek, Lisa K, Mark L Mitchell, J Harold Mulherin, Jeffry M Netter, and Annette B Poulsen, 1990, Shark repellents and managerial myopia: An empirical test, *Journal of Political Economy* 98, 1108–1117.

Mian, Atif, and Amir Sufi, 2014, What Explains the 2007–2009 Drop in Employment?, *Econometrica* 82, 2197–2223.

Mitchell, Olivia S, and Robert S Smith, 1994, Pension Funding in the Public Sector, *The Review of Economics and Statistics* 76, 278–290.

Molloy, Raven, Christopher L Smith, and Abigail Wozniak, 2014, Declining Migration within the US: the Role of the Labor Market, NBER Working Paper No. 20065.

Munnell, Alicia H, Jean-Pierre Aubry, Josh Hurwitz, and Laura Quinby, 2011a, Comparing compensation: State-local versus private sector workers, *Center for Retirement Research Issue in Brief* 20.

Munnell, Alicia H, Jean-Pierre Aubry, and Laura Quinby, 2011b, Public pension funding in practice, *Journal of Pension Economics and Finance* 10, 247–268.

Munnell, Alicia H, and Laura Quinby, 2012, Legal constraints on changes in state and local Pensions, *Center for Retirement Research Issue in Brief* 25.

Nagarajan, Nandu J, K Sivaramakrishnan, and Sri S Sridhar, 1995, Managerial entrenchment, reputation and corporate investment myopia, *Journal of Accounting, Auditing & Finance* 10, 565–585.

Narayanan, MP, 1985, Managerial incentives for short-term results, *The Journal of Finance* 40, 1469–1484.

Nordhaus, William D, 1975, The Political Business Cycle, *The Review of Economic Studies* 42, 169–190.

Nordhaus, William D, 2002, Productivity growth and the new economy, *Brookings Papers on Economic Activity* 211–267.

Novy-Marx, Robert, and Joshua Rauh, 2011, Public pension promises: how big are they and what are they worth?, *The Journal of Finance* 66, 1211–1249.

Novy-Marx, Robert, and Joshua Rauh, 2014, The revenue demands of public employee pension promises, *American Economic Journal: Economic Policy* 6, 193–229.

Panousi, Vasia, and Dimitris Papanikolaou, 2012, Investment, idiosyncratic risk, and ownership, *The Journal of Finance* 67, 1113–1148.

Peltzman, Sam, 1992, Voters as fiscal conservatives, *The Quarterly Journal of Economics* 107, 327–361.

Peri, Giovanni, Kevin Yang Shih, and Chad Sparber, 2014, Foreign Stem Workers and Native Wages and Employment in US Cities, NBER Working Paper No. 20093.

Pérignon, Christophe, and Boris Vallée, 2017, The political economy of financial innovation: evidence from local governments, *The Review of Financial Studies* 30, 1903–1934.

Persson, Torsten, and Guido Enrico Tabellini, 2002, *Political economics: explaining economic policy* (MIT press).

Poterba, James M, 1994, State Responses to Fiscal Crises: The Effects of Budgetary Institutions and Politics, *Journal of Political Economy* 799–821.

Rauh, Joshua D, 2006, Investment and financing constraints: Evidence from the funding of corporate pension plans, *The Journal of Finance* 61, 33–71.

Rauh, Joshua D, et al., 2010, Are State Public Pensions Sustainable? Why The Federal Government Should Worry About State Pension Liabilities, *National Tax Journal* 63, 585–601.

Reynolds, C Lockwood, 2014, State politics, tuition, and the dynamics of a political budget cycle, *Empirical Economics* 46, 1241–1270.

Rogoff, Kenneth, 1990, Equilibrium Political Budget Cycles, *American Economic Review* 80, 21–36.

Rogoff, Kenneth, and Carmen Reinhart, 2010, Growth in a Time of Debt, *American Economic Review* 100, 573–8.

Rogoff, Kenneth, and Anne Sibert, 1988, Elections and macroeconomic policy cycles, *The Review of Economic Studies* 55, 1–16.

Rose, Shanna, 2006, Do fiscal rules dampen the political business cycle?, *Public choice* 128, 407–431.

Shi, Min, and Jakob Svensson, 2006, Political budget cycles: Do they differ across countries and why?, *Journal of Public Economics* 90, 1367–1389.

Simintzi, E, V Vig, and P Volpin, 2015, Labor Protection and Leverage, *The Review of Financial Studies* 28, 561–591.

Splinter, David, 2015, State pension contributions and fiscal stress, *Journal of Pension Economics and Finance* 16, 65–80.

