Three Essays on Capital Budgeting and Allocation Efficiency

by

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Abstract

This dissertation consists of three essays concerning corporate economic efficiency. More specifically, I document how efficiently firms have used and allocated capital over the last three decades in the U.S. and worldwide. More importantly, I explore firm characteristics that affect their efficiency, emphasizing the effects of governance quality, institutional ownership, and size. I also study the mechanisms through which these traits impact the efficient use and allocation of capital. Overall, an understanding of how closely firms' investment decisions are aligned with shareholder value maximization and how well capital is allocated to the best available growth opportunities – referred to as capital budgeting efficiency and capital allocation efficiency in this thesis, respectively – helps us to evaluate firms' investment behaviour, comprehend the investment dynamics, and understand the real economic consequences of the stock market.

Chapter 1 explores the impact of quasi-indexers – a predominant type of institutional investor characterized by a highly diversified portfolio, long holding periods, and low turnover – on a firm's capital budgeting efficiency and potential mechanisms through which that quasi-indexers may affect firms' efficiency. Following Durnev, Morck, and Yeung (2004), I use the deviation of a firm's marginal q from the optimal level as a measure of the firm's capital budgeting inefficiency. I instrument quasi-indexer ownership by the S&P 1500 index membership and exploit the relationship between a firm's capital budgeting efficiency and its quasi-indexer ownership within a small distance around the size-rank inclusion threshold, and find that quasi-indexer improved firms' capital budgeting efficiency, dominated by

the alleviation of underinvestment. Moreover, the improvement is more substantial for firms with more research and development (R&D) investment, which is not directly affected by quasi-indexer ownership, pointing to the information channel that quasi-indexers affect capital budgeting efficiency.

Chapter 2 examines whether more substantial shareholder rights drive firms' marginal q closer to or further away from the optimal level, indicating firms' capital budgeting inefficiency. I utilize governance indices – cumulant indices of corporate provisions that delegate controls to managers – to capture the opposite of the strength of firms' shareholder rights following Gompers, Ishii, and Metrick (2003) and L. Bebchuk, Cohen, and Ferrell (2009). In contrast to existing evidence of a positive relationship between shareholder rights and firms' market valuation, I find that weaker shareholder rights are associated with more value-enhancing capital budgeting decisions. The results are robust to instrumenting governance index by the average corresponding governance indices in previous years of focus firms' non-industry, geographically proximate peers or peers going public in the same year as the firm in question, following Karpoff, Schonlau, and Wehrly (2017). The negative relationship between shareholder rights and capital budgeting efficiency is more pronounced for younger firms and firms with more competent managers, indicating that strong shareholder rights may limit managers' discretion in making efficient decisions. Furthermore, I find evidence suggesting cash holdings and operation volatility are the mechanisms that shareholder rights affect capital budgeting efficiency.

Chapter 3 outlines the capital allocation efficiency of firms around the world. This work contributes to the literature by analyzing the heterogeneity of capital allocation efficiency at the firm level across countries and examining whether and how financial development disproportionately affects small and large public firms in terms of economic efficiency. More specifically, following the insights of Wurgler (2000), I measure capital allocation efficiency as the elasticity of a firm's investment to its sales, of which growth reflects the firm's growth opportunities. I find that

capital is allocated more efficiently among large firms. A larger financial market improves only large firms' capital allocation efficiency. In contrast, the price informativeness of the stock market is associated with a higher allocation efficiency among both large and small firms. These findings suggest that the informational efficiency of financial markets is vital for allocating capital to its best use.

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Chapter 1

Quasi-Indexer Ownership and Capital Budgeting Efficiency

1.1 Introduction

Quasi-indexers are institutional investors with diversified holdings, long holding periods and low turnover, including those who explicitly mimicking a market index or buy-and-hold a highly diversified portfolio that implicitly benchmarks to a broad index. Figure 1.1 shows that the average fraction of a firm's shares outstanding held by quasi-indexers doubled from less than 20% to about 40% over the 2000s, and ownership by quasi-indexers accounts for more than 50% of the overall institutional ownership on average.[1] These statistics are consistent with existing research documenting the predominance of quasi-indexers among institutional investors (Wurgler, 2010; Craig, 2013; Gutiérrez & Philippon, 2017; Akey, Robertson, & Simutin, 2021, etc.).[2] As broad indexing strategies rise and growing attention is paid to the real economic effects of the secondary financial market trading (Bond, Edmans, & Goldstein, 2012, etc.), there are active debates about the impacts of quasi-indexers on portfolio firms. For example, their passive strategy and diversified holdings make collecting firm-specific information more costly and thus discourage such informa-

[1]The fraction of quasi-indexer ownership to overall institutional ownership varies over time, but quasi-indexers remain the predominant type among institutional investors during our sample period.

[2]According to Standard & Poor, on December 31, 2020, the total assets benchmarking to the S&P 500 index amounted to USD 13.5 trillion, almost tripled the amount in 2011, when explicit index funds were valued at USD 5.4 trillion.

tion collection. However, their long holding period and low turnover limit their ability to vote by foot and may force them to fulfill their fiduciary responsibilities and resolve any concerns about the firm through direct engagement with portfolio firms' management.

Capital budgeting is among the most important managerial decisions, and managers are expected to allocate capital to its best use to maximize a firm's valuation. However, agency problems and informational asymmetry compromise managers' incentives and ability to invest efficiently. Thus, the extent to which capital budgeting maximizes a firm's valuation is a matter of economic efficiency. Less severe agency problems and a better information environment are associated with more efficient capital budgeting (Durnev et al., 2004; Greene, Hornstein, & White, 2009; Hornstein & Zhao, 2011). However, existing evidence is insufficient to suggest a relationship between a firm's quasi-indexer ownership and its capital budgeting efficiency. On one side, quasi-indexers' passive or semi-passive investment strategies and fragmented holdings may reduce their incentives to monitor portfolio firms,[3] discourage firm-specific information acquisition, induce managerial short-termism (Porter, 1992; Gutiérrez & Philippon, 2017, 2018), and thus harm the firms' capital allocation efficiency. Alternatively, however, their long holding period, low turnover, and benchmarking strategy may limit quasi-indexers' ability to exit freely, and thus pressure them to voice their concerns about governance or promote more efficient information disclosure (Boone & White, 2015; Appel, Gormley, & Keim, 2016), thereby improving capital allocation efficiency. In this study, I find that greater quasi-indexer ownership is associated with greater value-enhancing capital budgeting in the future, providing evidence for secondary market participants affecting real corporate decisions.

To examine capital budgeting efficiency from the value maximization perspective, I follow Durnev et al. (2004) and regard the deviation of a firm's marginal q from the first-best benchmark as an inverse measure of capital budgeting efficiency. It measures the proximity of a firm's investment to its equilibrium level given avail-

[3] Quasi-indexing institutional investors include pure indexing funds that completely replicate the index constituents and weights and semi-indexing funds that select holdings from the index constituents with discretionary weights.

able resources at the time. More specifically, I firstly estimate Tobin's marginal q as the ratio of a marginal change in a firm's value to the contemporaneous changes in its capital stock per Durnev et al. (2004). To incorporate firm-specific heterogeneity, I follow Greene et al. (2009) and use random coefficients to estimate marginal q for each firm in each year. The absolute deviation of the estimated firm-year marginal q from one is then used as the explained variable in tests exploring the relationship between a firm's quasi-indexer ownership and its capital budgeting efficiency.[4] A negative relationship emerges between the distance of marginal q from one and quasi-indexer ownership. The results are robust to the estimation precision of marginal q, the choice of optimal benchmark and controls for firm-fixed effects and various variables, such as a firm's cash flow, leverage, and size. Moreover, the positive impacts of quasi-indexer ownership on firms' investment sensitivity to growth opportunities echo its positive relationship with capital budgeting efficiency.

However, some unobserved factors can confound the relationship between a firm's capital budgeting efficiency and its quasi-indexer ownership. For instance, a more competent manager could make more efficient investment decisions, and quasi-indexers' long holding periods and low turnover may drive them to gravitate toward firms with more competent managers. To mitigate this concern, inspired by Aghion, Van Reenen, and Zingales (2013) and Appel et al. (2016), I repeat the analysis using S&P 1500 membership as an instrumental variable for quasi-indexer ownership. More specifically, I exploit variation in quasi-indexer ownership that occurs around the threshold of the S&P1500, in addition to utilizing index inclusion as a global instrumental variable for quasi-indexer ownership. The S&P 1500 consists

[4] Assume that a firm's capital investment over a period is aggregated into a project with an initial cost and a series of future cash flows, and the marginal q of the firm over that period is equivalent to the NPV of the assumed project. Given the decreasing marginal return of capital, a firm that maximizes its value should invest until the NPV of the marginal project equals zero, which is equivalent to marginal q equals one. However, the taxation, lumpiness of investment, aggregation of capital stock and other real-world complications may push the optimal threshold of the estimated marginal q deviating from one. Moreover, these factors should affect the estimated marginal q and the optimal level uniformly or randomly, which leaves the distance between marginal q and the optimal level to meaningfully measure the proximity of firms' investment to the optimal level given conditions at the time (See Durnev et al. (2004)), regarded as capital budgeting inefficiency in this study. More importantly, these factors should not affect firms' capital budgeting inefficiency and its relationship with quasi-indexer ownership. Nevertheless, industry average marginal q is used as an alternative optimal level based on the conjecture that effective competition drives growth opportunities to converge to an optimal level within an industry.

of all members of S&P Large Cap 500, S&P MidCap 400 and S&P SmallCap 600, and thus captures the impacts of quasi-indexers not limited to those targeting large-cap stocks. Moreover, more than 20% of S&P 500 index weights are concentrated in the top ten constituents, and the market capitalization cutoff for S&P 500 members overlaps with the upper limit in market capitalization for S&P 400 members, which collectively attenuates the effectiveness of S&P 500 inclusion in identifying the variation in quasi-indexer ownership. Although the Russell 1000/2000 cutoff provides clear identification of purely passive institutional investors, who minimize tracking errors by replicating the exact weights and constituents of the index, S&P 1500 inclusion better represents broader quasi-indexers, including purely indexed funds and funds primarily benchmarking against the index with discretionary weights allocation. Using S&P1500 is optimal, especially when using the whole sample in addition to the local analyses around the index threshold.[5]

For the overall sample, using S&P1500 inclusion as an instrumental variable shows that one standard deviation increase in quasi-indexer ownership is associated with a 0.35 standard deviation decrease in a firm's capital budgeting inefficiency, equivalent to that marginal q deviates 49.5% less from the one on average. Moreover, using smaller distances around the index threshold, different polynomial orders of market capitalization, and various control variables does not alter the results qualitatively. The results confirm that quasi-indexer ownership is positively associated with portfolio firms' capital budgeting efficiency. Overall, the results highlight the real economic consequences of quasi-indexer ownership beyond its impact on a firm's governance, information disclosure practices, or market valuation.

In addition, separate analyses for underinvestment and overinvestment reveal that the positive association between quasi-indexer ownership and a firm's capital budgeting mainly resides in alleviating the problems of underinvestment. To explore how quasi-indexing institutional investors might push firms' capital budgeting closer to the optimal level, I examine governance and information environment as two potential channels, as has been suggested in prior works (Boone & White, 2015; Appel et al., 2016; Appel, Gormley, & Keim, 2019, etc.). I find that quasi-

[5] Taking S&P 500 as an example, the purely indexed assets account for only 40% of the total assets benchmarking to the index as of Dec. 31st, 2021, according to the S&P Global.

indexers improve capital budgeting efficiency more profound for firms with greater information opaqueness, regardless of whether these firms underinvest or overinvest. However, there are no differential impacts of quasi-indexers for firms with more or less entrenched managers. These findings collectively suggest that an improved information environment induced by quasi-indexers (Boone & White, 2015) could lead to more efficient capital budgeting by facilitating managers' learning from informational efficient asset prices, while to what extent that better governance, caused by quasi-indexers, leads to improvement in capital budgeting efficiency remains unclear.

By presenting empirical evidence that quasi-indexer ownership is associated with more value-enhancing capital budgeting decisions, this study complements existing literature that examines the impact of quasi-indexers on portfolio firms' governance structures, information production, and stock market performances and contributes to the debate about quasi-indexers' real economic effects on portfolio firms. Moreover, I provide evidence on the mechanisms through which quasi-indexers, as significant secondary market participants, play a role in affecting portfolio firms' real economic efficiency. This work highlights the essential role of a transparent informational environment in the feedback effects from the financial market to the real economy.

The rest of the paper is organized as follows. Section 1.2 briefly summarizes the literature related to this study and highlights the rationale for the link between quasi-indexer ownership and a firm's capital budgeting efficiency. In Section 1.3, I introduce intuition and detailed processes for measuring capital budgeting efficiency and demonstrate empirical strategies to analyze the relationship between quasi-indexer ownership and firms' capital budgeting efficiency. In Section 1.4, I illustrate the sample construction for my empirical analysis, and Section 1.5 summarizes the main empirical results and additional analyses. Finally, Section 1.6 concludes.

1.2 Related Literature

This study connects works that examine the impacts of institutional investors and their constituents with literature that explores how efficiently firms are run by testing the association between a firm's quasi-indexer ownership and its capital budgeting efficiency.

Capital budgeting is one of a firm's fundamental functions, and to what extent a firm's capital budgeting aligns with value maximization is a matter of economic efficiency. Previous literature finds that firms' capital budgeting efficiency is related to governance quality and informational asymmetry. Durnev et al. (2004) estimate Tobin's marginal q as changes in market value associated with unexpected changes in investment scaled by unexpected contemporaneous changes in capital stock and construct the deviation of marginal q from one. They find such an inverse measure of capital budgeting efficiency is negatively associated with firm-specific stock return variation across industries, which suggests that more informative stock prices facilitate the alignment of corporate capital budgeting with value maximization. Their findings are robust to using absolute or squared deviation and endogenous optimal marginal q selection and survive controlling for firm-specific fundamentals. Greene et al. (2009) apply the random coefficient method to estimate marginal q for each firm in each year and form an unbalanced firm-level panel to better incorporate the firm's heterogeneity in their analysis. They find that multinational firms make more efficient capital budgeting decisions than purely domestic firms. They also discover that a multinational firm's advantages in capital budgeting stem from alleviating both underinvestment and overinvestment, implying that multinational firms gain benefits beyond the mitigation of financial constraints. However, they do not find evidence of a relationship between capital budgeting efficiency and institutional ownership. Hornstein and Zhao (2011) explore a sample of 342 U.S. firms with internal information sharing data and reveal a robust positive relationship between a firm's internal R&D linkage and its capital budgeting efficiency, suggesting that internal information sharing promotes value-enhancing capital budgeting and reduces overinvestment in particular. My study extends existing research on capital budgeting efficiency by connecting it with a firm's ownership structure, particularly its ownership by quasi-indexers, a specific type of institutional investor.

Prior research connecting overall institutional ownership to a firm's corporate governance and information environment provides prevailing evidence that institutional investors play a positive role in improving a firm's governance and informational symmetry. Bushee (1998) demonstrates that except for those with high portfolio turnover and engaging in momentum tradings, institutional ownership reduces the likelihood that managers cut R&D to reverse an earnings decline, which provides credence to the conjecture that institutional investors serve a monitoring role in reducing pressure for myopic behavior. Carleton, Nelson, and Weisbach (1998) study a private dataset illustrating correspondence between TIAA-CREF and firms it contacts for governance issues. They find evidence of effective private negotiation between institutional investors and firms they tend to influence. Concerning the valuation, the effectiveness of such behind-the-scene interaction is contingent on the type of targeted issues. For instance, board diversity is associated with negative abnormal returns, while blank check preferred issues are viewed positively by the market, yielding a positive abnormal return. However, they do not find evidence in accounting measured performance changes related to this institutional activism. Ajinkya, Bhojraj, and Sengupta (2005) find a positive relationship between institutional ownership and the occurrence, frequency, and quality (accuracy) of (voluntary) management earnings forecasts, but this beneficial impact is overturned by highly concentrated institutional ownership. They also document a negative relationship between institutional ownership and managerial optimism in earnings forecasts. Aghion et al. (2013) find that the presence of institutional investors boosts a firm's innovation, especially the quality of innovation, which is measured by future cite-weighted patents per R&D dollar, and they argue the positive impacts of institutional ownership on a firm's innovation tends to be casual using policy changes and S&P500 membership as instrumental variables. They find that the beneficial influences of institutional ownership on a firm's innovation are stronger when the product market is more competitive or when the managers are less entrenched, consistent with their career concern model prediction. More specifically, institutional investors encourage innovation through the reassurance that they provide to competent managers who are concerned about losing jobs due to bad luck. McCahery, Sautner, and Starks (2016) conduct a survey on institutional investors and find that institutional investors, especially those long-term investors and investors that are less concerned about stock liquidity, commonly intervene with portfolio firm governance issues directly or indirectly.

However, institutional investors are not a homogeneous group regarding their influences on holding firms (Bushee, 1998; Boone & White, 2015; Lewellen & Lewellen, 2022; Y. Liu, Shen, Wang, & Wang, 2019; Cremers, Pareek, & Sautner, 2020, etc.). Moreover, institutional investors' holding features and investment patterns matter the most for their relationship with holding firms. For example, diversified holdings require more resources and induce higher costs to collect information on each portfolio firm. On the other hand, low turnover and long holding periods may force institutional investors to engage more with portfolio firms. Based on their investment patterns, particularly their holding period, diversification, and turnover, Bushee and Noe (2000) classify institutional investors into dedicated investors, quasi-indexer institutional investors and transient investors. With the growth of passive funds and the broad usage of a market index as a benchmark, quasi-indexers have become the most significant component of institutional investors.

Recent research shows that quasi-indexers affect a firm's corporate governance, informational environment, and capital investment. Boone and White (2015) exploit the annual reconstitution of the Russell 1000 and 2000 index to isolate exogenous changes to institutional ownership and find that quasi-indexer ownership reduces information asymmetry and improves the information environment. They attribute this effect to a higher likelihood and frequency of voluntary disclosure through management forecasts and voluntary 8-K filings, greater analyst following, and greater consensus in analyst forecasts. They further conclude that demand for transparency from quasi-indexers generates positive spillover effects for all shareholders via improving internal and external monitoring. Appel et al. (2016) exploit variation in passive institutional ownership around the Russell 1000/2000 cutoff and find that passive institutional ownership positively affects a portfolio firm's governance practices in terms of more independent directors, fewer anti-takeover provisions, and more equal voting rights. Moreover, passive institutional ownership is positively associated with the firm's long-term performance, which is measured by ROA and average q. Gutiérrez and Philippon (2017) find that quasi-indexer ownership, which accounts for about 60% of total institutional ownership, is significantly correlated with underinvestment relative to average q across firms and industries. Transient institutional ownership and total institutional ownership exhibit the same pattern as quasi-indexers, except that dedicated ownership is positively related to a firm's investment. They attribute the predominant underinvestment problems to the reduction in competition due to common ownership and the short-termism induced by quasi-indexers. In contrast, Cremers et al. (2020) do not find evidence indicating quasi-indexers are responsible for cutting R&D to boost short-term earnings. They apply difference-in-difference analysis to the Russell 2000 index inclusion and find that a large transient institutional ownership is associated with a cut to R&D spending and an increase in short-term earnings. However, this myopic effect is not observed with quasi-index investors. I add credence to the impact of quasi-indexers on holding firms by examining the relationship between a firm's quasi-indexer ownership and the extent to which its capital budgeting follows the value maximization principle. By exploring the connection between a firm's quasi-indexer ownership and its capital budgeting efficiency, I provide more empirical evidence on the potential impacts of quasi-indexers as a particular group of institutional investors.

1.3 Empirical Design

1.3.1 Theoretical Framework of Capital Budgeting Efficiency

Suppose a firm's capital budgeting from time t to t+1 is to determine whether to invest in a project with a setup cost boiled down to $-\Delta A_t$ and expected to generate a series of incremental cash flows, $E[\Delta CF_{t+i}]$, for the foreseen future. Then the (expected) net present value (NPV) of the project, which equals the present value of all relevant cash flows, is $E[NPV_t] = -\Delta A_t + E[\sum_{i=1}^{\infty} \frac{\Delta CF_{t+i}}{(1+r)^i}]$, where r is the cost of capital. The expected incremental market value associated with this project is $\Delta V_t = E[\sum_{i=1}^{\infty} \frac{\Delta CF_{t+i}}{(1+r)^i}]$.

Marginal q, by definition, is the change in the market value of a firm associated with corresponding changes in its capital stocks and is denoted by

$$\dot{q}_t = \frac{\Delta V_t}{\Delta A_t} = 1 + \frac{E[NPV_t]}{\Delta A_t}. \qquad (1.1)$$

Optimal capital budgeting requires that a value-maximizing firm fully exploits non-negative NPV opportunities at any given point in time, ignoring financial constraints. At the optimal status, assuming continuously divisible investment and decreasing marginal return of capital, the NPV of the last unit of the investment will be zero, which is simply equivalent to that marginal q equals to one, according to Equation 1.1.[6] In a frictionless world without tax and other complications, a positive (negative) deviation of marginal q from one indicates forgoing positive NPV projects (undertaking negative NPV projects), or in other words, under-(over-) investment.

1.3.2 Estimating Capital Budgeting Efficiency

Although a firm's capital budgeting decisions, such as capital investment, are influenced by managerial expectations, their expectations are mostly biased and extrapolative from past performance (Gennaioli, Ma, & Shleifer, 2016). Therefore, I rely on the market perspective to exempt the measures of capital budgeting efficiency from such biases. Following Durnev et al. (2004) and Greene et al. (2009), the marginal q of firm i at time t can be estimated as the unexpected change in the market value of firm relative to the unforeseen change in its capital assets over the same period:

$$\dot{q}_{i,t} = \frac{V_{i,t} - E_{t-1}V_{i,t}}{A_{i,t} - E_{t-1}A_{i,t}} = \frac{V_{i,t} - (1 + \hat{r}_{i,t} - \hat{d}_{i,t} - \hat{a}_{i,t})V_{i,t-1}}{A_{i,t} - (1 + \hat{g}_{i,t} - \hat{\delta}_{i,t})A_{i,t-1}} \tag{1.2}$$

where $V_{i,t}$ and $A_{i,t}$ are the market value and capital stock of firm i at time t. E_{t-1} represents the expectation based on all the information available at time t-1. The expected market value of firm i at time t is its market value at the beginning of the period $V_{i,t-1}$ grown at the expected return rate $\hat{r}_{it}$ adjusted for the disbursement ratio $\hat{d}_{it}$ and an adjustment cost $\hat{a}_{it}$.[7] By the same token, the expected capital assets of firm i at time t is the capital stock at the beginning of the period $A_{i,t-1}$ augmented by the expected growth rate of investment $\hat{g}_{it}$ net of the expected depreciation rate $\hat{\delta}_{it}$.

Cross-multiplying, rearranging terms in Equation 1.2 and simplifying results to:

$$\frac{\Delta V_{i,t}}{A_{i,t-1}} = \alpha_{it} + \beta_{1,it}\frac{\Delta A_{i,t}}{A_{i,t-1}} + \beta_{2,it}\frac{V_{i,t-1}}{A_{i,t-1}} + \beta_{3,it}\frac{Div_{i,t}}{A_{i,t-1}} + \mu_{i,t} \tag{1.3}$$

where $\beta_{1,it}$ is the marginal q for firm i at time t, and $\beta_{2,it}$ is the estimated net expected return of firm i's assets $\hat{r}_{i,t} - \hat{a}_{i,t}$, where $\hat{r}_{i,t}$ and $\hat{a}_{i,t}$ are the expected return of firm

[6] This equation is equivalent to equation (8) in Durnev et al. (2004).

[7] Similar to Gould (1968); Hayashi (1982), I account for the installation cost of capital assets in the value function of the firm instead of the capital accumulation process.

i's assets and the adjustment cost of implementing these assets, respectively. The adjustment cost accounts for the loss during asset installation due to disruption in production, costly learning, etc. Capital budgeting efficiency is inversely related to the deviation of estimated marginal q, $\hat{\beta}_{1,it}$, from its optimal level. All parameters in Equation 1.3 are estimated using the random coefficient method.[8] Applying the random coefficient method to estimate parameters in Equation 1.3 explicitly incorporates individual heterogeneity and accounts for information about all firms.

I measure the divergence of marginal q from its optimal level as an absolute deviation $|\dot{q}_{it} - h|$,[9] where h denotes the optimal value of marginal q, which are set to be the theoretical value of one, industry average,[10] and the simultaneously estimated optimal level $\hat{h}$ using weighted nonlinear maximum likelihood estimation. This inverse indicator of capital budgeting efficiency is based on changes in the market value of the firm's capital stock; thus, it is more appropriate to measure the aggregate investor's assessment of a firm's investment efficiency.[11]

1.3.3 Quasi-indexer Ownership and Capital Budgeting Efficiency

As shown in Section 1.2, quasi-indexer ownership has been linked to informational asymmetry and agency problems which could cause a firm's investment to deviate from the optimal level. Thus, exploring the association between quasi-indexer ownership and a firm's capital budgeting efficiency is sensible.

There are reasons to expect a positive relationship between quasi-indexer ownership and a firm's capital budgeting efficiency. For example, more information transparency and a better public information environment induced by higher quasi-

[8]Random coefficient estimation allows individual heterogeneity in the estimated coefficient, i.e. each coefficient is estimated as $\hat{\beta}_{k,it} = \beta_k + v_{k,it}$ where i indicates firm i and k indicates the kth coefficient. See Swamy (1970), Greene (2008) for more details.

[9]For the robustness of the results, I also use a squared deviation $(\hat{q}_{it} - h)^2$ for most of the regression, however, the squared form tends to overweight the extreme deviation that exceeds one, so I mainly report results for absolute deviation.

[10]In a functionally efficient market, the marginal value of capital stock tends to converge (Lee, Shin, & Stulz, 2016)

[11]As discussed in Durnev et al. (2004) and Greene et al. (2009), taxes, lumpiness of capital investment, unobservability of expected and other frictions may affect the estimation of marginal q as well as the optimal value h uniformly, or at least randomly, so the distance between the estimated marginal q and the optimal benchmark is still an appropriate inverse indicator for capital budgeting efficiency.

indexer ownership could alleviate a firm's investment distortion by releasing its financial constraints, pressing its management to maximize the firm's valuation, and pushing its management to learn more information while improving the quality of information disclosure. Meanwhile, more informative stock prices provide better feedback regarding managers' decisions, and thus aid managers to make more efficient capital budgeting decisions. On the contrary, if quasi-indexer ownership intensifies managerial short-termism or worsens the informational asymmetry, a negative relationship between quasi-indexer ownership and a firm's capital budgeting efficiency is expected.

Linking Capital Budgeting Efficiency with Quasi-indexer Ownership

To examine the relationship between a firm's quasi-indexer ownership and the extent to which that firm's capital budgeting achieves value maximization, I regress the distance of marginal q from optimal on lagged quasi-indexer ownership and control for cash flows, leverage, firm size, investment in intangibles, and other variables, as shown in Equation 1.4.

$$|\dot{q}_{it} - h| = \alpha + \beta_1 QixOwn_{i,t-1} + \sum_{j}^{J} \gamma_j X_{j,i,t-1} + \theta_s + \varepsilon_{it}, \tag{1.4}$$

where the subscripts i, t, s, j indicate individual i, time t, the jth control variable and industry s, respectively. Since $\hat{\beta}_{1,it}$ estimated in Equation 1.3 is used to construct the capital budgeting efficiency measure, i.e. the independent variable of Equation 1.4, I apply the Hornstein and Greene (2012) techniques to weight all observations by the inverse of the nonlinear transformation of the standard errors of estimated $\dot{q}_{it}$.[12] h denotes the optimal threshold of marginal q, theoretically equal to one. As

[12] According to Hornstein and Greene (2012), when using a nonlinear function of an estimated variable as the dependent variable, the corresponding nonlinear transformation on the standard errors of the estimated variables should be applied to deal with the heteroskedasticity of the disturbance. Since I use the absolute distance of estimated marginal q from the optimal level, measuring the capital budgeting inefficiency, as an independent variable, I adjust the standard errors of estimated marginal q to reflect the nonlinear transformation. More specifically, $Var|\hat{q}_{i,t} - 1| = Pr(\hat{q}_{i,t} \geq 1) \times Var(\hat{q}_{i,t}|\hat{q}_{i,t} \geq 1) + Pr(\hat{q}_{i,t} < 1) \times Var(\hat{q}_{i,t}|\hat{q}_{i,t} < 1) + Pr(\hat{q}_{i,t} \geq 1) \times (E(\hat{q}_{i,t}|\hat{q}_{i,t} \geq 1) - E(\hat{q}_{i,t}))^2 + Pr(\hat{q}_{i,t} < 1) \times (E(\hat{q}_{i,t}) - E(\hat{q}_{i,t}|\hat{q}_{i,t} < 1))^2$. For the squared deviation of estimated marginal from the optimal level, the adjusted variance is $Var(\hat{q}_{i,t} - h)^2 = Var(\hat{q}_{i,t}^2 - 2\hat{q}_{i,t} + h) = Var(\hat{q}_{i,t}^2) + 4Var(\hat{q}_{i,t}) - 4Cov(\hat{q}_{i,t}, \hat{q}_{i,t}^2) = 2\sigma^4_{\hat{q}_{i,t}} + 4\sigma^2_{\hat{q}_{i,t}}$. Nevertheless, I also adopt Saxonhouse (1976) method and use the inverse of standard errors of estimated marginal q as weights, and the results are reported in the Appendix. The results are qualitatively the same.

noted in Durnev et al. (2004) and Greene et al. (2009), taxation and other real-world complications may drive the optimal threshold h away from one. To better fit reality, I use industry average marginal q as an alternative threshold to the theoretical one. Additionally, I apply a nonlinear maximum likelihood technique to estimate the threshold h simultaneously with parameters $\alpha, \beta_1,$ and γ_j.[13]

Instrumental Variable Method

In addition to controlling for a firm's capital structure, cash flows, and other factors that could affect both its capital budgeting efficiency and quasi-indexer ownership in the weighted least squared regression, I use S&P1500 index inclusion as an instrument for quasi-indexer ownership to mitigate the confounding effects of omitted variables. More specifically, I first estimate Equation 1.5, which regresses quasi-indexer ownership on S&P1500 membership and control variables.

$$QixOwn_{it} = \eta + \lambda S\&P500_{it} + \sum_{n=1}^{N} \theta_n (ln(Mktcap_{it}))^n + \sum_{j}^{J} \gamma_j X_{j,i,t} + \phi Industry_{it} + \delta_t + \mu_{it}, \tag{1.5}$$

where $S\&P1500_{it}$ is an indicator for S&P1500 members, $Mktcap_{it}$ denotes the market capitalization of a firm at time t, as it primarily determines the S&P1500 membership. As S&P1500 also accounts for industry balance, I add $Industry_{it}$ to control for these effects.

Then I regress the inverse measure of capital budgeting efficiency on instrumented quasi-indexer ownership along with other controls in the second-stage regression, as follows:

$$|\dot{q}_{it} - h| = \alpha + \beta QixOwn_{it} + \sum_{n=1}^{N} \Theta_n (ln(Mktcap_{it}))^n + \sum_{j}^{J} \gamma_j X_{j,i,t} + \Phi Industry_{it} + \delta_t + \varepsilon_{it} \tag{1.6}$$

This IV estimation relies on the assumption that, once controlling for the S&P500 inclusion criteria, quasi-indexer ownership is the only channel for index inclusion associated with a firm's capital budgeting efficiency. Before I implement the instrumental variable method to identify the impact of quasi-indexer ownership on a firm's capital budgeting efficiency, I verify the relevancy of S&P1500 inclusion with

[13] A detailed estimation procedures are demonstrated in Durnev et al. (2004)

quasi-indexer ownership in Section 1.4.2. In addition, it is unclear why index inclusion directly or through channels other than institutional ownership affects a firm's capital budgeting efficiency, especially after controlling for the inclusion criteria.

Impact of Quasi-indexer Ownership on the Investment-Average q Relationship

Tobin (1969) argues that average q summarizes the market's perception of growth opportunities and should thus matter the most for a firm's investment decisions. Therefore, the responsiveness of a firm's investment to its growth opportunities, which is measured by average q, at least in part, reflects the efficiency of its capital budgeting activities. Based on this idea, examining the impact of quasi-indexer ownership on the investment-average q sensitivity is an alternative way to explore the association between quasi-indexer ownership and a firm's capital budgeting efficiency. Thus, I have the following empirical test:

$$\frac{I_{it}}{K_{it}} = \alpha + \beta_1 \bar{q}_{i,t-1} + \beta_2 \bar{q}_{i,t-1} \times QixOwn_{i,t-1} + \beta_3 QixOwn_{i,t-1} + \beta_4 CashFlow_{i,t-1} + \theta_s + \varepsilon_{it}, \tag{1.7}$$

where $\bar{q}$ is the average q of the firm, and $\frac{I_{it}}{K_{it}}$ denotes the firm's investment to capital ratio, and the coefficient of the interaction term of average q and quasi-indexer ownership (β_2) is to capture the impact of quasi-indexer ownership on the investment-growth opportunity sensitivity.

In addition to average q, cash slacks have been found empirically relevant to a firm's investment, and the investment-cash flow sensitivity could result from managerial empire-building (Jensen, 1986), external financing (Fazzari, Hubbard, & Petersen, 1987), or a mix of these two (Stein, 2003). Either case is in contrast to the efficient capital budgeting practice. Therefore, in addition to the investment-average q sensitivity, I add the interaction of quasi-indexer ownership and cash flow to Equation 1.7, resulting in the following test:

$$\begin{aligned} \frac{I_{it}}{K_{it}} = \alpha + \beta_1 \bar{q}_{i,t-1} + \beta_2 \bar{q}_{i,t-1} \times QixOwn_{i,t-1} + \beta_3 CashFlow_{i,t-1} \times QixOwn_{i,t-1} \\ + \beta_4 QixOwn_{i,t-1} + \beta_5 CashFlow_{i,t-1} + \theta_s + \varepsilon_{it}, \end{aligned} \tag{1.8}$$

To obtain consistent estimation given that average q and/or cash flows are mismeasured, I apply Erickson, Jiang, and Whited (2014) method based on the estimation of higher-order cumulants to Equations 1.7 and 1.8. The coefficients β_1 and β_3 capture the interactive effects of quasi-indexer ownership on the association of a firm's investment with its average q and cash flows, respectively.

1.4 Data Description

1.4.1 Sample Construction

My analysis begins with the annual CRSP-Compustat Merged (CCM) data set from 1980 to 2019, excluding financial firms (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999), because the demarcation of their operation, financing and investment activities are different from other industries, and they may also face some special regulations. I select firms operating in the U.S. and listed on one of the three major U.S. stock exchanges, i.e. NYSE, NASDAQ, and AMEX, and eliminate observations with negative total assets (COMPUSTAT item AT) or negative shares outstanding (COMPUSTAT item CSHO) to mitigate the effects of bad recording of the data. I obtain institutional ownership data from the Thomson Reuters Institutional (13f) Holdings database and aggregate the holdings of shares outstanding across all institutional investors classified as quasi-indexer for each firm to obtain quasi-indexer ownership. I also access the ISS (Institutional Shareholder Service) database through WRDS to construct the entrenchment index or E-Index.

To implement the instrumental variable method, I obtain the S&P1500 Composite Index membership from COMPUSTAT from 1995 (the starting year of the S&P1500 Index) to 2017. In addition, I retrieve the bid-ask spread and return data from CRSP to merge with annual firm-level marginal q data to control for index inclusion criteria other than market capitalization.

1.4.2 Quasi-indexers

Overview of Quasi-indexers

Quasi-indexers are institutional investors characterized by long holding periods, high diversification, and low portfolio turnover, following Bushee and Noe (2000) and

Bushee (2001).[14] This classification includes both passive funds and actively managed ones.[15]

Quasi-indexers are the largest category of institutional investors. For the entire sample period, 1980 to 2019, there are 9407 institutional investors, of which 4037 are classified as quasi-indexers.[16] Figure 1.2 shows that despite their rapid growth, particularly after 2000, quasi-indexers have been the predominant type of institutional investors since the 1980s. Quasi-indexers are majorly composed of independent investment advisors (31.78 %) and pension funds (50.57 %) from 1980 to 2017. The average holding size of quasi-indexers is 282 stocks, and Figure 1.3 shows the time variation of the average holdings size of quasi-indexers. In addition, as shown in Figure 1.1, ownership by quasi-indexers accounts for more than 50% of total institutional ownership on average, and the fraction is over 70% in the late 2000s. Within my sample, the average holding duration for quasi-indexers is 21 quarters, which is longer than both dedicated institutional investors (14 quarters) and transient institutional investors (7 quarters).

Quasi-indexer Ownership and Index Inclusion

Quasi-indexers include passive institutional investors and actively managed funds that hold a broadly diversified portfolio. Passive institutional investors explicitly track a market-wide index and thus hold the constituents of the target index. Non-index fund managers that hold diversified portfolios often implicitly benchmark to

[14] They conduct a factor analysis and identify common factors reflecting institutional investors' behavior, which measures the average investment stake and portfolio turnover. Note that, in their most recent classification method, they dropped a third common factor they identified in Bushee (1998), the sensitivity of trading to firms' current earnings due to its noisiness. And then, applying a k-means cluster analysis, which minimizes the within-cluster variance, they categorize institutional investors into three kinds: transient, dedicated and quasi-indexers, based on the standardized factor scores resulting from the common factors. The classification data is available https://accounting-faculty.wharton.upenn.edu/bushee/ and covers the time period from 1981 to 2018, and I propagate the permanent classification for each fund manager for 2019, and using data up to 2018 does not change the results.

[15] I randomly select 39 quasi-indexers and manually checked their holdings, investment philosophy, latest holdings, etc. and I find that except for 1 bond investor, 3 REITs investors, the rest invests either majorly in market index ETFs, or most of their top holdings are members of S&P1500 with different weights. More careful examination is required regarding the details of their holdings, but this evidence gives a hint of the close relationship between market index inclusion and quasi-indexer ownership.

[16] From 1995 to 2019, during which I construct the instrumental variable using S&P1500 membership, 3681 out of 8802 institutional investors are classified as quasi-indexers.

some market-wide index that fits their investment philosophy by holding the index's constituents with their discretionarily chosen weights. In addition, fiduciary duties implicitly guide institutional investors to broad indexing (Aghion et al., 2013, etc.).

S&P 1500 combines all constituents of the S&P500, S&P MidCap 400, and S&P SmallCap 600. Although S&P 500 inclusion has been used to capture the impact of institutional ownership, its float-market-capitalization-weighted methodology makes the index highly concentrated in the top members,[17] and the bottom members of the S&P 500 may have lower quasi-indexer ownership than the top members of the S&P 400,[18] and this weakens the representativeness of S&P 500 membership for quasi-indexer ownership. Besides, since January 1st, 2015, the constituents of one S&P 1500 composite index, i.e. S&P500, S&P MidCap 400, or S&P SmallCap600, can be migrated to another, as long as market capitalization criteria are met, which increases the integration of the S&P1500. Thus, I deem S&P1500 a better candidate for representing quasi-indexer ownership than composite indices.

On average 65.52 % of quasi-indexer holdings are S&P 1500 members, and the Figure 1.4 shows that the fraction of S&P 1500 members within quasi-indexers' holdings grew rapidly in the 1980s and remained above 60 % since the 1990s, but has declined since the late 2000s. An unreported univariate test shows that quasi-indexer ownership of S&P 1500 members is significantly higher than non-members.[19] Moreover, the positive jump at the S&P 1500 cutoff in Figure 1.11b shows a significant positive impact of the S&P1500 index inclusion imposed on quasi-indexer ownership.

1.4.3 Control Variables

Larger firms tend to have more internal cash and/or greater financing capacities, so they may have more minor distortions in investment. However, they may also have fewer value-enhancing growth opportunities, and thus are more prone to free-cash-flow-induced overinvestment problems. Meanwhile, the index replicating strategy of

[17] The cumulative weights of the top five firms in S&P500 is about 20.19% at the end of 2021. See https://www.indexologyblog.com/2021/01/25/sp-400-and-sp-600-why-consider/

[18] Similar logic as the Russell 1000/2000. A top member of the S&P 400 index is likely to receive more weight than a bottom member of S&P500 due to their relative ranking and weights in the index

[19] The difference is 26.5% and is significant at 1% level for 1980-2017

quasi-indexers causes them to load more weights on larger firms. I thus control for firm size using firms' market capitalization, but the results are robust to using the total assets or total sales.

I also control for a firm's cash flow in analyzing the impact of quasi-indexer ownership on a firm's capital budgeting efficiency. The influence of cash flow on a firm's capital budgeting efficiency is contingent. A firm with excess free cash flows is more likely to overinvest, while a cash-strapped firm may have to forego value-enhancing opportunities. Quasi-indexers are subject to strict due diligence and thus may have preferences for firms with healthy cash flows. Cash flow is measured as the sum of income and depreciation scaled by the replacement value of tangible assets. An alternative measure is operating income before depreciation, subtracting relevant taxes and paid dividends, and then scaling by total assets.

Capital structure may affect a firm's capital budgeting efficiency in various ways. Jensen (1986) asserts that financial leverage in a firm with few growth opportunities raises the agency cost for managers to use the firm's cash flow discretionarily, and thus, in part, relieves overinvestment problems. However, debt overhang may cause a firm to underinvest, especially when the investment is financed by issuing claims that are junior to current debt. At the same time, a large debt burden may discourage prudent institutional investors, including quasi-indexers, due to their fiduciary liability. Financial leverage is measured as the ratio of long-term debt to the value of tangible assets. An alternative measure is the ratio of the market value of debt to the sum of the market value of debt and equity.

A firm that relies more on intangible assets tends to increase the ambiguity in predicting its future cash flows and thus may have lower capital budgeting efficiency. In addition, due to its technical sophistication and complication, more possession of intangible assets may also induce information asymmetry between the manager and investors. Such asymmetry may cause distortion in a firm's investment and discourage quasi-indexers due to their preference for lower monitoring costs. I measure the intangible assets ratio as the ratio of intangible capital stock, including R&D capital stock and SG&A capital stock, to the sum of tangible and intangible capital. Alternatively, I include only R&D capital stock in the numerator.

Diversified firms tend to be larger in size and generate more stable cash flows, and may also be more attractive to quasi-indexers with diversified portfolios and strict fiduciary liabilities. However, diversification induced by managers' private desires that conflict with shareholders' interests, especially when a firm lacks growth opportunities, is likely to result in a value-destroying investment. Diversification of a firm is measured as the average count of 2-digit SIC codes of the firm's all operating segments. Alternatively, I only account for operating segments with no less than 5% of (absolute) sales.

Recent research finds that industry concentration in part contributes to firms' underinvestment (Gutiérrez & Philippon, 2017; E. Liu, Mian, & Sufi, 2022), and thus is expected to be associated with less efficient capital budgeting. However, conditions in highly concentrated industries may be easier to predict, and capital budgeting quality could therefore be better. Meanwhile, quasi-indexer ownership is likely to be higher in more concentrated industries due to their holding of multiple firms within the same industry. Furthermore, firms in highly concentrated industries tend to have features like higher market value and stable cash flows that attract quasi-index institutional investors. I measure the concentration of an industry using the Fama-French 48 industry Herfindahl indices constructed from the number of employees or sales. In addition, I use the Lerner index, or the price-cost ratio, which is measured as operating income before depreciation minus depreciation scaled by total sales, per Gutiérrez and Philippon (2017).