Stefanescu, Irina, Kangzhen Xie, and Jun Yang, 2015, Pay me now (and later): bonus boosts before pension freezes and executive departures, Kelley School of Business Research Paper No. 15-5. Available at SSRN: https://ssrn.com/abstract=2533459 or http://dx.doi.org/10.2139/ssrn.2533459.

Stein, Jeremy C, 1988, Takeover threats and managerial myopia, *Journal of Political Economy* 96, 61–80.

Stein, Jeremy C, 1989, Efficient capital markets, inefficient firms: A model of myopic corporate behavior, *The Quarterly Journal of Economics* 104, 655–669.

Tirole, Jean, 1994, The Internal Organization of Government, *Oxford Economic Papers* 46, 1–29.

Wahal, Sunil, and John J McConnell, 2000, Do institutional investors exacerbate managerial myopia?, *Journal of Corporate Finance* 6, 307–329.

Zingales, Luigi, 2000, In search of new foundations, *The Journal of Finance* 55, 1623–1653.

Appendix A

Proofs

A.1. Proof of Lemma 1

Proof. In order to express the partial derivative of Ω with respect to w, it is useful to first re-frame the voter's election decision in terms of m_2^Δ, which we define as $m_2^\Delta = m_{I2} - m_{C2}$. Substituting 4.2.7 and 4.2.8 into 4.2.10 and 4.2.11, we obtain

$$\theta = \begin{cases} 1 & \text{if } m_2^\Delta \geq 0 \\ 0 & \text{if } otherwise, \end{cases} \tag{A.1.1}$$

if the representative voter observes d before the election and

$$\theta = \begin{cases} 1 & \text{if } m_2^\Delta \geq \mu(w - \bar{w}) \\ 0 & \text{if } otherwise, \end{cases} \tag{A.1.2}$$

if the representative voter does not observe w before the election.

At the beginning of period 1, m_2^Δ is a random variable that follows the distribution

$$m_2^\Delta | \Psi_1 \sim N(m_1^\Delta, \frac{\mu}{h_{I1}}), \tag{A.1.3}$$

where Ψ_1 denotes the incumbent's information set at the beginning of period 1, and we get $Var(m_2^\Delta | \Psi_1) = \frac{\mu}{h_{I1}}$ from the fact that

$$\begin{aligned} Var(m_2^\Delta | \Psi_1) &= Var((1-\mu)m_{I1} + \mu z - m_{C2} | \Psi_1) \\ &= \mu^2 Var(\eta_I + \epsilon_I) \\ &= \frac{\mu}{h_{I1}}. \end{aligned}$$

Therefore, we can express Ω as

$$\begin{aligned} \Omega &= E_1[\theta(\eta_I - \eta_C + x)] \\ &= E_1[\theta(m_{I2} - m_{C2} + x)] \\ &= E_1[\theta(m_2^\Delta + x)], \end{aligned}$$

where the second line follows from applying the law of iterated expectations, and the third line

follows the definition of m_2^Δ. Next, we use the definition of the expectation function as an integral, and apply A.1.1, A.1.2, and A.1.3 to obtain

$$\Omega = \rho \int\limits_{\mu(w-\bar{w})}^{\infty} (m_2^\Delta + x)\phi(m_2^\Delta; m_1^\Delta, \frac{\mu}{h_{I1}})dm_2^\Delta + (1-\rho)\int\limits_{0}^{\infty}(m_2^\Delta + x)\phi(m_2^\Delta; m_1^\Delta, \frac{\mu}{h_{I1}})dm_2^\Delta,$$

which follows from the fact that the representative voter's decision follows A.1.2 with probability ρ, and follows A.1.1 with probability $1-\rho$.

Differentiating both sides with respect to w and applying the fundamental theorem of calculus, we obtain the required result

$$\frac{\partial\Omega}{\partial w} = -\rho\mu\phi(\mu(w-\bar{w}); m_1^\Delta, \frac{\mu}{h_{I1}})(x + \mu(w-\bar{w})).$$

$\square$

A.2. Proof of Proposition 1

Proof. To solve the optimization problem according to 4.2.12, we take the first order necessary conditions of the Lagrangian

$$\mathcal{L} = E_1[\eta_I - w + \epsilon_1 + \eta_C + \theta(\eta_I - \eta_C + x) - b + \epsilon_2] + \lambda[u(w) + u(b) - \bar{u}],$$

to obtain

$$\omega^* + \lambda u'(w) = 1 \tag{A.2.1}$$

$$\lambda u'(b) = 1 \tag{A.2.2}$$

$$u(w) + u(b) = \bar{u} \tag{A.2.3}$$

$$\lambda > 0, \tag{A.2.4}$$

where $\omega^* \equiv \frac{\partial\Omega}{\partial w}\Big|_{w=\bar{w}}$ represents the equilibrium equilibrium election manipulation incentive.