Corporate governance that protects shareholders and limits the entrenchment of managers is one of the devices designed to alleviate agency problems and maximize shareholder value. Thus better governance quality should promote more efficient capital budgeting. Additionally, a firm with higher governance quality is more attractive to institutional investors in part because they must meet certain fiduciary responsibilities and want to minimize monitoring and existing costs (Chung & Zhang, 2011). I construct the E-Index, following L. Bebchuk et al. (2009) to measure a firm's corporate governance quality.[20]

In addition to the firm and industry features listed above, the time series of marginal q and the differences in capital budgeting inefficiency between firms with

[20] I also use G-index constructed by Gompers et al. (2003) as a measure of governance, however, due to the changes in the ISS database, G-index is only available for 1990 to 2006.

high versus low quasi-indexer ownership demonstrate a time variation. On the other hand, the overall average quasi-indexer ownership experienced a significant increase around early 2000 and exhibits an increasing trend over time with some time variation, so I include year dummies in the main regressions. In addition, to control for a firm's characteristics that affect its capital budgeting efficiency but were not captured by the control variables, I include firm-fixed effects whenever it is applicable.

1.4.4 Data Summary

Table 1.1 lists the definitions of main variables, and Table 1.2 summarizes their univariate statistics for the years 1980 to 2019. Table 1.2 shows that, on average, the firm's marginal q is greater than one, which indicates a predominant underinvestment phenomenon. Figure 1.6 plots the mean estimated marginal q and residuals of total investment regressed on lagged marginal q and other controls by Fama-French 48 industries. Industries, on average, have marginal q exceeding one and total investment below the predicted level, and that confirms underinvestment indicated in Table 1.2.

Univariate comparison between high and low quasi-indexer ownership groups in Table 1.3 shows that higher quasi-indexer ownership is associated with less underinvestment and higher overall capital budgeting efficiency (smaller deviation of marginal q from one or industry average). Additionally, firms with higher quasi-indexer ownership are larger and more diversified and have more cash flows, higher leverage, lower intangible capital investment, and more entrenchment (higher E-Index and more staggered board).

1.5 Empirical Results

1.5.1 Evolution of Valuation and Efficiency

Figure 1.5 demonstrates that starting from the late 1990s, despite high valuations, measured by average q, investment declines significantly and has stayed low ever since. However, contrary to the average q, marginal q experienced a downward shift, and the median of marginal q has moved closer to one,[21] the theoretical equilibrium value for marginal q. Figures 1.12, 1.13, and 1.7 depict more direct evidence of the silver lining behind the secular decline in investment via the time series of capital budgeting efficiency, measured by the absolute divergence of marginal q from one. The overall efficiency has improved (the deviation of marginal q from optimal decreases) since the mid-1990s and has remained high, except for a drop in the early 2000s. Another interesting observation here is that the overall efficiency improvement does not conceal the fact that underinvestment is the predominant force in distorting optimal capital budgeting. Separately measuring capital budgeting (in)efficiency for underinvestment and overinvestment shows that the extent to which marginal q deviates from one or industry average is greater for underinvestment. Using the industry average as an optimal benchmark to gauge capital budgeting inefficiency shows a similar pattern, but with more variation in recent years.

1.5.2 Main Results

Relationship between Capital Budgeting Efficiency and Quasi-Indexer Ownership

Figure 1.8 illustrates a monotonic increasing (decreasing) relationship between quasi-indexer ownership and a firm's capital budgeting efficiency (deviation of marginal q from one) by sorting and grouping firms according to their quasi-index ownership, regardless of whether the absolute or squared deviation is used. As quasi-indexers tend to reside in larger firms, I also sort firms by their market capitalization and total institutional ownership separately along with the quasi-index ownership, and the pattern stays the same. Figures 1.9 and 1.10 plot the time series of capital budgeting inefficiency measures for firms with high versus low quasi-index ownership separately, and they show a persistent gap in capital budgeting inefficiency between these two groups up to around 2012, regardless of whether the absolute or squared deviation is used.

To explore the linkage between capital budgeting efficiency and quasi-indexers,

[21] The median (average) of marginal q before and after 2000 are 1.252 (1.511) and 1.006 (1.202) respectively.

I perform a regression of the absolute divergence of marginal q from one and from industry average marginal q on quasi-index ownership and other controls. As I discussed in Section 1.3, since the dependent variable is based on the estimation of marginal q from Equation 1.3, to correct for the varying degrees of precision of the estimated marginal q, I follow Hornstein and Greene (2012) and weigh all observations by the inverse of the nonlinear transformation of the standard error of estimated marginal q, as illustrated in Section 1.3.3, and the regression results are summarized in Table 1.4. To ensure that the results are not sensitive to the choice of weights, I also follow Saxonhouse (1976) to use inverse standard errors as the weights, and the results are reported in Table 1B.1 in the Appendix. The results are qualitatively the same.

Table 1.4 shows that higher quasi-index ownership is statistically significantly associated with a smaller deviation of marginal q from one, i.e. more efficient capital budgeting, regardless of whether I use absolute or squared dispersion of marginal q from one as the inverse indicator of capital budgeting efficiency. Moreover, the inclusion of leverage, cash flow, internal governance, and other control variables does not affect this pattern.

Table 1.4 also demonstrates that more diversified firms, i.e. the firm's operations span more industries, tend to make less efficient capital budgeting, consistent with value-destroying diversification which may be due to more complicated internal structure and/or more severe agency problems. Meanwhile, external dependence shows significant power in distorting the capital budgeting efficiency, and this may reflect the impact of financial constraints, managerial concerns with reputation, or overconfidence in disturbing optimal investment. In addition, the results suggest that larger firms tend to do capital budgeting more efficiently. I conjecture that this mainly reveals that large firms underinvest less since they are more mature, have more cash, and bear less informational asymmetry. I do not observe a clear pattern for the concentration measure.

Table 1.5 shows the results of a nonlinear maximum likelihood estimation of the optimal capital budgeting threshold simultaneously with the coefficients of quasi-index ownership and other control variables and demonstrates the same pattern. Additonally, inspecting industry-level results or using industrial average marginal q as the optimal threshold confirms the positive association between quasi-index ownership and capital budgeting efficiency.

Instrumental Variables Identification

Controlling for potential confounding factors in the above weighted least squared regression and nonlinear maximum likelihood estimation does not completely solve concerns of a spurious relationship between a firm's capital budgeting efficiency and its quasi-indexer ownership due to other unobserved factors. Therefore, to further address this issue, I include S&P1500 index inclusion as an instrumental variable to identify the impact of quasi-indexer ownership on a firm's capital budgeting efficiency.

Table 1.6 confirms the observed positive relationship between S&P 1500 inclusion and a firm's quasi-indexer ownership observed in Figure 1.11b. Columns (2) and (6) of Table 1.6 present the first-stage regression for the sample with a bandwidth equal to 50, where I regress quasi-indexer ownership on a dummy equal to unity if the firm is an S&P1500 member for 50 firms above and 50 firms below the S&P 1500 cutoff. Table 1.6 also demonstrates that the increase in total institutional ownership due to the index inclusion is mainly attributed to the increase in quasi-indexer ownership. Table 1.7 demonstrates that the positive impacts of S&P 1500 inclusion on a firm's quasi-indexer ownership are robust to using different bandwidths and various polynomial orders of market capitalization. To better illustrate the scale of the impact of index inclusion on quasi-indexer ownership, I scale quasi-indexer ownership by its sample standard deviation in Table 1.7. The results show that S&P 1500 inclusion induces about half of a sample standard deviation increase in quasi-indexer ownership. Moreover, the F-statistics are well above ten in all specifications, which confirms the efficiency of the S&P 1500 as an instrumental variable for quasi-indexer ownership.

The second stage estimation of Equation 1.6 using S&P 1500 as an instrumental variable for quasi-indexer ownership is reported in Table 1.8. The results demonstrate a positive relationship between a firm's quasi-indexer ownership and its capital budgeting efficiency, aligned with the weighted least squares estimation and the nonlinear maximum likelihood estimation. Table 1.9 confirms that the improvement impacts of index inclusion on a firm's capital budgeting efficiency (i.e., reduction in the deviation of a firm's marginal q from its optimal level) are robust to controlling for other index inclusion criteria, such as liquidity, and firm-specific characteristics that are found relevant to a firm's capital budgeting efficiency. In unreported analysis, I also include the total institutional ownership as and additional control, and the results remain the same. After controlling for the exogenous impact of quasi-indexer ownership, a firm's capital budgeting efficiency is positively related to its cash flow and diversification and negatively related to its fraction of intangible assets and dependence on external financing.

Impact of Quasi-indexer Ownership on the Investment-Average Q Relationship

As discussed in Section 1.3.3, the sensitivity of investment to growth opportunities, which is proxied by average q (See, e.g. Chen, El Ghoul, Guedhami, and Wang (2017)), is an alternative way to capture capital budgeting efficiency. Table 1.10 summarizes the results of the Errors-in-Variables (EIV) regression of investment ratio on average q and other variables, including an interaction term of average q and institutional ownership, as Equations 1.7 and 1.8 depict. The significant positive coefficient of the interaction term indicates that institutional ownership by quasi-indexers strengthens the linkage between investment and growth opportunities, which is in line with the above findings that quasi-index ownership promotes capital budgeting efficiency. Moreover, I also observe in models (3) to (5) of Table 1.10 that quasi-index ownership decreases the sensitivity of investment to cash flows, and this illustrates that the positive impacts of quasi-index ownership on a firm's capital budgeting efficiency could be in part from relaxing the firm's financial constraints. Another notable pattern residing in Table 1.10 is the negative association between quasi-indexer ownership and investment, showing that despite the positive impacts that quasi-indexers have on investment efficiency, higher quasi-indexer ownership is related to a lower investment ratio, which is consistent with Gutiérrez and Philippon (2017).

Overall, these findings are consistent with the conjecture that quasi-index ownership is associated with more efficient capital budgeting practices.

1.5.3 Mechanism Discussion

Underinvestment and Overinvestment

Underinvestment and overinvestment confound the overall deviation of marginal q from the first-best threshold, and the improvement on firms' capital budgeting efficiency from quasi-indexers could result from alleviating either or both problems.

Previous work demonstrates that agency problems, informational asymmetry, and investors' recognition that these frictions collectively lead to either underinvestment or overinvestment. Overinvestment could result from managers' incentives to grow a firm beyond its optimal scale to have more power and increased resources under their control (Jensen, 1986, 1993). Additionally, overconfident managers, who overestimate the future return of the firm, tend to overinvest when having abundant internal cash flows (Malmendier & Tate, 2005). On the contrary, the informational asymmetry between managers and investors could cause external financing to be so expensive that managers have to give up positive NPV projects due to insufficient internal cash flows (Stein, 2003). In addition, concerns about reputation or near-term stock returns may cause managers to be reluctant to invest in assets that are risky or less observable to investors, thus resulting in underinvestment problems (Stein, 1989). However, there is no clear implication on whether quasi-indexers and other forces affect firms that underinvest or overinvest unanimously. Moreover, one could draw some implications about the mechanisms via which quasi-indexers improve firms' capital budgeting efficiency by exploring whether and how quasi-indexers disproportionately mitigate underinvestment and overinvestment. For instance, if quasi-indexer ownership is viewed as a signal of less severe informational asymmetry or agency problems by the investors and is thus associated with alleviation of firms' financing constraints, it is expected that quasi-indexers have more significant improvement impacts on underinvesting firms' capital budgeting efficiency.

Some empirical studies suggest that underinvestment and overinvestment are not equally likely. For example, McConnell and Muscarella (1985) find that, except in the oil industry, which systematically overinvested during the period 1975-1981, the market reacts positively to the announcement of new capital expenditures. This evidence speaks to the conjecture that typical firms are underinvesting during this time. In addition, the recent trend that investment is low relative to growth opportunities and profitability at both aggregate and firm levels has escalated concerns about underinvestment and distortions in the efficiently allocating capital to where it is needed the most (Lee et al., 2016; Gutiérrez & Philippon, 2017). The measure of capital budgeting inefficiency I apply enables me to distinguish which distortion is more prevalent across time and industries from the average market perspective. More importantly, separate analyses of firms underinvesting or overinvesting could shed more light on the importance of the improvement impacts of quasi-indexers on firms' capital budgeting efficiency.

I regard underinvestment (overinvestment) as when a firm's marginal q is above (below) the first-best optimal level, which is equivalent to the NPV of the marginal investment is positive (negative; See, e.g., Stein (2003), Durnev et al. (2004), and Greene et al. (2009)).

I separate the sample into observations of underinvestment and overinvestment based on marginal q relative to the optimal threshold, and I conduct the weighted least squared estimation and instrumental variable estimation of the quasi-indexers impacts on capital budgeting inefficiency for underinvestment and overinvestment subsamples. Tables 1.11 and 1.12 demonstrate that the improvement effects of quasi-indexer ownership on a firm‘s capital budgeting efficiency resides mostly in the alleviation of underinvestment. Additionally, I introduce an interaction term of quasi-indexer ownership and indicator of underinvestment in Table 1.11 columns (3) and (6), and the significant negative interaction confirms that quasi-indexers most significantly improve the capital budgeting efficiency of firms that underinvest. Another observation from Table 1.11 is that the inefficiency of the underinvestment group contributes to the overall inefficiency more significantly than the overinvestment group, which is consistent with the pattern in Figures 1.12, 1.13, and existing studies documenting the prevalence of the underinvestment problem (McConnell & Muscarella, 1985; Gutiérrez & Philippon, 2017, etc.). Given the more significant mitigation of underinvestment problems that quasi-indexers have, the improvement of capital budgeting efficiency due to the quasi-indexer ownership is not trivial.

To ensure the robustness of my findings regarding the asymmetric behavior that quasi-indexers have on a firm's capital budgeting efficiency in underinvestment and overinvestment cases, I also perform Tobit analysis with slightly modified dependent variables. I denote underinvestment (overinvestment) as the absolute deviation of marginal q from the optimal benchmark if marginal q is greater (less) than the benchmark and zero otherwise, and use it as the dependent variable of Tobit regression. Figure 1.14 depicts the coefficients of quasi-index ownership of the Tobit regressions with choices of different optimal benchmarks. It confirms that the overall improvement impacts of quasi-index ownership on capital budgeting efficiency mainly result from mitigating underinvestment.

Information and Governance Channel

Previous literature documents that quasi-indexers have an impact on a firm‘s corporate governance and informational environment. For instance, Boone and White (2015) demonstrate a causal effect of quasi-indexers on a firm's informational environment. More specifically, applying regression discontinuity around the Russell 1000/2000 cut-off, they show that higher quasi-indexer ownership increases firms' transparency and information production via more voluntary disclosures of management forecasts and filing 8-K documents, and more importantly, that quasi-indexer ownership is positively associated with more timely and precise management forecasts. Appel et al. (2016) regard quasi-indexers as a broader definition of passive investors and find that larger quasi-indexer ownership is associated with more independent board directors, fewer takeover defenses, and less likelihood of having a dual-class share structure. Moreover, they find that quasi-indexer ownership is positively related to a firm's ROA; however, they do not find evidence speaking to the impacts of quasi-indexers on a firm‘s capital expenditures or R&D spending.

Combining the documented positive impacts of quasi-indexers on a firm's governance quality and the informational environment with the observed negative links of a firm's capital budgeting efficiency and its information opaqueness and management entrenchment, one might expect two possible channels through which quasi-indexers play a role in improving firms' capital budgeting efficiency. The first, referred to as the governance channel, is that quasi-indexers monitor the management and improve firms' governance quality such that managers are forced to make capital budgeting decisions that align more with shareholder value maximization. The other mechanism, i.e. the information channel, is that more informationally efficient asset prices introduced by quasi-indexers may facilitate better learning by managers about the cost of capital and the value of relevant cash flows, and thus more efficient capital budgeting. Thus, I try to distinguish empirically through which of the two channels, namely the information channel or governance channel, quasi-indexers affect a firm's capital budgeting efficiency. In other words, I intend to examine whether the discovered impacts of quasi-indexers on firms' information environment and governance design may have real implications on firms' economic efficiency.

To examine the information channel, I first split the sample into observations with high and low informational opaqueness based on a ranking by R&D to total assets ratio and estimate the impacts of quasi-indexers for each subsample. More specifically, I categorize an observation as high (low) in information opaqueness if it locates in the top (bottom) quartile of the R&D ratio because a higher portion of intangible assets is associated with more informational opaqueness (Durnev et al., 2004; Greene, 2008). I repeat the process for subsamples divided according to the E-Index to test the governance channel. Tables 1.13 and 1.14 report the weighted least squared estimation results for the subsample tests. In columns (1) and (3) of Table 1.13, where informational opaqueness is high, the negative coefficients of quasi-indexer ownership are significantly larger than that in columns (2) and (4), where information is less opaque. However, as shown in Table 1.14, the impacts of quasi-indexer ownership on a firm's capital budgeting efficiency are not different in firms with more or less entrenched management. To ensure the robustness of my findings, I repeat the subsample analysis using the instrumental variable method and observe the same patterns as the weighted least squared analysis. In unreported results, I do not find that quasi-indexer ownership directly affects a firm's (future) R&D investment, which is consistent with Aghion et al. (2013); Appel et al. (2016) etc.

To evaluate the robustness of these mechanisms, I introduce the interaction term of quasi-indexer ownership with R&D ratio and E-Index, respectively, to estimate the following equation:

$$|\dot{q}_{it} - h| = \alpha + \beta_1 QixOwn_{i,t-1} + \beta_2 QixOwn_{i,t-1} \times Intan_{i,t-1} (\text{or } E - index_{i,t}) + \sum_{j}^{J} \gamma_j X_{j,i,t-1} + \theta_s + \epsilon_{it}, \tag{1.9}$$

where h denotes the optimal level, $QixOwn_{i,t-1}$ is the quasi-indexer ownership of firm i in time t-1, and $X_{j,i,t-1}$ is a matrix of control variables. Table 1.15, which reports the outcome of the interaction estimation, only shows a significant negative interaction of quasi-indexer ownership with the R&D ratio, but not with the entrenchment index, which confirms the pattern demonstrated in split samples.

Since previous results demonstrate that the positive impacts of quasi-indexers on a firm's capital budgeting efficiency are mainly via alleviation of underinvestment, one question is that the information channel, through which quasi-indexers likely exert their impacts, works only for underinvestment, overinvestment or both. Moreover, suppose the better information environment induced by quasi-indexers helps management make more efficient capital budgeting decisions by facilitating their learning from the more efficient asset prices. In that case, I expect that the information channel plays a role in both under- and over-investment cases. In contrast, if the alleviation of financial constraints is the dominant outcome of the information channel, one may expect that the differential impacts of quasi-indexer ownership in firms with more opaque information are present only in underinvestment firms. I thus repeat the interaction estimation for underinvestment and overinvestment observation in Table 1.16, and I find the differential impacts of quasi-indexers on firms with more opaque information exist in both underinvestment and overinvestment cases.

Collectively, my empirical evidence suggests quasi-indexers improve a firm's capital budgeting efficiency by the informational channel, i.e. the improved information environment induced by quasi-indexers (Boone & White, 2015) leads to more efficient capital budgeting by facilitating managerial learning from informational efficient asset prices. However, I do not find evidence suggesting that better governance brought by quasi-indexers, which is documented in previous studies (Appel et al., 2016, etc.), results in more efficient capital budgeting.

1.5.4 Time Series Variation

Quasi-index ownership has experienced a significant increase since the early 2000s, but the focus of investors' strategy changes over time. For example, demand to align investment with positive environmental, social, and governance (ESG) outcomes continues unabated and has steered quasi-index investors' strategy toward ESG-related performance in recent decades. As investment strategy reflects the core values of the investors and guides investors' involvement in business operations, the impact of quasi-index ownership in aligning capital budgeting with shareholders' valuation maximization objective may fluctuate as the dominant investment ideology changes. Thus, I examine the association of quasi-index ownership with a firm's capital budgeting efficiency year by year. Since I have observed that quasi-index ownership alleviates underinvestment most significantly, I perform my yearly analysis for underinvestment and overinvestment separately, and the results are consistent with the overall sample.

Figure 1.15 plots the coefficients from a regression of the absolute deviation of marginal q from the estimated first-best optimal $\hat{h}$ on quasi-index ownership in each yearly regression.[22] The results show that since the early 1990s, quasi-index ownership has been associated with more efficient capital budgeting practices, on average, with more significant impacts in the 1990s and early 2000s. In addition, the asymmetric impacts of quasi-index ownership on underinvestment versus overinvestment are persistent over time but get smaller in the most recent decades.

1.6 Conclusion

Quasi-indexers have become the most significant institutional investors, and their fragmented holdings and index-like investment strategy raise broad debate regarding their impacts on portfolio firms. Some arguments consider quasi-indexers to be passive and deem that they lack incentives and resources to improve a firm's governance or alleviate informational asymmetry. At the same time, some evidence shows that despite their passive investment strategy, they actively reinforce a firm's

[22] I also perform annual regression using theoretical value,1, and the industry average as the first best benchmark, and the pattern holds still.

governance and demand better public information disclosure. Although there is evidence suggesting capital budgeting will be more efficient when there are fewer agency problems and less informational asymmetry, it requires empirical investigation of the impacts of quasi-indexer ownership on aligning a firm's capital budgeting with value maximization.

In this paper, I use a random coefficient method to estimate marginal q for each firm in each year and construct a reverse measure of capital budgeting efficiency as the absolute deviation of marginal q from a first-best benchmark. Applying weighted least squared regression to account for the precision of estimated marginal q, I find that higher quasi-indexer ownership is associated with a smaller deviation of marginal q from the optimal level, which means a positive relationship between quasi-indexer ownership and a firm's capital budgeting efficiency. To mitigate concerns for unobserved factors and investigate the causal relationship, I exploit the variation in quasi-indexer ownership around the cutoff of the S&P 1500 index and utilize S&P 1500 membership as an instrumental variable for quasi-indexer ownership. The discovered positive connection is robust to various bandwidths and controls.

Moreover, I find that the distortion of capital budgeting efficiency is majorly driven by underinvestment. I observe that there are more marginal qs above the benchmark than below, and the scale of the deviation is larger for marginal qs that are greater than the benchmark. Splitting the sample into underinvestment and overinvestment based on whether the estimated marginal q is above or below the first-best benchmark shows that the positive association between quasi-indexer ownership and capital budgeting efficiency is mainly due to the alleviation of underinvestment. In addition, I find that the positive association between capital budgeting efficiency and quasi-indexer ownership is more significant for a firm with more intangible assets. This interaction effect exists in both underinvestment and overinvestment samples. Collectively, this implies that the improvement effects of quasi-indexer ownership on capital budgeting efficiency in part results from the alleviation of informational asymmetry and that the benefits of less informational asymmetry are not limited to easing financial constraints.

The findings of this paper highlight the net positive effects of quasi-indexers on firms' capital budgeting efficiency and address the real economic impact of secondary market participants. However, the puzzling relationship between capital budgeting efficiency and cash flows is worth future exploration. While I provide some pieces of evidence that the positive association between a firm's capital budgeting efficiency and its quasi-indexers' ownership is at least partly due to its alleviation of informational asymmetry, it requires more work to explore the exact mechanisms via which quasi-indexer ownership influences investment efficiency. Additionally, it may also be interesting to investigate why evidence fails to establish quasi-indexers' association with more value-enhancing capital budgeting decisions through better governance, since institutional investors are subjected to fiduciary responsibilities.

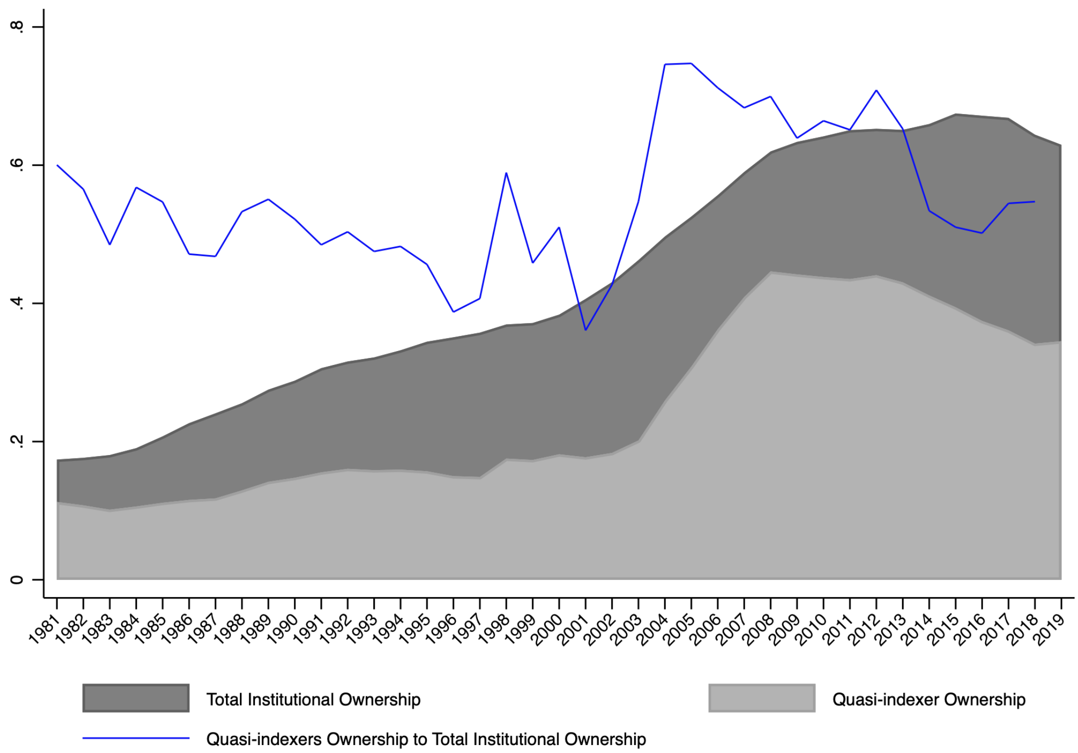


Figure 1.1: Average Quasi-indexer Ownership and Total Institutional Ownership

This figure shows the institutional ownership, quasi-indexers ownership, and the ratio of quasi-indexers ownership to the total institutional ownership averaging across all firms for each year. The sample is an unbalanced panel of 5,507 U.S. firms listed in NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019.

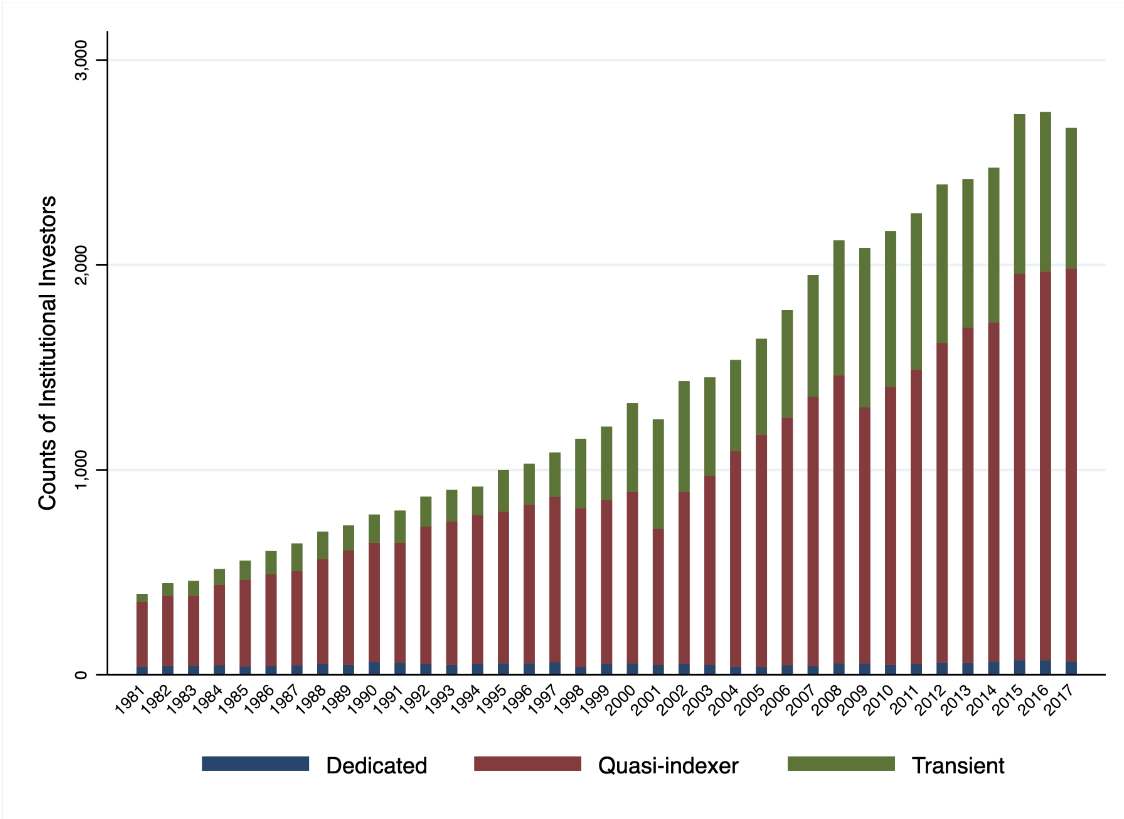


Figure 1.2: Counts of Institutional Investors

This figure shows the annual counts of institutional investors classified by their trading patterns for 1980 to 2017. Institutional investors are categorized into dedicated institutional investors, quasi-indexers institutional investors and transient institutional investors based on Bushee and Noe (2000).

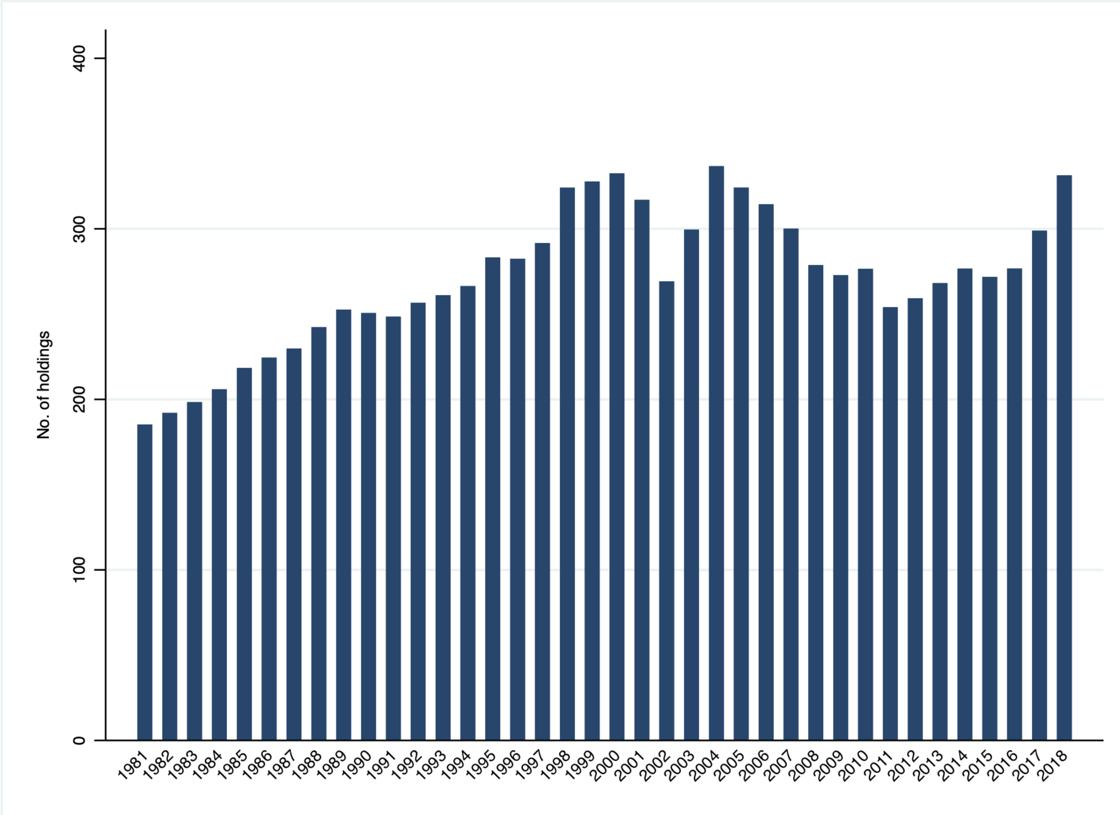


Figure 1.3: Number of Stocks Held

This figure shows the annual variation in the average holding size of quasi-indexers from 1980 to 2017. I count the number of stocks held by each institutional investor at each reporting date, and I average the counts across all quasi-indexers institutional investors for each year. Quasi-indexers are classified based on Bushee and Noe (2000).

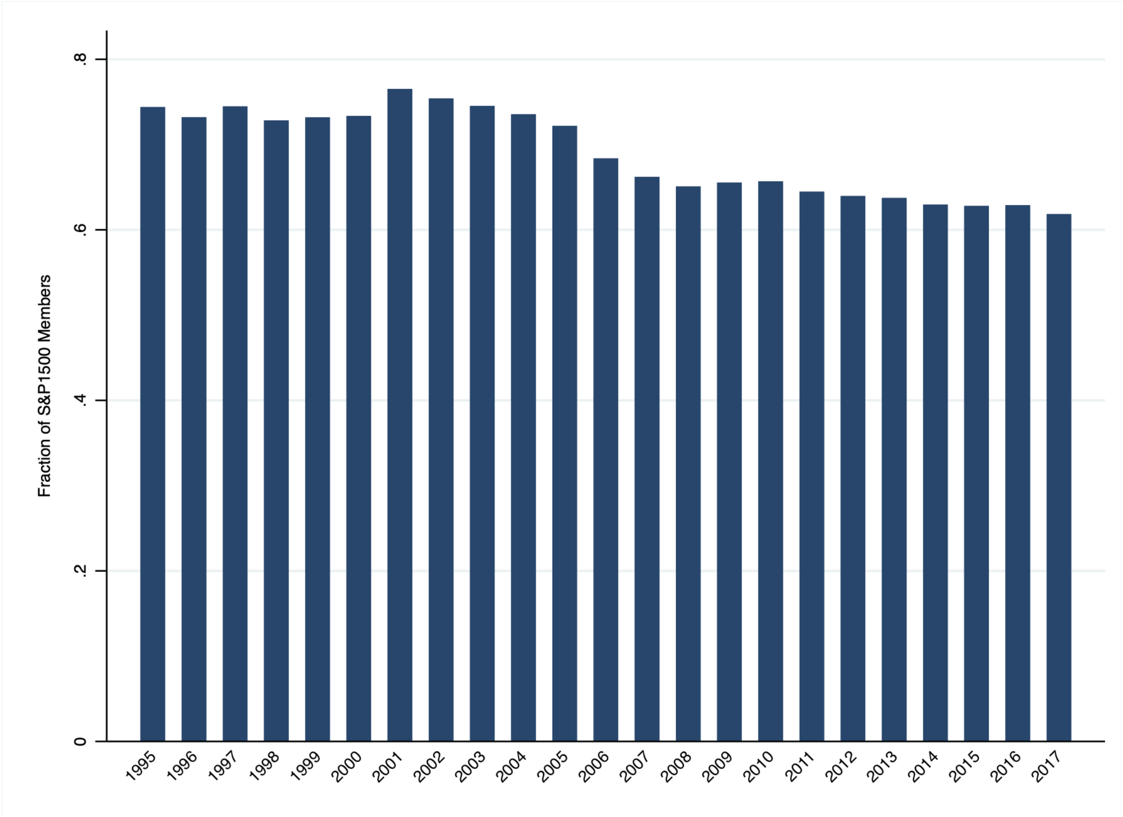


Figure 1.4: Fraction of S&P 1500 Members

This figure shows the average fraction of S&P 1500 members in the Quasi-indexers holdings for each year from 1995 to 2017. I count the number of stocks that are members of S&P 1500 for each quasi-indexer, and I scale it by the holding size of that quasi-indexer to get the fraction of S&P 1500 members for each quasi-indexer on each reporting date. Quasi-indexers are classified based on Bushee and Noe (2000).

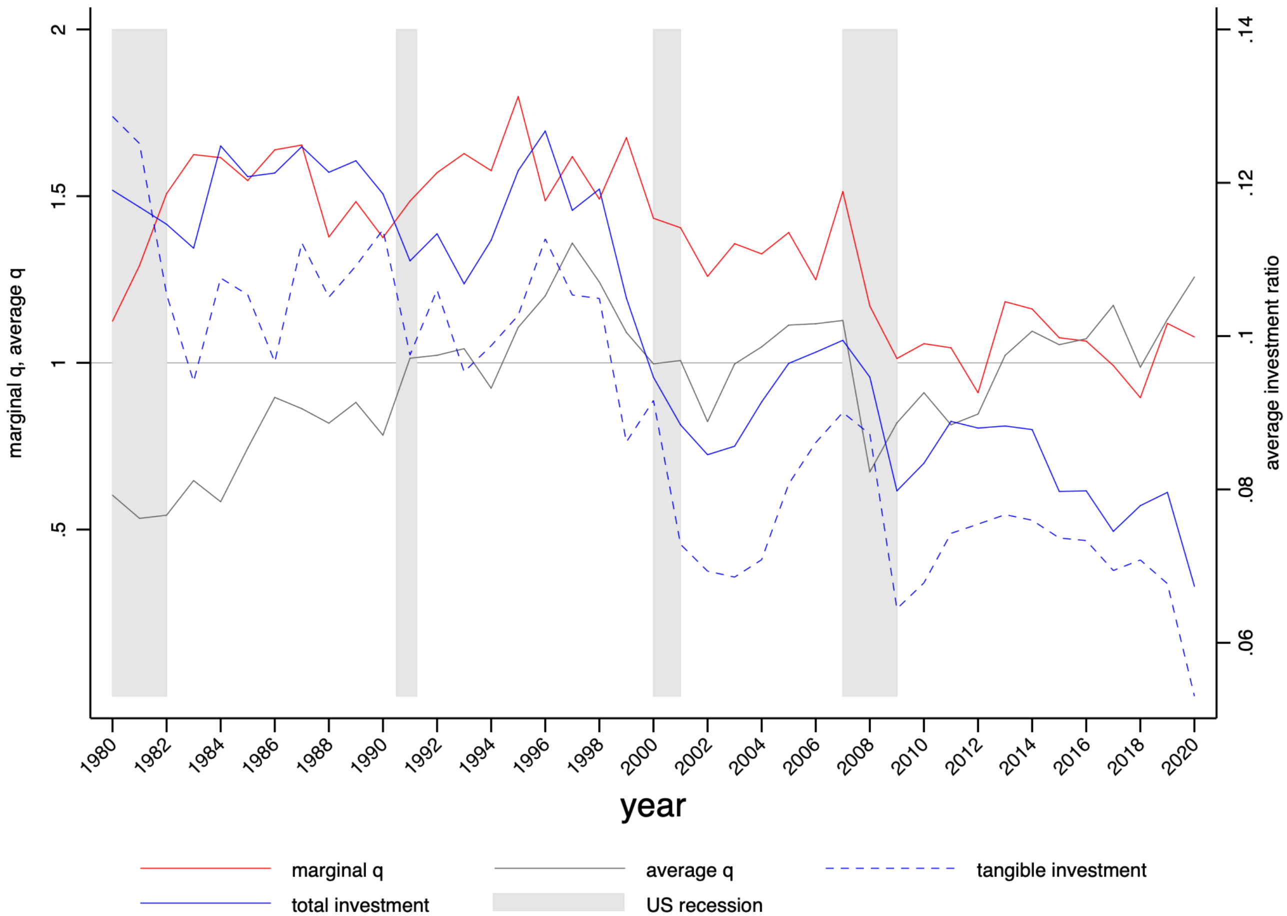


Figure 1.5: Time Series of marginal q, average q and investment

This figure shows the time series of marginal q, average q, total investment ratio and tangible investment ratio averaging across all firms. The sample is an unbalanced panel of 5,507 U.S. firms listed in NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019.

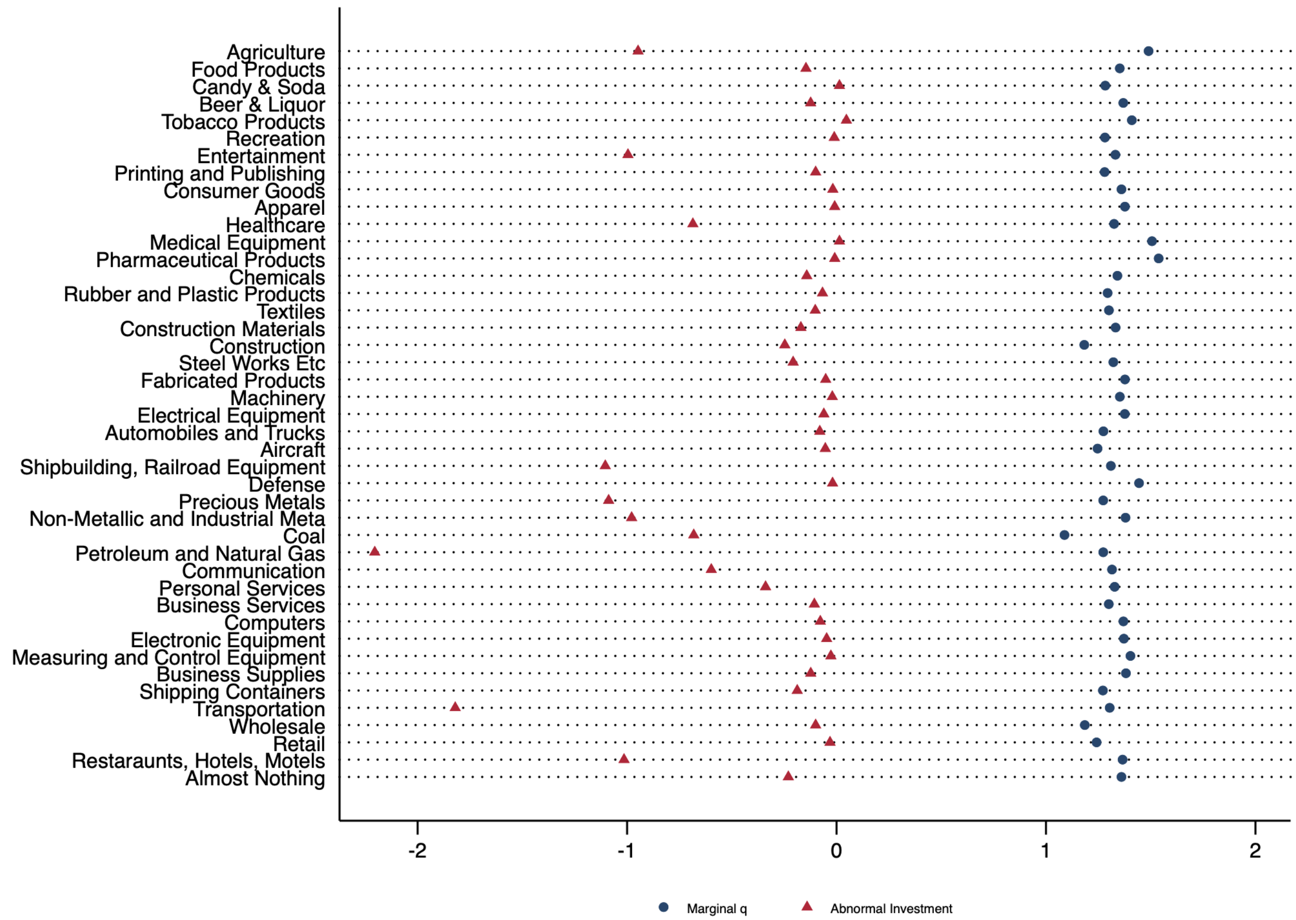


Figure 1.6: Industry composition of firms

This figure shows the estimated marginal q and abnormal investment averaging over firms for each available Fama-French 48 industries (ff48). Marginal q is the estimated coefficient of unexpected changes in market value in response to the unexpected changes in capital stock. Abnormal investment is the residuals of the investment regression, which regresses total investment on lagged average q and other controls.The sample is an unbalanced panel of 5,507 U.S. firms listed in NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019.

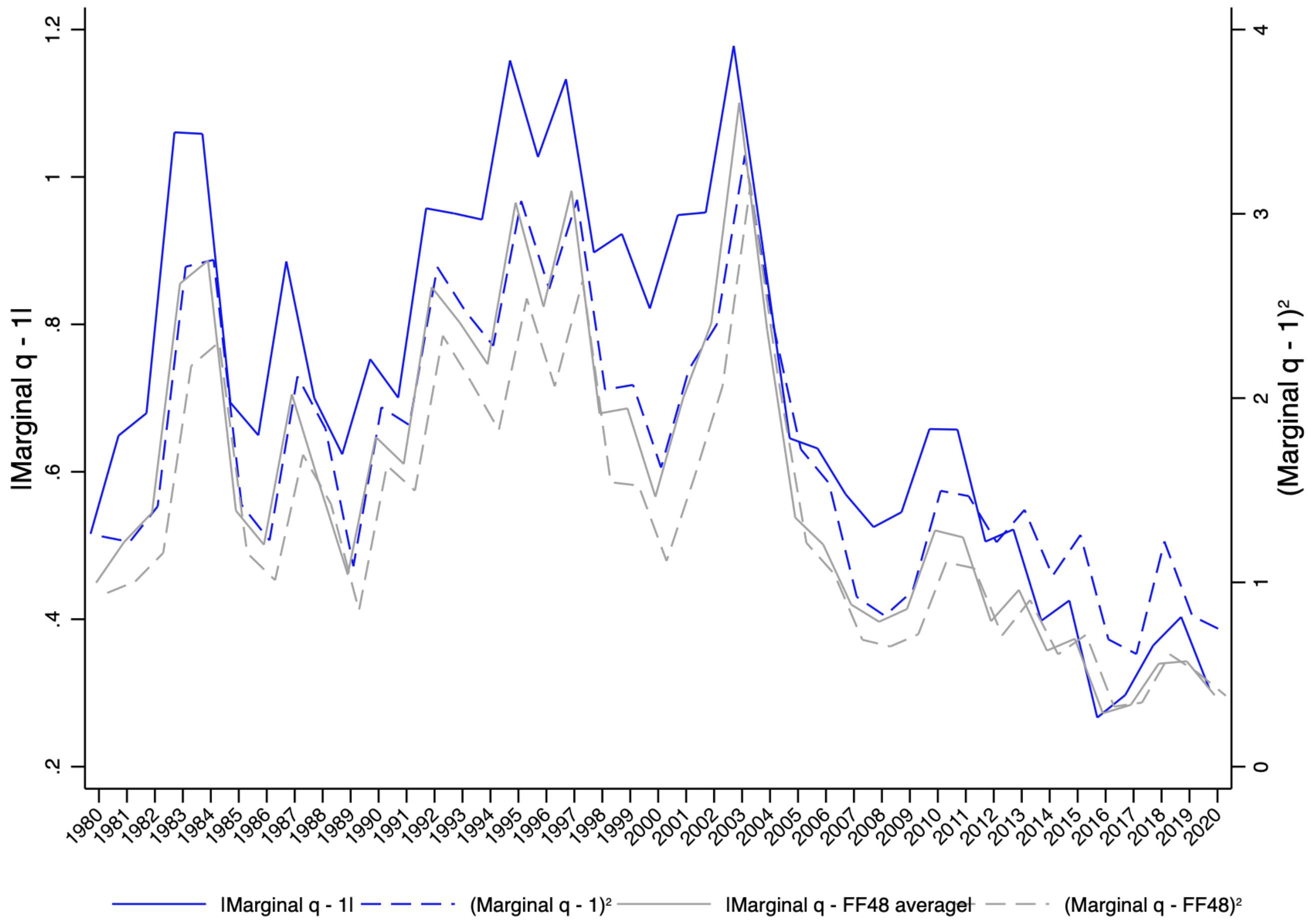
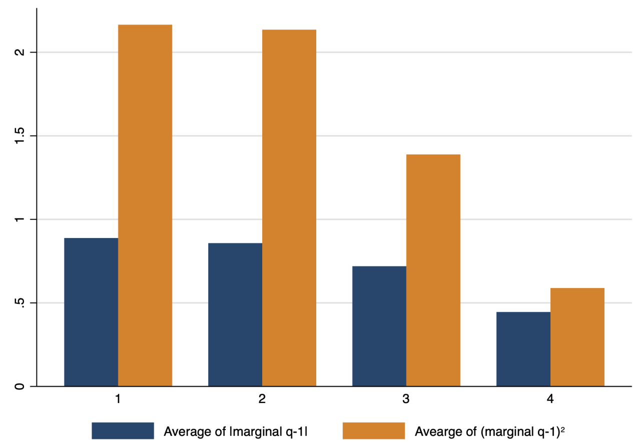
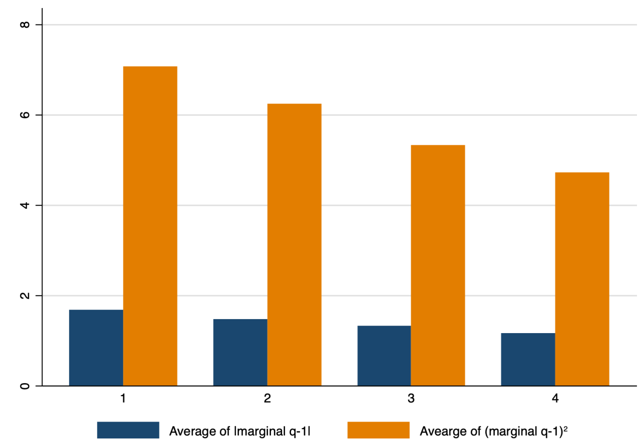


Figure 1.7: Time Series of Marginal q Deviation from Optimal

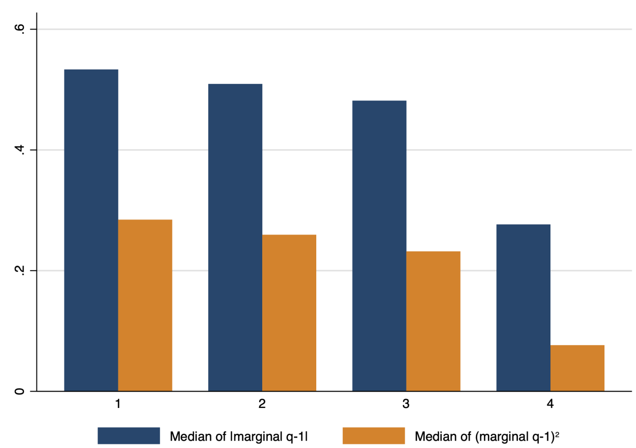
This figure shows the various measures of capital budgeting efficiency averaging over firms in each year. |Marginal q−1| and |Marginal q−FF48 average| denote the absolute deviation of estimated marginal q from 1 and industry average, respectively. (Marginal q − 1)^2 and (Marginal q − FF48 average)^2 denote the squared deviation of estimated marginal q from 1 and industry average. The sample is an unbalanced panel of 5,507 U.S. firms listed in NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019.



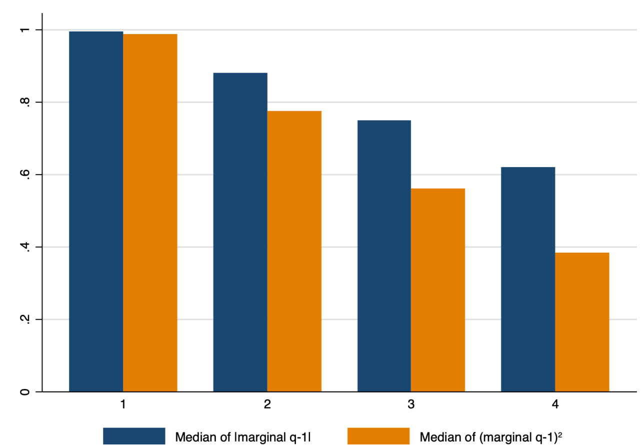
(a) Firm Average



(b) FF48 Average



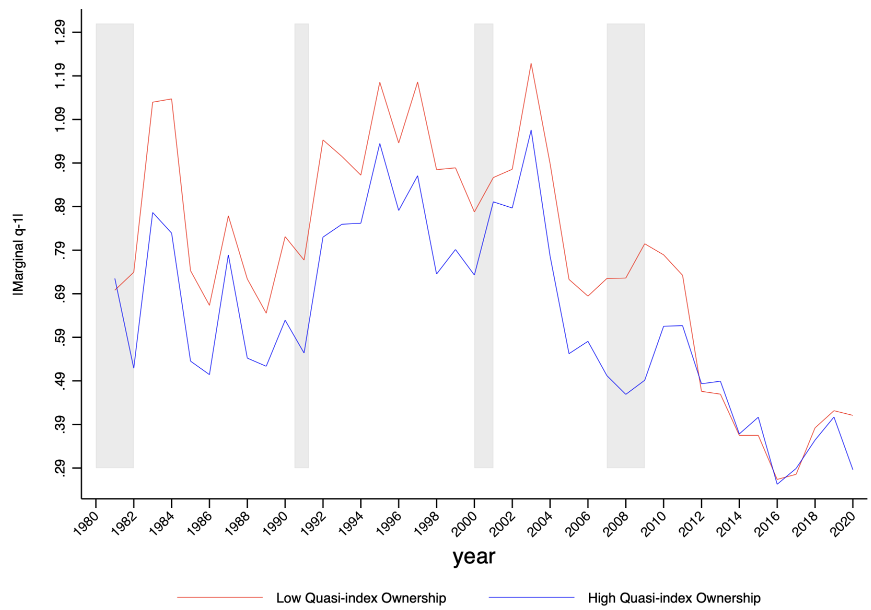
(c) Firm Median



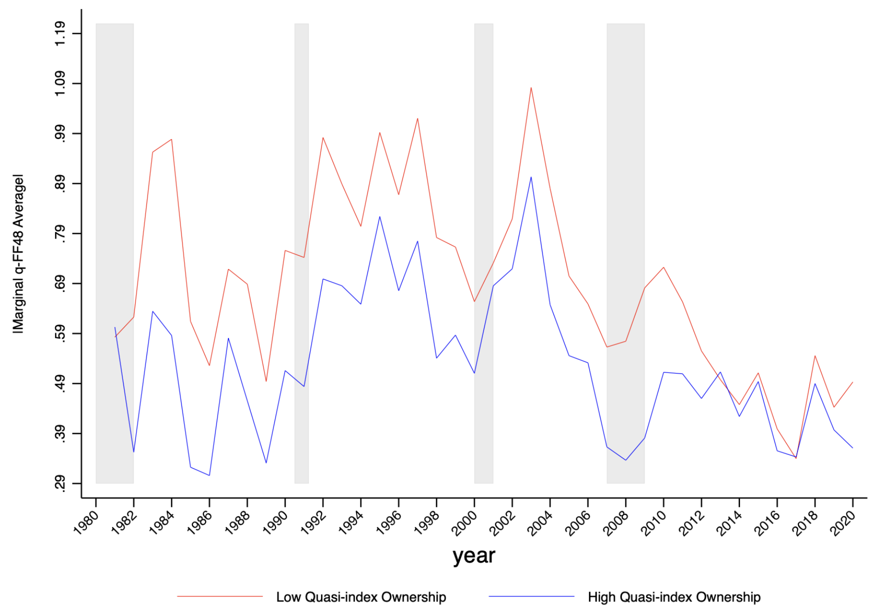
(d) FF48 Median

Figure 1.8: Capital Budgeting Efficiency within Quasi-indexer Ownership groups

This figure shows the average and median of capital budgeting efficiency for each quasi-indexers ownership quartile. Figure (a) and (c) are based on the firm-level estimated marginal q, and (b) and (d) are based on the marginal q estimated for each Fama-French 48 industry. The sample is an unbalanced panel of 5,507 U.S. firms listed in NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019.



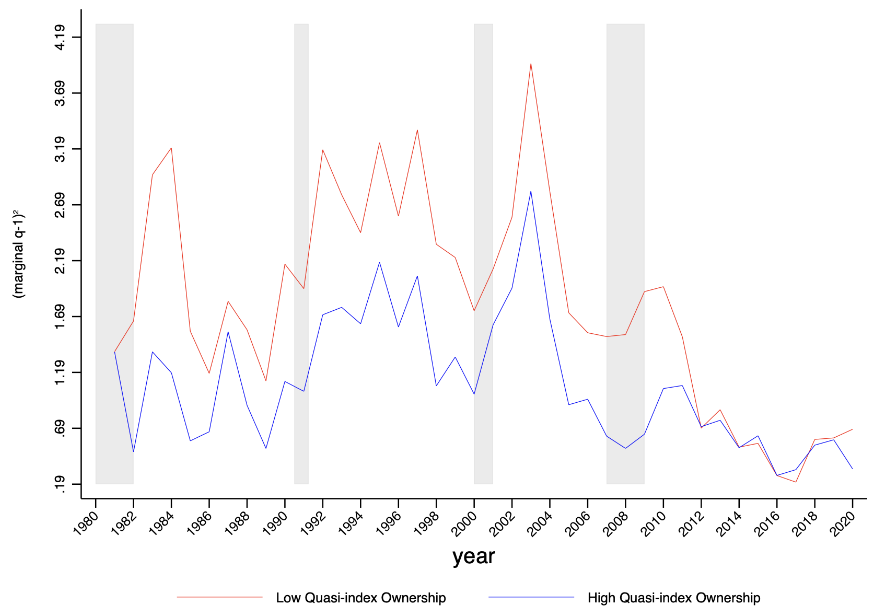
(a) $|\dot{q} - 1|$



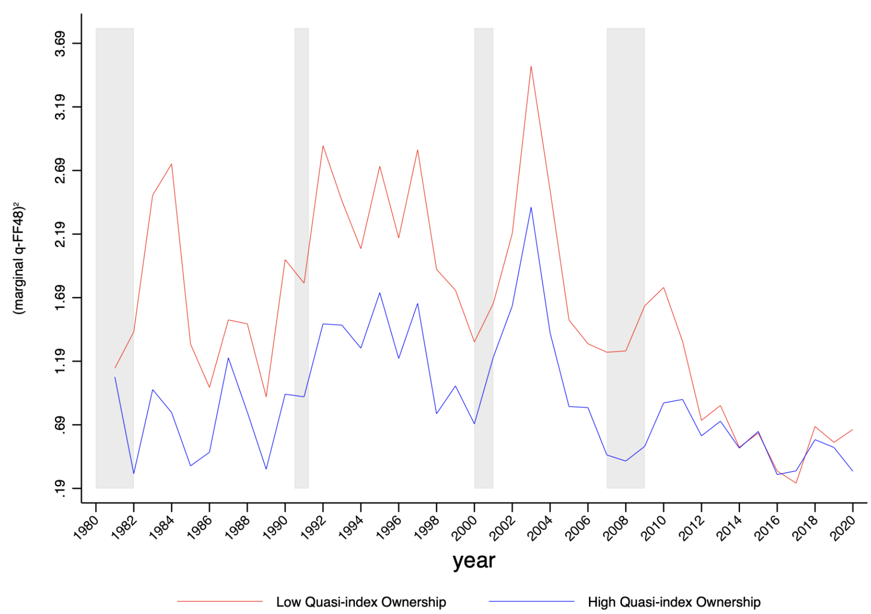
(b) $|\dot{q} - \text{FF48 Average}|$

Figure 1.9: Time Series of Absolute Deviation of Marginal Q from Optimal for High versus Low Quasi-indexers Ownership

This figure shows annual average capital budgeting efficiency for the top 40 percentile and bottom 40 percentile regarding quasi-indexers ownership. Figures (a) and (b) demonstrate the absolute deviation of marginal from one and from the industry average, respectively. The sample is an unbalanced panel of 5,507 U.S. firms listed in NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019.



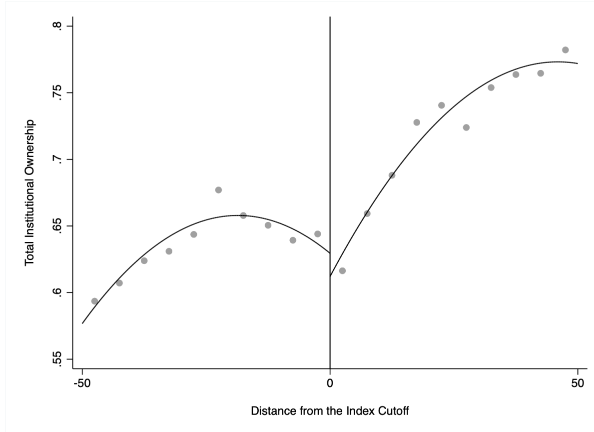
(a) $(\dot{q} - 1)^2$



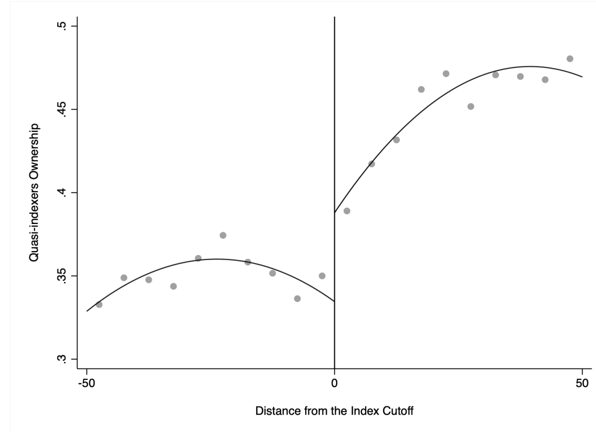
(b) $(\dot{q} - \text{FF48 Average})^2$

Figure 1.10: Time Series of Squared Deviation of Marginal Q from Optimal for High versus Low Quasi-indexers Ownership

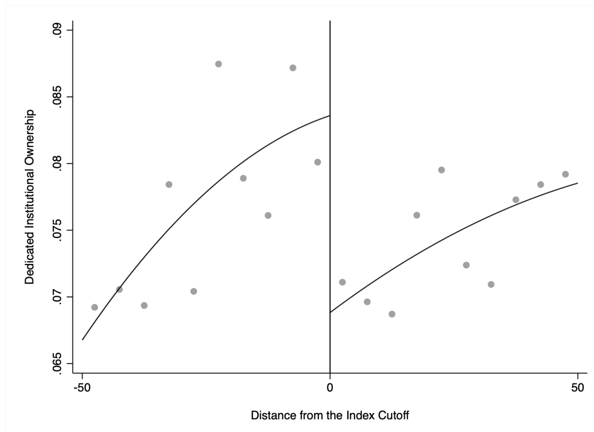
This figure shows annual average capital budgeting efficiency for the top 40 percentile and bottom 40 percentile regarding quasi-indexers ownership. Figures (a) and (b) shows the squared deviation of marginal q from one and from the industry average, respectively. The sample is an unbalanced panel of 5,507 U.S. firms listed in NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019.



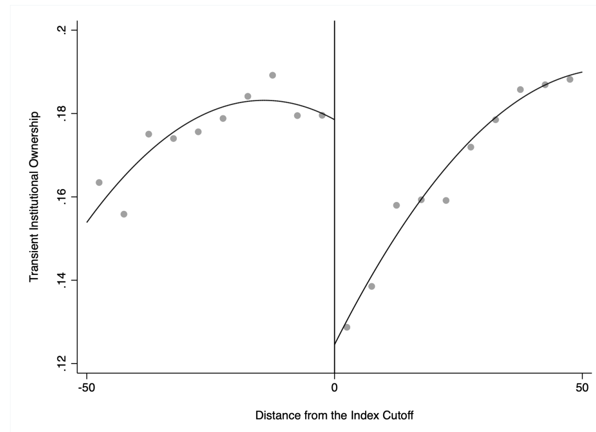
(a) Total Institutional Ownership



(b) Quasi-indexers Ownership



(c) Dedicated Institutional Ownership

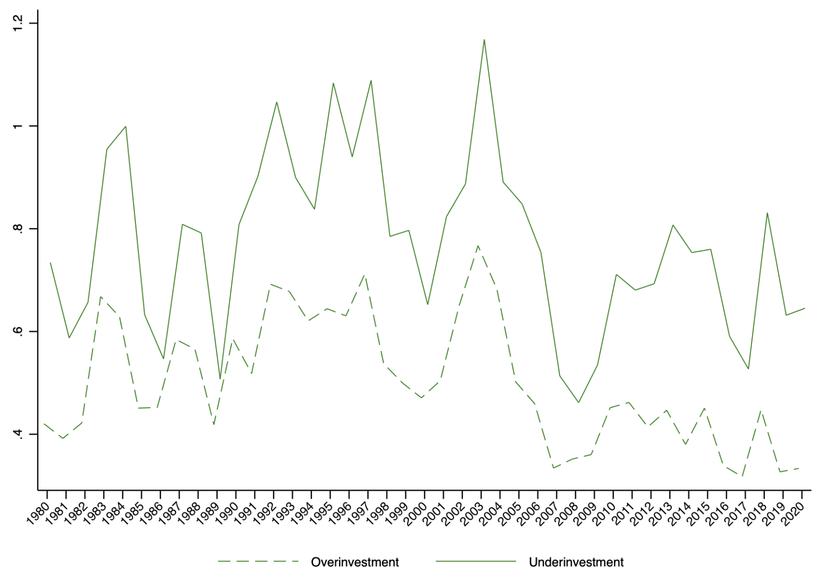


(d) Transient Institutional Ownership

Figure 1.11: Institutional Ownership around the S&P1500 Cutoffs

This figure shows the discontinuity plots of local sample means of ten non-overlapping evenly spaced bins on each side of the S&P1500 market capitalization cutoff and a second-order polynomial fitted curve for the total institutional ownership (A), quasi-indexer ownership (B), dedicated institutional ownership (C) and transient institutional ownership (D) for firms ranking by market capitalization around the S&P1500 index cutoffs for the year 1995-2018. The bandwidth is 50. The horizontal axis represents the market capitalization ranking relative to the S&P1500 Index cutoffs, with positive (negative) values indicating members (non-members) of the S&P1500 Index.

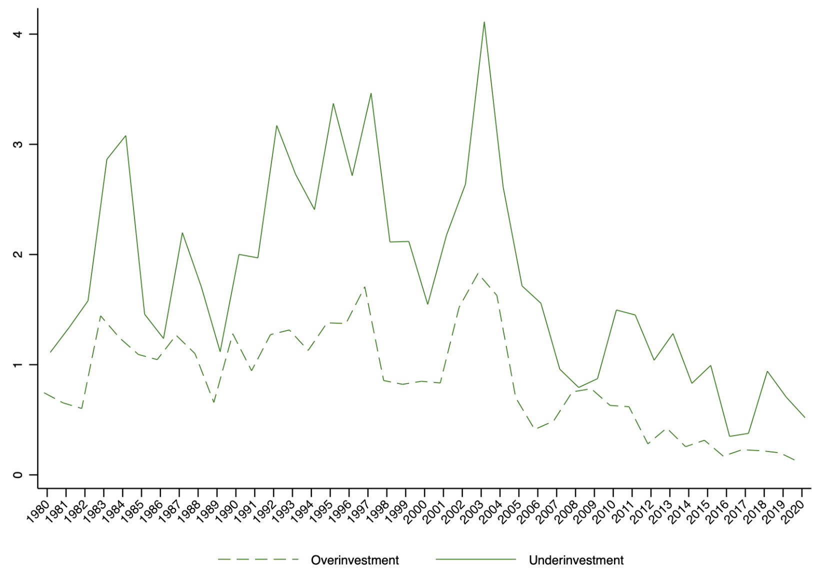
(a) $|\dot{q} - 1|$



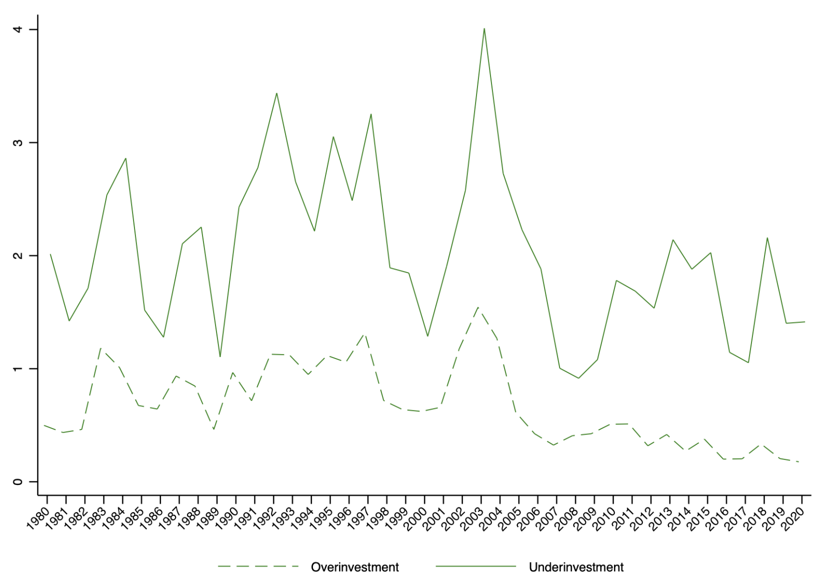
(b) $|\dot{q} - \text{FF48 average}|$

Figure 1.12: Time Series of Absolute Deviation of Marginal Q from Optimal for Underinvestment and Overinvestment Firms

This figure shows the time series of capital budgeting inefficiency, measured as the absolute deviation of marginal q from optimal, for underinvestment and overinvestment samples. At any time, a firm is classified as underinvestment (overinvestment) if its marginal q is greater (less) than the benchmark. Figures(a) and (b) show the absolute deviation of estimated marginal q from 1 and industry average, respectively. The sample is an unbalanced panel of 5,507 U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019.



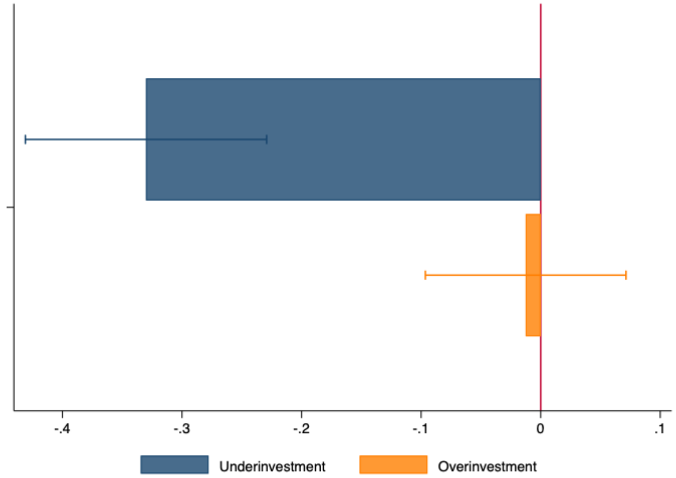
(a) $(\dot{q} - 1)^2$



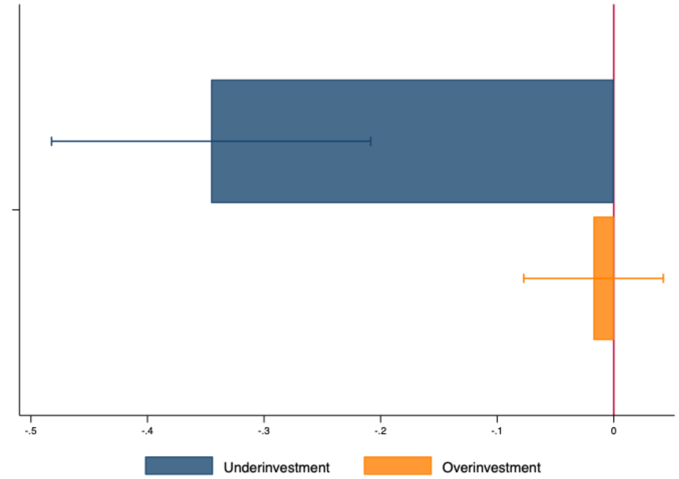
(b) $(\dot{q} - \text{FF48 average})^2$

Figure 1.13: Time Series of Squared Deviation of Marginal q from Optimal for Underinvestment and Overinvestment Firms

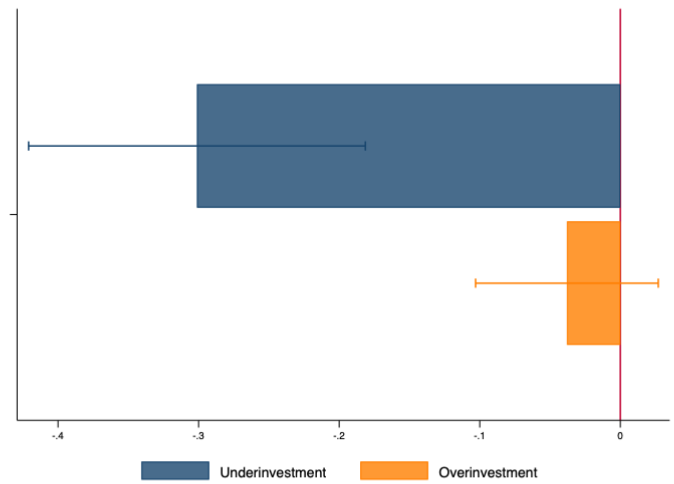
This figure shows the time series of capital budgeting inefficiency, measured as squared deviation of marginal from optimal, for underinvestment and overinvestment samples. At any time, a firm is classified as underinvestment (overinvestment) if its marginal q is greater (less) than the benchmark. Figures (a) and (b) denote the squared deviation of estimated marginal q from 1 and industry average, respectively. The sample is an unbalanced panel of 5,507 U.S. firms listed in NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019.



(a) Dependent variable: $|\dot{q} - 1|$



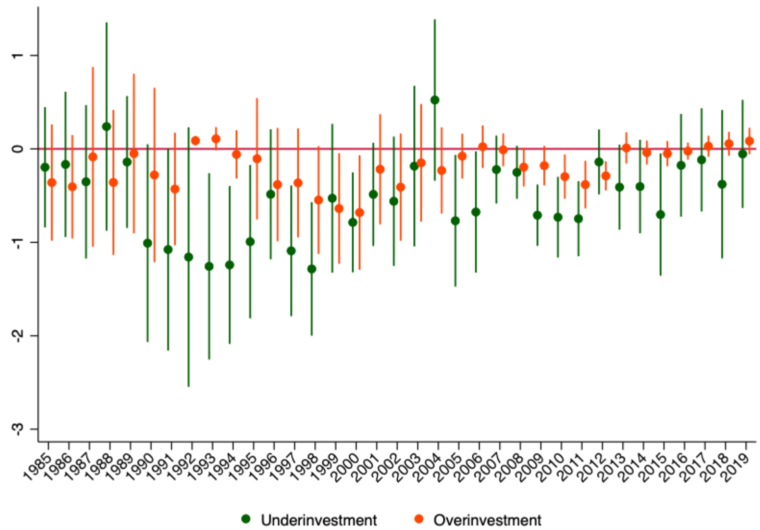
(b) Dependent variable: $|\dot{q} - \text{FF48 average}|$



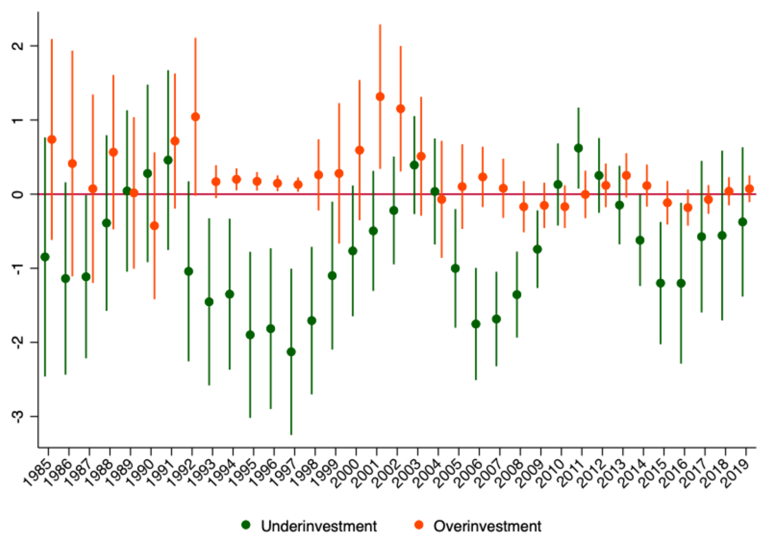
(c) Dependent variable: $|\dot{q} - \hat{h}|$

Figure 1.14: Tobit Regression Coefficient of Quasi-indexer Ownership for Underinvestment versus Overinvestment

This figure represents the quasi-indexers ownership coefficients in the Tobit regressions of various capital budgeting efficiency measures on quasi-indexers ownership, cash flows, financial leverage, intangible assets ratio, firm size for underinvestment and overinvestment samples. $|\dot{q} - 1|$, $|\dot{q} - \text{FF48 average}|$ and $|\dot{q} - \hat{h}|$ denote the absolute deviation of estimated marginal q from 1, industry average and the estimated benchmark, respectively. For underinvestment (overinvestment) sample, the dependent variables are the absolute deviation of marginal q from its optimal level if the marginal q is above (below) the benchmark, and zero otherwise. All variables are defined in table 1.1. The sample is an unbalanced panel of 5,507 U.S. firms listed in NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019.



(a) 1-year regression



(b) 5-year regression

Figure 1.15: Annual Association between Quasi-indexer Ownership and Capital Budgeting Efficiency

This figure shows the point estimation and 95th percentile confidence intervals of the quasi-indexers ownership coefficients in equation 1.4 for underinvestment and overinvestment samples for each year. The dependent variable is the absolute deviation of marginal from the estimated benchmark. All regressions control for cash flows, financial leverage, intangible asset ratio, firm size and diversification. (a) and (b) are the results for annual OLS regressions and 5-year panel firm-fixed effect regressions, respectively. All variables are defined in table 1.1. The sample is an unbalanced panel of 5,507 U.S. firms listed in NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019.

Table 1.1: Definition of Variables

Variable	Definition
Marginal q	The unexpected changes in a firm's market value in response to the unexpected changes in its capital stock. More specifically, it is the estimated coefficient $\beta_{1,it}$ in Equation 1.3, i.e. the coefficient of regressing the changes in the market value of a firm on the changes in its capital stock, controlling for its lagged market value and dividends (all variables are scaled by the lagged capital stock), using annual data from 1975 through 2019. The firm's capital stock is defined in 1A.2 as the sum of tangible and intangible capital stock, and the firm's market value is defined in 1A.1 as the sum of the market value of equity and debt.
Capital budgeting inefficiency	The squared (or absolute) deviation of marginal q from the optimal threshold.
Total investment	It is the ratio of tangible and intangible investment to the lagged replacement value of total capital stock.
PP&E investment	The ratio of capital expenditures to the lagged tangible capital stock.
Quasi-indexer Ownership (QixOwn)	The annual average percentage of a firm's shares outstanding owned by institutional investors who are classified as *Quasi-indexers* by Bushee (1998). Institutional ownership data is obtained from *Thomson/Refinitiv - Institutional (13f) Holdings - s34 Master File* via WRDS.
E-index	Also called the "Bebchuk Index" or "Entrenchment Index". Data is obtained from *ISS: Institutional Shareholder Services* via WRDS. The index is constructed following L. Bebchuk et al. (2009), is the number of entrenchment provisions implemented by the firm. The entrenchment provisions are as follows: classified (staggered) board, limited ability to amend bylaws, limited ability to amend charters, golden parachutes, and supermajority voting.

Table 1.1 continued from previous page

Leverage	The ratio of long-term debt to the replacement value of tangible assets. The alternative measure is the ratio of the market value of debt to the sum of the market value of debt and equity.
Cash flow	The sum of income and depreciation, scaled by the replacement value of tangible assets. The alternative measure is the operating income before depreciation (OIBDP), subtracting relevant taxes (XINT, TXT) and paid dividends (DVC), scaled by the total assets.
Diversification	The average counts of 2-digit SIC codes of all operating segments of a firm. Alternatively, the average counts of 2-digit SIC codes of a firm's all operating segments with no less than 5% of (absolute) sales.
Intangible ratio	The ratio of intangible capital stock, including estimated R&D capital stock and SG&A capital stock, to the sum of tangible and intangible capital. Alternatively, include only R&D capital stock in the numerator.
Size	The log of net sales of a firm. Alternatively, using the log of total assets or the log of PP&E capital.
Lerner Index	The price-cost ratio, measured following Gutiérrez and Philippon (2017) as operating income before depreciation minus depreciation scaled by sales
Herfindahl index	The Fama-French 48 industry Herfindahl indices, constructed using the number of employees or the scale of sales.
Average q	The ratio of the market value of a firm to its replacement costs of tangible and intangible assets. The market value and the replacement costs of tangible and intangible assets are depicted in the Appendix

Table 1.2: Univariate Statistics for Main Variables

This table reports the summary statistics for the variables defined in Table 1.1. The sample is an unbalanced panel of 5,507 U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019. All variables are in 2012 dollars and are winsorized at 1% and 99% level.

Variables	No. of Observations	Mean	Median	Standard Deviation	Min	Max
Marginal q	67690	1.4985	1.3217	1.0989	-0.7929	7.3412
$\lvert\dot{q}-1\rvert$	67690	0.7249	0.4290	1.0262	0.0079	6.5579
$\lvert\dot{q}-$ FF48 average$\rvert$	67690	0.6370	0.3385	0.9754	0.0057	6.2811
Total investment	67204	0.7361	0.3247	1.8921	0.0098	16.8210
PP&E investment	67658	0.1238	0.0908	0.1355	-0.0671	1.3734
Average q	67690	1.1528	0.7219	1.7280	-0.7988	17.2996
Quasi-indexer Ownership	51103	0.2948	0.2679	0.2043	0.0000	0.8144
Institutional Ownership	52004	0.4951	0.4953	0.2968	0.0040	1.0937
E-index	26537	2.4428	2.8000	1.2401	0.0000	5.0000
Cash flow	67414	0.0690	0.0813	0.1334	-1.1301	0.3873
Leverage	67683	0.9416	0.4936	1.5410	0.0000	14.9028
Diversification	67676	1.7995	1.2000	1.1102	1.0000	10.4000
Intangible ratio	67406	0.1208	0.0029	0.4809	0.0000	7.9560
Size	67638	6.1641	6.1755	1.9925	-0.0742	10.5400
Lerner Index	67632	-0.0544	0.0723	1.0386	-14.4944	0.4256
Herfindahl index	67690	0.1111	0.0869	0.0869	0.0292	0.9344

Table 1.3: Univariate Comparison for Firms with High Versus Low Quasi-indexer Ownership

This table reports the univariate test of the variables defined in Table 1.1 for samples with high quasi-indexer ownership (top 50 percentile) versus those with low quasi-indexer ownership (bottom 50 percentile). The sample is an unbalanced panel of 5,507 U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019. All variables are in 2012 dollars and are winsorized at 1% and 99% levels. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% levels.