It is immediately clear from A.2.1 and A.2.2 that $w = b$ under full transparency (i.e. when $\omega^* = 0$). To show how b varies with ρ, we differentiate both sides of A.2.1, A.2.2, and A.2.3 with respect to ρ to obtain

$$\frac{\partial\omega^*}{\partial\rho} + \frac{\partial\lambda}{\partial\rho}u'(w) + \lambda u''(w)\frac{\partial w}{\partial\rho} = 0 \tag{A.2.5}$$

$$\frac{\partial\lambda}{\partial\rho}u'(b) + \lambda u''(b)\frac{\partial b}{\partial\rho} = 0 \tag{A.2.6}$$

$$u''(w)\frac{\partial w}{\partial\rho} + u''(b)\frac{\partial b}{\partial\rho} = 0. \tag{A.2.7}$$

Solving for $\frac{\partial b}{\partial \rho}$, we obtain

$$\frac{\partial b}{\partial \rho} = \frac{u'(b)u'(w)}{\lambda(u''(b)u'(w)^2 + u''(w)u'(b)^2)} \frac{\partial \omega^*}{\partial \rho}.$$ (A.2.8)

Since $u'(\cdot) > 0$ and $u''(\cdot) < 0$, and $\lambda > 0$, it follows that $\frac{u'(b)u'(w)}{\lambda(u''(b)u'(w)^2 + u''(w)u'(b)^2)}$ is negative, which implies that $\frac{\partial b}{\partial \rho}$ has the opposite sign as $\frac{\partial \omega^*}{\partial \rho}$. But we know from 4.2.14 that $\frac{\partial \omega^*}{\partial \rho} < 0$, which means that $\frac{\partial b}{\partial \rho} > 0$. This completes the proof for part (a) of the Proposition.

Following a similar path, we differentiate both sides of A.2.1, A.2.2, and A.2.3 with respect to m_1^Δ and solve for $\frac{\partial b}{\partial m_1^\Delta}$, we obtain

$$\frac{\partial b}{\partial m_1^\Delta} = \frac{u'(b)u'(w)}{\lambda(u''(b)u'(w)^2 + u''(w)u'(b)^2)} \frac{\partial \omega^*}{\partial m_1^\Delta}.$$ (A.2.9)

Since we have already established $\frac{u'(b)u'(w)}{\lambda(u''(b)u'(w)^2 + u''(w)u'(b)^2)}$ is negative, A.2.9 implies that $\frac{\partial b}{\partial m_1^\Delta}$ has the opposite sign as $\frac{\partial \omega^*}{\partial m_1^\Delta}$. Using the definition of ω^* from 4.2.14 and by the properties of the normal distribution function, it follows that

$$\frac{\partial \omega^*}{\partial m_1^\Delta} \begin{cases} > 0 & \text{if } m_1^\Delta > 0 \\ < 0 & \text{if } m_1^\Delta < 0 \\ = 0 & \text{if } m_1^\Delta = 0, \end{cases}$$

which means that

$$\frac{\partial b}{\partial m_1^\Delta} \begin{cases} < 0 & \text{if } m_1^\Delta > 0 \\ > 0 & \text{if } m_1^\Delta < 0 \\ = 0 & \text{if } m_1^\Delta = 0, \end{cases}$$

which completes the proof for part (b) and (c) of the Proposition.

□

A.3. Proof of Lemma 2

Proof. Following the same logic as the first part of the proof from A.1, we can express Ω as follows:

$$\Omega = \rho \int_{\mu(w-\bar{w}+k-\bar{k})}^{\infty} (m_2^\Delta + x)\phi(m_2^\Delta; m_1^\Delta, \frac{\mu}{h_{I1}})dm_2^\Delta + (1-\rho) \int_0^{\infty} (m_2^\Delta + x)\phi(m_2^\Delta; m_1^\Delta, \frac{\mu}{h_{I1}})dm_2^\Delta$$

which we apply the fundamental theorem of calculus to differentiate with respect to w and k,

respectively, to obtain the required results

$$\frac{\partial \Omega}{\partial w} = -\rho \mu \phi(\mu(w - \bar{w} + k - \bar{k}); m_1^\Delta, \frac{\mu}{h_{I1}})(x + \mu(w - \bar{w} + k - \bar{k})),$$

and

$$\frac{\partial \Omega}{\partial k} = -\rho \mu \phi(\mu(w - \bar{w} + k - \bar{k}); m_1^\Delta, \frac{\mu}{h_{I1}})(x + \mu(w - \bar{w} + k - \bar{k})).$$