	Low Quasi-index Ownership		High Quasi-index Ownership		Low minus high
	N	Mean	N	Mean	
Marginal q	20176	1.592	27582	1.438	0.153***
Abnormal investment	33014	0.625	35817	0.518	0.107***
$\lvert\dot{q}-1\rvert$	20176	0.846	27582	0.633	0.214***
Total investment	33867	0.897	36977	0.67	0.227***
PP&E investment	34081	0.193	37042	0.15	0.043***
Average q	36937	1.803	36879	1.548	0.255***
Quasi-indexer Ownership	38154	0.097	38155	0.404	-0.306***
Institutional Ownership	38154	0.235	38155	0.671	-0.437***
E-index	3860	1.821	23250	2.508	-0.687***
Classified Board	744	0.482	3209	0.519	-0.036*
Cash Flow	37337	0.012	37092	0.079	-0.067***
Leverage	38033	0.893	38104	1.137	-0.244***
Diversification	38120	1.432	38140	1.734	-0.302***
Intangible Ratio	37751	0.344	37847	0.263	0.081***
Size	37733	4.587	37985	6.67	-2.083***
Lerner Index	37703	-0.378	37962	-0.098	-0.280***
Herfindahl Index	38154	0.111	38155	0.105	0.005***

Table 1.4: Weighted Least Squares Regression of Firms' Capital Budgeting Efficiency on Quasi-indexer Ownership and Control Variables

This table reports the weighted least squared regressions of a firm's capital budgeting inefficiency on its quasi-indexer ownership and various control variables. The dependent variables for column (1) to (3) and columns (4) to (6) are the distance of estimated marginal q from the theoretical optimal level, i.e. one, ($|\dot{q}-1|$) and from industry average level ($|\dot{q}-\text{FF48 Average}|$), respectively. All variables are as defined in Table 1.1 and all independent variables lag dependent variables for one year. All observations are weighed by the inversed transformation of the standard error of estimated marginal q following Hornstein and Greene (2012). Firm-fixed effects and year-fixed effects are included in all models. The sample is an unbalanced panel of U.S. firms listed in NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019. All variables are in the 2012 dollar and are winsorized at 1% and 99% levels. T-Statistics are shown in parentheses, and standard errors are clustered by firm. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

Dependent Var =	$\lvert\dot{q}-1\rvert$				$\lvert\dot{q}-\text{FF48 Average}\rvert$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Quasi-index Ownership	-0.960***	-0.440***	-0.426***	-0.427***	-0.750***	-0.264**	-0.247*	-0.247*
	(-4.23)	(-2.92)	(-2.83)	(-2.84)	(-3.67)	(-2.02)	(-1.89)	(-1.89)
Leverage	-0.028**	-0.008	-0.01	-0.01	-0.01	0.012	0.008	0.008
	(-1.99)	(-0.62)	(-0.79)	(-0.81)	(-0.67)	(1.00)	(0.67)	(0.67)
Cash Flow	0.815***	0.232	0.149	0.152	0.797***	0.194	0.092	0.094
	(3.10)	(1.02)	(0.64)	(0.65)	(3.25)	(0.91)	(0.42)	(0.43)
Intangible Assets	0.397***	0.081	0.076	0.076	0.348**	0.033	0.025	0.025
	(2.72)	(0.72)	(0.66)	(0.66)	(2.39)	(0.30)	(0.23)	(0.22)
Size	0.082**	-0.186***	-0.185***	-0.185***	0.048	-0.217***	-0.216***	-0.216***
	(2.54)	(-6.40)	(-6.32)	(-6.32)	(1.62)	(-7.78)	(-7.70)	(-7.71)
Diversification	-0.014	0.007	0.007	0.007	0.001	0.021*	0.020*	0.020*
	(-0.79)	(0.56)	(0.55)	(0.55)	(0.06)	(1.69)	(1.66)	(1.66)
E-index	-0.003	0.02	0.021	0.021	-0.013	0.012	0.012	0.012
	(-0.15)	(1.14)	(1.14)	(1.15)	(-0.63)	(0.72)	(0.75)	(0.75)
Average q		0.349***	0.347***	0.347***		0.346***	0.344***	0.344***
		(14.09)	(13.95)	(13.98)		(14.92)	(14.78)	(14.80)
External dependence			0.014***	0.014***			0.018***	0.018***
			(2.72)	(2.73)			(3.44)	(3.45)
HHI Index				-0.215				-0.099
				(-0.62)				(-0.33)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	21461	21461	21421	21421	21461	21461	21421	21421
No. of Firms	2346	2346	2344	2344	2346	2346	2344	2344
R-square	0.53	0.63	0.63	0.63	0.48	0.59	0.59	0.59
F-Statistics	19.28	27.55	27.39	26.78	15.25	22.33	22.32	21.77

Table 1.5: Nonlinear Regression of Capital Budgeting Efficiency on Quasi-indexer Ownership and Control Variables

This table reports nonlinear maximum likelihood regression of capital budgeting efficiency on quasi-indexer ownership and control variables. This method estimates the optimal marginal q, $\hat{h}$, simultaneously with coefficients of quasi-indexers ownership and other controls. The dependent variables are the absolute deviation of estimated marginal q from the simultaneously estimated optimal level. All control variables are as defined in Table 1.1. The sample is an unbalanced panel of 5,507 U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019. All variables are in 2012 dollars and are winsorized at 1% and 99% levels. T-statistics are shown in parentheses. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	$\lvert\dot{q}-h\rvert$				$(\dot{q}-h)^2$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Quasi-index Ownership	-0.077**	-0.073***	-0.059*	-0.059*	-0.252***	-0.279***	-0.259***	-0.261***
	(-2.49)	(-2.62)	(-1.94)	(-1.94)	(-2.91)	(-3.50)	(-3.28)	(-3.30)
Leverage	0.001	0	-0.002	-0.002	0.008	0.012*	0.005	0.005
	(0.66)	(-0.06)	(-1.47)	(-1.45)	(1.09)	(1.67)	(0.64)	(0.63)
Cash Flows	0.205***	-0.140***	-0.199***	-0.184***	0.112	-0.275*	-0.322**	-0.348**
	(5.18)	(-3.63)	(-5.16)	(-4.45)	(0.59)	(-1.77)	(-2.07)	(-2.14)
Intangible Ratio	0.097***	0.052***	0.039***	0.030***	0.056	-0.011	-0.017	-0.006
	(8.80)	(5.42)	(3.76)	(2.73)	(1.54)	(-0.33)	(-0.50)	(-0.15)
Size	0.002	-0.009***	-0.012***	-0.012***	0.000	-0.022**	-0.019**	-0.019**
	(1.22)	(-5.23)	(-6.80)	(-6.80)	(0.02)	(-2.28)	(-2.02)	(-2.02)
Diversification	-0.021***	-0.009***	-0.007***	-0.008***	-0.032***	-0.014	-0.014*	-0.014*
	(-10.62)	(-4.51)	(-3.94)	(-3.97)	(-3.42)	(-1.58)	(-1.71)	(-1.69)

Table 1.5 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
E-index	-0.006**	0.003	0.003	0.003	-0.026*	-0.006	-0.004	-0.004
	(-2.39)	(1.44)	(1.41)	(1.42)	(-1.85)	(-0.48)	(-0.30)	(-0.29)
Average q		0.089***	0.086***	0.086***		0.141***	0.140***	0.139***
		(26.44)	(25.45)	(25.47)		(8.38)	(8.30)	(8.31)
External Dependence			0.016***	0.016***			0.022***	0.022***
			(11.57)	(11.57)			(3.95)	(3.92)
Lerner Index				-0.007				0.011
				(-0.88)				(0.47)
$\hat{h}$	1.157+	1.090+	1.145+	1.144+	1.080+	1.070+	1.074+	1.074+
	(7.41e+07)	(6.77e+07)	(443.11)	(443.24)	(39.93)	(42.70)	(43.44)	(43.51)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	19373	19373	19344	19337	21480	21480	21444	21442
Adj. R-square	0.60	0.64	0.65	0.65	0.86	0.87	0.87	0.87
Log-likelihood	-4787.5	-3790.9	-3608.1	-3597.5	-14628.8	-13343.5	-13152.3	-13148.9

Table 1.6: S&P1500 Index Inclusion Impacts on Institutional Ownership

This table reports OLS estimation of the regression $Y_{it} = \eta + \lambda S\&P500_{it} + \sum_{n=1}^{N} \theta_n (ln(Mktcap_{it}))^n + \phi Industry_{it} + \delta_t + \mu_{it}$, where the Y_{it} are total institutional ownership((1),(5)) quasi-indexer ownership ((2), (6)), dedicated institutional ownership ((3), (7)) and transient institutional ownership ((4), (8)), respectively. The bandwidth is 50, i.e. the sample consists of 50 firms below and above the S&P1500 cutoff. The model is estimated over 1995-2018 using a second polynomial order control for the log of market capitalization (N=2). T-statistics are shown in parentheses, and standard errors are clustered at firm level. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	Institutional Ownership of							
	Total	Qix	Ded	Trans	Total	Qix	Ded	Trans
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
S&P1500	0.114***	0.096***	0.014***	-0.006	0.107***	0.094***	0.011***	-0.004
	(6.932)	(7.770)	(3.476)	(-0.960)	(7.117)	(9.662)	(3.091)	(-0.658)
Bandwidth	50	50	50	50	50	50	50	50
Polynomial order (N)	2	2	2	2	2	2	2	2
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
No. of Observations	4931	4931	4931	4931	4931	4931	4931	4931
F-Statistics	16.49	16.06	383.05	22.96	28.97	75.69	65.20	46.71
R-square	0.25	0.16	0.03	0.11	0.45	0.59	0.45	0.38

Table 1.7: First-stage Estimation for Quasi-indexers Ownership

This table reports the 1st-stage regression of quasi-indexer ownership onto S&P1500 membership indicator and control variables, i.e. estimation of $QixOwn\% = \eta + \lambda S\&P500_{it} + \sum_{n=1}^{N} \theta_n (ln(Mktcap_{it}))^n + \phi Industry_{it} + \delta_t + \mu_{it}$. The dependent variable $QixxOwn\%$ is a firm's quasi-indexers' ownership scaled by the sample standard deviation to better quantify the economic magnitude of the impact of S&P1500 index inclusion. The bandwidth is 50, 100, 150 and 250 for columns (1), (2), (3) and (4), respectively, i.e. the sample consists of 50, 100, 150 and 250 firms below and above the S&P1500 cutoff. The model is estimated over 1995-2018 using various polynomial order control for the log of market capitalization. Panel A, B and C report the results using 2nd, 3rd and 4th polynomial orders, respectively. T-statistics are shown in parentheses, and standard errors are clustered at firm level. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	(1)	(2)	(3)	(4)
Panel A: Polynominal Orders N = 2				
S&P1500	0.429***	0.470***	0.482***	0.490***
	(9.66)	(13.95)	(15.32)	(16.65)
Bandwidth	50	100	150	250
Polynominal Orders (N)	2	2	2	2
Industry Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
No. of Observations	4931	10153	13110	16459
F-Statistics	75.69	104.48	119.60	150.31
R-square	0.59	0.59	0.61	0.63
Panel B: Polynominal Orders N = 3				
S&P1500	0.428***	0.462***	0.477***	0.491***
	(9.69)	(13.81)	(15.26)	(16.61)
Bandwidth	50	100	150	250
Polynominal Orders (N)	3	3	3	3
Industry Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
No. of Observations	4931	10153	13110	16459
F-Statistics	75.21	103.02	117.38	150.79

Table 1.7 continued from previous page

	(1)	(2)	(3)	(4)
R-square	0.59	0.59	0.61	0.63
Panel C: Polynominal Orders N = 4				
S&P1500	0.422***	0.462***	0.470***	0.467***
	(9.43)	(13.82)	(14.98)	(15.69)
Bandwidth	50	100	150	250
Polynominal Orders (N)	4	4	4	4
Industry Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
No. of Observations	4931	10153	13110	16459
F-Statistics	72.64	102.31	116.11	149.32
R-square	0.59	0.59	0.61	0.64

Table 1.8: IV Identification of the Quasi-indexer Ownership's Impact on Capital Budgeting Efficiency

This table reports the results of instrumental variables identification of the impact of the quasi-indexer ownership on a firm's capital budgeting efficiency. Specifically, I estimate $|\dot{q}_{it} - h| = \alpha + \beta QixOwn_{it} + \sum_{n=1}^{N} \Theta_n (ln(Mktcap_{it}))^n + \Phi Industry_{it} + \delta_t + \varepsilon_{it}$, where the dependent variables are the inverse measure of capital budgeting efficiency, with the absolute deviation of marginal q from unit for column (1) to (5), and the absolute deviation of marginal q from the industry average for column (6) to (10). $QixOwn_{it}$ is the percentage of shares outstanding held by quasi-indexers scaled by the sample standard deviation, and I use the S&P1500 membership $S\&P1500_{it}$ as its instrumental variable. $Mktcap_{it}$ is the market capitalization of the firm i at year t. The model is estimated over 1995-2018 using 50 firms (column (1), (6)), 100 firms (column (2), (7)), 150 firms (column (3), (8)), 200 firms (column (4), (9)), and 250 firms (column (5), (10)) below and above the S&P1500 cutoff. Various polynomial orders of $ln(Mktcap_{it})$ are controlled, with N=2,3, and 4 for panel A, B and C, respectively. Kleibergen-Paap Wald F statistic is the F-statistics of weak identification test for the 1st-stage estimation robust to firm-level clustered standard errors, see Kleibergen (2007). Anderson-Rubin F and P-value of AR F show the weak identification test based on Anderson-Rubin (1949). T-statistics are shown in parentheses, and standard errors are clustered at firm level. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

Dep. variable =	$\lvert\dot{q} - 1\rvert$					$\lvert\dot{q} - FF48Average\rvert$				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Polynomial Orders N=2										
QixOwn	-0.403***	-0.420***	-0.364***	-0.316***	-0.319***	-0.397***	-0.390***	-0.340***	-0.292***	-0.282***
	(-3.46)	(-4.90)	(-4.85)	(-4.63)	(-5.96)	(-3.49)	(-4.72)	(-4.70)	(-4.48)	(-5.57)
No. of Observations	4931	10153	13110	14893	16459	4931	10153	13110	16459	32845
Kleibergen-Paap rk Wald F statistic	93.35	194.68	234.57	277.15	423.54	93.35	194.68	234.57	277.15	423.54
Anderson-Rubin F	18.42	7.80	5.66	1.03	36.77	13.09	22.59	22.21	20.44	31.85
P-value of AR F	0.00	0.01	0.02	0.31	0.00	0.00	0.00	0.00	0.00	0.00

Table 1.8 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
F-stats	5.44	7.93	9.28	11.67	25.68	3.91	4.98	6.43	8.10	16.45
R-square	0.42	0.41	0.42	0.42	0.42	0.38	0.36	0.37	0.37	0.37
Panel B: Polynomial Orders N=3										
QixOwn	-0.387***	-0.420***	-0.360***	-0.315***	-0.365***	-0.382***	-0.390***	-0.338***	-0.291***	-0.312***
	(-3.36)	(-4.82)	(-4.77)	(-4.63)	(-6.19)	(-3.39)	(-4.64)	(-4.64)	(-4.48)	(-5.61)
No. of Observations	4931	10153	13110	14893	16459	4931	10153	13110	16459	32845
Kleibergen-Paap rk Wald F statistic	93.35	194.68	234.57	277.15	423.54	93.35	194.68	234.57	277.15	423.54
Anderson-Rubin F	18.42	7.80	5.66	1.03	36.77	12.31	21.94	21.78	20.46	32.75
P-value of AR F	0.00	0.01	0.02	0.31	0.00	0.00	0.00	0.00	0.00	0.00
F-stats	5.37	7.99	9.19	11.57	26.08	5.44	7.93	9.28	11.67	25.68
R-square	0.43	0.41	0.42	0.42	0.41	0.38	0.36	0.37	0.37	0.36
Panel C: Polynomial Orders N=4										
QixOwn	-0.403***	-0.427***	-0.384***	-0.346***	-0.397***	-0.390***	-0.395***	-0.360***	-0.319***	-0.340***
	(-3.37)	(-4.87)	(-4.90)	(-4.70)	(-6.30)	(-3.34)	(-4.68)	(-4.76)	(-4.53)	(-5.73)
No. of Observations	4931	10153	13110	14893	16459	4931	10153	13110	16459	32845
Kleibergen-Paap rk Wald F statistic	88.96	190.94	224.26	246.05	312.5	93.35	194.68	234.57	277.15	423.54
Anderson-Rubin F	12.23	24.54	24.57	22.87	42.97	12.00	22.44	23.05	21.17	34.84

Table 1.8 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
P-value of AR F	0.00	0.01	0.02	0.31	0.00	0.00	0.00	0.00	0.00	0.00
F-stats	5.58	7.91	9.05	11.40	25.32	3.96	4.87	6.20	7.86	15.79
R-square	0.42	0.41	0.42	0.42	0.41	0.38	0.36	0.37	0.37	0.36
Bandwidth	50	100	150	250	NA	50	100	150	250	NA
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 1.9: IV Identification of the Quasi-indexer Ownership's Impact on Capital Budgeting Efficiency with Controls

This table reports the results of the 2nd-stage of instrumental variables identification of the impact of the quasi-indexer ownership on a firm's capital budgeting efficiency including controls for cash flows, leverage and other variables besides polynomial of market capitalization. Specifically, I estimate $|\dot{q}_{it} - h| = \alpha + \beta QixOwn_{it} + \sum_{n=1}^{N} \Theta_n (ln(Mktcap_{it}))^n + \sum_{j=1}^{J} \gamma_j X_j + \Phi Industry_{it} + \delta_t + \varepsilon_{it}$, where the dependent variables are the inverse measure of capital budgeting efficiency, with the absolute deviation of marginal q from unit for column (1) to (4), and the absolute deviation of marginal q from the industry average for column (5) to (8). $QixOwn_{it}$ is the percentage of shares outstanding held by quasi-indexers scaled by the sample standard deviation, and I use the S&P1500 membership $S\&P1500_{it}$ as its instrumental variable. $Mktcap_{it}$ is the market capitalization of the firm i at year t. The model is estimated over 1995-2018 using various bandwidths around the S&P1500 cutoff. Results reported control for two or three polynomial orders of $ln(Mktcap_{it})$. Kleibergen-Paap LM statistic (Chi2) and p-value of Chi2 report the LM test of under-identification (relevance of instrumental variables) robust to standard errors clustered by firms, and Kleibergen-Paap Wald F statistic is the F-statistics of weak identification test robust to firm-level clustered standard errors, see Kleibergen (2007). Anderson-Rubin F and P-value of AR F show the weak identification test based on Anderson-Rubin (1949). T-statistics are shown in parentheses and standard errors are clustered at firm level. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

Dependent Variable =	$\lvert\dot{q} - 1\rvert$				$\lvert\dot{q} - FF48Average\rvert$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Quasi-indexer Ownership	-0.343**	-0.334**	-0.276***	-0.283***	-0.364**	-0.352**	-0.227**	-0.238**
	(-2.11)	(-2.00)	(-2.60)	(-2.59)	(-2.16)	(-2.04)	(-2.10)	(-2.14)
Leverage	-0.14	-0.145*	-0.217***	-0.213***	-0.031	-0.038	-0.059	-0.052
	(-1.64)	(-1.66)	(-3.47)	(-3.34)	(-0.35)	(-0.42)	(-0.90)	(-0.78)
Cash Flow	-0.749***	-0.748***	-0.952***	-0.955***	-0.908***	-0.907***	-1.101***	-1.107***
	(-2.66)	(-2.65)	(-4.93)	(-4.98)	(-3.18)	(-3.18)	(-5.63)	(-5.70)
Diversification	-0.036**	-0.036**	-0.020**	-0.021**	-0.034**	-0.034**	-0.018*	-0.019*
	(-2.38)	(-2.33)	(-2.04)	(-2.08)	(-2.18)	(-2.13)	(-1.74)	(-1.82)
Intangible Assets	0.214*	0.214*	0.159**	0.159**	0.246**	0.246**	0.159**	0.159**

Table 1.9 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	(1.86)	(1.86)	(2.19)	(2.20)	(2.20)	(2.20)	(2.19)	(2.20)
Average q	0.185***	0.185***	0.189***	0.190***	0.185***	0.184***	0.191***	0.192***
	(8.70)	(8.56)	(10.27)	(10.26)	(9.42)	(9.24)	(11.11)	(11.11)
E-index	-0.01	-0.01	0.006	0.007	-0.008	-0.009	-0.003	-0.002
	(-0.54)	(-0.56)	(0.44)	(0.47)	(-0.43)	(-0.45)	(-0.20)	(-0.14)
External Dependence	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	0	0
	(-0.27)	(-0.27)	(-0.61)	(-0.63)	(-0.20)	(-0.19)	(0.16)	(0.13)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Polynomial Orders	2	3	2	3	2	3	2	3
Bandwidth	50	50	250	250	50	50	250	250
No. of Observations	3238	3238	9380	9380	3238	3238	9380	9380
R-square	0.51	0.51	0.52	0.52	0.47	0.47	0.48	0.47
F-Stats	10.83	78.99	13.92	13.71	7.5	14.9	9.39	9.09
Kleibergen-Paap rk LM statistic (Chi2)	32.58	31.75	67.88	66.6	32.58	31.75	67.88	66.6
P-value of Chi2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 1.9 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Kleibergen-Paap rk Wald F statistic	39.49	38.4	94.63	92.83	39.49	38.4	94.63	92.83
Anderson-Rubin F	4.55	4.09	6.91	6.88	4.91	4.39	4.46	4.64
P-value of AR F	0.03	0.04	0.01	0.01	0.03	0.04	0.03	0.03

Table 1.10: Errors-in-Variables Regression of Investment

This table presents the results of the Errors-in-Variables (EIV) regression of investment on average q, cash flows and quasi-indexer ownership, along with the interaction terms. The dependent variables are the total investment to capital stock ratio which is the sum of tangible and intangible investment scaled by the replacement value of total capital stock defined as 1A.2. All other variables are defined in Table 1.1. Following Erickson et al. (2014), I demean each variable to incorporate firm fixed effects. ρ^2 is an estimated R-squared of the regression. The sample is an unbalanced panel of 5,507 U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019. All variables are in 2012 dollars and are winsorized at 1% and 99% levels. Z-statistics are shown in parentheses. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	(1)	(2)	(3)	(4)	(5)	(6)
Average q	0.004*	-0.004	0.043***	0.048***	0.042***	0.048***
	(1.79)	(-1.38)	(25.82)	(18.67)	(25.37)	(18.77)
Cash Flow	-0.834***	-0.754***	0.107***	0.034	0.106***	0.029
	(-17.52)	(-13.01)	(4.93)	(0.86)	(4.87)	(0.73)
QixOwn × Average q	0.134***	0.149***	0.015***	0.008**	0.016***	0.008**
	(16.97)	(16.55)	(4.67)	(2.00)	(5.04)	(2.14)
QixOwn × Cash Flow			-0.330***	-0.126*	-0.319***	-0.117*
			(-6.51)	(-1.76)	(-6.27)	(-1.66)
QixOwn	-0.759***	-0.268***	-0.232**	-0.673***	-0.236***	-0.672***
	(-10.34)	(-2.82)	(-2.54)	(-10.80)	(-2.59)	(-10.82)
HHI index					-0.105	0.442
					(-0.40)	(1.28)
Year Fixed Effects	No	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	No	No	No	Yes	No	Yes
No. of Observations	67645	67645	67645	67645	67645	67645
ρ^2	0.005	0.017	0.026	0.031	0.026	0.031
Std. Err. of ρ^2	0.002	0.003	0.003	0.003	0.003	0.003

Table 1.11: Weighted Least Square Regression for Underinvestment and Overinvestment

This table reports the weighted least squared regression of measures of capital budgeting inefficiency on a firm's quasi-indexer ownership and control variables for underinvestment and overinvestment sample, respectively. The dependent variables for columns (1) to (4) and columns (5) to (8) are the absolute deviation of estimated marginal from 1 and industry average, respectively. Columns (1),(3),(5),(7) report the results for underinvestment, and the rests are for the overinvestment sample. Underinvestment (Overinvestment) is defined as marginal q > (<) 1 or industry average that is consistent with the dependent variable. The significance of the differences in the coefficients for underinvestment and overinvestment are shown by the p-value. All variables are as defined in Table 1.1. The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019. The limited availability of the E-index causes the sample size to shrink significantly in columns (4),(5),(9),(10). All variables are in 2012 dollars and are winsorized at 1% and 99% levels. T-Statistics are shown in parentheses, and standard errors are clustered by firm. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	$\|\dot{q}-1\|$				$\|\dot{q}-FF48Average\|$			
	Underinvest	Overinvest	Underinvest	Overinvest	Underinvest	Overinvest	Underinvest	Overinvest
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
QixOwn	-0.555**	0.061	-0.540***	0.059	-0.731**	0.073	-0.715***	0.073
	(-2.51)	(1.06)	(-3.45)	(1.02)	(-2.45)	(1.07)	(-3.06)	(1.29)
	Diff p-value: 0.0001		Diff p-value: 0.0001		Diff p-value: 0.0003		Diff p-value: 0.0003	
Leverage	0.008	0.009	0.009	0.009	0.017	0.018**	0.016	0.018***
	(0.37)	(1.40)	(0.55)	(1.53)	(0.49)	(2.38)	(0.60)	(3.10)
Cash Flow	-0.026	-0.234*	-0.118	-0.195	0.371	-0.06	0.236	-0.065
	(-0.17)	(-1.99)	(-0.48)	(-1.53)	(1.51)	(-0.66)	(0.66)	(-0.63)
Intangible Assets	0.124***	-0.001	0.162	-0.034	0.174**	-0.062	0.227	-0.06
	(2.73)	(-0.02)	(1.05)	(-0.45)	(2.37)	(-1.32)	(0.84)	(-0.83)

Table 1.11 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Size	-0.280***	-0.001	-0.297***	0.002	-0.351***	-0.011	-0.373***	-0.011
	(-7.13)	(-0.06)	(-6.51)	(0.08)	(-7.67)	(-0.67)	(-5.48)	(-0.65)
Diversification	0.011	0.012	0.013	0.011	0.005	0.012	0.008	0.012
	(0.86)	(0.71)	(0.83)	(0.90)	(0.29)	(1.26)	(0.34)	(1.33)
Average q	0.319***	0.033***	0.317***	0.034***	0.316***	0.027***	0.314***	0.027***
	(9.11)	(3.92)	(12.91)	(3.36)	(11.34)	(3.95)	(11.29)	(2.83)
External Dependence	0.019***	0.011***	0.019***	0.011***	0.036***	0.013***	0.036***	0.013***
	(3.42)	(2.91)	(2.60)	(3.04)	(3.92)	(4.92)	(3.32)	(4.42)
E-index	0.033***	0.004	0.033*	0.004	0.021	-0.001	0.021	-0.001
	(2.83)	(0.33)	(1.66)	(0.30)	(0.83)	(-0.09)	(0.61)	(-0.10)
Lerner Index			0.075*	-0.054			0.108	0.006
			(1.82)	(-1.07)			(1.59)	(0.25)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	17089	5080	17087	5080	10156	12006	10154	12006
No. of Firms	2199	1463	2199	1463	1723	2018	1723	2018
R-square	0.68	0.61	0.68	0.61	0.69	0.51	0.69	0.51
F-Stats	749.64	355.64	25.29	7.02	2051.81	121.01	15.13	13.06

Table 1.12: Instrumental Variable Estimation for Underinvestment and Overinvestment

This table reports the results of instrumental variables identification of the impact of the quasi-indexer ownership on a firm's capital budgeting efficiency for underinvestment and overinvestment groups, respectively. Panel A and B show the estimation of the first-stage $QixOwn_{it} = \eta + \lambda S\&P500_{it} + \sum_{n=1}^{N} \theta_n (ln(Mktcap_{it}))^n + \phi Industry_{it} + \delta_t + \mu_{it}$ and second-stage $|\dot{q}_{it} - FF48Average| = \alpha + \beta QixOwn_{it} + \sum_{n=1}^{N} \Theta_n (ln(Mktcap_{it}))^n + \Phi Industry_{it} + \delta_t + \varepsilon_{it}$, respectively, where the dependent variables for the second-stage are the absolute deviation of marginal q from its industry average. $QixOwn$ is the percentage of shares outstanding held by quasi-indexers, and I use the S&P1500 membership $S\&P1500$ as its instrumental variable. $Mktcap$ is the market capitalization of the firm i at year t. All other controls are as defined in Table 1.1. The model is estimated over 1995-2018 using 50 firms (column (1), (2)), 250 firms (column (3), (4))) below and above the S&P1500 market capitalization cutoff. Columns (5) and (6) report the results for the overall sample. Up to 3rd polynomial orders of $ln(Mktcap)$ are controlled. T-Statistics are shown in parentheses, and standard errors are clustered at firm level. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level. All variables are in 2012 dollars and are winsorized at 1% and 99% levels.

	Underinvest	Overinvest	Underinvest	Overinvest	Underinvest	Overinvest
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: 1st Stage						
S&P1500	0.542***	0.385***	0.472***	0.385***	0.404***	0.416***
	(6.46)	(4.70)	(9.69)	(4.70)	(10.17)	(10.02)
F-Statistics	29.06	35.34	77	35.34	142.07	124.91
Panel B: 2nd Stage						
$QixOwn$	-0.437**	-0.022	-0.261**	-0.022	-0.333***	0.038
	(-2.02)	(-0.18)	(-2.05)	(-0.18)	(-2.83)	(0.63)
	Diff p-value:	0.098	Diff p-value:	0.042	Diff p-value:	0.005
Leverage	-0.154	0.074	-0.253**	0.074	-0.283***	0.147***

Table 1.12 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)
	(-0.89)	(1.04)	(-2.57)	(1.04)	(-3.27)	(3.04)
Cash Flow	-1.774***	-1.157***	-1.369***	-1.157***	-0.932***	-0.569***
	(-3.40)	(-3.13)	(-4.40)	(-3.13)	(-4.00)	(-4.62)
Diversification	-0.069*	0.004	-0.019	0.004	-0.015	-0.003
	(-1.94)	(0.36)	(-0.88)	(0.36)	(-0.93)	(-0.43)
Intangible Assets	0.311*	0.137**	0.186*	0.137**	-0.019	0.036
	(1.67)	(2.14)	(1.94)	(2.14)	(-0.29)	(1.09)
Average q	0.327***	0.219***	0.345***	0.219***	0.323***	0.164***
	(7.92)	(3.81)	(9.96)	(3.81)	(12.68)	(7.28)
E-index	0.045	0.009	0.051*	0.009	0.050**	0.003
	(1.13)	(0.53)	(1.89)	(0.53)	(2.45)	(0.27)
External Dependence	0.025	0.021***	0.035***	0.021***	0.042***	0.023***
	(1.38)	(3.53)	(2.77)	(3.53)	(3.84)	(5.14)
Bandwidth	50	50	250	250	NA	NA
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	1436	2065	4495	5596	8471	10494
R-square	0.43	0.31	0.44	0.31	0.39	0.25

Table 1.12 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)
F-Statistics	10.39	3.81	15.17	3.81	20.37	12.88

Table 1.13: Weighted Least Square Estimation of Quasi-indexer Ownership Impacts on Firms' Capital Budgeting Efficiency for Samples with High and Low R&D Ratio

This table reports the weighted least squared estimation of regressing measures of capital budgeting inefficiency on a firm's quasi-indexer ownership and control variables for samples located at the top (High R&D Ratio, i.e. columns (1), (3)) and bottom (Low R&D Ratio, i.e. columns (2), (4)) R&D ratio quartile, respectively. The dependent variables for columns (1), (2) and columns (3), (4) are the absolute deviation of estimated marginal q from 1 and its industry average, respectively. All variables are as defined in Table 1.1. The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019. The limited availability of the E-index causes the sample size to shrink significantly in columns (4),(5),(9),(10). All variables are in 2012 dollars and are winsorized at 1% and 99% levels. T-Statistics are shown in parentheses, and standard errors are clustered at firm level. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	$\lvert\dot{q}-1\rvert$		$\lvert\dot{q}-FF48Average\rvert$	
	High R&D	Low R&D	High R&D	Low R&D
	(1)	(2)	(3)	(4)
QixOwn	-1.179***	-0.417***	-0.909***	-0.279**
	(-4.66)	(-2.68)	(-3.77)	(-2.08)
	Diff P-value: 0.009		*Diff P-value: 0.078*	
Leverage	0.021	-0.028**	0.033**	-0.017
	(1.44)	(-1.98)	(2.38)	(-1.27)
Cash Flow	0.023	0.258	-0.085	0.131
	(0.09)	(1.12)	(-0.36)	(0.52)
Diversification	-0.041*	0.031**	-0.034	0.029**
	(-1.71)	(2.00)	(-1.49)	(2.01)
Intangible Assets	0.104	3.596**	0.039	-4.096
	(1.58)	(2.55)	(0.61)	(-1.40)
Average q	0.331***	0.265***	0.334***	0.275***
	(15.52)	(9.08)	(16.12)	(8.47)
E-index	0.058*	0.019	0.029	0.032**
	(1.72)	(1.11)	(0.89)	(1.98)
External Dependence	0.036***	0.008*	0.040***	0.015***
	(2.70)	(1.70)	(3.10)	(3.10)
Size	-0.216***	-0.138***	-0.268***	-0.125***

Table 1.13 continued from previous page

	(1)	(2)	(3)	(4)
	(-4.93)	(-5.21)	(-6.29)	(-4.79)
Year Fixed Effects	Yes	Yes	Yes	Yes
No. of Observations	5623	5623	5623	5623
R-square	0.65	0.66	0.63	0.62
F-Statistics	26.90	22.77	21.64	11.40

Table 1.14: Weighted Least Square Estimation of Quasi-indexer Ownership Impacts on Firms' Capital Budgeting Efficiency for Samples with High and Low Entrenchment Index

This table reports the weighted least squared estimation of regressing measures of capital budgeting inefficiency on a firm's quasi-indexer ownership and control variables for samples located at the top (High E-Index, i.e. columns (1), (3)) and bottom (Low E-index, i.e. columns (2), (4)) E-index quartile, respectively. The dependent variables for columns (1), (2) and columns (3), (4) are the absolute deviation of estimated marginal q from 1 and its industry average, respectively. All variables are as defined in Table 1.1. The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019. The limited availability of the E-index causes the sample size to shrink significantly in columns (4),(5),(9),(10). All variables are in 2012 dollars and are winsorized at 1% and 99% levels. T-Statistics are shown in parentheses, and standard errors are clustered at firm level. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	$\|\dot{q}-1\|$		$\|\dot{q}-FF48Average\|$	
	High E-index	Low E-index	High E-index	Low E-index
	(1)	(2)	(3)	(4)
QixOwn	-0.728***	-0.209	-0.522***	-0.108
	(-4.26)	(-1.10)	(-3.07)	(-0.57)
	Diff P-value: 0.892		*Diff P-value: 0.310*	
Leverage	-0.012	0.016	0.015	-0.006
	(-0.49)	(0.65)	(0.42)	(-0.27)
Cash Flow	-0.577	1.150**	1.126	-0.619*
	(-1.62)	(2.12)	(1.47)	(-1.90)
Diversification	0.013	0.008	0.011	0.027*
	(0.88)	(0.42)	(0.33)	(1.93)
Intangible Assets	0.185	0.394	0.484	0.476*
	(0.73)	(0.99)	(1.11)	(1.91)
Average q	0.224***	0.353***	0.358***	0.230***
	(5.36)	(13.53)	(8.54)	(5.27)
E-index	0.034	-0.082*	-0.007	0.034
	(1.47)	(-1.71)	(-0.13)	(1.44)
External Dependence	0.027*	0.01	0.009	0.033**
	(1.84)	(1.53)	(0.93)	(2.37)
Size	-0.019	-0.284***	-0.295***	-0.097**

Table 1.14 continued from previous page

	(1)	(2)	(3)	(4)
	(-0.44)	(-5.39)	(-4.72)	(-2.30)
Year Fixed Effects	Yes	Yes	Yes	Yes
No. of Observations	5179	5178	5179	5178
R-square	0.72	0.68	0.71	0.67
F-Statistics	14.09	20.57	5.62	16.85

Table 1.15: WLS Estimation Allowing Impacts of Quasi-Indexer Ownership on Capital Budgeting Efficiency to Vary with Informational Opaqueness and Governance

This table reports the weighted least squared regression of capital budgeting efficiency on quasi-indexer ownership and its interaction with R&D ratio and/or with E-index and various control variables. The dependent variables for columns (1) to (3) and columns (4) to (6) are the absolute deviation of estimated marginal from 1 and industry average, respectively. All variables are defined in Table 1.1. All observations are weighed by the inversed transformation of the standard error of estimated marginal q following Hornstein and Greene (2012). The sample includes firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019. All variables are in 2012 dollars and are winsorized at 1% and 99% level. T-statistics are shown in parentheses, and standard errors are clustered by firm. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	$\|\dot{q}-1\|$			$\|\dot{q}-FF48Average\|$		
	(1)	(2)	(3)	(4)	(5)	(6)
QixOwn	-0.363**	-0.619***	-0.554**	-0.225*	-0.493**	-0.421**
	(-2.49)	(-2.69)	(-2.42)	(-1.73)	(-2.39)	(-2.07)
Qix × Intan	-0.749**		-0.751**	-0.786**		-0.787**
	(-2.11)		(-2.11)	(-2.36)		(-2.36)
Qix × E-index		0.079	0.081		0.084	0.084
		(1.16)	(1.19)		(1.36)	(1.37)
Intangible Assets	0.287		0.291	0.224		0.228
	(1.62)		(1.64)	(1.37)		(1.39)
Leverage	-0.006	-0.007	-0.007	0.012	0.01	0.011
	(-0.45)	(-0.53)	(-0.54)	(0.94)	(0.77)	(0.84)

Table 1.15 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)
Cash Flow	-0.016	-0.084	-0.017	-0.201	-0.261	-0.202
	(-0.07)	(-0.38)	(-0.08)	(-0.93)	(-1.24)	(-0.94)
Diversification	0.018	0.019	0.018	0.028**	0.030**	0.029**
	(1.32)	(1.46)	(1.37)	(2.21)	(2.36)	(2.28)
Average q	0.298***	0.301***	0.297***	0.289***	0.292***	0.288***
	(13.70)	(13.96)	(13.71)	(14.42)	(14.68)	(14.42)
E-index	0.023	-0.013	-0.013	0.015	-0.023	-0.022
	(1.36)	(-0.33)	(-0.33)	(0.98)	(-0.64)	(-0.61)
External Dependence	0.015***	0.016***	0.016***	0.018***	0.018***	0.018***
	(2.81)	(2.87)	(2.86)	(3.42)	(3.48)	(3.46)
Size	-0.221***	-0.228***	-0.219***	-0.208***	-0.214***	-0.207***
	(-6.03)	(-6.30)	(-6.04)	(-6.00)	(-6.18)	(-6.01)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	22565	22565	22565	22565	22565	22565
R-square	0.63	0.62	0.63	0.58	0.58	0.58
F-Statistics	27.68	27.97	27.09	21.76	21.98	21.37

Table 1.16: Weighted Least Squared Regression of Absolute Deviation of Marginal from the Benchmark for Underinvestment and Overinvestment

This table reports the results of weighted least squared regression of capital budgeting efficiency on quasi-indexer ownership and its interaction with intangible asset ratio and various control variables for the overall sample, underinvestment and overinvestment sample. The dependent variables for columns (1) to (6) and columns (7) to (12) are the absolute deviation of estimated marginal from 1 and industry average, respectively. All variables are defined in Table 1.1. The sample is an unbalanced panel of 5,507 U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019. Including E-index causes significant decrease in sample size due to the limited coverage of the ISS database. All variables are in 2012 dollar and are winsorized at 1% and 99% level. T-statistics are shown in parentheses, and standard errors are clustered at firm level. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	$\|\dot{q}-1\|$		$\|\dot{q}-1\|^{+}$		$\|\dot{q}-1\|^{-}$		$\|\dot{q}-FF48Average\|$		$\|\dot{q}-FF48Average\|^{+}$		$\|\dot{q}-FF48Avrage\|^{-}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
QixOwn	-0.158	-0.363**	-0.211	-0.474**	0.256***	-0.021	-0.122	-0.265*	-0.441**	-0.676*	0.145	0.06
	(-1.52)	(-2.23)	(-1.62)	(-2.24)	(3.33)	(-0.20)	(-1.20)	(-1.67)	(-2.15)	(-1.86)	(1.63)	(0.82)
Intangible Ratio(Intan)	0.397***	0.792***	0.574***	1.060***	0.177***	0.534***	0.399***	0.723***	0.753***	1.828***	0.110*	0.301**
	(3.27)	(3.52)	(3.85)	(2.77)	(3.07)	(5.82)	(3.62)	(3.32)	(3.29)	(3.57)	(1.88)	(2.34)
QixOwn × Intan	-0.884***	-1.626***	-1.184***	-2.081***	-0.492***	-0.854***	-0.991***	-1.654***	-1.462***	-3.442***	-0.283	-0.651*
	(-3.03)	(-3.53)	(-3.76)	(-2.95)	(-3.58)	(-4.75)	(-3.91)	(-3.77)	(-3.46)	(-3.21)	(-1.63)	(-1.80)
Leverage	0.018*	-0.002	0.028**	0.017	0.008	-0.011	0.032***	0.015	0.040**	0.043*	0.021**	0.009
	(1.85)	(-0.19)	(2.18)	(1.11)	(1.29)	(-1.46)	(3.37)	(1.24)	(2.20)	(1.68)	(2.40)	(0.98)
Cash Flows	1.314***	1.554***	1.671***	1.828***	0.189*	0.252	1.237***	1.402***	2.160***	2.722***	0.355**	0.311**
	(7.28)	(6.42)	(7.70)	(6.13)	(1.76)	(1.59)	(7.27)	(6.12)	(7.20)	(5.33)	(2.19)	(2.15)
Size	-0.277***	-0.308***	-0.341***	-0.384***	-0.080***	-0.033	-0.269***	-0.310***	-0.340***	-0.433***	-0.084***	-0.064**
	(-10.85)	(-7.10)	(-11.49)	(-7.53)	(-5.72)	(-1.33)	(-11.14)	(-7.38)	(-8.33)	(-6.05)	(-3.56)	(-2.23)
Diversification	0.024*	0.026	0.02	0.015	0.029**	0.061***	0.031**	0.040**	0.019	0.009	0.022	0.040**
	(1.92)	(1.55)	(1.41)	(0.79)	(2.46)	(3.75)	(2.50)	(2.45)	(0.93)	(0.31)	(1.57)	(2.50)

Table 1.16 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
HHI Index	0.3	0.347	0.466*	0.284	-0.203	0.419	0.172	0.181	0.371	0.069	-0.112	0.209
	(1.23)	(1.18)	(1.66)	(0.71)	(-0.98)	(1.51)	(0.70)	(0.60)	(0.90)	(0.11)	(-0.39)	(0.85)
E-Index		0.016		0.033		0		0.009		0.038		-0.005
		(0.79)		(1.34)		(-0.03)		(0.44)		(0.80)		(-0.32)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	48504	22612	36771	17120	11733	5492	48504	22612	24007	10181	24497	12431
R-square	0.56	0.55	0.61	0.62	0.64	0.68	0.53	0.51	0.64	0.65	0.56	0.58
F-statistics	27.67	19.82	25.46	17.70	16.21	11.93	20.88	14.21	8.07	9.27	11.96	9.75

Chapter 2

Do Stronger Shareholder Rights Prompt Firms' Capital Budgeting Efficiency?

2.1 Introduction

Shareholder rights remain at the centre of corporate governance discussion. Better protection of shareholder rights, normally in the forms of corporation provisions facilitating takeover or limiting managerial power, is thought to be beneficial for firms as it alleviates the agency problems between managers and shareholders. For instance, stronger shareholder rights can facilitate the removal of incompetent or undutiful managers. (See, for example, Fisman, Khurana, Rhodes-Kropf, and Yim (2014)). In addition, fewer takeover defenses evoke the disciplinary effects of the market for control and prevent or restrict managers from activities destroying shareholders' value through, for example, shirking and empire building. (See, for example, Richardson (2006); Masulis, Wang, and Xie (2007)).

However, shareholder rights, closely related to shareholders' control, come with costs that induce suboptimal managerial decisions. Takeover deterrence, which weakens shareholder rights, may provide job security to managers to reduce their needs to cater to shareholders' preferences. Similarly, strong shareholder rights may induce managers' concerns about the lower-tail consequences of ex-ante positive NPV projects and hence induce managers to behave in a value-destroying risk-averse manner. Moreover, weak shareholder rights may alleviate managerial myopia if they reduce the managers' incentive to signal their own quality by boosting short-term profitability at the expense of long-term value (Stein, 1988). Additionally, strong shareholder rights may intensify managers' concerns about losing controls and induce managers to entrench themselves by engaging in value-destroying investment that requires their specific skills (Shleifer & Vishny, 1989).

As illustrated above, given shareholder rights may have both positive and negative effects on a firm's capital budgeting efficiency, the net effects are an empirical question and the focus of this paper.

Capital budgeting decisions are among the most fundamental decisions that managers regularly make. The outcomes of such decisions may be affected by the extent to which managers' interests align with shareholders' and managers' initiatives and capability to use discretionary judgement. By linking firms' balance of shareholder and managerial rights to capital budgeting efficiency, this paper attempts to provide direct evidence about the relationship between shareholder rights and firms' value maximization practices, complementing evidence inferred from shareholder rights' monotonic or nonmonotonic association with firms' stock market performance, firms' effective usage of free cash flows, acquisition premium, and other issues (See, for example, Gompers et al. (2003); Richardson (2006); L. Bebchuk et al. (2009); L. A. Bebchuk, Cohen, and Wang (2013)).