$\square$

A.4. Proof of Proposition 2

Proof. The Lagrangian associated with the optimization problem according to 4.3.5 is

$$\mathcal{L} = E_1[\eta_I - w - k + \epsilon_1 + \eta_C + \theta(\eta_I - \eta_C + x) - \pi(b - k) + \epsilon_2] + \lambda[u(w) + u(k + \pi(b - k)) - \bar{u}]$$

which yields the first order necessary conditions

$$\omega^* + \lambda u'(w) = 1 \tag{A.4.1}$$

$$\omega^* + (1 - \pi)\lambda u'(s) = 1 - \pi \tag{A.4.2}$$

$$u(w) + u(s) = \bar{u} \tag{A.4.3}$$

$$\lambda > 0, \tag{A.4.4}$$

where $\omega^* \equiv \left.\frac{\partial \Omega}{\partial w}\right|_{w=\bar{w}, k=\bar{k}} = \left.\frac{\partial \Omega}{\partial k}\right|_{w=\bar{w}, k=\bar{k}}$ represents the equilibrium equilibrium election manipulation incentive and $s = k + \pi(b - k)$ represents employees' period 2 consumption.

It is immediately clear from A.4.1 and A.4.2 that $w = s$ under full transparency (i.e. when $\omega^* = 0$). To show how k varies with ρ, we differentiate both sides of A.4.1, A.4.2, and A.4.3 with respect to ρ to obtain

$$\frac{\partial \omega^*}{\partial \rho} + \frac{\partial \lambda}{\partial \rho}u'(w) + \lambda u''(w)\frac{\partial w}{\partial \rho} = 0 \tag{A.4.5}$$

$$\frac{\partial \omega^*}{\partial \rho} + (1 - \pi)(\frac{\partial \lambda}{\partial \rho}u'(s) + (1 - \pi)\lambda u''(s)\frac{\partial k}{\partial \rho}) = 0 \tag{A.4.6}$$

$$u''(w)\frac{\partial w}{\partial \rho} + (1 - \pi)u''(s)\frac{\partial k}{\partial \rho} = 0. \tag{A.4.7}$$

Solving for $\frac{\partial k}{\partial \rho}$, we obtain

$$\frac{\partial k}{\partial \rho} = \frac{-\pi u'(w)}{(1 - \pi)\lambda^2(u''(w)u'(s)^2 + u''(s)u'(w)^2)}\frac{\partial \omega^*}{\partial \rho}. \tag{A.4.8}$$

Since $u'(\cdot) > 0$ and $u''(\cdot) < 0$, and $\lambda > 0$, it follows that

$$\frac{-\pi u'(w)}{(1 - \pi)\lambda^2(u''(w)u'(s)^2 + u''(s)u'(w)^2)} \begin{cases} > 0 & \text{if } \pi > 0 \\ = 0 & \text{if } \pi = 0, \end{cases}$$

which implies that $\frac{\partial k}{\partial \rho}$ has the same sign as $\frac{\partial \omega^*}{\partial \rho}$ if $\pi > 0$, and is zero otherwise. But we know from 4.3.7 that $\frac{\partial \omega^*}{\partial \rho} < 0$, which means that $\frac{\partial k}{\partial \rho} < 0$ if $\pi > 0$. This completes the proof for part (a) of the Proposition.

Following a similar path, we differentiate both sides of A.4.1, A.4.2, and A.4.3 with respect to m_1^Δ and solve for $\frac{\partial k}{\partial m_1^\Delta}$, we obtain

$$\frac{\partial k}{\partial m_1^\Delta} = \frac{-\pi u'(w)}{(1 - \pi)\lambda^2(u''(w)u'(s)^2 + u''(s)u'(w)^2)} \frac{\partial \omega^*}{\partial m_1^\Delta}. \tag{A.4.9}$$

Since we have already established $\frac{-\pi u'(w)}{(1-\pi)\lambda^2(u''(w)u'(s)^2+u''(s)u'(w)^2)}$ is nonnegative, A.4.9 implies that $\frac{\partial k}{\partial m_1^\Delta}$ has the same sign as $\frac{\partial \omega^*}{\partial m_1^\Delta}$ if $\pi > 0$, and is equal to zero otherwise. Using the definition of ω^* from 4.3.7 and by the properties of the normal distribution function, it follows that

$$\frac{\partial k}{\partial m_1^\Delta} \begin{cases} < 0 & \text{if } m_1^\Delta < 0 \\ > 0 & \text{if } m_1^\Delta > 0 \\ = 0 & \text{if } m_1^\Delta = 0, \end{cases}$$

if $\pi > 0$, and $\frac{\partial k}{\partial m_1^\Delta} = 0$ if $\pi = 0$. This completes the proof for part (b) and (c) of the Proposition.