Compared to the benefits of enhancing shareholder rights with respect to alleviating classical agency problems, the costs of strong shareholder rights are less recognized in the literature, with a few exceptions. Burkart, Gromb, and Panunzi (1997) theoretically show that delegation controls to managers may promote their (noncontractible) initiatives, like searching for firm-specific investment opportunities, and induce them to exert efforts to increase firms' value. Boot, Gopalan, and Thakor (2006) propose that, with potential disagreements on the prior beliefs about how to achieve shareholder value maximization, corporate governance may be intrusive to managers when it is extremely stringent and leaves the managers with little elbow room to make decisions with which shareholders may disagree. Using the bank's holding of their own stocks in a fiduciary capacity to separate the managerial voting rights from cash flow rights attached to managerial ownership, Adams and Santos (2006) find a concave relationship between managerial voting rights and firms' average q and ROA, suggesting that, even though too much managerial control harms firms' performance, some voting control entitled to mangers may be beneficial for the firm.

Using the absolute deviation of firms' marginal q from the optimal threshold as a reverse measure of firms' capital budgeting efficiency, or a measure of capital budgeting inefficiency, which captures the proximity of firms' investment to maximize shareholders' value, this paper finds a negative association between the strength of shareholder rights and firms' capital budgeting efficiency. The results are robust to various measures of shareholder rights, different methodologies, and control variables. This evidence may reveal that the cost of shareholder rights outweighs the benefits with respect to firms' investment decisions, on which managers may have advanced information and professional judgements.

In order to deal with the potential endogeneity concerning the measures of governance indices, I rely on instrumental variables and two-stage least squares analysis following Karpoff et al. (2017). More specifically, I use the average corresponding governance indices in previous years of focus firms' non-industry peers that are geographically proximate to or going public in the same year as the focus firm to instrument their governance indices. These two instrumental variables rely on the similarity in managers' and shareholders' inceptions of corporate governance to isolate exogenous variation in corporate governance, respectively. The negative association between capital budgeting efficiency and firms' shareholder rights, as reversely measured by governance indices, is robust and consistent with weighted least squares estimation that weighs all observations using the inverse of the transformed standard deviation of estimated marginal q to account for the estimation precision.[1] I also find a negative relationship between shareholder rights and firms' return on assets (ROA), an accounting measure of operating efficiency, which is positively (negatively) related to capital budgeting efficiency (the distance of firms' marginal q from one). This result confirms the findings that shareholder rights come with costs with respect to firms' efficiency.

Additionally, I find that the relationship between shareholder rights and capital budgeting efficiency is symmetric for underinvesting and overinvesting firms, although firms with weak shareholder rights are more likely to underinvest relative to

[1]Ignoring the weights does not change the results qualitatively.

their growth opportunities than to overinvest. However, weak shareholder rights are more prominently related to value-enhancing capital budgeting decisions for firms that are younger or have more competent managers. These results indicate that strong shareholder rights may limit managers' discretion in making efficient decisions. Furthermore, I find that governance indices are negatively associated with firms' cash holdings and variation in investments and profits, and firms holding more cash or experiencing higher investment or profit volatility are associated with value-destroying capital budgeting decisions. Through these mechanisms, I conjecture that delegating controls to managers may improve firms' efficiency by limiting the waste of cash or avoiding excessive operational volatility that may destroy firms' efficiency.

The rest of the paper proceeds as follows: Section 2.2 narrates the background of this study with the most related literature while Section 2.3 illustrates the empirical strategy. Section 2.4 explains the data used for analysis, Section 2.5 presents the empirical results and the discussion of hypothesized mechanisms, and Section 2.6 makes concluding remarks.

2.2 Background

Empirical literature that examines the effects of firms' shareholder rights has focused on the relationships between takeover defenses, as measured by governance indices, and firms' market valuation or stock market returns.

Gompers et al. (2003) construct a "G-Index" index using twenty-four corporate governance provisions to measure the extent to which shareholders' power is yielded to managers, and they find that a higher G-Index is associated with lower Tobin's q. They also observe that an investment strategy longing in low G-Index firms and shoring in high G-Index firms earns a significant positive abnormal return. L. Bebchuk et al. (2009) identify six IRRC provisions that are most relevant to the firms' value and abnormal returns to construct an Entrenchment-Index (or E-Index, hereafter), which is thought to capture the constitutional limitations to shareholders facilitating management entrenchment, and document that increasing in E-Index is associated with decreasing in firms' value, as measured by Tobin's

q. However, they remain silent on the relationship between the entrenchment index and firms' operating performance. Cremers, Ferrell, et al. (2009) demonstrate that a poorly governed firm is robustly associated with a lower industry-adjusted Tobin's q value throughout 1978-2006 with little sign of reverse causality. In contrast, they find that higher q firms tend to adopt more antitakeover provisions. In addition, they document a negative cross-sectional relationship between governance indices and firms' sales growth or net profit margins, but not for returns on assets (all estimations include year-fixed effects). However, the cross-sectional relationship disappears when firm fixed effects are included. L. A. Bebchuk et al. (2013) confirms the negative relationship between industry-adjusted Tobin's q and governance indices using pooled estimation accounting for both cross-sectional and time-series correlation during 1990-2001 and 2002-2008.

Although the detrimental effects of firms' takeover defenses are supported by empirical findings that (more) adoption of antitakeover provisions is associated with lower Tobin's q or worse stock market performance, the evidence concerning the relationship between firm-level takeover defenses and firms' operating performance has been mixed. For example, the seminal work of G-Index by Gompers et al. (2003) only finds marginal evidence suggesting poorly governed firms, as measured by a higher G-Index and indicative of weaker shareholder rights, have lower net profit margin or sales growth. However, they do not find evidence concerning return on equity using the Fama-French time-series estimation. Brown and Caylor (2004) does not find a significant relationship between G-Index and firms' performance as measured by return on equity or net margins. Core, Guay, and Rusticus (2006) find some evidence for a negative relationship between firms' industry-adjusted ROA and G-Index, but only when the market value of equity and book-to-market value are included as control variables. Bhagat and Bolton (2008) document that better governance, measured by G-Index and E-Index, is positively associated with better contemporaneous and subsequent operating performance, measured by ROA. Cremers et al. (2009) show that firms' G-Index is negatively associated with industry-adjusted sales growth cross-sectionally, but no evidence is found concerning the relationship between shareholder rights and ROA either cross-firm or cross-time. Exploiting corporate governance information of 7700 companies in the advanced economies, Bruno and Claessens (2010) find that a negative association between firms' adoption of antitakeover provisions, which is measured by the E-Index constructed following L. Bebchuk et al. (2009), and their Tobin's q and ROA only for firms operating in countries with weaker investors' protection. Gormley and Matsa (2016) document the ROA declines only among firms with leverage or insider ownership below the median after adopting a BC law in the state.

Despite the extensive research efforts, there is little conclusive evidence resolving the relationship between shareholder rights and firms' operating performance. I intend to fill in this gap by examining the impact of firms' shareholder rights, which is opposite to firms' adoption of antitakeover provisions, on their capital budgeting efficiency, as capital budgeting is among the most important operating decisions that managers make on a regular basis and is fundamental to a firm's growth.

In addition, another line of research that this paper may directly contribute to is the examination of the impacts of corporate governance on firms' investment behaviour. Gompers et al. (2003) find evidence suggesting that stronger shareholder rights, being represented by a lower G-Index, are associated with lower industry-adjusted capital expenditures. Richardson (2006) documents that the presence of staggered boards and poison pills in place are related to more over-investment of free cash flows, whereas firms operating in management-friendly states or with supermajority voting provisions experience less over-investment of free cash flows. Harford, Mansi, and Maxwell (2008) find a positive relationship between firms' G-Index and firms' increase in capital investments, and the incremental investments associated with weaker shareholder rights are mainly through asset acquisition and capital expenditures. Gutiérrez and Philippon (2017, 2018) demonstrate that tightening governance due to the raising of institutional investors may induce underinvestment by imposing excess pressure on management to cater to shareholders' preference for short-term earnings or payments. Instead of focusing on the level or change in investment, this paper complements the studies concerning the impact of governance on firms' investment by exploring how and through which mechanisms the strength of firms' shareholder rights affects their investment efficiency.

A similar study by Greene et al. (2009) finds that constitutional limitations on shareholders power, as measured by the presence of a staggered board or a high E-Index, are associated with more value-enhancing capital budgeting decisions in multinational firms. In this paper, I intend to generalize the relationship between capital budgeting (in)efficiency and firms' shareholder rights by extending the sample to all firms covered by Compustat and CRSP merged database, excluding those in financial, utility and other specially regulated industries. Moreover, I try to examine the heterogeneity of the relationship between firms' capital budgeting (in)efficiency and the strength of shareholder rights, and through which mechanism this relationship may present.

2.3 Empirical Design

2.3.1 Measuring Capital Budgeting (In)Efficiency

In this study, following Durnev et al. (2004), Greene et al. (2009) and others, I use the distance of a firm's marginal q from one, $|\dot{q}-1|$, as an inverse indicator of the firm's capital budgeting efficiency. This measure conveys how far the firm is away from its optimal investment (i.e., the investment that maximizes its market valuation), which can be justified by the neoclassic investment theory and the NPV rule of capital budgeting decisions. Marginal q is the shadow price of the capital stock,[2] which equals one when the company achieves its optimal investment according to the conventional neoclassical investment theory. Therefore, the distance of a firm's marginal q from one measures the extent to which the firm's investment deviates from the value-maximization goal.

In addition, defining marginal q as the ratio of firms' incremental market value to the corresponding marginal investment, it reconciles with the NPV of a firm's periodical investment. More specifically, assuming a firm's capital investment during time t can be summarized by a project with an initial cost of C_t and incremental cash flows of ΔCF_{t+s} for the foreseen future, the incremental cash flows should result in that the value of the firm changes by $\Delta V_{i,t} = \sum_{s=0}^{\infty} \Delta CF_{i,t+s}$, which equals the present value of the project. Thus, marginal q is equivalent to one plus the ratio of NPV to the initial cost, i.e. $\dot{q}_{i,t} = \frac{\Delta V_{i,t}}{\Delta K_{i,t}} = \frac{NPV_t + C_t}{C_t} = 1 + \frac{NPV}{C_t}$. With diminishing returns of capital investment, the optimal investment of a value-maximization firm is

[2] It can be seen as the ratio of marginal value to the marginal cost of capital stock

achieved when the NPV of the marginal investment equals zero, which is equivalent to marginal q equals one, and the deviation of marginal q from one captures to what extent the firm is away from the value-maximization optimal investment. Moreover, the direction of the deviation of marginal q from its optimal indicates whether the firm is underinvestment (positive deviation or marginal q is greater than one) or overinvestment (negative deviation or marginal q below one).

To empirically estimate a firm's marginal q, I follow Durnev et al. (2004) to define marginal q the marginal q as the unexpected changes in the market value of the firm in response to the unexpected changes in capital stocks,[3] as follows:

$$\dot{q}_{i,t} = \frac{V_{i,t} - E_{t-1}V_{i,t}}{A_{i,t} - E_{t-1}A_{i,t}} = \frac{V_{i,t} - (1 + \hat{r}_{i,t} - \hat{a}_{i,t} - \hat{d}_{i,t})V_{i,t-1}}{A_{i,t} - (1 + \hat{g}_{i,t} - \hat{\delta}_{i,t})A_{i,t-1}}, \tag{2.1}$$

where $V_{i,t}$ and $A_{i,t}$ are the market value and replacement cost of capital stock of firm i in time t, respectively. E_{t-1} denotes the (market's) expectation based information available in time t-1. The terms $V_{i,t} - E_{t-1}V_{i,t}$ and $A_{i,t} - E_{t-1}A_{i,t}$ are the unexpected changes in market value and capital stock. The expected market value is the market value in the previous year grows at the market expected capital gain of $\hat{r}_{i,t}$ excluding the expected adjustment cost $\hat{a}$ and dividend yield $\hat{d}_{i,t}$, and the expected capital stock is the last year's capital stock augmented by the market expected growth rate of $\hat{g}_{i,t}$ and depreciated at the rate of $\hat{\delta}_{i,t}$.

Cross-multiply and reorganize the terms in Equation 2.1 results in the following equation:

$$\frac{\Delta V_{i,t}}{A_{i,t-1}} = \alpha_{i,t} + \beta_{1,t}\frac{\Delta A_{i,t}}{A_{i,t-1}} + \beta_{2,t}\frac{V_{i,t-1}}{A_{i,t-1}} + \xi_{i,t}\frac{D_{i,t-1}}{A_{i,t-1}} + \mu_{i,t}, \tag{2.2}$$

where $D_{i,t-1}$ denotes the dividend in year t-1, β_1 is the estimated value of marginal q, and the β_2 is the estimation of $\hat{r}_{i,t} - \hat{a}_{i,t}$. I estimate marginal q from Equation 2.2 using the random coefficient method following Greene et al. (2009).[4]. Based on the marginal q estimated from Equation 2.2, I construct the measure for capital budgeting inefficiency as $|\dot{q} - 1|$, the distance of marginal q from one, denoted as CBiE.

[3]Using unexpected changes in both market value and capital stocks is to alleviate the endogeneity in the market's expectations.

[4]All coefficient are estimated as $\beta_{i,t} = \beta_t + \nu_{i,t}$ to incorporate firm heterogeneity as well as the connection among individuals (Swamy, 1970; Greene et al., 2009, etc.)

2.3.2 Explore the Relationship between Capital Budgeting Efficiency and Corporate Governance

Weighted Least Squares Estimation

To examine the relationship between a firm's antitakeover provision adoption and the extent to which that firm's capital budgeting achieves value maximization goals, I regress the distance of marginal q from one on lagged G-Index or E-Index, and control for cash flows, leverage, firm size, investment in intangibles and other variables, as shown in equation 2.3.

$$|\dot{q}_{it} - 1| = \alpha + \beta_1 GovIndex_{i,t-1} + \sum_{j}^{J} \gamma_j X_{i,j,t-1} + \varepsilon_{it}, \tag{2.3}$$

where the subscripts i, t, and j indicate individual i, time t, and the jth control variable, respectively. For robustness concern, I also include industry-fixed effects in some specifications. Since the dependent variable is constructed from the estimated $\hat{\beta}_{1,it}$ in Equation 2.2, I apply the Saxonhouse (1976) techniques to weight all observations by the inverse of transformed standard errors of estimated $\dot{\beta}_{it}$ to account for the precision of the estimation of marginal q.

The focus of this paper is the cross-sectional relationship between the use of takeover defenses and firms' investment efficiency, given that the variation in corporate governance mainly resides in cross-firms,[5] especially after the 1990s (Cremers et al., 2009). Following Petersen (2009), for most of the regressions, I include year fixed effects and cluster standard errors at firm level to account for time and firm effects. I also include industry-fixed effects in some specifications for the robustness of the results, using Fama-French 48 industry classification.[6]

[5]For example, the between-firm standard deviation of G-Index and E-Index are 2.56 and 1.16 which are three times and two times larger than their corresponding within-firm variation. Moreover, the within-firm standard deviations of G-Index and E-Index are below one, which is not meaningful variation since the minimum incremental value of either index is one. Gompers et al. (2003), Core et al. (2006) and others also note that G-Index does not change often enough to explore the impact of within-firm changes.

[6]Petersen (2009) suggest that when both a firm and a time effect are present in the data, estimating the standard errors by clustering along the dimension that contains sufficient clusters and addressing the other dimension by including dummies can achieve unbiased estimators and standard errors.Given that I have only 14 years of data, the time dimension is not sufficient to yield unbiased standard errors, and the focus of this analysis is the cross-sectional relationship; I thus include year-fixed effects and cluster standard errors along the firm dimension for most models.

Instrumental Variables

The relationship between a firm's corporate governance and its capital budgeting efficiency could be biased by the endogeneity of the antitakeover provision adoption. The endogeneity concern is partially raised by the common determinants of the use of takeover defenses and firms' capital budgeting efficiency. For example, more competent managers may not be interested in using takeover defenses to secure their jobs or private interests if they can make better capital budgeting decisions resulting in better performance. Additionally, although governance indices have been workhorses of empirical corporate governance research, the raw index may confound endogenous choices and the effects of takeover deterrence, which may facilitate self-interested managers to deviate from maximizing shareholders' value. More specifically, a positive relationship between a firm's efficiency and its use of takeover defenses may reflect that takeover defenses promote firms' efficiency or that firms that face a higher likelihood of being takeover targets invest more efficiently.

To explore the causal relationship between the strength of shareholder rights and firms' capital budgeting efficiency, I address these endogeneity concerns by instrumenting the governance indices following Karpoff et al. (2017). Specifically, two types of instruments are used to isolate the exogenous variation in firms' adoption of takeover defenses. One set of instrumental variables is constructed based on the governance indices of firms geographically proximate to but in different industries as the focus firms, which utilize the similarities in governance influenced by the interactions among top managers and regional conventions or regulations. The other set of instrumental variables is based on the use of takeover defenses and the adoption of shareholder undermining provisions in non-industry peers going public in the same year as the focus firm, and this instrument highlights the influence of shareholders' preferences regarding governance practice on firms' governance design. Both types use the corresponding values in the last five years relative to the focus year. I then use a two-stage least squares regression to examine the impact of shareholder rights on a firm's capital budgeting inefficiency. In the first stage, I regress the governance indices on corresponding instrumental variables as shown in the following equation:

$$GovIndex_{it} = \beta_0 + \beta_{IV} IV_{it} + \sum_{j}^{J} \gamma_j X_{j,i,t} + \phi Industry_{it} + \delta_t + \mu_{it}, \tag{2.4}$$

where $GovIndex_{it}$ denotes G-Index or E-Index, and IV_{it} refers to the corresponding instrumental variables. $X_{j,i,t}$ is a list of control variables, including leverage, cash flow, institutional ownership, intangible assets, diversification, and firm size. $Industry_{it}$ denotes the industry fixed effects using Fama-French 48 industry classification.[7] δ_t represents the year-fixed effects.

I then regress the absolute deviation of marginal q from one on the instrumented governance index and the same set of pre-determined control variables as the first-stage in a second-stage regression, as follows:

$$|\dot{q}_{it} - 1| = \alpha + \beta Gov\hat{I}ndex_{it} + \sum_{j}^{J} \gamma_j X_{j,i,t} + \Phi Industry_{it} + \delta_t + \varepsilon_{it} \tag{2.5}$$

where $|\dot{q}_{it} - 1|$ is the inverse indicator of a firm's capital budgeting efficiency, whose larger value indicates a lower efficiency or a higher inefficiency.

Robustness

Following a seminal framework set out by Tobin (1969) that assumes a firm's average q summarizes its growth opportunities perceived by the market and that higher investment-q sensitivity is associated with a more efficient investment in an efficient market (See also, e.g. Whited (2001)), I examine the impact of corporate governance on the investment-q sensitivity as an alternative way to demonstrate the relationship between governance and investment efficiency.

Due to reasons such as the divergence between managers' and market's perception of investment opportunities, difficulties in measuring the intangible assets, and differences between marginal q and average q, the measured average q may contain measurement errors that are related to firms' investment. To deal with this measurement error problem, I implement the errors-in-variable model developed by

[7] For the robustness of the results, I report the 2SLS estimation results with and without industry-fixed effects.

Erickson and Whited (2000) and Erickson et al. (2014), which exploits information contained in higher cumulants of potentially mismeasured variables to obtain consistent estimators.

However, the sensitivity of investment to average q measures the investment efficiency only to the extent that average q gauges the firms' growth opportunities appropriately. In addition, a higher sensitivity may only suggest that the firm invests more efficiently compared to a firm with a lower sensitivity, yet it does not imply to what extent the firm's investment deviates or approaches its optimal level. Nevertheless, a firm associated with more efficient capital budgeting should have its investment align more tightly with its growth opportunities.

2.4 Data

To construct measures for shareholder rights, I obtain data, spanning 1991-2018, from Institutional Shareholder Services (ISS) through WRDS. More specifically, I construct G-Index and E-Index as cumulant indices of twenty-four and six provisions recorded by ISS following Gompers et al. (2003) and L. Bebchuk et al. (2009), respectively. [8] I use the average index of firms' non-industry peers that are either geographically proximate to or go public in the same year as the focus firm as instrumental variables for corresponding governance indices, per Karpoff et al. (2017). Additonally, I calculate firms' overall and assorted institutional investors' ownership based on institutional holding (f13) data from Refinitiv accessing via WRDS.

In addition to the governance data, I rely on the Compustat-CRSP merged (CCM) database and ExecuComp for annual firm-specific accounting and managers' tenure information. More specifically, I obtain firms' common shares outstanding, stock prices at the end of fiscal years, book values of long-term and short-term debts, gross property, plant and equipment, capital expenditures, R&D spending, dividends

[8] ISS data went through some structural changes in 2006. Although only about half of the original twenty-four provisions of the G-Index remain unchanged, the post-change dataset covers the information of the original G-Index provisions in a somewhat different format. Therefore, I could distill information from the new provisions and match it with the original G-Index provisions and expand the G-Index to 2018. The mean, median and standard deviation of the G-Index for 1990-2018 are 9.26, 9 and 2.74, similar to the original G-index as reported in Gompers et al. (2003), Karpoff et al. (2017) and others. Nevertheless, using the original G-Index for 1990-2006 does not qualitatively change the results.

and other variables to construct market value and replacement cost of assets for marginal q estimation as described in Section 2.3.1 and . I also construct firms' leverage, cash flows, average q, ROA, and other variables as defined in Table 2.1 using data from CCM. I exclude financial firms (SIC code 6000-6999), Utilities (SIC code 4900-4999), and other special regulated firms (SIC code 9000-9999) from the analysis because they may be subjected to special regulations, and the demarcation of their operation, financing, and investment activities may be different from the rest of the industries. The analysis focuses on firms operating in the U.S. and listed on one of the three major U.S. stock exchanges, i.e. NYSE, NASDAQ, and AMEX. I eliminate observations with negative total assets (Compustat item AT) or negative shares outstanding (Compustat item CSHO) to mitigate the effects of bad recording of the data. Most of the analyses use the integrated data of governance indices, estimated capital budgeting inefficiency, and control variables, which consist of 2168 unique firms spanning 1991-2018. However, subject to the limitation of the data availability of instrumental variables, the IV analysis examines 1994-2008. Table 2.2 reports the summary statistics of all variables.

2.5 Empirical Results

In this section, I examine the relationship between firms' capital budgeting inefficiency and the strength of their shareholder rights using the weighted least squares and instrumental variables method and discuss the heterogeneity in this relationship and potential mechanisms.

2.5.1 Main Results

Weighted Least Squared Estimation of Capital Budgeting Inefficiency on Corporate Governance Indices and Controls

I begin examining the relationship between capital budgeting inefficiency and corporate governance by regressing the absolute deviation of marginal q from one on different governance indices and controls using weighted least squares estimation with the inverse of transformed standard errors of marginal q estimation as weights as illustrated in Section 2.3.1. Table 2.3 reports the results. Given that the deviation of marginal q from one is an inverse measure of firms' capital budgeting efficiency, the negative coefficients of G-Index and E-Index in Table 2.3 demonstrate a negative relationship between a firm's capital budgeting inefficiency and its adoption of antitakeover and shareholder rights undermining provisions, indicating that weaker shareholder rights are associated with more efficient capital budgeting.

Moreover, I find that capital budgeting efficiency is positively related to firms' leverage and negatively associated with firms' cash flows, which aligns with the agency problems due to abundant cash flows and the agency cost reduction effect of debt (Jensen, 1986). Although the relationship between institutional investors' ownership and the efficiency of firms' capital budgeting decisions is not significant when institutional ownership enters the regression on its own, it shows a negative effect on capital budgeting efficiency when quasi-indexer ownership is included, and higher quasi-indexer ownership is associated with more value-enhancing capital budgeting. In addition, the results show that firms with a higher level of intangible assets tend to make less efficient capital budgeting decisions, which is in line with the conjecture that information asymmetry may distort firms' investment behavior, given that firms with more intangible assets are more difficult understand by outsiders due to the complexity of the technology. Finally, I find that a more diversified firm is associated with more value-enhancing capital budgeting decisions, suggesting that diversification's benefits, such as internal capital markets and more access to external capital (Stein, 1997; Durnev, Morck, & Yeung, 2001), outweigh the induced complexity in affecting managers' capital budgeting practice.

Instrumental Variables Identification

As discussed previously, the impact of adopting shareholder rights undermining provisions due to the corporate governance design on firms' efficiency may be confounded by the effects of the likelihood of being a takeover target. For example, given the sample propensity to be taken over, the negative relationship between governance indices and capital budgeting efficiency may reflect weaker shareholder rights associated with lower efficiency. Nevertheless, without proper control of takeover propensity, it may also demonstrate that a firm with higher efficiency is more likely to be an acquisition target. To address this endogeneity concern, as illustrated in Section 2.3.2, I use the takeover defenses of a firm's non-industry peers that are either geographically proximate to the firm or launched IPO in the same year as the focus firm as instrumental variables for governance indices following Karpoff et al. (2017).

Table 2.4 reports the results of the first stage of 2SLS estimation, corresponding with Equation 2.4, for the instrumental variables. For each model, the Kleibergen-Paap F-statistic is robust to standard errors clustered by firms (See Kleibergen (2007)), and all F-statistics exceed the critical values suggested by Stock and Yogo (2005) for the identification of strong instruments. All models show that the geography-based and IPO-cohort-based instruments are significantly positively related to the corresponding governance index. In addition, the significance indicated by the Kleigergen-Paap firm-clustered errors robust χ^2 statistics confirms the relevance of the instrumental variables to the instrumented variables.

Table 2.5 reports the second-stage estimation corresponding with Equation 2.5 using both the geography-based and IPO-cohort-based instruments for G-Index and E-Index. The column headers indicate the instrumental variables used in each model. Consistent with the weighted least squared estimation, Table2.5 demonstrates a positive (negative) relationship between antitakeover and shareholder rights undermining provision adoption and the firm's capital budgeting efficiency (inefficiency) robust to various governance indices and instrumental variables. Moreover, leverage is positively associated with value-enhancing capital budgeting, confirming the agency cost reduction effects of debt. However, the relationship between capital budgeting inefficiency and informational asymmetry and that between capital budgeting inefficiency and firm size become marginally negative.

Robustness

The measure of capital budgeting inefficiency used in this study relies on one assumption: the optimal threshold of firms' marginal q is one when their investments are at the level maximizing their valuation at the equilibrium. However, due to the empirical imperfections, such as taxes, aggregation of capital stock over a long period, lumpiness of the capital investment, and aggregation across different types of capital assets, the empirical optimal level of marginal q may deviate from one. Although it is virtually impossible to predict the net effects of all the implications, these effects are exogenous to capital budgeting efficiency, shareholder rights and, most importantly, the relationship between these two.[9] Nevertheless, to ensure that the choice of optimal level of estimated marginal q does not alter the relationship between capital budgeting efficiency and firms' shareholder rights, I perform nonlinear maximum likelihood estimation of optimal capital budgeting threshold simultaneously as the estimation of coefficients of governance indices and control variables, following Durnev et al. (2004), Greene et al. (2009), and others. Table 2.6 reports the results of the nonlinear maximum likelihood regression of capital budgeting inefficiency on shareholder rights, measured by governance indices, and controls. Although the estimated threshold h is statistically significantly different from one, the magnitude of the deviation is negligible for all specifications. More importantly, none of the coefficients are qualitatively different from the weighted least squared estimation.

In addition to the capital budgeting efficiency, ROA has been used to capture firms' operating efficiency (e.g., see, Core et al. (2006); Gormley and Matsa (2016)). I posit that if the market is efficient in a way that the distance of the market expected marginal q from one reflects firms' inefficient capital use, then there is consistency between capital budgeting efficiency and ROA. Therefore, I examine the relationship between ROA and shareholder rights and report the results of the two-stage least squares regression of ROA on instrumented corporate governance indices, which measure the strength of shareholder rights, in Table 2.7. I control for firms' total assets, market valuation, and lagged ROA following Core et al. (2006), Fisman et al. (2014), and others. I also report the results using a different set of control variables in Appendix 2B.1, which shows qualitatively the same results. Consistent with previous results presented in Table 2.3 and Table 2.5, Table 2.7 shows that weaker shareholder rights, as measured by higher G-Index or E-Index, are associated with higher ROA.

[9]See Durnev et al. (2004) for detailed discussion.

2.5.2 Impacts of Governance on Sensitivity of Investment to Growth Opportunities

As discussed in Section 2.3.2, for the robustness of the relationship between corporate governance and firms' capital budgeting efficiency, I also examine whether the governance affects the sensitivity of firms' investment to their growth opportunities represented by average q. Given the potential measurement errors problem, following Erickson et al. (2014), I use the fifth-order cumulant estimator to estimate the investment regression, and I report the results in Table 2.8. As suggested by Erickson et al. (2014), I use within-firm transformed variables to account for the firm-fixed effect, and the results are similar with or without year-fixed effects.

Consistent with estimating the relationship between firms' capital budgeting efficiency and governance quality in Table 2.3, Table 2.8 shows that the sensitivity of firms' investment to growth opportunities increases as the firms take more antitakeover provisions or the governance becomes weaker. The estimated R^2, ρ^2, is higher than that reported by Erickson et al. (2014), suggesting that corporate governance may be essential for a firm's investment and its relationship with growth opportunities.[10] With the similar scale of the coefficient of average q, I conjecture that the much higher measurement quality of q in these estimations is due to the usage of "Total q," accounting for both tangible and intangible assets in the firm's market value and replacement value.[11] Moreover, the Sagan tests reject the overidentifying restrictions for all the models in Table 2.8.

However, contradicting prior findings that poor governance is associated with higher industry-adjusted investment (Richardson, 2006; Harford et al., 2008, etc.), the relationship between corporate governance quality and investment for firms with average growth opportunities is positive.[12] Moreover, if institutional ownership is

[10] Erickson et al. (2014) reports an R^2 of 0.211 for their fifth-order cumulant estimators of investment regression only including q and cash flows as independent variables.

[11] The coefficient and measurement quality index of the fifth-order cumulant estimators of q in Erickson et al. (2014) are 0.03 and 0.352, respectively.

[12] Take column (1) in Table 2.8 for example, the average value of within-firm transformed q is -0.221, and thus the overall effect of G-index for firms with average growth opportunities is -0.004*(-0.221)-0.001=-0.0001. Given that G-index increases as firms' government quality decrease, the negative coefficient demonstrates a positive relationship between governance quality and firms' investment.

viewed as an external push toward good governance, [13] its positive coefficient confirms that governance quality is positively associated with firms' investment. One hypothesis is that a well-governed firm has a better internal capital market and better access to the external fund, which could induce more investment; however, my focus is on the efficiency of the investment rather than determinants of the level of investment, so this interesting phenomenon is left to be explored in the future. Finally, older firms tend to invest less, potentially because they lack investment opportunities.

Collectively, the above results show that weak shareholder rights are associated with more efficient investments, reflected in the negative relationship between governance indices and capital budgeting inefficiency, the positive relationship between governance indices and ROA, and the positive relationship between governance indices and firms' investment sensitivity to growth opportunities. These findings seem to contradict the previously documented positive relationship between corporate governance and firms' valuation (e.g., see, (Gompers et al., 2003) and Cremers et al. (2009). One hypothesis is that the market may favor disbursements of profits more than investment, and if strong shareholder rights induce managers to cater to the market's preferences to boost short-term stock prices (Polk & Sapienza, 2008), one may observe a positive relationship between shareholder rights and market valuation and a negative relationship between shareholder rights and investment efficiency at the same time. Though it is interesting to explore the potential differences between marginal q and average q and the reasons behind the different relationships in the future, it is beyond the scope of this paper.

2.5.3 Heterogeneity in the relationship between capital allocation inefficiency and corporate governance

Underinvestment and Overinvestment

Given that the investment distortion may result from (over)investing in value-destroying projects or (under)investing in value-enhancing ones, it is natural to examine whether and how corporate governance affects firms' capital budgeting ef-

[13] The coefficients of G-Index and E-Index become insignificant when the institutional ownership is included consistent with this intuition.

ficiency differently in these two cases.

Considering that other factors, such as cash flows and leverage, may also have different impacts on firms' capital budgeting efficiency, I conduct separate analyses of underinvesting and overinvesting firms to explore whether corporate plays different roles in affecting the extent to which a firm under- and over-invests. The results are shown in Table 2.9. The p-values of the differences of the coefficients of the G-Index for the underinvestment versus overinvestment samples in Table 2.9 demonstrate that weaker shareholders' rights are associated with more efficient capital budgeting decisions regardless of whether the firm underinvests or overinvests. In the unreported results, I interact dummy variables indicating underinvestment with only the governance index, and the coefficients are not statistically significant.

Although weaker shareholder rights are associated with less distortion in capital budgeting efficiency regardless of underinvesting or overinvesting firms, it is unclear whether entrenched management is more likely to underinvest or overinvest. I thus examine the relationship between a firm's corporate governance and the likelihood of the firm overinvesting. Table 2.10 displays the results of regressing a dummy variable, which equals one if a firm's investment is above the level predicted by its average q, on the corporate governance index and other variables. The negative coefficients of the G-Index demonstrate that firms with weaker shareholders' rights are more likely to underinvest than to overinvest. This result may be because that weaker shareholders' rights limit firms' ability to raise external funds to conduct value-enhancing projects, in addition to its adverse effects due to agency problems.

Firm Age

The relationship between firms' efficiency and shareholder rights may differ for firms at different life stages. For instance, a powerful and entrenched founder could be beneficial for the firm at a younger age when it faces more growth opportunities along with uncertainties and requires the founder, often one of the top managers, to be entrusted with enough power to navigate the firm. However, management entrenchment will be more problematic for an older firm that survives its early stage and accumulates more resources while exhausting its original growth opportunities set.

Concerning that the relationship between capital budgeting efficiency and factors other than governance may vary for firms in different life stages, I split the sample into observations into the bottom and top age quintiles within each industry year. As the IRRC records more larger and older firms, I conduct the age ranking for the overall sample, including the firms with missing values in the governance index, to avoid bias toward large firms, and the unbalanced sample size for young and old firms confirms the necessity of doing so.

Table 2.12 reports the results of weighted least squares estimation for young (bottom age quintile) and old firms (top age quintile). Using E-Index shows a more contrasting relationship between capital budgeting inefficiency and governance quality in young versus old firms. The pattern that more entrenched management is associated with more value-enhancing capital budgeting decisions exists only for young firms. Nevertheless, regardless of whether using G-Index or E-Index, the association between entrenched management and efficient capital budgeting is more significant in young firms than in old firms. However, the diversification shows a puzzling pattern: the positive relationship between diversification and capital budgeting efficiency is mainly reflected in small firms. This result could be because a young firm that spans multiple industries may indicate better operation quality, or the internal capital market is more critical for young firms. Moreover, cash flows and institutional ownership do not impact capital budgeting efficiency differently for young and old firms. Finally, the more positive relationship between a firm's leverage and its capital budgeting efficiency for young firms than old firms indicates the agency cost reduction effect of debt is more prominent in young firms.

Managers' Quality

In addition to a firm's life cycle, the relationship between a firm's capital budgeting efficiency and shareholder rights may also vary with its managers' quality. For example, given that takeover pressures, due to strong shareholder rights, may induce managers to focus on short-term profits at the expense of long-term efficiency (See, for example, Stein (1988)), adopting antitakeover provisions may improve long-term capital budgeting efficiency by reducing this tendency inasmuch as managers are capable of making value-enhancing capital budgeting decisions without these pressures. Moreover, adopting antitakeover provisions may dissipate the adverse effects of managerial career concerns resulting from takeover pressure or shareholders (See, for example, Fos and Tsoutsoura (2014)) and reduce the time and resources that managers divert to defend their jobs. To what extent this would improve a firm's efficiency may be related to the managers' capability. Therefore, I posit that the negative relationship between the adoption of antitakeover and shareholder rights undermining provisions and firms' capital budgeting efficiency may be more pronounced or exclusive to firms with more competent management.

Following Bhagat and Bolton (2008), I use the CEO's tenure-to-age ratio to proxy for the CEO's quality. Columns (1) and (4) in Table 2.13 show that adoption of antitakeover provisions is associated more with value-enhancing capital budgeting decisions when the CEO's quality is higher, represented by a higher value of the CEO's tenure to age ratio. This is confirmed in the subsamples analysis, which demonstrates that greater shareholders' power may harm firms' investment efficiency only when firms have a high-quality CEO. However, in the unreported results, I do not find a statistically significant relationship between capital budgeting inefficiency and the CEO's tenure-to-age ratio controlling for firms' governance, leverage, cash flows, diversification, intangible assets ratio, institutional ownership and size.

Another proxy I use to capture the firms' management quality is its (long-term) annualized sales growth, as competent management is likely to lead firms to grow fast. The correlation between CEO's tenure-to-age ratio and firms' one-year, two-year, and three-year sales growth are 0.091, 0.119, and 0.147, respectively, and all are significant at the 1% level. I perform weighted least squares estimation of capital budgeting inefficiency on lagged governance and controls for subsamples of high and low growth in Table 2.14. For robustness of the results, I perform subsample analysis using instrumental variables for G-Index and E-Index and for simplicity, I report the coefficients of the governance index of the second stage estimation in Figure 2.2.[14] Consistent with Table 2.13, Table 2.14 and Figure 2.2 illustrates that the association between value-enhancing capital budgeting decisions and antitakeover

[14]Due to the non-overlapping time span of CEO tenure and governance index instrument variables, I cannot perform the IV estimation for the subsamples based on the CEO's tenure-age ratio.

provisions adoption is more remarkable in firms with higher sales growth. Moreover, the negative association between cash flows and the distance marginal q away from its optimal threshold existing only in firms with lower sales growth may be because that firms run by low-quality management are more financially constrained. Finally, the positive impacts of leverage on firms' investment efficiency are stronger for firms with higher sales growth and may imply that more competent management is capable of borrowing more money and investing in value-enhancing projects.

2.5.4 Mechanism Discussion

Cash Holdings

The first mechanism through which that takeover defense may affect firms' governance to address is the cash holdings channel. Previous research documents that a firm with weaker governance, as measured by the adoption of more antitakeover provisions, tends to hold less cash reserve or to dissipate excess more quickly (See, for example, Harford et al. (2008), Dittmar and Mahrt-Smith (2007), and Bates, Kahle, and Stulz (2009)). If more cash holding exacerbates free cash flow problems, less cash at hand may force managers to spend more efficiently. Moreover, less takeover pressure may reduce the precautionary demand for cash holdings, which may result in more cash for investment; however, whether the investments are value-enhancing or value-destroying is up to empirical examination.

I first examine the relationship between a firm's cash holdings and its governance index, and the results are reported in columns (1), (2), (5), and (6) of Table 2.15. The findings demonstrate that a firm's governance quality is positively associated with its cash holdings, consistent with Bates et al. (2009), Harford et al. (2008) and others. I then add the lagged cash holdings as an additional explanatory variable into the baseline regression of absolute deviation of marginal q from one on governance and other controls. The results are reported in columns (3), (4), (7), and (8) in Table 2.15 and illustrate a positive relationship between a firm's cash holdings and future capital budgeting inefficiency. Moreover, adding lagged cash holdings to the capital budgeting inefficiency regression improves the R-squared only marginally and slightly decreases F-statistics. In the unreported results, instrumenting the governance index by firms' geographically proximate non-industry peers' corresponding governance index does not qualitatively alter the results. Collectively, antitakeover provisions adoption is positively associated with value-enhancing capital budgeting decisions may, at least partly, through reducing the cash holdings effectively. The results highlight one of the potential costs of takeover pressure is to reserve more cash at the expense of value-enhancing investments.

Volatility in Operation

Another hypothesis regarding the negative relationship between shareholder rights and capital budgeting efficiency is that delegation of controls to managers may increase the persistence of firms' operational decisions by reducing the deviation from optimal decisions due to shareholders' interruption, which may, in turn, improve firms' capital budgeting efficiency. The volatility in firms' operating variables, such as sales and investment, may reflect the persistence of firms' operations.

To explore the above hypothesis, I first examine the relationship between firms' governance and various measures of firms' operational risk. The negative coefficients of G-Index in columns (1), (3), and (5) of Table 2.16 demonstrate that poorly governed firms, reflected as those with more antitakeover provisions, tend to have less variation in future investment, sales growth, and EBIT, which is consistent with previous literature (See, for example, John, Litov, and Yeung (2008)). However, to my surprise, the relationship between firms' capital budgeting efficiency and variation in investment and operating performance, as shown in columns (2), (4), and (6) of Table 2.16, is significantly negative. In the unreported results, I repeat the analysis using instrumental variables for the G-Index and E-Index and observe the same pattern, regardless of using the deviation of marginal q from one or the firms' ROA as the second-stage dependent variables. Moreover, adding the variation in investment or operating performance to the benchmark regression of capital budgeting inefficiency on governance index and control variables reduces the scale of the G-Index's coefficient more significantly than it increases the overall R-squared. Collectively, the results suggest that delegation of controls to managers may release the firm from taking unnecessary volatility that may harm firms' efficiency, through which mechanism is associated with more value-enhancing capital budgeting decisions. This finding does not necessarily contradict findings of a positive relationship between firms' risk-taking and valuation (See, for example, John et al. (2008)). A higher market value or average q ratio reflecting a higher market's expected growth opportunities does not guarantee that the firm exploits the opportunities to the optimal, and this may be an interest for future exploration.

2.6 Conclusion

Shareholder rights have been at the center of corporate governance empirical research. Weaker shareholder rights have been related to lower market valuation of the firm, mostly due to the deterioration of agency problems. However, enhancing shareholder rights may come with costs as well. For instance, strong shareholder rights may induce otherwise competent managers to cater to the shareholders' preferences for short-term performance or invest in projects requiring their specific skills yet value-destroying to the firm. Overall, the impact of shareholder rights on the firm could be multifaced and requires empirical examination. Existing empirical evidence addressing weak shareholder rights are detrimental to firms is mainly rooted in the positive relationship between firms' governance and market valuation. I take a different path by examining the relationship between shareholder rights, measured by the corporate governance indices, and firms' capital budgeting efficiency. Compared to the overall market valuation, capital budgeting efficiency may better reflect the consequence of balancing shareholder rights and delegation of controls to managers, as capital budgeting decisions are at the core of managers' domain. The outcomes of capital budgeting may be affected by the consistency between managers' interests and that of shareholders' aw well as managers' initiatives and capability to use discretionary judgement. Additionally, I contribute to the literature on corporate governance's impacts on firms' investment decisions by focusing on efficiency.

Using the distance of a firm's marginal q from one as a measure of the proximity of firms' capital budgeting to the value maximization goal, this paper documents a surprising positive relationship between a firm's capital budgeting efficiency and its use of takeover defenses and shareholder undermining provisions, which is normally considered a sign of poor governance. Using ROA, an accounting measure of efficiency, does not qualitatively alter the results. To address the endogeneity of adoption of antitakeover provisions with respect to firms' capital budgeting efficiency due to the confounding effects of takeover deterrence and endogenous choices, I instrument the governance index and use two-stage least squares estimation to re-examine the relationship between firms' capital budgeting inefficiency and its governance quality. The results confirm the positive linkage between the two. Moreover, I find that the adoption of takeover defenses is associated with more value-enhancing capital budgeting decisions symmetrically within underinvesting and overinvesting firms. However, poorly governed firms, as measured by adopting more antitakeover provisions, are more likely to underinvest than to overinvest.