$\square$

Appendix B

Variable Definitions

B.1. Variable Definitions for Chapter 2

CapEx: Quarterly capital expenditures ($capxy$) scaled by lagged total assets (atq). Note Compustat variable $capxy$ is year-to-date cumulate, so for fiscal quarter 2, 3, 4, the lagged $capxy$ is subtracted from current $capxy$ (Source: Compustat).

Tobin's Q: Market value of quarter-end total assets ($atq + prccq \times cshoq - ceqq - txditcq$) scaled by quarter-end book value of total assets (atq) (Source: Compustat).

ln(Size): Natural log of quarter-end total assets (atq) (Source: Compustat).

Cash Flow: Quarterly income before extraordinary items and depreciation ($ibq + dpq$) scaled by quarter-end total assets (atq) (Source: Compustat).

Cash Holdings: Quarter-end cash holdings ($cheq$) scaled by total assets (atq). (Source: Compustat).

Leverage: Quarter-end long-term book value of debt ($dlttq$) scaled by quarter-end total assets (atq). (atq) (Source: Compustat).

H1B use: The total number of H-1B initial petitions submitted to the USCIS during the 2001 calendar year, scaled by the average number of workers employed by the firm in 2001 (Source: USCIS petitions, Compustat).

ln(H1B use): The natural log of *H1B use* as defined above (Source: USCIS petitions, Compustat).

High H1B use: A dummy variable that takes a value of one if *H1B use*, as defined above, is above the sample median, and zero otherwise (Source: USCIS petitions, Compustat).

H1B use$_j$: The total number of H-1B initial petitions submitted to the USCIS during the 2001 calendar year for workers in occupational category j, scaled by the average number of workers employed by the firm in 2001 (Source: USCIS petitions, Compustat).

H1B: A dummy variable that takes on a value of one if the firm filed at least one H-1B initial petition to the USCIS during 2001, and zero otherwise (Source: USCIS petitions).

H1B wage: The sum of wages listed across H-1B initial petitions submitted to the USCIS during the 2001 calendar year, scaled by the product of the average number of workers employed by the firm in 2001 and the national industry average wage at the 3-digit NAICS level (Source: USCIS petitions, Compustat, BLS QCEW files).

ln(H1B wage): The natural log of *H1B wage* as defined above (Source: USCIS petitions, Compustat, BLS QCEW files).

High H1B wage: A dummy variable that takes a value of one if *H1B wage*, as defined above, is above the sample median, and zero otherwise (Source: USCIS petitions, Compustat, BLS QCEW files).

Wage: The wage listed for the position for the prospective H-1B worker on the H-1B petition (Source: USCIS petitions).

High Wage: A dummy variable that takes a value of one if the firm average *Wage*, as defined above, for initial petitions submitted in 2001 is above the sample median, and zero otherwise (Source: USCIS petitions).

Occ Wage: The wage from BLS Occupational Employment Statistics corresponding to the DOT occupational code (cross-referenced with SOC codes) for the H-1B worker (Source: USCIS petitions, BLS OES files).

Age: The age of the prospective H-1B worker listed on the H-1B petition (Source: USCIS petitions).

High Age: A dummy variable that takes a value of one if the firm average *Age*, as defined above, for initial petitions submitted in 2001 is above the sample median, and zero otherwise (Source: USCIS petitions).

Grad: A dummy variable that takes a value of one if the prospective H-1B worker is listed on the H-1B petition as possessing a Master's or PhD degree, and zero otherwise (Source: USCIS petitions).

Grad: A dummy variable that takes a value of one if the firm average *Grad*, as defined above, for initial petitions submitted in 2001 is above the sample median, and zero otherwise (Source: USCIS petitions).

HQ State: A dummy variable that takes a value of one if the prospective H-1B worker is listed to be in the same state as the location of firm headquarters as reported in Compustat, and zero otherwise (Source: DOL LCA files, Compustat).

NearHQ: A dummy variable that takes a value of one if the firm average *HQ State*, as defined above, for initial petitions submitted in 2001 is above the sample median, and zero otherwise (Source: DOL LCA files, Compustat).

Manufacturing: A dummy variable that takes on a value of one if the firm SIC classification is between 2000 and 3999, and zero otherwise (Source: Compustat).

Services: A dummy variable that takes on a value of one if the firm SIC classification is between 7000 and 8999, and zero otherwise (Source: Compustat).