With the conjecture that the positive impact of takeover defenses and adoption of shareholder rights undermining provisions on firms' efficiency may result from the reduction of the cost of takeover pressures on managers' decision-making, I examine the heterogeneity of the relationship between firms' governance and capital budgeting efficiency with respect to firms' lifecycle and managers' competence. I find that the positive relationship between firms' capital budgeting inefficiency and their shareholder rights is more prominent in younger firms and firms with higher-quality managers. These results suggest that, for firms where agency problems are of less concern, the cost of takeover pressures, for example, distortion in managers' decision-making due to too much takeover pressure or less control, may outweigh the benefits.

In this paper, I also try to explore the mechanisms through which the adoption of antitakeover provisions may positively affect a firm's investment efficiency. I find that firms have weaker shareholder rights hoard less cash reserve, and the firm's cash holdings are positively associated with its capital budgeting inefficiency. The results suggest that poorly governed firms may have to make investment decisions more carefully with less cash at hand. In addition, a positive relationship between governance quality and variations in firms' investment and operating outcomes, measured by sales growth and EBIT, is unveiled. These variations are found to be positively related to firms' capital budgeting inefficiency. These results collectively indicate that the positive impacts of takeover defenses on firms' investment efficiency may be partly due to the fact that management facing less takeover pressure can avoid unnecessary risks that harm firms' efficiency.

It is important to note that corporate governance may affect many aspects of firms other than capital budgeting decisions, and the findings of this study do not suggest that strong shareholder rights or antitakeover provisions are beneficial or detrimental for firms in general.

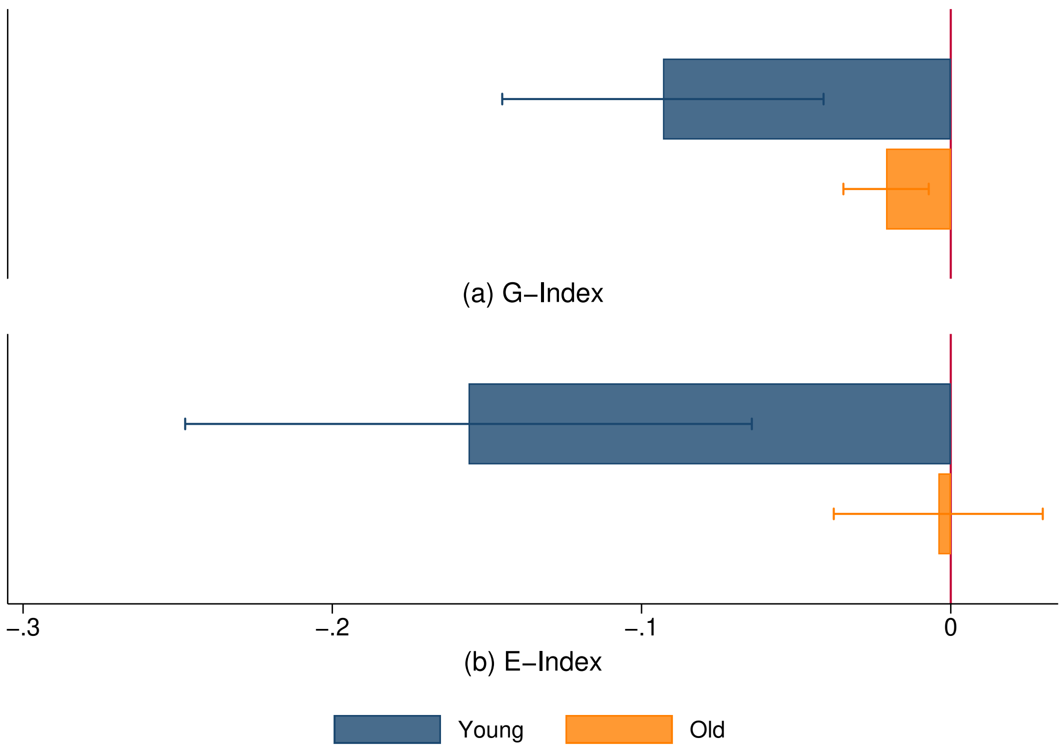


Figure 2.1: Relationship between Capital Budgeting Efficiency and Governance Index for Young and Old Firms

This graph shows the coefficients of the governance index in the regressions of capital budgeting efficiency, measured by the absolute deviation of marginal q from one, for young firms versus old firms using weighted least squares estimation. Figures (a) and (b) show the coefficients of G-Index and E-Index, respectively. The inverse of the transformed standard errors of estimated marginal q is used as the weights to account for the estimation precisions of marginal q. Young (Old) firms are those whose age ranks at the bottom (top) twenty-percentile within each industry year. All regressions control for leverage, cash flows, institutional ownership, intangible assets ratio, diversification, firm size and year-fixed effects. All variables are defined in Table 2.1. The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) and spans 1991-2018. All variables are in 2012 dollars and are winsorized at 1% and 99% levels. Standard errors clustered by firms are used to calculate the significance intervals. The coefficients are shown as the bars, and the capped lines denote the 10% significance interval.

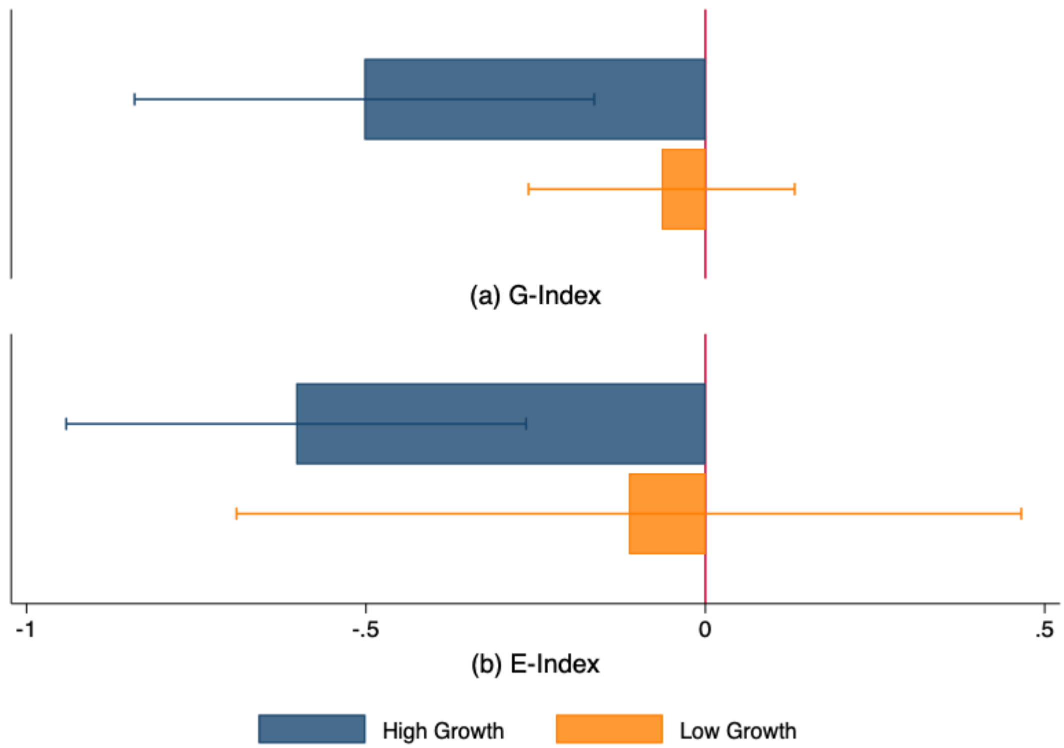


Figure 2.2: Relationship between Capital Budgeting Efficiency and Governance Index for High and Low Growth Firms

This figure shows the coefficients of the governance index in the second stage of instrumental variable regressions of capital budgeting efficiency, measured by the absolute deviation of marginal q from one, for firms located in the top and bottom twenty percentiles within industry year in terms of 5-year sales growth. Figures (a) and (b) show the coefficients of G-Index and E-Index, instrumented by Geo5Gindex and Geo5Eindex, respectively. The inverse of the transformed standard errors of estimated marginal q is used as the weights to account for the estimation precisions of marginal q. High (Low) growth firms are those whose annualized 5-year sales growth ranks at the bottom (top) twenty-percentile within each industry year. All regressions control for leverage, cash flows, institutional ownership, intangible assets ratio, diversification, firm size and year-fixed effects. All variables are defined in Table 2.1. The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) and spans 1991-2018. All variables are in 2012 dollars and are winsorized at 1% and 99% levels. Standard errors clustered by firms are used to calculate the significance intervals. The coefficients are shown as the bars, and the capped lines denote the 10% significance interval.

Table 2.1: Definition of Variables

Variable	Definition & Construction
Age	Years since the founding year. For firms missing the founding year, the first year it appears in COMPUSTAT is used as an alternate starting year. Alternatively, age is defined as the years since the firm's IPO year or the first year it appeared in COMPUSTAT records. The founding year is obtained from Jay R. Ritter's website (Access through https://site.warrington.ufl.edu/ritter/files/founding-dates.pdf).
Average q	Average q is measured as the ratio of a firm's market value to its replacement costs of tangible and intangible assets, where the market value and the replacement value of the firm are calculated as shown in Appendix
CashHoldings	Cash holdings ratio is calculated as the ratio of cash holdings and equivalence to total assets.
CashFlow	Cash flow is calculated as the operating income before depreciation (OIBDP), subtracting relevant taxes (XINT, TXT), and paid dividends (DVC) scaled by the total assets.
Diversification	Diversification is measured as the count of 2-digit SIC codes of the firms' segments.
E-Index	Entrenchment index constructed by L. Bebchuk et al. (2009).
G-Index	Governance index constructed by Gompers et al. (2003).
Geo5Gindex	Calculated as the sum of each G-Index provision weighted by the portion of geographically proximate non-industry peers adopting that provision five years prior to the analysis year.
Geo5Eindex	Calculated as the sum of each E-Index provision weighted by the portion of geographically proximate non-industry peers adopting that provision five years prior to the analysis year.
I	Investment ratio is the ratio of investment, including property, plant, and equipment (PPE) and R&D to the last year's capital stock of both tangible assets and R&D (K_{rd}).
InstOwn	Institutional ownership is calculated as the ratio of shares owned by all institutional investors to the firm's total outstanding shares.

Table 2.1 continued from previous page

Intan	Intangible to assets ratio is measured as the ratio of intangible capital stock, including R&D capital stock and SG&A capital stock, to the sum of tangible and intangible capital.
Ipo5Gindex	Calculated as the sum of each G-Index provision weighted by the portion of the same IPO cohort of non-industry peers adopting that provision five years prior to the analysis year.
Ipo5Eindex	Calculated as the sum of each E-Index provision weighted by the portion of the same IPO cohort of non-industry peers adopting that provision five years prior to the analysis year.
K_{rd}	Capital stock of tangible and R&D assets, which is calculated as the sum of gross property, plant, and equipment (COMPUSTAT item PPEGT), and replacement cost of knowledge capital, following Peters and Taylor (2017).
Leverage	Leverage is measured as the ratio of long-term debt to the replacement value of tangible assets following Whited (1992).
QixOwn	Quasi-indexer ownership is measured as the ratio of a firm's outstanding shares held by institutional investors classified as quasi-indexers to its total shares outstanding, where quasi-indexer is classified by Bushee and Noe (2000).
ROA	Return on assets is calculated as the ratio of net income to average total assets at the beginning and end of the year.
SalesGrowth	SalesGrowth is the annualized growth rate of net sales in the last few years. I calculate the growth rate for one-year, two-year, and three-year, and denoted as $Sale_{g1}$, $Sale_{g2}$ and $Sale_{g3}$, respectively.
SD_I	Calculated as the five-year standard deviation of tangible investment (COMPUSTAT item PPE) to the gross capital stock (COMPUSTAT item PPEGT) ratio.
SD_{CF}	Calculated as the five-year standard deviation of the ratio of EBITDA to total assets (COMPUSTAT item AT).
SD_{SaleG}	Calculated as the five-year standard deviation of the one-year net sales (COMPUSTAT item SALE) growth.
Size	Size is measured as the log of firms' total assets.
TenureAge(TAG)	Tenure-to-age ratio is measured as the ratio of CEOs' tenure (in the company) to their age as a measure of CEO quality following Bhagat and Bolton (2008).

Table 2.2: Summary Statistics

This table represents the summary statistics of the main variables used in the analysis. All variables are defined in Table 2.2. The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999). All variables are in 2012 dollars and are winsorized at 1% and 99% level.

Variable	No. of Obs.	Mean	Median	Std. Dev.	P5	P95	Year Coverage
Age	18990	33.50	30.00	18.82	12.00	65.00	1991-2018
Average q	18990	1.34	0.92	1.65	0.08	3.97	1991-2018
CashHoldings	18990	0.14	0.08	0.15	0.01	0.45	1991-2018
CashFlow	18984	0.10	0.09	0.08	0.00	0.22	1991-2018
Diversification	18984	1.92	2.00	1.19	1.00	4.00	1991-2018
E-Index	18112	2.45	3.00	1.28	0.00	4.00	1991-2018
G-Index	10071	9.26	9.00	2.74	5.00	14.00	1991-2018
Geo5Gindex	8553	9.10	9.03	0.94	7.52	10.60	1994-2008
Geo5Eindex	8553	2.60	2.60	0.42	1.85	3.25	1994-2008
I	18990	0.14	0.11	0.10	0.03	0.31	1991-2018
InstOwn	18961	0.73	0.77	0.21	0.34	1.02	1991-2018
Intan	18115	0.52	0.55	0.25	0.06	0.88	1991-2018
Ipo5Gindex	8541	2.58	2.59	0.27	2.08	3.00	1994-2008
Ipo5Eindex	8541	2.58	2.59	0.27	2.08	3.00	1994-2008
Leverage	18969	0.30	0.27	0.22	0.01	0.73	1991-2018
QixOwn	18959	0.46	0.46	0.18	0.16	0.76	1991-2018
ROA	18989	0.05	0.06	0.09	-0.08	0.17	1991-2018
$Sale_{g1}$	18986	0.07	0.05	0.26	-0.19	0.37	1991-2018
$Sale_{g2}$	18986	0.06	0.05	0.19	-0.15	0.31	1991-2018
$Sale_{g3}$	18984	0.06	0.05	0.15	-0.12	0.28	1991-2018
SD_I	18989	0.06	0.03	0.07	0.01	0.17	1991-2018
SD_{CF}	18977	0.04	0.03	0.04	0.01	0.10	1991-2018
SD_{SaleG}	18114	0.24	0.10	11.91	0.03	0.40	1991-2018
Size	18990	7.61	7.50	1.43	5.48	10.37	1991-2018
TenureAge(TAG)	5024	0.15	0.12	0.12	0.00	0.41	2011-2019

Table 2.3: Weighted Least Squares Regression of Firms' Capital Budgeting Efficiency on Governance and Control Variables

This table represents the relationship between firms' capital budgeting efficiency and corporate governance using weighted least squared estimation and controlling for firms' leverage, cash flow and other characteristics. The inverse of the transformed standard errors of estimated marginal q is used as the weights to account for the estimation precisions. The dependent variables are the deviation of marginal q from one. All variables are defined in Table 2.1. All independent variables are one-year lagged than the dependent variable. The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) and spans 1991-2018. All variables are in 2012 dollars and are winsorized at 1% and 99% level. *T-statistics* are shown in parentheses and standard errors clustered by firm are used to compute the *T-statistics*. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
G-Index	-0.036***	-0.032***	-0.034***	-0.031***				
	(-6.11)	(-5.73)	(-5.92)	(-5.58)				
E-Index					-0.030**	-0.027**	-0.029**	-0.026**
					(-2.29)	(-2.12)	(-2.19)	(-2.05)
Leverage	-0.787***	-0.725***	-0.814***	-0.750***	-0.802***	-0.740***	-0.830***	-0.765***
	(-14.35)	(-13.73)	(-14.61)	(-13.96)	(-14.54)	(-13.92)	(-14.81)	(-14.16)
CashFlow	0.493**	0.562***	0.478**	0.549***	0.505**	0.570***	0.489**	0.556***
	(2.23)	(2.73)	(2.18)	(2.68)	(2.29)	(2.77)	(2.23)	(2.72)
InstOwn	-0.087	-0.114	0.308***	0.214**	-0.098	-0.125	0.317***	0.218**
	(-0.93)	(-1.23)	(2.86)	(2.02)	(-1.04)	(-1.35)	(2.89)	(2.04)
Intan	0.276***	0.078	0.277***	0.08	0.273***	0.072	0.274***	0.074
	(5.60)	(1.08)	(5.66)	(1.12)	(5.51)	(0.99)	(5.58)	(1.03)
Diversification	-0.042***	-0.026***	-0.040***	-0.025***	-0.047***	-0.029***	-0.045***	-0.029***
	(-4.84)	(-2.99)	(-4.68)	(-2.93)	(-5.36)	(-3.40)	(-5.19)	(-3.33)
Size	-0.015	-0.014	-0.011	-0.011	-0.021**	-0.020**	-0.017*	-0.016*
	(-1.64)	(-1.53)	(-1.24)	(-1.14)	(-2.31)	(-2.14)	(-1.86)	(-1.71)
QixOwn			-0.702***	-0.585***			-0.736***	-0.612***
			(-6.42)	(-5.49)			(-6.72)	(-5.75)
Industry-Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
Year-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	18990	18990	18988	18988	18990	18990	18988	18988
R-squared	0.16	0.19	0.16	0.19	0.15	0.18	0.16	0.19
F	46.59	10.70	41.76	10.73	44.63	10.79	40.06	10.43

Table 2.4: First-Stage Regressions and Validity of Instruments

This table represents the first-stage regressions of the governance index on the instrumental variables and pre-determined control variables included in the second-stage regression of capital budgeting efficiency on the governance index. All variables are defined in Table 2.1. Kleibergen-Paap LM statistic (Chi2) and p-value of Chi2 report the LM test of under-identification (relevance of instrumental variables) robust to standard errors clustered by firms, and Kleibergen-Paap Wald F statistic is the F-statistics of weak identification test robust to firm-level clustered standard errors, see Kleibergen-Paap (2006). Anderson-Rubin F and P-value of AR F show the weak identification test based on Anderson-Rubin (1949). The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) and spans 1991-2018. All variables are in 2012 dollars and are winsorized at 1% and 99% level. *T-statistics* are shown in parentheses and standard errors clustered by firm are used to compute the *T-statistics*. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

Instrumented Variables	Gindex		Eindex		Gindex		Eindex	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Instruments								
Geo5Gindex	0.358***	0.333***						
	(4.64)	(4.36)						
Geo5Eindex			0.384***	0.340***				
			(4.81)	(4.28)				
Ipo5Gindex					0.590***	0.547***		
					(8.61)	(8.26)		
Ipo5Eindex							0.474***	0.454***
							(4.19)	(4.19)
Predetermined Variables								
Leverage	0.768**	0.695*	0.189	0.132	0.794**	0.655*	0.225	0.137
	(2.60)	(2.30)	(1.33)	(0.92)	(2.71)	(2.18)	(1.59)	(0.97)
CashFlow	-0.453	-0.532	-0.347	-0.335	-0.251	-0.332	-0.31	-0.294
	(-0.78)	(-0.93)	(-1.22)	(-1.22)	(-0.42)	(-0.58)	(-1.06)	(-1.05)
InstOwn	1.053**	1.141**	0.535**	0.590***	1.363***	1.407***	0.579***	0.635***
	(2.71)	(3.05)	(3.10)	(3.39)	(3.63)	(3.86)	(3.34)	(3.64)
Intan	0.198	0.589	-0.174	-0.14	0.023	0.451	-0.263	-0.202
	(0.69)	(1.42)	(-1.27)	(-0.75)	(0.08)	(1.08)	(-1.93)	(-1.08)
Diversification	0.327***	0.248***	0.061*	0.039	0.236***	0.182**	0.057*	0.035
	(5.37)	(4.08)	(2.31)	(1.43)	(3.97)	(3.03)	(2.16)	(1.30)
Size	0.313***	0.356***	-0.036	-0.026	0.224***	0.262***	-0.048	-0.039
	(5.76)	(6.65)	(-1.49)	(-1.07)	(4.09)	(4.83)	(-1.93)	(-1.55)
Year-fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
No. of Obs.	8683	8683	8683	8683	8668	8668	8668	8668
Kleibergen-Paap rk LM statistic (Chi2)	21.94	20.00	23.35	18.70	65.40	61.52	17.23	17.29
P-value of Chi2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kleibergen-Paap rk Wald F statistic	21.57	19.03	23.10	18.29	74.08	68.17	17.58	17.54
Anderson-Rubin F	18.42	7.80	5.66	1.03	36.77	28.71	5.42	3.22
P-value of AR F	0.00	0.01	0.02	0.31	0.00	0.00	0.02	0.07

Table 2.5: Second-Stage Regressions of Capital Budgeting Efficiency on Governance Index

This table represents the second-stage regressions of capital budgeting efficiency on the instrumented governance index and control variables. Columns (1)-(2), (3)-(4), (5)-(6), and (7)-(8) use Geo5Gindex, Geo5Eindex, Ipo5Gindex and Ipo5Eindex are instrumental variables for corresponding governance index, respectively. All variables are defined in Table 2.1. F Stats report the F-statistics of the second-stage regression. The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) and spans 1991-2018. All variables are in 2012 dollars and are winsorized at 1% and 99% level. *T-statistics* are shown in parentheses and standard errors clustered by firm are used to compute the *T-statistics*. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

Instrumental Variables:	Geo5Gindex		Geo5Eindex		Ipo5Gindex		Ipo5Eindex	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
G-Index	-0.220***	-0.150**			-0.190***	-0.174***		
	(-3.44)	(-2.49)			(-5.29)	(-4.71)		
E-Index			-0.320**	-0.152			-0.394**	-0.298*
			(-2.18)	(-1.00)			(-2.10)	(-1.65)
Leverage	-0.704***	-0.638***	-0.818***	-0.723***	-0.726***	-0.615***	-0.798***	-0.697***
	(-6.53)	(-6.73)	(-8.40)	(-8.82)	(-7.77)	(-6.84)	(-7.70)	(-7.75)
CashFlow	-0.048	0.132	-0.074	0.156	-0.047	0.114	-0.109	0.102
	(-0.17)	(0.51)	(-0.25)	(0.59)	(-0.17)	(0.44)	(-0.36)	(0.37)
InstOwn	0.236	0.134	0.191	0.057	0.211	0.167	0.235	0.151
	(1.54)	(0.92)	(1.30)	(0.38)	(1.58)	(1.23)	(1.42)	(0.90)
Intan	0.282***	0.039	0.187**	-0.059	0.277***	0.045	0.166	-0.09
	(3.00)	(0.32)	(2.04)	(-0.54)	(3.12)	(0.38)	(1.64)	(-0.74)
Diversification	0.003	-0.01	-0.049***	-0.041***	-0.006	-0.003	-0.043**	-0.034**
	(0.10)	(-0.48)	(-2.91)	(-3.03)	(-0.35)	(-0.18)	(-2.33)	(-2.23)
Size	0.065**	0.054**	-0.016	-0.003	0.055**	0.061***	-0.019	-0.009
	(2.51)	(2.03)	(-0.94)	(-0.21)	(2.53)	(2.77)	(-1.10)	(-0.51)
Year-fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
No. of Obs.	8683	8683	8683	8683	8668	8668	8668	8668
R-squared	0.30	0.42	0.37	0.46	0.35	0.40	0.33	0.41
F Stats	13.71	7.00	13.93	7.46	14.57	6.78	13.02	6.20
P-value of F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 2.6: Nonlinear Estimation of Regression of Capital Budgeting Efficiency on Governance Indices and Control Variables

This table reports nonlinear maximum likelihood regression of capital budgeting efficiency on governance indices and control variables. This method estimates the optimal threshold of estimated marginal q, $\hat{h}$, and simultaneously estimates the relationship between $|mq - h|$ and governance indices and controls. The dependent variables are the absolute deviation of estimated marginal q from the simultaneously estimated optimal level, $|mq - h|$. Columns (1) (2) and (3) (4) adopt G-Index and E-Index as measures of shareholder rights. All variables are as defined in Table 2.1. The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) and spans 1991-2018. All variables are in 2012 dollars and are winsorized at 1% and 99% level. χ^2 statistics for tests of "$h = 1$" are present in brackets. + denotes that estimated h is significantly different from one at the level of 1%. *T-statistics* are shown in parentheses, and standard errors clustered by firms are used to compute the *T-statistics*. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	(1)	(2)	(3)	(4)
G-Index	-0.012***	-0.011***		
	(-5.48)	(-4.96)		
E-Index			-0.014***	-0.012**
			(-2.89)	(-2.47)
Leverage	-0.288***	-0.278***	-0.293***	-0.266***
	(-11.78)	(-11.38)	(-11.93)	(-10.70)
CashFlow	0.126	0.164**	0.128	0.143*
	(1.58)	(2.15)	(1.58)	(1.85)
InstOwn	0.043	0.025	0.041	0.028
	(1.47)	(0.86)	(1.39)	(0.95)
Intan	0.141***	0.095***	0.143***	0.096***
	(6.03)	(4.09)	(6.10)	(4.08)
Diversification	-0.012***	-0.008**	-0.013***	-0.010***
	(-3.02)	(-2.13)	(-3.39)	(-2.61)
Size	-0.009**	-0.009**	-0.011***	-0.010***
	(-2.43)	(-2.18)	(-3.00)	(-2.66)
h	1.039+	1.030+	1.038+	1.056+
	(182.11)	(5.15e+07)	(180.63)	(192.77)
	[46.64]	[>1000]	[42.73]	[105.66]

Table 2.6 continued from previous page

Year-Fixed Effects	Yes	Yes	Yes	Yes
Industry-Fixed Effects	No	Year	No	Year
No. of Observations	18040	18040	18040	18040
Adj. R-square	0.6027	0.6128	0.6012	0.6118
Log-likelihood	-6215.5	-5983.4	-6249.0	-6006.3

Table 2.7: 2SLS Regressions of ROA on Governance Indices and Validity of Instruments

This table represents 2SLS estimation of firms' ROA on instrumental variables for corporate governance indices and control variables. Panel A reports the first-stage regressions of the governance index on the instrumental variables and pre-determined control variables included in the second-stage regression of capital budgeting efficiency on the governance index. Dependent variables are G-Index and E-Index for columns (1),(2),(5),(6) and (2),(3),(7),(8), respectively. Panel B reports the second-stage regression of ROA on the instrumented governance index and control variables. Columns (1)-(2), (3)-(4), (5)-(6), and (7)-(8) use Geo5Gindex, Geo5Eindex, Ipo5Gindex and Ipo5Eindex are instrumental variables for corresponding governance index, respectively. All variables are defined in Table 2.1. Kleibergen-Paap LM statistic (Chi2) and p-value of Chi2 report the LM test of under-identification (relevance of instrumental variables) robust to standard errors clustered by firms, and Kleibergen-Paap Wald F statistic is the F-statistics of weak identification test robust to firm-level clustered standard errors, see Kleibergen (2007). Anderson-Rubin F and P-value of AR F show the weak identification test based on Anderson-Rubin (1949). The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) and spans 1991-2018. All variables are in 2012 dollars and are winsorized at 1% and 99% level. *T-statistics* for Panel A and *Z-statistics* for Panel B are shown in parentheses. Standard errors clustered by firms are used to compute the *T-statistics* and *Z-statistics*. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: First-Stage Estimation								
Instrumented Variables	Gindex		Eindex		Gindex		Eindex	
Instruments								
Geo5Gindex	0.366***	0.310***						
	(4.34)	(3.76)						
Geo5Eindex			0.401***	0.346***				
			(4.96)	(4.32)				
Ipo5Gindex					0.668***	0.593***		
					(9.23)	(8.45)		

Table 2.7 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ipo5Eindex							0.467***	0.427***
							(4.13)	(3.90)
Predetermined Variables (Excluded Instruments)								
Size	0.822***	0.739***	0.215**	0.190**	0.674***	0.573***	0.250***	0.192**
	(5.49)	(4.74)	(3.14)	(2.62)	(4.61)	(3.71)	(3.70)	(2.63)
MV_{equity}	-0.406**	-0.284	-0.221***	-0.185**	-0.377**	-0.233	-0.266***	-0.199**
	(-2.80)	(-1.94)	(-3.38)	(-2.72)	(-2.68)	(-1.62)	(-4.11)	(-2.93)
ROA_{t-1}	-0.273	-0.615	-0.217	-0.258	-0.396	-0.745	-0.064	-0.181
	(-0.55)	(-1.28)	(-0.91)	(-1.11)	(-0.79)	(-1.54)	(-0.26)	(-0.77)
Year-fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
No. of Obs.	8683	8683	8683	8683	8668	8668	8668	8668
Kleibergen-Paap rk LM statistic (Chi2)	19.6	15.07	24.84	19.13	75.09	62.83	17.06	15.13
P-value of Chi2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kleibergen-Paap rk Wald F statistic	18.86	14.1	24.6	18.66	85.22	71.45	17.03	15.2

Table 2.7 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Anderson-Rubin F	18.79	5.97	15.55	4.02	25.51	19.18	5.06	2.57
P-value of AR F	0.00	0.01	0.00	0.05	0.00	0.00	0.02	0.11
Pnnel B: Second-Stage Estiamtion								
Dependent Var =	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA
G-Index	0.011***	0.007**			0.007***	0.007***		
	(3.25)	(2.10)			(4.54)	(3.91)		
E-Index			0.024***	0.013*			0.018**	0.014
			(3.24)	(1.86)			(1.99)	(1.49)
Size	-0.055***	-0.063***	-0.051***	-0.060***	-0.051***	-0.063***	-0.049***	-0.060***
	(-9.50)	(-11.56)	(-9.30)	(-11.67)	(-11.17)	(-13.02)	(-9.45)	(-11.43)
MV_{equity}	0.053***	0.062***	0.054***	0.062***	0.051***	0.062***	0.052***	0.063***
	(10.72)	(13.50)	(9.99)	(12.75)	(11.66)	(13.93)	(10.10)	(12.40)
ROA_{t-1}	0.451***	0.407***	0.453***	0.406***	0.452***	0.407***	0.453***	0.406***
	(13.93)	(13.27)	(13.64)	(13.16)	(14.22)	(13.22)	(13.86)	(13.04)
Year-fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
No. of Obs.	8683	8683	8683	8683	8668	8668	8668	8668

Table 2.7 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
R-squared	0.46	0.51	0.46	0.52	0.5	0.51	0.48	0.51
F Stats	116.62	99.48	106	49.15	126.9	99.4	113.87	47.9
P-value of F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 2.8: Errors-in-Variables Regression of Investment on Average Q and Governance

This table reports the regression of firms' investment on average q, governance and controls, using fifth-order cumulant estimators (Erickson et al., 2014). Dependent variables for all models are the investment ratio which is the ratio of investment including property, plant & equipment (PPE) and R&D to the last year's capital stock of both tangible assets and R&D (K_{rd}). ρ^2 is an estimated R-squared of the regression, and $\tau^2 \in [0, 1]$ is average q's measurement quality index to proxy for growth opportunities, which increases as the proxy quality improves. J-Stats is the J statistics of the overidentification restriction test from Sargan (1958). All variables are defined in Table 2.1, and all are within-firm transformed (demeaned at firm-level) as suggested in Erickson et al. (2014). All independent variables are one-year lagged than the dependent variable. The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) and spans 1991-2018. All variables are in 2012 dollars and are winsorized at 1% and 99% level. *Z-statistics* are shown in parentheses. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Average q	0.034***	0.036***	0.037***	0.036***	0.032***	0.034***	0.030***	0.033***
	(58.70)	(56.82)	(55.32)	(56.08)	(53.11)	(38.75)	(34.69)	(33.92)
Q*G-index	0.004***	0.002***	0.002***	0.002***				
	(20.98)	(7.50)	(7.95)	(6.59)				
G-index	-0.001***	-0.002***	0.001	0.000				
	(-12.21)	(-3.67)	(1.07)	(-0.65)				
Q*E-index					0.004***	0.008***	0.005***	0.005***
					(6.59)	(10.67)	(7.90)	(6.62)
E-index					-0.003***	0.002	0.000	0.002
					(-7.77)	(0.72)	(0.23)	(0.62)
CashFlow	0.018	0.026	0.064***	0.028	0.049**	0.087***	0.106***	0.083***
	(0.91)	(1.24)	(2.80)	(1.28)	(2.10)	(3.71)	(3.97)	(3.81)
Age			-0.057***	-0.058***			-0.062***	-0.061***
			(-12.45)	(-10.98)			(-12.97)	(-11.10)
InstOwn			0.028***	0.023**			0.030***	0.022**
			(3.31)	(2.50)			(3.60)	(2.50)
Year Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
Firm demeaned	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	18990	18990	18990	18990	18990	18990	18990	18990
ρ^2	0.228	0.265	0.284	0.290	0.223	0.257	0.250	0.279
Std. Err. of ρ^2	0.012	0.013	0.013	0.013	0.011	0.013	0.012	0.013
τ^2	0.874***	0.809***	0.756***	0.781***	0.899***	0.85***	0.899***	0.831***
J-Stats	503.47	278.02	275.72	281.47	583.79	246.15	348.46	235.66

Table 2.8 continued from previous page

p-value of Sargan Test	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 2.9: Impacts of Governance on Capital Budgeting Efficiency for Underinvestment and Overinvestment Firms

This table reports the association between corporate governance index and capital budgeting efficiency for underinvestment and overinvestment samples. All estimations use the weighted least squares method, and the inverse of the transformed standard errors of estimated marginal q is used as the weights to account for the estimation precisions of marginal q. Two classification methods are used to identify underinvestment and overinvestment samples. Columns (1) and (3) ((2) and (4)) classify firms with estimated marginal q above (below) one as underinvesting (overinvesting) and denote as $|mq-1|^{+}$ ($|mq-1|^{-}$). Columns (5) and (7) ((6) and (8)) regard a firm with investments below (above) its average q predicts as underinvestment (overinvestment). The dependent variables are the absolute deviation of marginal q from one. All variables are defined in Table 2.1. All independent variables are one-year lagged than the dependent variable. The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) and spans 1991-2018. All variables are in 2012 dollars and are winsorized at 1% and 99% levels. *T-statistics* are shown in parentheses, and standard errors clustered by firm are used to compute the *T-statistics*. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	$\|mq-1\|^{+}$	$\|mq-1\|^{-}$	$\|mq-1\|^{+}$	$\|mq-1\|^{-}$	Under	Over	Under	Over
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
G-Index	-0.018***	-0.020***	-0.015***	-0.015**	-0.018***	-0.017**	-0.014***	-0.013**
	(-3.47)	(-2.60)	(-2.93)	(-2.07)	(-3.80)	(-2.52)	(-3.20)	(-1.97)
	p-value of Diff = 0.97		p-value of Diff = 0.68		p-value of Diff = 0.31		p-value of Diff = 0.52	
Leverage	-0.933***	-0.453***	-0.838***	-0.401***	-0.762***	-1.178***	-0.700***	-0.983***
	(-14.28)	(-4.63)	(-13.64)	(-4.62)	(-12.36)	(-11.68)	(-12.22)	(-10.08)
CashFlow	-0.469	-0.098	-0.295	-0.009	-0.204	-0.795*	-0.115	-0.139
	(-1.49)	(-0.30)	(-1.05)	(-0.03)	(-0.81)	(-1.67)	(-0.50)	(-0.36)

Table 2.9 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
InstOwn	0.007	-0.027	-0.033	-0.018	-0.083	0.115	-0.13	0.048
	(0.07)	(-0.19)	(-0.35)	(-0.14)	(-0.82)	(0.83)	(-1.33)	(0.34)
Intan	0.193***	0.167**	0.004	-0.029	0.130**	0.313***	-0.032	-0.12
	(3.33)	(2.12)	(0.05)	(-0.25)	(2.29)	(4.66)	(-0.38)	(-1.07)
Diversification	-0.052***	-0.021	-0.034***	-0.020*	-0.039***	-0.063***	-0.027***	-0.023
	(-5.55)	(-1.35)	(-3.69)	(-1.78)	(-4.59)	(-3.91)	(-3.28)	(-1.39)
Size	0.000	-0.003	-0.002	0.000	-0.008	0.019	-0.003	0.012
	(-0.00)	(-0.25)	(-0.16)	(0.01)	(-0.84)	(1.14)	(-0.34)	(0.67)
Industry-Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes
No. of Observations	14259	4125	14259	4125	13423	5567	13423	5567
R-squared	0.16	0.13	0.19	0.20	0.16	0.16	0.20	0.22
F	36.52	8.89	9.33	3.52	31.56	26.63	7.79	7.65

Table 2.10: Impacts of Governance on Likelihood of Overinvesting

This table reports the impact of the corporate governance index on the likelihood of overinvesting. Columns (1) - (4) and (5) - (8) report the results using the linear probability model and probit model with year-fixed effects, respectively. The dependent variables are dummy variables equaling one if the firm's investment exceeds its average q predicts. All variables are defined in Table 2.1. All independent variables are one-year lagged than the dependent variable. The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) and spans 1991-2018. All variables are in 2012 dollars and are winsorized at 1% and 99% levels. *T-statistics* (*Z-statistics*) are shown in parentheses for columns (1)-(4) ((5)-(8)), and standard errors clustered by firms are used to compute the statistical significance. F-stats and Chi-squared stats are reported for columns (1)-(4) and (5) - (8), respectively. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	Linear probability				Probit			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
G-Index	-0.011***	-0.013***	-0.012***	-0.015***	-0.008***	-0.014***	-0.009***	-0.016***
	(-4.04)	(-5.15)	(-4.62)	(-5.60)	(-4.10)	(-9.57)	(-4.46)	(-10.71)
Leverage	0.025	-0.043	-0.061**	-0.120***	-0.147***	-0.043***	-0.227***	-0.138***
	(0.86)	(-1.51)	(-1.97)	(-3.99)	(-6.51)	(-2.80)	(-9.45)	(-8.11)
CashFlow	0.148*	0.183**	0.220***	0.260***	0.418***	0.185***	0.509***	0.288***
	(1.90)	(2.35)	(2.85)	(3.32)	(7.34)	(3.87)	(8.74)	(5.87)
InstOwn	0.196***	0.209***	0.199***	0.217***	0.166***	0.217***	0.183***	0.233***
	(5.53)	(6.33)	(5.62)	(6.38)	(5.84)	(10.91)	(6.44)	(11.72)
Intan	0.178***	0.470***	0.191***	0.472***	0.628***	0.466***	0.622***	0.476***
	(6.18)	(13.19)	(6.63)	(13.05)	(15.07)	(25.41)	(14.86)	(25.91)
Diversification	-0.004	-0.023***	-0.006	-0.024***	0.009**	-0.023***	0.009**	-0.024***
	(-0.83)	(-4.48)	(-1.17)	(-4.72)	(2.36)	(-7.77)	(2.35)	(-8.16)
Size	-0.022***	-0.021***	-0.020***	-0.020***	-0.008	-0.021***	-0.012*	-0.020***
	(-4.45)	(-4.30)	(-4.14)	(-4.10)	(-1.14)	(-8.53)	(-1.72)	(-7.89)
Average q			-0.029***	-0.027***			-0.028***	-0.036***
			(-9.65)	(-7.27)			(-9.91)	(-13.21)
Industry-Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
No. of Observations	18990	18990	18990	18990	13478	18990	13478	18990
R-squared	0.05	0.11	0.06	0.12	0.26	0.10	0.27	0.11
F/Chi2	19.41	11.31	26.39	11.36	4519.27	2177.70	4631.31	2380.71

Table 2.11: Weighted Least Squares Regression of Firms' Capital Budgeting Efficiency on Governance and Interactions with Age

This table represents the weighted least squares estimation of firms' age impacts on the relationship between firms' capital budgeting efficiency and corporate governance. The inverse of the transformed standard errors of estimated marginal q is used as the weights to account for the estimation precisions of marginal q. The dependent variables are the absolute deviation of marginal q from one. Columns (1) to (4) and (5) to (8) use G-index and E-index as measures of governance quality, respectively. Age is the count of years since the firm is founded. $GIndex \times Age$ and $EIndex \times Age$ are the interactions of age with G-Index and E-Index. All variables are defined as in Table 2.1. All independent variables are one-year lagged than the dependent variable. The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) and spans 1991-2018. All variables are in 2012 dollars and are winsorized at 1% and 99% levels. *T-statistics* are shown in parentheses, and standard errors clustered by firm are used to compute the *T-statistics*. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
G-Index	-0.059***	-0.058***	-0.057***	-0.056***				
	(-4.26)	(-4.25)	(-4.15)	(-4.14)				
$GIndex \times Age$	0.001***	0.001***	0.001**	0.001***				
	(2.59)	(2.75)	(2.56)	(2.70)				
E-Index					-0.101***	-0.095***	-0.096***	-0.092***
					(-4.17)	(-4.01)	(-4.01)	(-3.87)
$EIndex \times Age$					0.002***	0.002***	0.002***	0.002***
					(4.42)	(4.36)	(4.28)	(4.23)
Age	-0.011***	-0.010***	-0.010***	-0.010***	-0.011***	-0.010***	-0.011***	-0.010***
	(-4.32)	(-4.05)	(-4.25)	(-3.99)	(-6.50)	(-5.88)	(-6.33)	(-5.74)
Leverage	-0.773***	-0.712***	-0.798***	-0.736***	-0.789***	-0.727***	-0.814***	-0.750***
	(-14.51)	(-13.74)	(-14.72)	(-13.95)	(-14.71)	(-13.94)	(-14.90)	(-14.13)
CashFlow	0.478**	0.547***	0.465**	0.535***	0.476**	0.544***	0.463**	0.532***
	(2.20)	(2.68)	(2.15)	(2.63)	(2.20)	(2.67)	(2.15)	(2.62)
InstOwn	-0.097	-0.12	0.259**	0.186*	-0.11	-0.133	0.251**	0.177*
	(-1.05)	(-1.31)	(2.41)	(1.77)	(-1.18)	(-1.44)	(2.30)	(1.67)
Intan	0.252***	0.062	0.253***	0.064	0.251***	0.058	0.252***	0.06
	(5.27)	(0.86)	(5.33)	(0.90)	(5.22)	(0.80)	(5.29)	(0.84)
Diversification	-0.035***	-0.023***	-0.033***	-0.022***	-0.037***	-0.023***	-0.035***	-0.023***
	(-4.12)	(-2.67)	(-3.98)	(-2.62)	(-4.29)	(-2.71)	(-4.15)	(-2.65)
Size	-0.003	-0.004	0	-0.001	-0.006	-0.007	-0.002	-0.003
	(-0.32)	(-0.42)	(-0.01)	(-0.08)	(-0.58)	(-0.70)	(-0.26)	(-0.35)
QixOwn			-0.632***	-0.546***			-0.641***	-0.552***
			(-5.78)	(-5.15)			(-5.87)	(-5.21)
Industry-Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
No. of Observations	18990	18990	18988	18988	18990	18990	18988	18988
R-squared	0.17	0.19	0.17	0.20	0.17	0.19	0.17	0.20
F	39.22	10.19	35.75	9.95	38.07	9.96	34.73	9.69

Table 2.12: Weighted Least Squares Regression of Firms' Capital Budgeting Efficiency on Governance and Control Variables for Subsamples based on Age