IT: A dummy variable that takes on a value of one if the firm SIC classification is 3341, 3342, 3343, 3344, 3345, 3346, 5111, 5112, 5161, 5181, 5182, 5191, or 5415, and zero otherwise (Source: Compustat).

New Econ: A dummy variable that takes on a value of one if the firm SIC classification is between 35, 36, 48 (2-digit), or 873 (3-digit), and zero otherwise (Source: Compustat).

High TQ: A dummy variable that takes a value of one if the pre-treatment (2002) industry average *Tobin's Q* at the 2-digit SIC level is above the sample median, and zero otherwise (Source: Compustat).

High Size: A dummy variable that takes a value of one if the pre-treatment (2002) industry average $ln(Size)$ at the 2-digit SIC level is above the sample median, and zero otherwise (Source: Compustat).

High RD: A dummy variable that takes a value of one if the pre-treatment (2002) industry average R&D expenditures scaled by assets at the 2-digit SIC level is above the sample median, and zero otherwise (Source: Compustat).

Notes: Compustat data comes from the Compustat Fundamentals Annual (annual) and Compustat Fundamentals Quarterly files (quarterly). USCIS data comes from the United States Citizenship and Immigration Services via a Freedom of Information Act (FOIA) request. DOL LCA data comes from the Department of Labor's website at www.foreignlaborcert.doleta.gov/performancedata.cfm. BLS QCEW data comes from www.bls.gov/cew/. BLS OES data comes from www.bls.gov/oes/.

B.2. Variable Definitions for Chapter 3

$Election_{it}$: Indicator variable that takes on a value of one if a gubernatorial election occurs before the end of the fiscal year for plan i's state in fiscal year t, and zero otherwise (Source: Klarnerpolitics.com, The Book of the States).

$ContribGov_{it}$: Total employer contributions ($contrib\_ER\_regular + contrib\_ER\_state$) divided by total pensionable earnings of plan participants ($payroll$) (source: CRR Public Plans Database).

$ContribMbrs_{it}$: Total employee contributions ($contrib\_EE\_regular + contrib\_ER\_other + contrib\_EE\_PurchaseService$) divided by total pensionable earnings of plan participants ($payroll$) (source: CRR Public Plans Database).

$Contrib_{it}$: The sum of $ContribGov_{it}$ and $ContribMbrs_{it}$ (source: CRR Public Plans Database).

$AccGov_{it}$: The employer's share of the normal cost rate ($NormCostRate\_ER$) (source: CRR Public Plans Database).

$AccMbrs_{it}$: The employee's share of the normal cost rate ($NormCostRate\_EE$) (source: CRR Public Plans Database).

Acc_{it}: The sum of $AccGov_{it}$ and $AccMbrs_{it}$ (source: CRR Public Plans Database).

$PenDef_{it}$: The difference between Acc_{it} and $Contrib_{it}$ (source: CRR Public Plans Database).

$PenDefGov_{it}$: The difference between $AccGov_{it}$ and $ContribGov_{it}$ (source: CRR Public Plans Database).

$PenDefMbrs_{it}$: The difference between $AccMbrs_{it}$ and $ContribMbrs_{it}$ (source: CRR Public Plans Database).

$ln(Payroll)_{it}$: The natural log of total pensionable earnings of plan participants ($payroll$) (source: CRR Public Plans Database).

$ln(Avg\ Salary)_{it}$: The natural log of the average salary among active participants ($ActiveSalary\_avg$) (source: CRR Public Plans Database).

$Income_{it}$: The difference between total income ($income\_net$) and total contributions ($contrib\_tot$), divided by total pensionable earnings of plan participants ($payroll$) (source: CRR Public Plans Database).

$Discount\ Rate_{it}$: The assumed return on investments used to discount plan liabilities reported under GASB requirements ($InvestmentReturnAssumption\_GASB$) (source: CRR Public Plans Database).

Inflation Rate$_{it}$: The assumed inflation rate ($Inflation Assumption\_GASB$) (source: CRR Public Plans Database).

CostMthd EAN$_{it}$: An indicator variable that takes on a value of one if the plan uses the Entry Age Normal cost method in order to evaluate pension liabilities, and zero otherwise (source: CRR Public Plans Database).

Deficit Shock$_{it}$: Per capita unexpected budget deficit—i.e. ($expenditure\ shock - revenue\ shock$)/$state\ population$, where $expenditure\ shock = actual\ expenditures - projected\ expenditures - enacted\ expenditure\ adjustments$ and $revenue\ shock = actual\ revenue - projected\ revenue - enacted\ expenditure\ revenue$ (see Poterba (1994)) (source: National Association of State Budget Officers (NASBO) Fiscal Survey of States).