This table represents the relationship between firms' capital budgeting efficiency and corporate governance for young and old firms using weighted least squared estimation and controlling for firms' leverage, cash flow and other characteristics. The inverse of the transformed standard errors of estimated marginal q is used as the weights to account for the estimation precisions. The dependent variable is the deviation of marginal q from the theoretical optimal level, one. Columns (1), (3), (5), (7) and (2), (4), (6), (8) report results for firms ranking at the bottom and top twenty-percentile in terms of age within its industry-year and denoted as young and old, respectively, where age is the count of years since the firm is founded. All variables are defined in Table 2.1. All independent variables are one-year lagged than the dependent variable. The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) and spans 1991-2018. All variables are in 2012 dollars and are winsorized at 1% and 99% levels. *T-statistics* are shown in parentheses, and standard errors clustered by firm are used to compute the *T-statistics*. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	Young	Old	Young	Old	Young	Old	Young	Old
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
G-Index	-0.092***	-0.022**	-0.084**	-0.024***				
	(-2.97)	(-2.58)	(-2.45)	(-2.83)				
	P-value of diff = 0.058		P-value of diff = 0.096					
E-Index					-0.127***	-0.012	-0.093*	-0.012
					(-2.68)	(-0.67)	(-1.93)	(-0.61)
					P-value of diff = 0.024		P-value of diff = 0.099	
Leverage	-1.393***	-0.450***	-1.156***	-0.417***	-1.120***	-0.511***	-0.826***	-0.491***
	(-5.78)	(-6.77)	(-4.39)	(-6.40)	(-5.11)	(-7.22)	(-3.54)	(-6.42)
CashFlow	0.492	0.934***	1.393*	0.809***	-0.897	0.763**	0.891	0.648**
	(0.48)	(3.16)	(1.75)	(2.87)	(-0.67)	(2.34)	(1.21)	(1.97)
InstOwn	-0.729**	-0.186	-0.645*	-0.169	-0.344	-0.16	-0.504*	-0.172*
	(-2.05)	(-1.44)	(-1.89)	(-1.32)	(-1.04)	(-1.52)	(-1.68)	(-1.65)
Intan	0.744***	0.196***	0.189	-0.059	0.835***	0.115*	0.262	-0.114
	(3.66)	(2.99)	(0.59)	(-0.68)	(3.48)	(1.81)	(1.00)	(-1.24)
Diversification	-0.097**	-0.013	-0.148***	-0.005	-0.144***	-0.019*	-0.157***	-0.014
	(-2.42)	(-1.28)	(-3.25)	(-0.51)	(-3.15)	(-1.84)	(-3.28)	(-1.30)
Size	0.051	-0.015	0.063	-0.013	0.067	-0.008	0.066	0.001
	(1.12)	(-1.44)	(1.26)	(-1.13)	(1.20)	(-0.68)	(1.24)	(0.05)
Industry-Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes
No. of Observations	948	6596	948	6596	948	6596	948	6596
R-squared	0.25	0.17	0.37	0.20	0.20	0.16	0.39	0.19
F	8.43	11.35	7.85	14.07	7.72	11.44	9.49	22.38

Table 2.13: Impacts of Tenure-to-Age on Relationship between Firms' Capital Budgeting Efficiency and Governance

This table represents the weighted least squares estimation of two sets of regressions. One is regressing firms' capital budgeting efficiency on the governance index and its interaction term with CEO's tenure-to-age ratio and controls, which are reported in Columns (1) and (4). Columns (2), (3) and (5), (6) report the results of examining the relationship between capital budgeting efficiency and firms' governance quality for subsamples located in the top and bottom quintiles in terms of CEO's tenure-to-age ratio, respectively. The inverse of the transformed standard errors of estimated marginal q is used as the weights to account for the estimation precisions of marginal q. The dependent variables are the absolute deviation of marginal q from one for all the models. All variables are defined in Table 2.1. All independent variables are one-year lagged than the dependent variable. The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) and spans 1991-2018. All variables are in 2012 dollars and are winsorized at 1% and 99% levels. *T-statistics* are shown in parentheses, and standard errors clustered by firm are used to compute the *T-statistics*. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	All Sample	High TAG	Low TAG	All sample	High TAG	Low TAG
	(1)	(2)	(3)	(4)	(5)	(6)
G-Index	-0.001	-0.040***	-0.007	-0.003	-0.046***	-0.007
	(-0.07)	(-3.12)	(-0.56)	(-0.22)	(-3.41)	(-0.48)
		p-value of Diff: 0.042			p-value of Diff: 0.028	
TenureAge	0.279**			0.279**		
	(1.99)			(2.11)		
TAG × Gindex	-0.032*			-0.033*		
	(-1.84)			(-1.92)		
Leverage	-0.363***	-0.553***	-0.281***	-0.387***	-0.567***	-0.325***
	(-4.75)	(-4.32)	(-3.67)	(-3.89)	(-3.46)	(-3.63)
CashFlow	0.849***	0.790**	1.047***	0.904***	0.860**	1.088***
	(2.95)	(2.00)	(2.85)	(3.13)	(2.28)	(2.67)
InstOwn	-0.171	-0.024	-0.287	-0.173	-0.004	-0.28
	(-0.98)	(-0.14)	(-1.10)	(-0.91)	(-0.02)	(-1.07)
Intan	0.264***	0.261***	0.235***	0.333***	0.364**	0.238*
	(4.31)	(2.80)	(3.73)	(2.68)	(2.06)	(1.89)
Diversification	-0.029**	-0.041**	-0.011	-0.021*	-0.032**	-0.009
	(-2.43)	(-2.42)	(-0.89)	(-1.78)	(-2.05)	(-0.67)
Size	-0.023	0.001	-0.049**	-0.025	-0.006	-0.052**
	(-1.49)	(0.04)	(-2.26)	(-1.62)	(-0.27)	(-2.08)
Industry-Fixed Effects	No	No	No	Yes	Yes	Yes
No. of Observations	3457	2088	1898	3457	2088	1898
R-squared	0.11	0.13	0.11	0.15	0.19	0.14
F	7.79	9.16	5.42	4.36	22.05	503.34

Table 2.14: Impacts of Sales Growth on Relationship between Firms' Capital Budgeting Efficiency and Governance

This table represents the weighted least squares estimation of two sets of regressions. One is regressing firms' capital budgeting efficiency on the governance index and its interaction term with firms' sales growth and controls, which are reported in Columns (1) and (4). Columns (2), (5) and (3), (6) report the results of examining the relationship between capital budgeting efficiency and firms' governance quality for subsamples located in the top and bottom quintiles in terms of annualized sales growth, respectively. Columns (1)-(3) and (4)-(6) use annualized one-year growth and three-year growth, respectively. The inverse of the transformed standard errors of estimated marginal q is used as the weights to account for the estimation precisions of marginal q. The dependent variables are the absolute deviation of marginal q from one. All variables are defined in Table 2.1. All independent variables are one-year lagged than the dependent variable. The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) and spans 1991-2018. All variables are in 2012 dollars and are winsorized at 1% and 99% levels. *T-statistics* are shown in parentheses, and standard errors clustered by firm are used to compute the *T-statistics*. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	1-year growth			3-year growth		
	All Sample	Low Growth	High Growth	All Sample	Low Growth	High Growth
	(1)	(2)	(3)	(4)	(5)	(6)
G-Index	-0.018***	-0.026***	-0.065***	-0.004	-0.01	-0.080***
	(-2.92)	(-2.99)	(-4.54)	(-0.69)	(-1.36)	(-4.47)
		p-value of Diff: 0.070			p-value of Diff: 0.009	
SalesGrowth	0.437***			0.701***		
	(5.16)			(7.43)		
Gindex × SalesGrowth	-0.040***			-0.062***		
	(-3.97)			(-5.35)		
Leverage	-0.810***	-0.549***	-1.672***	-0.829***	-0.222***	-1.863***
	(-13.85)	(-6.65)	(-10.32)	(-13.78)	(-3.53)	(-10.53)
CashFlow	0.238	-0.828*	0.757*	0.234	-0.875**	0.54
	(0.96)	(-1.95)	(1.68)	(0.93)	(-2.24)	(1.22)
InstOwn	-0.105	0.014	-0.25	-0.183*	-0.094	-0.402
	(-1.13)	(0.13)	(-1.12)	(-1.71)	(-1.19)	(-1.63)
Intan	0.296***	0.111	0.403***	0.289***	0.078	0.436***
	(5.93)	(1.60)	(3.59)	(5.28)	(1.57)	(3.38)
Diversification	-0.042***	-0.040***	-0.061**	-0.046***	-0.008	-0.085***
	(-4.40)	(-2.93)	(-2.48)	(-4.55)	(-0.87)	(-3.33)
Size	-0.014	-0.01	0.008	-0.015	-0.005	0.025
	(-1.43)	(-0.80)	(0.28)	(-1.41)	(-0.57)	(0.81)
No. of Observations	14055	2791	2614	14195	2722	2875
R-squared	0.17	0.19	0.21	0.18	0.20	0.22
F	35.48	10.86	25.66	39.96	4.90	26.41

Table 2.15: Cash Holdings Mechanism

This table demonstrates the relationship between firms' cash holdings and their corporate governance index in columns (1), (2), (5) and (6), and the impact of firms' cash holdings on capital budgeting efficiency is shown in columns (3), (4), (7) and (8). The dependent variables are the cash holdings for columns (1), (2), (5), (6), and the deviation of marginal q from one is the dependent variable for columns (3), (4), (7) and (8). All variables are defined in Table 2.1. All independent variables are one-year lagged than the dependent variable. All models include year-fixed effects. The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) and spans 1991-2018. All variables are in 2012 dollars and are winsorized at 1% and 99% level. *T-statistics* are shown in parentheses, and standard errors clustered by firms are used to compute the *T-statistics*. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

Dependent Var. =	CashHoldings		$\|mq-1\|$		CashHoldings		$\|mq-1\|$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
G-Index	-0.005***	-0.004***	-0.030***	-0.028***				
	(-4.96)	(-4.36)	(-5.52)	(-5.28)				
E-Index					-0.008***	-0.007***	-0.021*	-0.021*
					(-3.62)	(-3.35)	(-1.67)	(-1.65)
CashHoldings			1.115***	0.897***			1.141***	0.920***
			(10.49)	(7.27)			(10.66)	(7.42)
Leverage	-0.188***	-0.150***	-0.572***	-0.584***	-0.190***	-0.152***	-0.581***	-0.594***
	(-15.46)	(-14.09)	(-11.47)	(-11.49)	(-15.61)	(-14.20)	(-11.60)	(-11.64)
CashFlow	-0.290***	-0.261***	0.780***	0.773***	-0.290***	-0.261***	0.799***	0.787***
	(-6.66)	(-7.52)	(3.84)	(3.95)	(-6.66)	(-7.52)	(3.93)	(4.02)
InstOwn	0.022	0.018	-0.118	-0.138	0.022	0.018	-0.132	-0.151
	(1.43)	(1.32)	(-1.31)	(-1.51)	(1.45)	(1.34)	(-1.44)	(-1.64)
Intan	0.086***	0.042***	0.188***	0.057	0.085***	0.040***	0.184***	0.052
	(7.91)	(3.12)	(4.03)	(0.81)	(7.73)	(2.98)	(3.92)	(0.73)
Diversification	-0.013***	-0.009***	-0.027***	-0.017**	-0.013***	-0.010***	-0.031***	-0.021**
	(-6.69)	(-4.83)	(-3.30)	(-2.09)	(-6.99)	(-5.02)	(-3.78)	(-2.47)
Size	-0.017***	-0.016***	0.005	0.000	-0.018***	-0.017***	0.001	-0.004
	(-8.37)	(-8.09)	(0.54)	(0.04)	(-9.07)	(-8.63)	(0.06)	(-0.42)
Industry-Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
No. of Observations	18990	18990	18990	18990	18990	18990	18990	18990
R-squared	0.23	0.36	0.19	0.20	0.22	0.36	0.18	0.20
F	78.24	24.46	47.34	11.37	78.02	24.94	46.20	11.56

Table 2.16: Risk Mechanism

This table relates the firms' variation of investment, variation of operating cash flows, and variation of sales growth to their corporate governance index in columns (1), (3) and (5), and the relationships between capital budgeting efficiency and these variations are shown in columns (2), (4) and (6). The dependent variables are a five-year standard deviation of investment ratio (SD_I), a five-year standard deviation of the ratio of EBITDA to total assets (SD_{CF}), and a five-year standard deviation of one-year sales growth (SD_{SaleG}) for columns (1), (3) and (5), respectively. The deviation of marginal q from one is the dependent variable for columns (2), (4) and (6), which deploy weighted least squares estimation with the inverse of the transformed standard errors of estimated marginal q as the weights. All variables are defined in Table 2.1. All independent variables are one-year lagged than the dependent variable. All models include a year-fixed effect. The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) and spans 1991-2018. All variables are in 2012 dollars and are winsorized at 1% and 99% level. *T-statistics* are shown in parentheses, and standard errors clustered by firms are used to compute the *T-statistics*. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

Dependent Var. =	SD_I	$\|mq-1\|$	SD_{CF}	$\|mq-1\|$	SD_{SaleG}	$\|mq-1\|$
	(1)	(2)	(3)	(4)	(5)	(6)
G-Index	-0.001***	-0.018***	-0.001***	-0.028***	-0.005***	-0.032***
	(-3.85)	(-3.44)	(-4.23)	(-5.15)	(-3.44)	(-5.75)
SD_I		2.928***				
		(10.42)				
SD_{CF}				2.790***		
				(7.16)		
SD_{SaleG}						0.001***
						(8.89)
Leverage	-0.018***	-0.670***	-0.005*	-0.710***	0.009	-0.723***
	(-4.37)	(-12.81)	(-1.82)	(-13.57)	(0.33)	(-13.61)
CashFlow	0.034**	0.581***	0.009	0.639***	-0.577***	0.576***
	(2.06)	(2.97)	(0.57)	(3.15)	(-2.75)	(2.71)
InstOwn	0.016***	-0.126	-0.001	-0.102	0.076***	-0.112
	(3.07)	(-1.41)	(-0.18)	(-1.11)	(3.34)	(-1.21)
Intan	0.029***	0.009	-0.013***	0.088	-0.047*	0.082
	(5.42)	(0.13)	(-3.25)	(1.24)	(-1.86)	(1.13)
Diversification	-0.001**	-0.01	-0.002***	-0.020**	-0.006**	-0.025***
	(-2.44)	(-1.34)	(-4.47)	(-2.34)	(-2.18)	(-2.96)
Size	-0.008***	0.014	-0.004***	0.000	-0.015***	-0.015
	(-10.68)	(1.60)	(-7.82)	(0.04)	(-4.10)	(-1.56)
Industry-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	13494	18629	13488	18981	12272	18979
R-squared	0.18	0.25	0.17	0.20	0.07	0.19
F	9.13	12.50	10.77	11.14	12.55	14.18

Chapter 3

Capital Allocation Efficiency and Firm Size

3.1 Introduction

Allocating capital to its best use is one of the fundamental functions of the economy and is essential to economic growth (Tobin, 1984; Wurgler, 2000, etc.). Empirical research primarily focuses on cross-industry allocation and finds that the capital allocation efficiency across sectors is higher in countries with a more developed financial system (Wurgler, 2000) and lower in regions with state- or tycoon-controlled banking systems (Morck, Yavuz, & Yeung, 2011). However, efficiently allocating to value-added sectors does not automatically guarantee that the capital will go to the firms that create the value within that industry. For instance, capital may flow to the innovative sector following a breakthrough innovation that successfully develops into productivity. But within the advancing sector, capital may be allocated to firms with more market share or collateral assets instead of better growth opportunities due to informational asymmetric and other market frictions. Therefore, hypothesizing that the firm is the most fundamental unit supporting economic growth, I want to explore the capital allocation efficiency at the firm level. Following Wurgler (2000), I regard capital allocation efficiency as the responsiveness of investment to growth opportunities across firms and years, including allocative efficiency across and within firms. In addition to a similar estimation pattern, the correlation is 53.99% between my firm-level capital allocation efficiency and Wurgler (2000)'s cross-sector estimation. Still, the cross-firm investment elasticity is lower on average.

Moreover, exploring capital allocation efficiency at the firm level enables us to examine whether the allocation efficiency is homogeneous across all firms. Firm size is one of the fundamental firm features, and small firms are different from large firms in various aspects, including financial constraints, access to finance, financing patterns, and informational asymmetric (Freeman, 1987; Beck, Demirgüç-Kunt, & Maksimovic, 2005; Angelini & Generale, 2008; Beck, Demirgüç-Kunt, & Maksimovic, 2008) which could affect how the capital is allocated. For example, smaller firms are more financially constrained (Beck et al., 2005), so they may not be able to increase investment even when they have growth opportunities, resulting in a lower sensitivity of investment to growth opportunities. Alternatively, less available capital and more competition in accessing capital may force small firms to be better at identifying growth opportunities and/or more responsive to declines, which leads to more efficient capital allocation. Thus, I rely on empirical examination to explore the differences in the capital allocation efficiency among small firms and that among large firms. Due to the data availability, I confine the analysis to publicly listed firms across countries to explore the size effects on capital allocation efficiency. Moreover, restricting the analysis to public firms avoids confounding differences in allocative efficiency due to a firm's size with that due to whether it is a public firm (Mortal & Reisel, 2013). To my best knowledge, this study is the first to provide systematic evidence on the prevalence of firm size effects on capital allocation efficiency across various institutions.

Although empirical research finds that a more developed financial market boosts the growth of small firms disproportionately (Beck et al., 2005; Beck, Demirguc-Kunt, Laeven, & Levine, 2008; Didier, Levine, & Schmukler, 2014, etc.), it is unclear whether it does so by improving the capital allocation efficiency. Additionally, theories yield ambiguous predictions regarding whether and how financial development benefits the capital allocation among small firms disproportionately. For instance, if it is challenging to allocate capital among small firms due to their information opaqueness while the obstacle for capital allocation among large firms is capital rationing, then improving financial access benefits large firms more while promoting informatively efficient financial markets may help allocate capital to better growth opportunities among both small and large firms. Therefore, I additionally aim to shed light on the cross-firm distributional effects of financial development from the perspective of capital allocation efficiency. More specifically, I intend to examine whether and to what extent financial development improves overall capital allocation efficiency (Wurgler, 2000; Pang & Wu, 2009; Morck et al., 2011, etc.) in small firms and large firms. Therefore, my research complements empirical works on the distributional effects of financial developments by investigating how financial development affects small and large firms. Moreover, considering that local government and international organizations spend substantial resources to support small and medium firms (Beck, Demirguc-Kunt, et al., 2008; Denes, Duchin, & Hackney, 2021, etc.), my study could help policymakers by illuminating the potential channels through which financial development facilitates capital allocation efficiency in small firms versus large firms.

In this paper, I apply Wurgler (2000) direct and transparent measure of capital allocation efficiency to panel data covering 37050 public firms across 32 countries from 1987 to 2020 to take into account the firm size heterogeneity in cross-firm capital allocation efficiency. More specifically, following Wurgler (2000), I conjecture that an efficient capital allocation is one in which the investment is responsive to growth opportunities, i.e. increasing investment in growing firms and decreasing investment in declining ones. For the primary analysis, I use a firm's sales growth to proxy for its growth opportunities (Lehn & Poulsen, 1989; Wurgler, 2000; Mortal & Reisel, 2013; Lyandres, Marchica, Michaely, & Mura, 2019; Erel, Jang, Minton, & Weisbach, 2021, etc.) under the premise that sales are the base of the outcome of accumulated capital stock and labour, and they are subjected to the least influences of the accounting rules differences across countries compared to measures of earnings. More importantly, a capital investment normally takes more than 13 months to be effective (Koeva, 2000; Salomon & Martin, 2008, etc.), and thus estimation of investment elasticity to sales naturally prevents reverse causality. Additionally, due to the adjustment cost, delivery delays and uncertainty in expectations, fixed capital investment does not respond to contemporaneous sales growth mechanically (Abel & Blanchard, 1986). Therefore, the responsiveness of investment to contemporaneous sales mainly reflects the investment responding to growth opportunities, especially when I control other potential mechanisms such as free cash flows and external dependence.

I document a significantly lower investment elasticity to sales among small firms than among large firms, robust to the standards separating large and small firms, time horizon, estimation methods, and controls of other firms' characteristics. However, the log growth of sales, representing the growth opportunities, is not different between the two groups. In addition, I find that the lower investment elasticity to growth opportunities among small firms results from both withdrawing less investment from declining firms and increasing less investment in growing ones. However, I do not find evidence suggesting that the differences are due to the differences between these two groups' cash flows or the external dependence variation.

To explore the roles that financial development plays in shaping capital allocation efficiency among small firms, I separately examine the relationship of investment elasticity to sales for small and large firms with the regional financial market size, financial market synchronicity, and external investors' protection. I do not find evidence that a large financial market, neither the stock market nor the credit market, is associated with a more efficient capital allocation among small firms, and the positive correlation between the financial market size and the capital allocation efficiency documented in previous literature mostly results from large firms. However, the association between the informational effectiveness of the stock market (the synchronicity of the equity price) and the extent to which a company invests its capital to the best use holds positively (negatively) for small firms and large firms, and is robust to controlling for financial market size, investors' protection, and other firms' characteristics, such as cash flows and external dependence. Moreover, I find that the informativeness of the stock market improves capital allocation efficiency among small firms mainly by enhancing the responsiveness of investment to growing entities. In contrast, it affects the allocative efficiency among large firms through both increasing investment in growing entities and decreasing investment in declining ones. To my surprise, I do not find robust evidence indicating that effective external investors' protection is positively associated with allocative efficiency; instead, external protection shows a marginally negative impact on the investment elasticity to sales. Although I suspect this negative relationship may be related to corporate governance and ownership structure dynamics, unfortunately, I do not find solid empirical evidence.

The remainder of this paper is organized as follows: Section 3.2 illustrates the background to this study and briefly reviews the evolution of related research; Section 3.3 mainly sets forth the empirical methodology I use to measure the capital allocation efficiency and examines the differences in the allocation efficiency among small firms and among large firms; Section 3.4 describes the data and variables construction and particularly presents the country-specific allocation efficiency measure; Section 3.5 summarizes empirical results and analysis; Section 3.6 concludes the study.

3.2 Background

Previous literature has regarded the extent to which capital is promoted in advancing industries and declines in deteriorating ones as a measure of the capital allocation efficiency across sectors and documented that capital allocation efficiency is positively associated with financial developments. Wurgler (2000) develops an empirical measure for cross-industry capital allocation efficiency, conjecturing that more efficient capital allocation is associated with increasing investment in advancing sectors and withdrawing investment from declining sectors. More specifically, the inter-sectoral capital allocation efficiency is captured by the investment elasticity to growth opportunities, with the latter being measured by the value-added growth. He finds that the industrial investment elasticity to value-added is higher in more developed financial markets. The positive relationship between capital allocation efficiency and financial market developments reflects in its positive relationship with the size of the financial market and the effective protection of external investors, and its negative association with the extent to which the stocks move together and the state ownership in the economy. In addition, Morck et al. (2011) finds that economies with a banking system controlled by tycoons or elite families endure losses in capital allocation efficiency comparable to ones with a state-owned banking system, in which the capital allocation efficiency is measured by the extent to which the capital investment is allocated to growing industries. Zhu (2019) discovers that the availability of alternative datasets revealing future profitability is associated with a firm's capital investment being more responsive to growth opportunities, constituting evidence that a more informative stock price influences managers to invest more efficiently. However, the discipline effects are mainly exhibited in deteriorating industries.

Some recent studies suggest that the cross-sector capital allocation efficiency may overlook the cross-firm heterogeneity in allocating capital efficiently. Mortal and Reisel (2013) examine the capital allocation efficiency among private and public firms across a wide range of institutions and find that public firms are associated with changing investments more responsive to growth opportunities compared to private firms in countries with developed stock markets. Carpenter, Lu, and Whitelaw (2021) finds that the stock informativeness about future profits for privately held firms in China has increased since 2001 and is paralleled with an increase in their capital allocation efficiency, which is measured as the predicted power of investment on future earnings. However, the stock price informativeness and investment efficiency for state-owned enterprises in China have declined relative to privately held firms after 2008.

Size is a fundamental feature of firms, and it is broadly recognized that small firms are different from large firms in accessing finance and information opaqueness (Berger & Udell, 2006; Beck, Demirgüç-Kunt, & Maksimovic, 2008; Ayyagari, Demirgüç-Kunt, & Maksimovic, 2017, etc.). However, whether and how these differences would result in systematic differences between small firms and large firms in allocating capital remains unveiled. For example, with limited external finances, small firms could be forced to pick projects with the most positive NPVs and withdraw capital faster from underperforming ones and thus resulting in more efficient capital allocation. Alternatively, small firms may be too financially constrained to invest in growth opportunities beyond basic survival, leading to less efficient capital allocation.

Moreover, financial markets and financial development, effectively promoting efficient capital allocation across industries, disproportionately impact small firms. Beck, Demirguc-Kunt, et al. (2008) estimate the technological share of small firms for 36 industries in the manufacturing sector as the share of firms with less than 20 employees in the U.S. in 1992, assuming that the U.S. financial market is relatively frictionless, and examine the relative growth of small-firm industries across 44 countries. They find that industries naturally composed of small firms grow faster and contribute more to overall value-added in countries with more developed financial markets, indicating that financial development exerts positive impacts disproportionately on small firms' growth. Beck, Demirgüç-Kunt, and Maksimovic (2008) explore a firm-level survey database comprising financial information for about 3000 firms across 48 countries and find that small firms use less external finance than large firms. They also reveal that better property rights protection benefits small firms more significantly in terms of accessing bank finance. By far, more particular benefits that financial development imposes on small firms seem mainly through pumping more capital into those firms or easing their access to external finance. If lacking capital is the major obstacle preventing the capital from being allocated efficiently among small firms, I would expect the disproportionate effects of financial developments on the capital allocation efficiency of small firms to parallel along with the particular improvement in access to finance. However, suppose small firms are associated with more severe agency problems, lower informational transparency, or higher fixed costs in implementing capital. In that case, financial development may not exert particularly positive impacts on the capital allocation efficiency of the small firms, even though it boosts the growth of small firms by making more money available to them. Therefore, I am interested in separating the impacts of financial development on capital allocation efficiency into that of small firms and large firms.

3.3 Empirical Design

3.3.1 Measuring the Efficiency of Capital Allocation

To investigate the extent to which capital flows most efficiently to its best use in a region, I adopt the investment sensitivity to growth opportunities as a measure of allocative efficiency, following Wurgler (2000). However, since I am interested in the heterogeneity of the capital allocation efficiency among small firms versus among large firms, I apply their estimation method to firm-level data to incorporate the potential impacts of the firms' characteristics on the allocative efficiency. More specifically, I use a firm's sales growth as a measure of its growth opportunities (Rozeff, 1982; Lehn & Poulsen, 1989; Martin, 1996; Wurgler, 2000, etc.), and rely on the coefficient of log growth in a firm's investment regressing on its log growth in sales to capture the allocative efficiency, i.e. the η in Equation 3.1.

$$ln\frac{I_{c,i,t}}{I_{c,i,t-1}} = \alpha + \eta_c ln\frac{S_{c,i,t}}{S_{c,i,t-1}} + \varepsilon_{c,i,t}, \tag{3.1}$$

where the $I_{c,i,t}$ and $S_{c,i,t}$ are the investment and sales of firm i in country c at time t, respectively. The bottom line investment includes a firm's capital expenditures and R&D spending. More detailed construction of each variable is described in Table 3.1.

η_c in Equation 3.1 is the estimated investment elasticity to sales of region c, which can be interpreted as the corresponding changes in a firm's investment in response to a shock that causes a 1% increase in its growth opportunities. Using log growth rate not only makes the measure closer to the definition of efficiency but also alleviates the problems of cross-country data differences due to variations in accounting definitions and rules. As long as the differences are consistent over time, the cross-country differences in magnitude will not be a problem and using log growth allows cross-country comparability. Using sales growth to proxy for growth opportunities is partially due to its close relationship with future growth and average q and partially because sales are subject to the least variations in accounting rules across countries among all the measures of accounting performance.[1] Moreover, since it takes time for the investment (i.e. capital expenditures, R&D spending or other intangible investment) to be effective (Mayer, 1960; R. E. Hall, Sims, Modigliani, & Brainard, 1977; Koeva, 2000; Salomon & Martin, 2008, etc.), using sales revenue naturally eliminates the reverse causality problem. Although earnings or net income may better represent the net operation outcome, they can be significantly affected by the contemporaneous investment through depreciation and relevant expenses. In addition, delivery lags and adjustment costs prevent firms from instantly responding to the changes in sales (Abel & Blanchard, 1986), making the measure more of an

[1]Due to the data limitation, I do not have data on the market price of firms' equity, which is required to construct the average q, for about 60% of the sample, but the correlation coefficient between sales growth and average q is 12.96% and significant at 1% level for those I have.

investment sensitivity to the growth opportunities than a mechanical change due to sales movement, especially after controlling for cash flows and external dependence.

3.3.2 Capital Allocation Efficiency and Firm Size

To investigate the allocative efficiency among small firms specifically and its differences from that among large firms, I first divide the sample into different size groups and estimate Equation 3.1 for each group in each country. For the main comparison, I follow the EU and U.S. Small and Medium Enterprise (SME) standards to define a firm as small (SME) either if it has less than 250 employees, or its total assets are less than 10 million U.S. dollars, resulting in about 21.32% and 6.53% of observations classified as small, respectively. Additionally, I also define the size groups according to the size distribution of each country in terms of firms' employee numbers and total assets, respectively.

In addition, to validate the differences in the allocative efficiency among small firms versus that among large firms, I directly estimate the difference through the Equation 3.2. Based on Equation 3.1, I add an interaction term of the log changes of sales and an indicator for small firms, and the coefficient of the interaction term, β_2, shows the difference of η among small firms and large firms.

$$ln\frac{I_{i,t}}{I_{i,t-1}} = \alpha + \beta_1 ln\frac{S_{i,t}}{S_{i,t-1}} + \beta_2 ln\frac{S_{i,t}}{S_{i,t-1}} \times Small_{i,t} + \sum_{j}^{J} \gamma_j X_{j,i,t-1} + \varepsilon_{i,t}, \qquad (3.2)$$

where $I_{c,i,t}$ and $S_{c,i,t}$ denote the investment and sales of a firm i in country c at time t, respectively. $Small_{i,t}$ is a dummy variable that equals one if the firm has less than 250 employees or its total assets are less than 10 million U.S. dollars. In addition, $X_{j,i,t-1}$ denotes a vector of control variables including measures of cash flows, lagged sales growth, and external dependence for robustness check.

3.3.3 Capital Allocation Efficiency and Financial Development

Since I am also interested in examining whether and how the financial development in a region affects the capital allocation efficiency among small firms and large firms differently, I first regress the estimated country-specific investment elasticity to sales, i.e. the measure of capital allocation efficiency, on the financial market activities (FM, $CRED$, STK) as shown in the Equation 3.3.

$$\eta_{c,Small} \text{ or } \eta_{c,Large} = a + \beta FD_c + \sum_{n}^{N} \gamma_n Z_{n,c} + \varepsilon_c, \tag{3.3}$$

where $\eta_{c,Small}$ and $\eta_{c,Large}$ denote the estimated investment elasticity among small firms and large firms, respectively, for country c, and $Z_{n,c}$ is the nth control variable.

I start with the aggregate financial market size partly because this is the most direct measure for financial development. More importantly, I am interested in investigating whether a larger financial market lead to the same efficient capital allocation for small firms and large firms. To account for the estimation precision, I apply the Saxonhouse (1976) techniques and weigh all observations by the inverse of standard errors of the estimated η_c, but the weight does not affect the empirical results significantly.

One crucial function of the financial market that may matter significantly to capital allocation efficiency is its informativeness. A financial market will not be able to allocate capital to its best use if the market price is uninformative. Morck, Yeung, and Yu (2000) suggest that the extent to which the firm-specific information is incorporated in the stock price, representing the informativeness of the market, is inversely associated with the comovement of individual stocks with the market. Although Wurgler (2000) finds a negative relationship between the stock market synchronicity and the capital allocation efficiency, I am interested in examining whether the information mechanism that facilitates overall effective capital allocation works among smaller firms particularly. In addition, the protection of investors has been broadly linked with financial development. However, I suspect that the relative power between shareholders and managers may differ for small and large firms. Thus, in order to explore the impacts of different dimensions of financial development on the allocative efficiency, I expand the Equation 3.3 to include measures for the stock market synchronicity ($SYNCH$) and effective protection for the external investors ($Eff.Rights$).

Given that sample size for the country-specific investment elasticity to sales is limited, in addition to the analysis stated above, I also conduct firm-level regression, including interactions of various measures of financial development and the log growth of sales of the firm, as shown in Equation 3.4, for small firms and large firms separately.

$$ln\frac{I_{i,t}}{I_{i,t-1}} = \alpha + \beta ln\frac{S_{i,t}}{S_{i,t-1}} + \sum_{n}^{N} \beta_n ln\frac{S_{i,t}}{S_{i,t-1}} \times F_{n,c} + \sum_{j}^{J} \gamma_j X_{j,i,t-1} + \varepsilon_{i,t} \qquad (3.4)$$

where $F_{n,c}$ denotes one or more measures of the following of country c: financial market size (FM_c, $CRED_c$, STK_c), stock market synchronicity ($SYNCH_c$), and effective protections of investors ($Eff.Rights$); the coefficient of the interaction term β_n shows the impact of the corresponding factor $F_{n,c}$ on the sensitivity of investment growth to the growth opportunities represented, i.e. the capital allocation efficiency in this study.

3.4 Data and Sample Construction

3.4.1 Sample Construction

To link capital allocation efficiency with country-specific financial market development, I need comparable international data to either estimate the investment elasticity to sales for each country or observe the impacts of the country-specific financial market features through Equation 3.4. I thus combine the *North American Database* and *Global Database* from *Compustat* to construct the basic sample of fundamental annual data for firms across a broad range of countries.[2] I exclude firms that are in Finance (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other specially regulated industries (SIC code 9000-9999) because the scope of their operation, financing and investment activities, and even accounting standards are different from the other industries. Additionally, they may also face special regulations affecting their operations.

Since I am interested in the capital allocation efficiency among firms and its connection with regional financial market development, concerning that multinational enterprises allocate capital differently (better) than purely domestic enter-

[2] *Global Database* cover active and inactive public firms operating outside of North America from 1987 and onward, so I combine it with the *North American Database* to have a more complete global database

prises (Greene et al., 2009), I restrict the primary analysis to local firms, i.e. firms that operate and headquarter in the same region.[3]

In addition, following Wurgler (2000), I restrict main analysis to the sample in which neither the log investment growth nor log sales growth exceeds one (i.e. change in investment and sales within the range of decreasing 63% to increasing 172%) to focus on the normal growth firms.[4] I adjust variables denominated in local currency to current U.S. Dollars using the annual average exchange rate reported in IBES Academic retrieved through WRDS and deflate all nominal variables by U.S. GNP deflator. I winsorize all variables at the 1st and 99th percentiles. Table 3.2 summarizes the basic statistics for the overall sample and region-specific statistics are reported in Table 2B.2.

3.4.2 Capital Allocation Efficiency

To validate the estimation methodology, I first inspect the estimation of the investment elasticity to sales for each country. For the 62 countries that I successfully estimate the investment elasticity to sales, the estimations are above zero, ranging from 0.02 to 0.61, excluding Bulgaria and Nigeria which have negative values of -0.04 and -0.03 with p-values of 0.16 and 0.11, respectively. The mean and median of the estimation across all countries are 0.26 and 0.25, respectively. The top three efficient countries are Austria, Luxembourg and Ireland, and the three least efficient countries are Kenya, Egypt and Kuwait.

Figure 3.1 plots the country-specific estimation of capital allocation efficiency, i.e. the estimation of coefficient η in Equation 3.1 for each country and the full list of estimated ηs are reported in Table 2B.2 in the Appendix. The figure shows that the most efficient countries in allocating capital to its best use are clustered in North America and Europe, and the allocative efficiency is mostly consistent with countries' income levels. I also find that, regardless of the differences in the data sources and time range, the correlation between our estimation of country-specific

[3]Including only domestic firms may underestimate the country-specific estimation of capital allocative efficiency, but given that I am interested in the development of the local economy, I stay with this sample. Nevertheless, relaxing this requirement does not affect the results.

[4]The normal growth firms account for 77.82% (89.78% or 87.52%) of the overall sample based on one-year growth (annualized two-year or annualized three-year growth). Moreover, relaxing normal growth restrictions does not affect the results.

investment elasticity to sales based on firm-level data and the industrial investment elasticity to value-added estimated in Wurgler (2000) is about 53.99% and significant at 1% level. However, the average elasticity across countries (0.28) is lower than Wurgler (2000)'s estimation (0.43), which is consistent with our conjecture that efficient allocation among industries can be distorted by misallocation among firms. Additionally, I find that although most regions rank similarly by cross-firm elasticity as by Wurgler (2000)'s cross-sector elasticity, Hong Kong and New Zealand fall significantly from the top ten to under thirtieth. Nevertheless, similar to Wurgler (2000), I find that, in general, the significance of the estimation and the model fits are better in countries with high estimated elasticities. For instance, the R^2 of Equation 3.1 for Austria (the highest η country) and Pakistan (the lowest significant *eta* country) are 23% and 13%, respectively.[5]

3.4.3 Financial development data

I rely on several established research on financial development and the Global Financial Development Database (2021) of The World Bank to construct the financial development data. More specifically, I focus on the size of the financial market, the synchronicity of the stock market and the effective protection of external investors to explore the links between financial development and regional capital allocation efficiency.

More financial market activities, including that of the credit and stock market, are, on average, associated with a better developed financial system featuring lower transaction costs, more informationally efficient security prices, and implicitly better-designed institutions. I thus use the data that measures the country-specific private credit to GDP ratio (CRED), the stock market capitalization to GDP ratio (STKC) and the aggregate of these two(FM) from Wurgler (2000).[6] For the robustness of our analysis, I obtain annual data on the domestic credit to private sectors to GDP ratio and stock market capitalization to GDP ratio as alternatives to construct CRED and STK, respectively, from the Global Financial Development

[5]The R^2 for Bulgaria, which has the lowest estimated η is 18%, but the estimation is not significant at 10% level.

[6]More specifically, they compute each of the three variables as log of one plus the average variable value across 1980, 1985 and 1990.

Database (2021) (Cihak, Demirgüç-Kunt, Feyen, & Levine, 2012, etc.) of The World Bank. The World Bank Financial Development database covers 42 countries for various ranges of years.

In addition to the overall financial market activities, I use data of the average R^2 from firm-level regressions of bi-weekly stock returns on local and U.S. market indexes from Morck et al. (2000) to measure the extent to which that individual stocks move together, and I use the fraction of stocks that move in the same direction in a given week averaged across 1995 as an alternative measure.

Porta, Lopez-de Silanes, Shleifer, and Vishny (1998) summarize six provisions protecting shareholders against managers and four provisions protecting senior debt holders that are written in commercial codes across a broad range of countries. They count how many items are included for a specific country to construct the "anti-director rights" index (0-6) and "creditor rights" index (0-4) for 49 countries. Besides, they also construct a "Rule of Law" index (1-10) as a measure of law enforcement. As weak enforcement may cause the provisions to be useless, I multiply the sum of shareholder and creditor rights with the rule of law index (scaled to 0-1) following Wurgler (2000) to measure the effective protections of external investors. Alternatively, I obtain the annual rule of law index from (Group, Kaufmann, Kraay, & Mastruzzi, 2010) for each country during 1996-2020.

When I merge the financial development data with the international firm-level data, it results in a dataset covering 37050 firms across 32 countries over 1987-2020.[7] All the variables are constructed as illustrated in Table 3.1 and the data are summarized in Table 3.2.

3.5 Empirical Results

3.5.1 Quality of Capital Allocation and Firm Size

Since I am interested in how efficiently the capital is allocated among different-size firms, I first estimate the investment elasticity to sales for different size groups for each country, and the average elasticity across all countries with more than 30

[7] There are 42 countries in common if I ignore the measure for the market synchronicity and the effective rights.

eligible firms for each size group are shown in Figures 3.2 and 3.3. It demonstrates that, on average, the efficiency of capital allocation differs among small firms and among large firms, and the unreported univariate tests show that the differences (p-value) in the estimates of η between small and large firms are -0.27 (0.019) and -0.21 (0.019) when the size is measured by whether the number of employees is less than 250 and whether the total assets are less than 10 million U.S. dollars, respectively. Both of the differences are significant at 1% level. Moreover, Figures 3.3a and 3.3b depict a monotonically increasing pattern between the allocation efficiency and firm size, and the pattern is confirmed by the firm-fixed effects estimation pooling all countries together and including year-fixed effects, as shown in Figures 3.4, 3.5 and 3.6. And the results are robust to various periodical elasticities (one-year, two-year and three-year) and size criteria used (number of employees and total assets).

To examine the statistical and economic significance of the difference, I interact the size dummy with the log change of sales, and the significant negative interaction term shown in Table 3.3 confirms that the efficiency of capital allocation is statistically lower among small firms than among large firms. More strikingly is that the difference is about 50% on average. I also define the size according to the firm's total assets and run the same regressions, and the pattern remains the same.

Considering that the differences in capital allocation efficiency among small and large firms are confounded with the differences in the extent to which they rely on external capital or their ability to generate cash flows, I sort and divide the sample into quintiles by their external dependence (*Dependence*) and internal cash flows ($CashFlow$) and employ Equation 3.2 within each group. For a more direct view, I represent the coefficients of the interaction between log growth of sales and the dummy that separates small and large firms (β_2 in Equation 3.2), i.e. the coefficient gauging the differences in capital allocation efficiency among small firms and that among large firms, of each group in Figures 3.7 and 3.8. Regardless of the standards defining small firms, Figures 3.7 and 3.8 show that the investment sensitivity to sales is significantly lower among small firms than that among large firms across almost all cash flow and external dependence groups. However, the result does not show any evidence that the differences in capital allocation efficiency for small firms and for large firms are related to the heterogeneity in cash flows or external dependence.

Since the lower capital allocation efficiency among small firms than among large firms could be due to either allocating too much capital to declining firms or allocating too little to growing firms or both, I am interested in investigating which is the case. Therefore, I split the sample into two groups based on the sales growth. One group has higher sales than last year (growing group), and the other has sales below the previous year (declining group). I then use Equation 3.2 to estimate the difference in capital allocation efficiency among small and large firms for the growing group and declining group separately, and the results are reported in Table 3.4. First of all, regardless of growing or declining firms, the investment elasticity to sales is positive, indicating that the capital is allocated efficiently overall. Moreover, I observe that small firms are associated with significantly lower investment sensitivity to growth opportunities under both growing and declining conditions relative to large firms – in other words, both underinvesting in growing firms and overinvesting in declining firms. In addition, the results suggest that small firms have more volatile investments resulting from faster growth and more aggressive decreases, which may, in part, be attributed to a smaller base.