State Unemp$_{it}$: State unemployment rate (source: Bureau of Labor Statistics).

Pub Union Mbrshp$_{it}$: Proportion of state public-sector workers that are members of a labour union (source: Unionstats.com (Hirsch and Macpherson)).

$\Delta UnfundedLiab_i$: The plan-level time series average for $\Delta \frac{Unfunded\ Liab_{it}}{Payroll_{it}}$, where Δ indicates the first difference operator, and *Unfunded Liability$_{it}$* is the unfunded actuarial accrued liability ($UAAL\_GASB$) (source: CRR Public Plans Database).

$PenDefCyc_i$: $\bar{E}_i[PenDef_{it}|Election_{it} = 1] - \bar{E}_i[PenDef_{it}|Election_{it} = 0]$, where $\bar{E}_i[X|Y]$ denotes the time-series average, for plan i, of X conditional on Y (source: CRR Public Plans Database).

$PenDefCycD_i$: $\bar{E}_i[PenDefD_{it}|Election_{it} = 1] - \bar{E}_i[PenDefD_{it}|Election_{it} = 0]$, where $\bar{E}_i[X|Y]$ denotes the time-series average, for plan i, of X conditional on Y and $PenDefD_{it}$ represents the residual term from estimating $PenDef_{it} = \alpha + \delta \cdot t + \epsilon_{it}$ (source: CRR Public Plans Database).

$PenDefCycR_i$: $\bar{E}_i[PenDefR_{it}|Election_{it} = 1] - \bar{E}_i[PenDefR_{it}|Election_{it} = 0]$, where $\bar{E}_i[X|Y]$ denotes the time-series average, for plan i, of X conditional on Y and $PenDefR_{it}$ represents the residual term from estimating $PenDef_{it} = \alpha + \kappa_i + \lambda_t + X_{it}\beta + \epsilon_{it}$ (source: CRR Public Plans Database).

Budget Year$_{it}$: An indicator variable that takes on a value of one if the plan i is located in a state that passed a budget in year t (source: Klarnerpolitics.com).

LegisExp$_{it}$: An indicator variable that takes on a value of one if the Governor has prior experience in the state legislature (source: Klarnerpolitics.com).

Opaque Pensions$_{it}$: An indicator variable that takes a value of one if plan i is in a state that is in the bottom decile in terms of the SII transparency indicator for state pension fund management, and zero otherwise (source: Center for Public Integrity State Integrity Investigation).

Transparent Pensions$_{it}$: An indicator variable that takes a value of one if plan i is in a state that is in the top decile in terms of the SII transparency indicator for state pension fund management, and zero otherwise (source: Center for Public Integrity State Integrity Investigation).

Opaque Budget$_{it}$: An indicator variable that takes a value of one if plan i is in a state that is in the bottom decile in terms of the SII transparency indicator for state budget process, and zero otherwise (source: Center for Public Integrity State Integrity Investigation).

Transparent Budget$_{it}$: An indicator variable that takes a value of one if plan i is in a state that is in the top decile in terms of the SII transparency indicator for state budget process, and zero otherwise (source: Center for Public Integrity State Integrity Investigation).

Transparent Budget$_{it}$: An indicator variable that takes a value of one if plan i is in a state that is in the top decile in terms of the SII transparency indicator for state budget process, and zero otherwise (source: Center for Public Integrity State Integrity Investigation).

VicMargin$_{it}$: The margin of victory (as a fraction of 1) between the winning candidate and the runner up given a gubernatorial election occurs in year t, and zero otherwise (source: Klarnerpolitics.com).

IncumbLoses$_{it}$: An indicator variable that takes on a value of one if the incumbent Governor loses an election in year t, and zero otherwise. (source: Klarnerpolitics.com).

Lame Duck$_{it}$: An indicator variable that takes on a value of one if the plan i is located in a state a Governor facing binding term limits in year t (source: Klarnerpolitics.com).

Republican$_{it}$: An indicator variable that takes on a value of one if the incumbent Governor belongs to the Republican party. (source: Klarnerpolitics.com).

Strong Protect$_i$: An indicator variable that takes on a value of one if the plan i is located in a state that offers constitutional protection of state DB pension benefits (source: Munnell and Quinby (2012)).

Weak Protect$_i$: An indicator variable that takes on a value of one if the plan i is located in a state that offers protection of state DB pension benefits under the gratuity principle (source: Munnell and Quinby (2012)).

Unconditional Protect$_i$: An indicator variable that takes on a value of one if the plan i is located in a state that offers unconditional protection of state DB pension benefits (source: Munnell and Quinby (2012)).

Gov Change$_{it}$: An indicator variable that takes a value of one if plan i is in a state where there was an unexpected Governor change due to death, resignation, or impeachment in year t and zero otherwise (source: Klarnerpolitics.com, The Book of the States).

$ln(GDP\ Growth)_j$: The time-series mean in the annual log growth rate of real GDP for state j over the 2001-2015 sample period (source: Bureau of Economic Analysis).

$ln(HPI\ Growth)_j$: The time-series mean in the quarterly log growth rate of seasonally-adjusted house price index values (based on purchases only) for state j over the 2001-2015 sample period (source: Federal Housing Finance Agency).

Appendix C

Miscellaneous

C.1. Occupation Definitions

Architecture, Engineering, And Surveying (Engineering)
001 Architectural Occupations
002 Aeronautical Engineering Occupations
003 Electrical/Electronics Engineering Occupations
005 Civil Engineering Occupations
006 Ceramic Engineering Occupations
007 Mechanical Engineering Occupations
008 Chemical Engineering Occupations
010 Mining And Petroleum Engineering Occupations
011 Metallurgy And Metallurgical Engineering Occupations
012 Industrial Engineering Occupations
013 Agricultural Engineering Occupations
014 Marine Engineering Occupations
015 Nuclear Engineering Occupations
017 Drafters, N.E.C.
018 Surveying/Cartographic Occupations
019 Occupations In Architecture, Engineering, And Surveying, N.E.C.

Mathematics And Physical Sciences (Combined under Sciences)
020 Occupations In Mathematics
021 Occupations In Astronomy
022 Occupations In Chemistry
023 Occupations In Physics
024 Occupations In Geology
025 Occupations In Meteorology
029 Occupations In Mathematics And Physical Sciences, N.E.C.

Computer-Related Occupations (Computers)
030 Occupations In Systems Analysis And Programming
031 Occupations In Data Communications And Networks
032 Occupations In Computer Systems User Support
033 Occupations In Computer Systems Technical Support
039 Computer-Related Occupations, N.E.C.

Life Sciences (Combined under Sciences)
040 Occupations In Agricultural Sciences
041 Occupations In Biological Sciences
045 Occupations In Psychology

049 Occupations In Life Sciences, N.E.C.

Administrative Specializations (Admin)
160 Accountants, Auditors, And Related Occupations
161 Budget And Management Systems Analysis Occupations
162 Purchasing Management Occupations
163 Sales And Distribution Management Occupations
164 Advertising Management Occupations
165 Public Relations Management Occupations
166 Personnel Administration Occupations
168 Inspectors And Investigators, Managerial And Public Service
169 Occupations In Administrative Specializations, N.E.C.

Managers And Officials, N.E.C. (Management)
180 Agriculture, Forestry, And Fishing Industry Managers And Officials
181 Mining Industry Managers And Officials
182 Construction Industry Managers And Officials
183 Manufacturing Industry Managers And Officials
184 Transportation, Communication, And Utilities Industry Managers And Officials
185 Wholesale And Retail Trade Managers And Officials
186 Finance, Insurance, And Real Estate Managers And Officials
187 Service Industry Managers And Officials
188 Public Administration Managers And Officials
189 Miscellaneous Managers And Officials, N.E.C.

C.2. Actuarial Valuations Methods

The information provided here is a brief summary of the much fuller description, including detailed formulas, found in Section II of Novy-Marx and Rauh (2011). We begin with the concept of the Accumulated Benefit Obligation (ABO), which reflects the terminal value of a plan's liabilities if all benefits were permanently frozen at its current level. Calculating the ABO requires assumptions about mortality rates and future inflation, and these assumptions are applied to the current benefit formula, wages, and employees' accumulated years of service to arrive at a discounted present value. In essence, the ABO captures benefits that have already been promised and accrued.

A broader concept of pension liabilities is the Projected Value of Benefits (PVB), which accounts for expected future years of service and wage growth for current employees. Estimating the PVB requires additional actuarial assumptions about salary growth rates and job separation rates. The PVB method is a significantly more conservative estimate of pension liabilities relative to the ABO, as it operates under the implicit assumption that the plan sponsor cannot curtail future benefit accruals for current employees.

Almost all state plans apply one of two liability measures—the Projected Benefit (PBO) and the Entry Age Normal (EAN)—both of which fall in between ABO and the PVB in terms of conservatism. The PBO takes the PVB and prorates it by current years of accrued service, which implies recognition of projected wage growth but not future years of service. The EAN takes the PVB and amortizes it into a series of annual accruals such that each accrual is a constant percentage of projected salary. Assuming that the wage growth rate is lower than the discount rate, the EAN is more conservative than the PBO, and is interpreted to account for some future service in addition to wage growth.