3.5.2 Allocative Efficiency among Small Firms and Financial Development

To investigate the association between the extent to which the capital is allocated to its better use and financial development, I first examine the relationship between financial market size and the allocation efficiency measure, η following Wurgler (2000). On the one hand, I am interested in reexamining this relationship given the significant growth and volatility of the financial market since 2000, especially the stock market capitalization. More importantly, I intend to break up the overall allocation efficiency into that of small firms and large firms, given their significant differences, and explore the impacts of the financial market on them separately. Figures 3.9 and 3.10 show the linear fits of the investment elasticity to sales of a country, η in Equation 3.1, to its financial market growth, which shows a positive relationship. However, the separate fits of η_{Small} and η_{Large} to the financial market size indicate that the positive relationship does not hold for small firms. Table 3.5 reports the results of the weighted least squared regression of the η on measures of a country's credit market size, stock market size and the overall financial market size controlling for the productivity level by GDP per capita. The results show that, while the pattern that a larger financial market is associated with higher allocative efficiency largely holds through the most recent years, the link between allocative efficiency and the stock market has become less robust. More importantly, the positive association between the financial market size and the allocation efficiency is predominated by the large firms, regardless of the standards I used to separate the small and large firms.

As stated in Section 3.3, to explore the impacts of the market synchronicity and the effective protection for external investors in addition to the size of the financial market, I thus regress the estimated investment elasticity to sales on the measures of stock market comovements and effective protections of investors controlling for the size of the financial market and economy, and the results are shown in Table 3.6. The significant negative coefficient of $Synch_c$ in columns (4), (6) and (7), (9) of Table 3.6 demonstrates that regardless of whether among small firms or among large firms, the less informative stock price is associated with lower allocative efficiency, which implies that the information mechanism is essential for both small firms and large firms in directing the capital to its best use. Moreover, the informativeness of the stock price seems to be the predominant allocative efficiency over the financial market size and protection of investors. Surprisingly, I find that the effective protection of investors is somehow negatively associated with the overall capital allocation efficiency.

Since I combine the rule of laws with the number of provisions protecting shareholders and senior creditors in Porta et al. (1998) to construct the effective protection indicator, to investigate whether the negative relationship is due to the law enforcement or the provisions, I include them separately in the regression along with other variables of interests and controls and report the results in Table 2B.3. The findings show that a higher score in anti-director provisions is associated with lower capital allocation efficiency, while efficient law enforcement, measured by the $RuleLaw$ is positively related to the allocative efficiency. One possible explanation of the negative relationship between the investors' protection and allocative efficiency in my findings is that the more powerful investors may limit the ability and willingness of managers to invest in the growth opportunities.

To address the concern that the small sample size of the country-level data and that firms' features other than growth opportunities that affect the changes in firms' investment may undermine the tests, I perform firm fixed effects regression of log change of investment on the log change of sales and interactions of log change of sales with measures of market synchronicity, size of financial market and the effective protections for investors, controlling for a firm's cash flow and external dependence, as shown in Equation 3.4. Table 3.7 shows the results that are highly consistent with the country-level regressions. The findings confirm that more informative stock market prices promote more effective capital allocation for both small and large firms.

Capital allocation efficiency results from a mix of directing more capital to growth opportunities and withdrawing capital from declining identities, which are independent of each other. For example, allocating capital to breakthrough innovations that create positive NPV does not prevent capital from investing in unqualified forgers. On the same coin, whenever a stock market bubble bursts, capital may be pulled out from negative NPV projects as well as positive NPV ones. Additionally, a higher overall allocative efficiency does not guarantee superiorities in either cases. Whenever growth opportunities are predominant in the economy, wasting money on negative NPV projects could be hidden by the more prevalent investment in positive NPV projects resulting in a seemingly high allocative efficiency. However, lacking the ability to pull out capital from value-destroying projects could accelerate the economic downturn by wasting scarce capital on bad investments. Thus, it is meaningful to investigate through which (or perhaps both) cases that various dimensions of financial development affect the allocative efficiency.

I thus separate the sample based on whether the sales are increasing or declining and reexamine the Equation 3.4 separately for each sample. Given the delay in the reaction of fixed investment to contemporaneous sales changes, the coefficient captures the sensitivity of investment to growth opportunities apart from the mechanical responses to operating outcomes, especially when the year effects are controlled. Tables 3.8 and 3.9 report the results for growing and declining samples, respectively.

There are a few things worth emphasizing from the results. First of all, the investment elasticity to sales is positive for both samples, indicating that, on average, capital is directed to positive NPV projects and withdrawn from value-destroying ones.[8] Secondly, a more informationally effective financial market (lower in the *Synch* value) is associated with both increasing investment in value-enhancing projects and reducing capital from value-destroying projects. However, the latter channel does not work for small firms, that is, a stock market incorporating more firm-specific information improves the allocative efficiency among small firms mainly through directing capital to positive NPVs other than correcting mistakes. Thirdly, the negative impacts of effective investors protection are more significant among growing firms, indicating that powerful investors may restrict managers from increasing investment and coincide with the recent underinvestment problem in the U.S. (Lee et al., 2016; Gutiérrez & Philippon, 2017, etc.). Fourthly, while more financial market activities are associated with higher investment elasticity to sales for both growing and declining samples, the effects are merely through large firms. Additionally, higher external dependence is associated with lower allocative efficiency among small growing firms but with higher capital allocation efficiency among large firms regardless of growing or declining. One interpretation of this pattern is that external monitoring improves large firms' efficiency in using capital, while financial constraints prevent small firms from increasing investment in growth opportunities.

3.6 Conclusion

In this paper, I measure the capital allocation efficiency as investments responsive to growth opportunities, following Wurgler (2000) and explore whether and how the capital allocation efficiency is different among small and large firms public firms across 44 countries.[9] I find that small public firms are associated with a lower capital allocation efficiency than large public firms, and the differences are prevalent

[8] For example, for the column (1) of Table 3.8 and Table 3.9, the aggregate investment elasticity to sales are 0.4044 (0.471+0.1066*(-0.8597)+5.2388*(-0.0193)+1.3549*0.0843+0.0508*0.2355) and 0.3321 (0.329+0.1238*(-0.521)+5.1351*(-0.0101)+1.407*0.0872+(-0.0138)*0.2338), respectively. In the unreported tests, I estimate $ln\frac{I_{i,t}}{I_{i,t-1}} = \alpha + \beta ln\frac{S_{i,t}}{S_{i,t-1}} + \varepsilon_{i,t}$ for each subsamples and β are all positive.

[9] Merging with financial development data reduces the sample coverage to 32 countries.

across countries and robust to various estimation methods, standards separating large and small firms and growth horizons. In addition, I discover that the lower efficiency of small firms in allocating capital exists in both growing and declining firms, suggesting that small firms are worse positioned in both cutting investments in deteriorating firms and adding investments in growing ones. However, I did not find evidence suggesting that the significant lower efficiency of small firms is due to their heterogeneity in free cash flows or dependence on external capital. This find suggests that the divergence in capital allocation efficiency between small and large firms requires further research in the future.

In addition, contrary to the evidence showing that financial development benefits SMEs disproportionately in their access to external finance and growth, I do not find such effects in capital allocation efficiency. More specifically, I find that a large financial market, whether a large stock market or credit market, is not associated with a more efficient capital allocation among small firms, but is among large firms. Additionally, I speculate that the positive correlation between the financial market size and the capital allocation efficiency documented in previous literature dominantly results from large firms. In contrast, the association between the informational effectiveness of the stock market (the synchronicity of the equity price) and capital allocation efficiency holds positively (negatively) for small and large firms and is robust to controlling for financial market size, investors' protection, and economic growth. Moreover, I find that the informativeness of the stock market improves capital allocation efficiency among small firms mainly by enhancing the responsiveness of investment to growing entities, while it affects the allocative efficiency among large firms through both increasing investment in growing entities and decreasing investment in declining ones. However, I do not find robust evidence indicating that effective external investors' protection is positively associated with allocative efficiency; instead, it shows a marginally negative impact on the investment elasticity to sales. Although I suspect that this negative relationship could be related to corporate governance and ownership structure dynamics, more solid theoretical and empirical evidence is desired in future research.

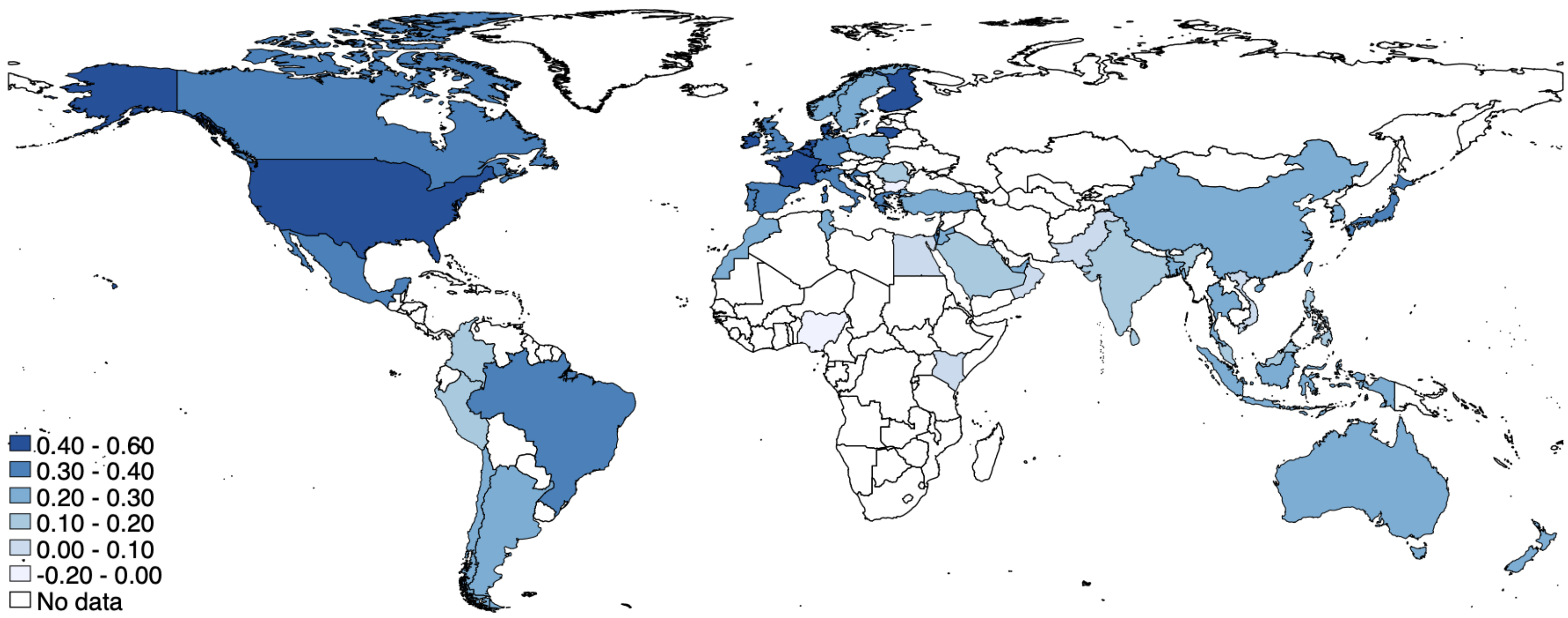
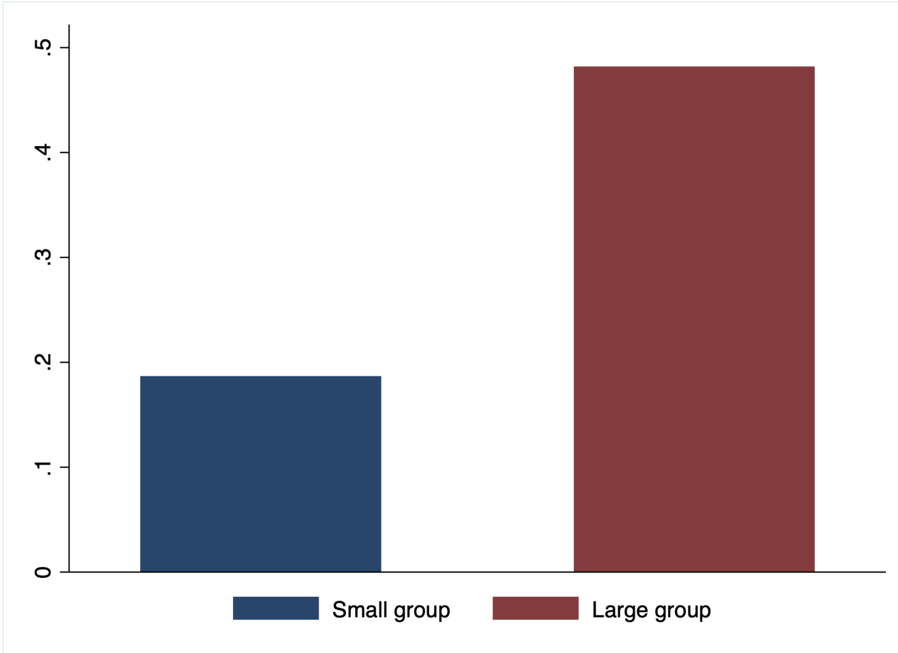
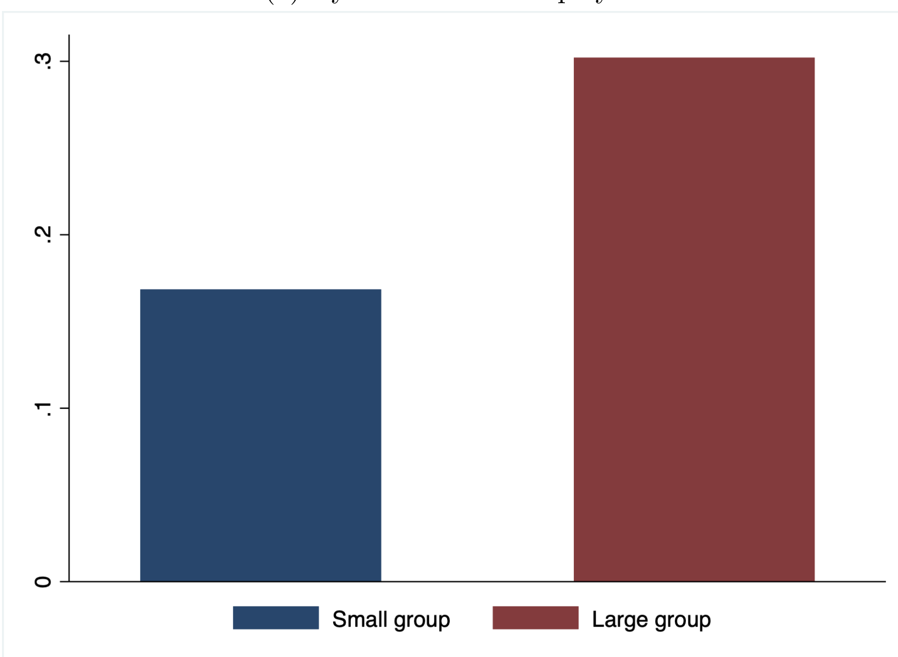


Figure 3.1: Capital Allocation Efficiency around the World

This figure plots the estimated country-specific investment elasticity to sales. More specifically, we estimate the η_c of the equation $ln\frac{I_{c,i,t}}{I_{c,i,t-1}} = \alpha + \eta_c ln\frac{S_{c,i,t}}{S_{c,i,t-1}} + \varepsilon_{c,i,t}$ for each country with more than thirty eligible firms controlling for firm-fixed effects and year-fixed effects, where the $I_{c,i,t}$ and $S_{c,i,t}$ denote the capital expenditures and sales revenue of firm i in country c in year t, and all variables are in 2012 U.S. Dollars and winsorized at 1 and 99 percentile.



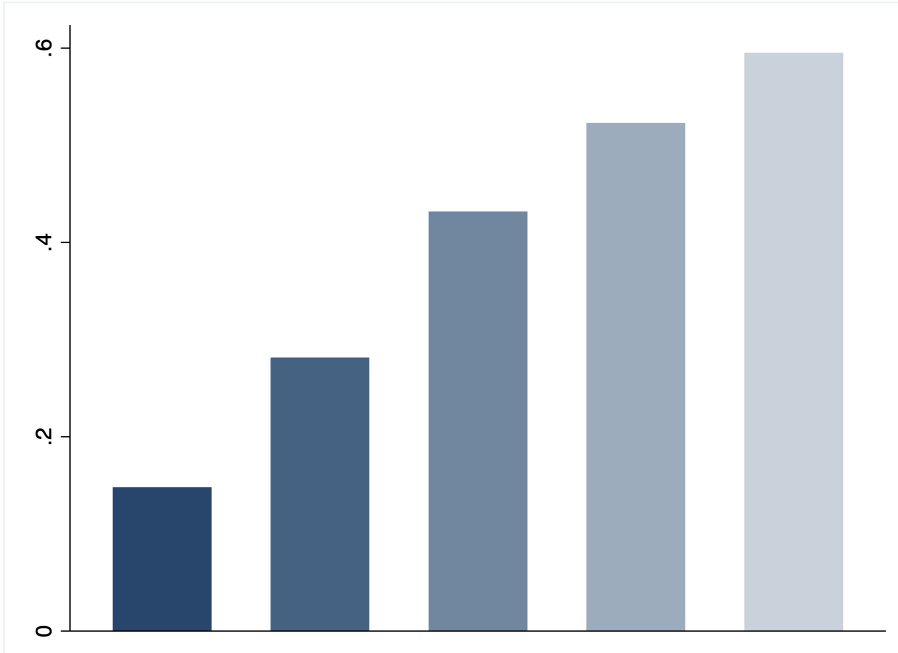
(a) By Numbers of Employees



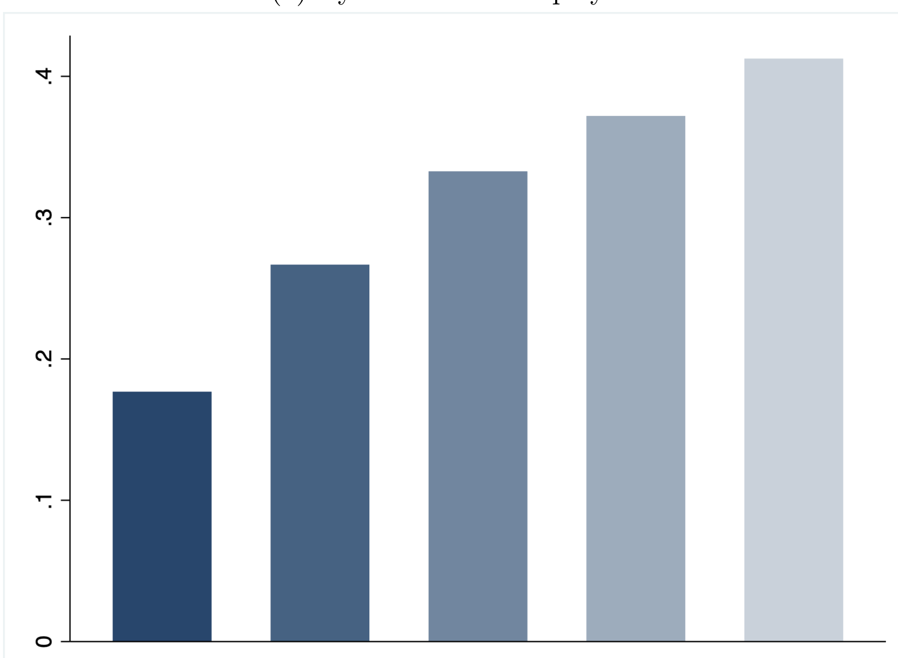
(b) By Total Assets

Figure 3.2: Average Estimates of Elasticity of Investment to Sales of Small and Large Firms

This figure shows the estimates of the elasticity of firm investment to sales, η, for small and large firms, respectively. The estimates of η are conducted for each country with more than 30 eligible firms for each group, and then average across countries within each size group. Figures (a) and (c) designate a firm as ”Small” if its number of employees is less than 250 and if its total assets are less than 10 million U.S. dollars, respectively.



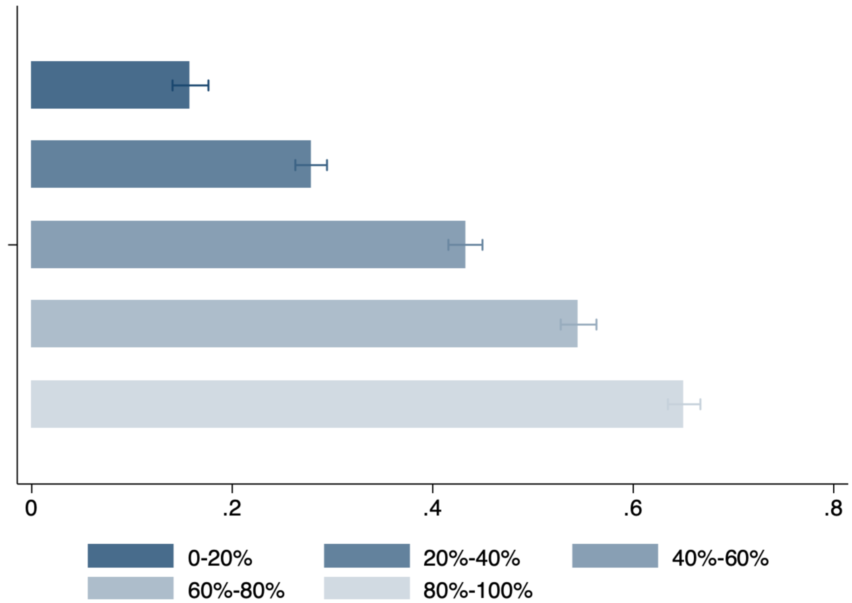
(a) By Number of Employees



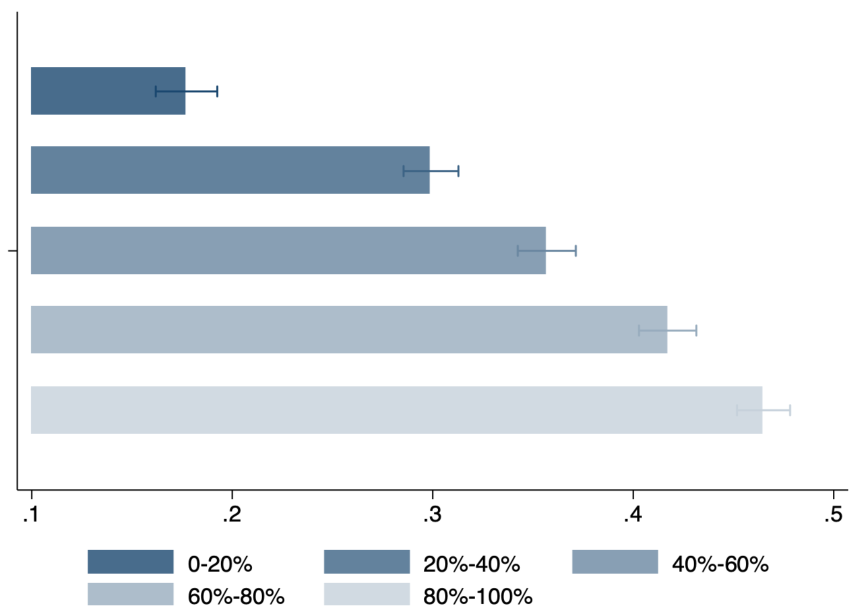
(b) By Total Assets

Figure 3.3: Average Estimates of Elasticity of Investment to Sales by Firm Size

This figure shows the estimates of the elasticity of firm investment to sales, η, for observations grouped by size. The estimates of η are conducted for each country with more than 30 eligible firms for each size group, and then average across countries within each size group. Figures (a) and (b) show the estimates of η for each employee number and total asset quintile within a country year, and the size increases from left to right.



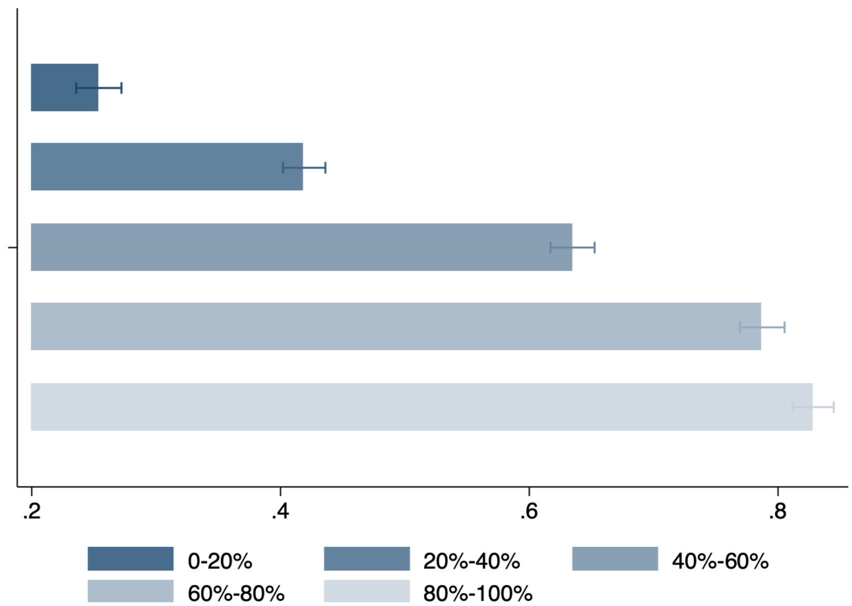
(a) Size Groups by Number of Employees



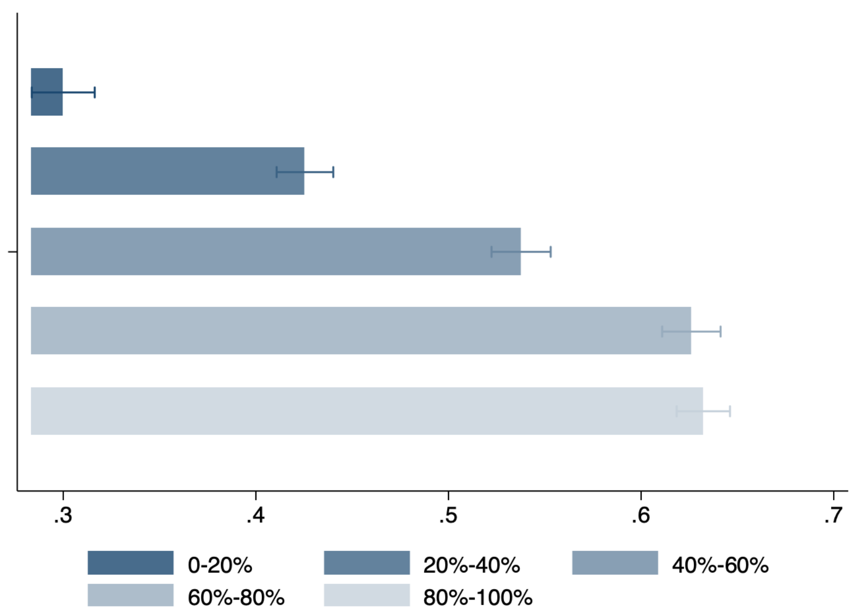
(b) Size Groups by Total Assets

Figure 3.4: Size Group Estimation of One-Year Investment to Sales Elasticity

This figure shows the firm-fixed effects estimation of β (the bar) and 95% confidential intervals (the short line on the top of each bar) of $ln\frac{I_{i,t}}{I_{i,t-1}} = \alpha + \beta ln\frac{S_{i,t}}{S_{i,t-1}} + \varepsilon_{i,t}$ for five size groups based on the size distribution within a country in a given year. Figure (a) and (b) use number of employees and total assets as a measure of size, respectively.



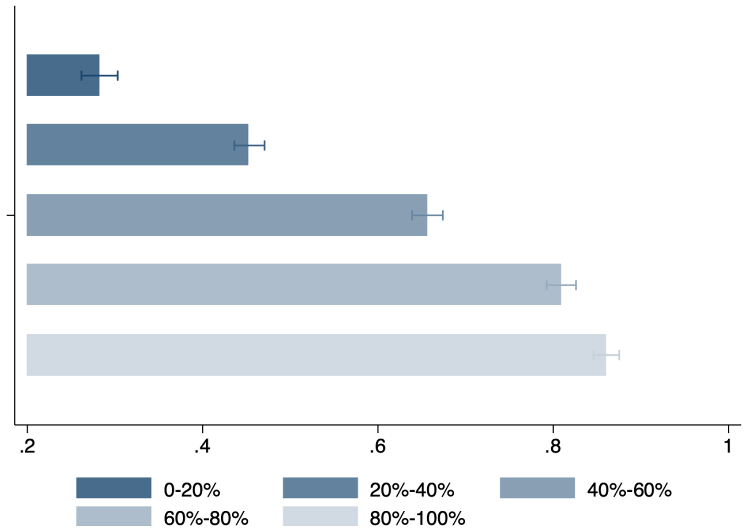
(a) Size Groups by Number of Employees



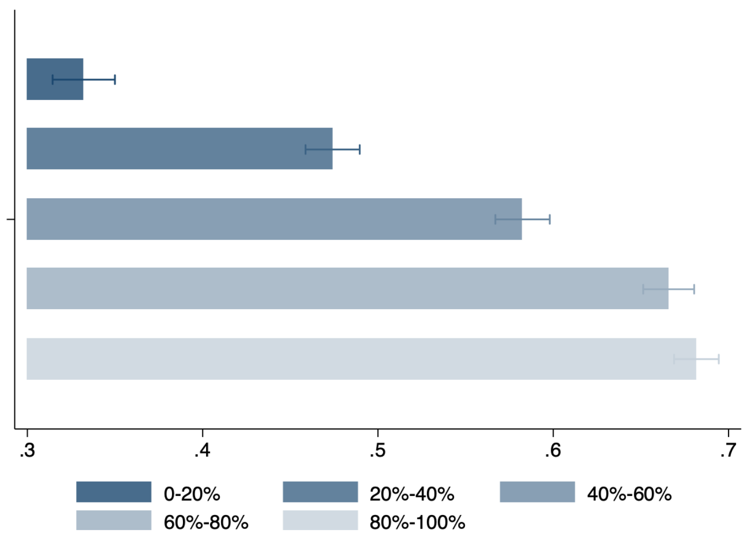
(b) Size Groups by Total Assets

Figure 3.5: Size Group Estimation of Two-Year Investment to Sales Elasticity

This figure shows the firm-fixed effects estimation of β (the bar) and 95% confidential intervals (the short line on the top of each bar) of $ln\frac{I_{i,t}}{I_{i,t-2}} = \alpha + \beta ln\frac{S_{i,t}}{S_{i,t-2}} + \varepsilon_{i,t}$ for five size groups based on the size distribution within a country in a given year. Figure (a) and (b) use number of employees and total assets as a measure of size, respectively.



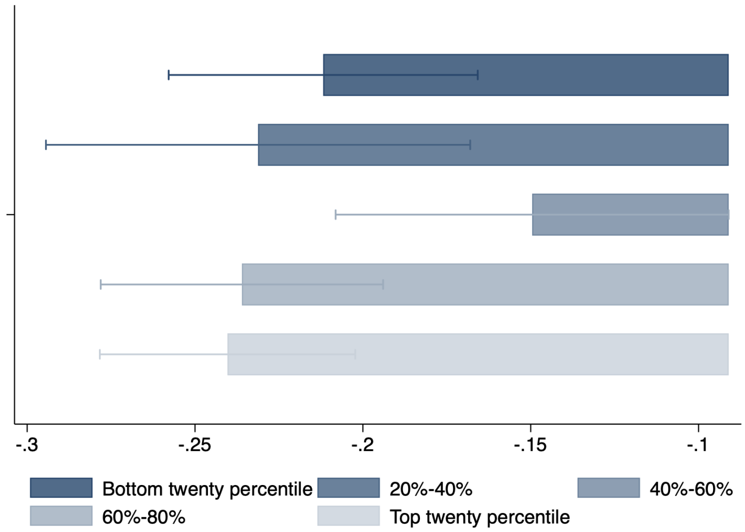
(a) Size Groups by Number of Employees



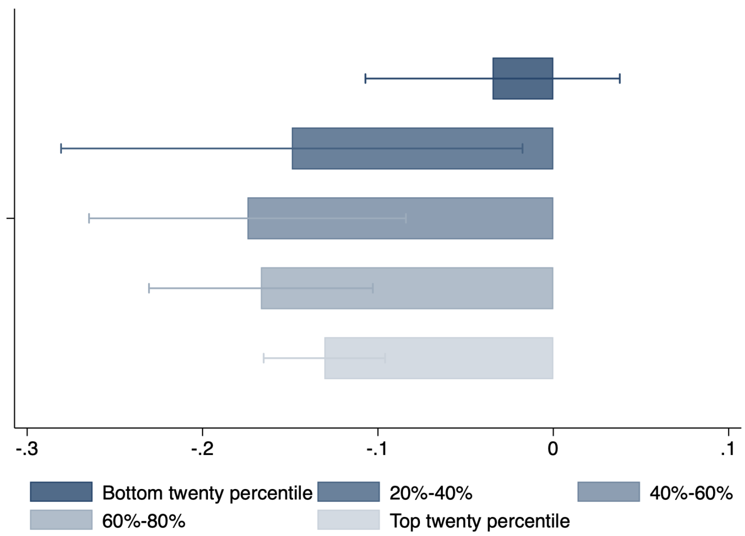
(b) Size Groups by Total Assets

Figure 3.6: Size Group Estimation of Three-Year Investment to Sales Elasticity

This figure shows the firm-fixed effects estimation of β (the bar) and 95% confidential intervals (the short line on the top of each bar) of $ln\frac{I_{i,t}}{I_{i,t-3}} = \alpha + \beta ln\frac{S_{i,t}}{S_{i,t-3}} + \varepsilon_{i,t}$ for five size groups based on the size distribution within a country in a given year. Figure (a) and (b) use number of employees and total assets as a measure of size, respectively.



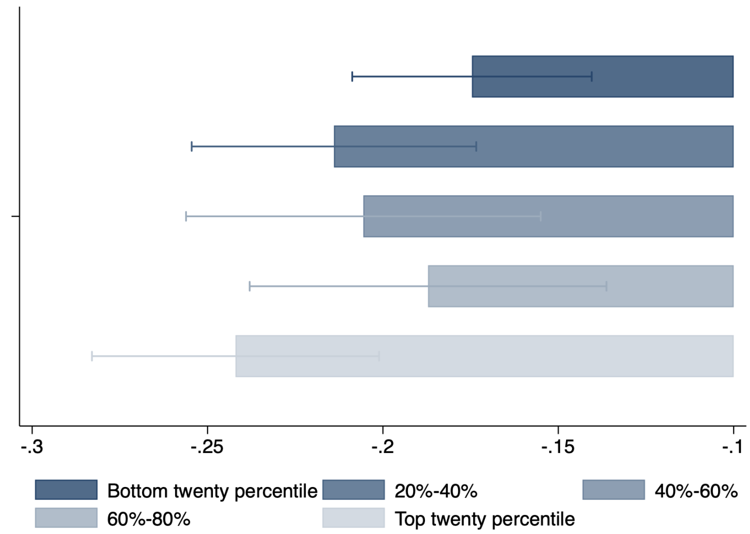
(a)



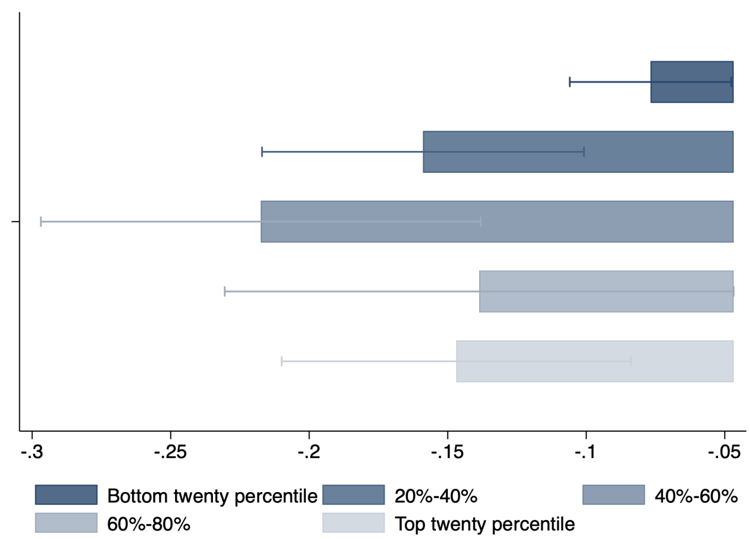
(b)

Figure 3.7: Differences in Allocation Efficiency among Small and among Large firms across External Dependence Groups

This figure shows the firm-fixed effects estimation of the differences in the investment elasticity to sales among small firms and that among large firms, i.e. the coefficient β_2 of the equation $ln\frac{I_{i,t}}{I_{i,t-1}} = \alpha + \beta_1 ln\frac{S_{i,t}}{S_{i,t-1}} + \beta_2 ln\frac{S_{i,t}}{S_{i,t-1}} \times Small_{i,t} + \varepsilon_{i,t}$, for subsamples divided based on the distribution of firms' external dependence. External dependence is defined as the difference between the capital expenditures and available internal funds, as in Table 3.1. $I_{i,t}$ and $S_{i,t}$ denotes the investment and sales, respectively, of firm i in year t. Figure (a) and (b) define small firms according to whether it has less than 250 employees and if it has less than ten million U.S. Dollars in total assets, respectively. The bars and the capped lines represent the scale of the coefficients and 95% confidential intervals for each group.



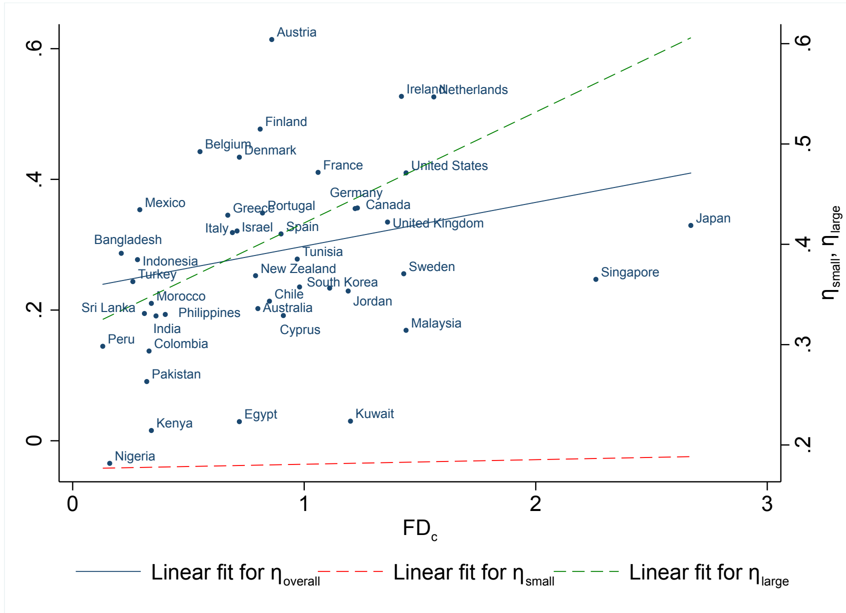
(a)



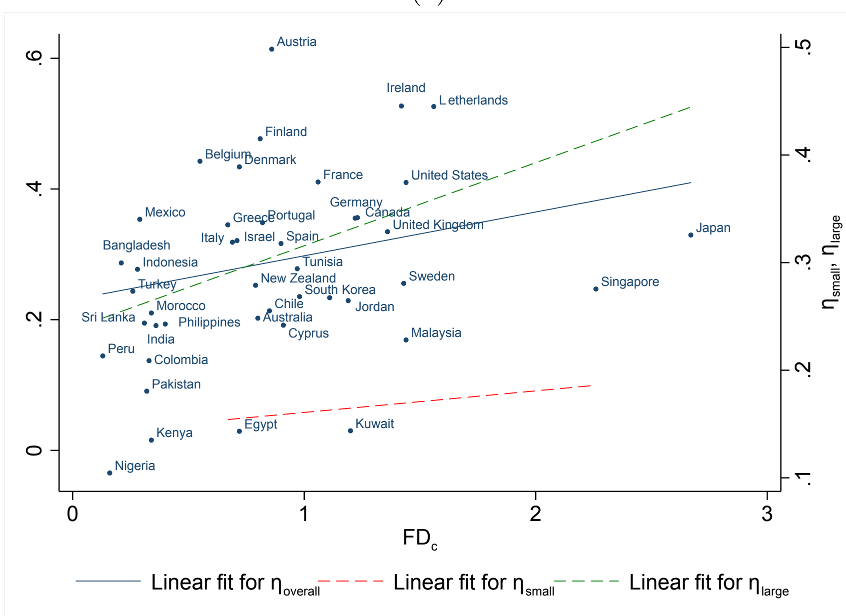
(b)

Figure 3.8: Differences in Allocation Efficiency among Small and among Large firms across Cash Flow Groups

This figure shows the firm-fixed effects estimation of the differences in the investment elasticity to sales among small firms and that among large firms, i.e. the coefficient β_2 of the equation $ln\frac{I_{i,t}}{I_{i,t-1}} = \alpha + \beta_1 ln\frac{S_{i,t}}{S_{i,t-1}} + \beta_2 ln\frac{S_{i,t}}{S_{i,t-1}} \times Small_{i,t} + \varepsilon_{i,t}$, for subsamples divided based on the distribution of firms' cash flows. Cash flows are defined as the sum of income and depreciation, as in Table 3.1. $I_{i,t}$ and $S_{i,t}$ denotes the investment and sales, respectively, of firm i in year t. Figure (a) and (b) define small firms according to whether it has less than 250 employees and if it has less than ten million U.S. Dollars in total assets, respectively. The bars and the capped lines represent the scale of the coefficients and 95% confidential intervals for each group.



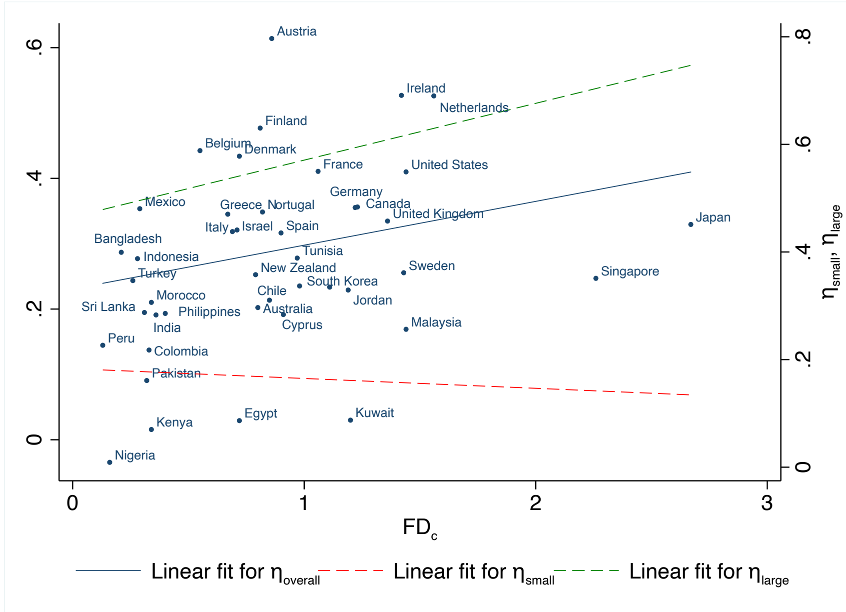
(a)



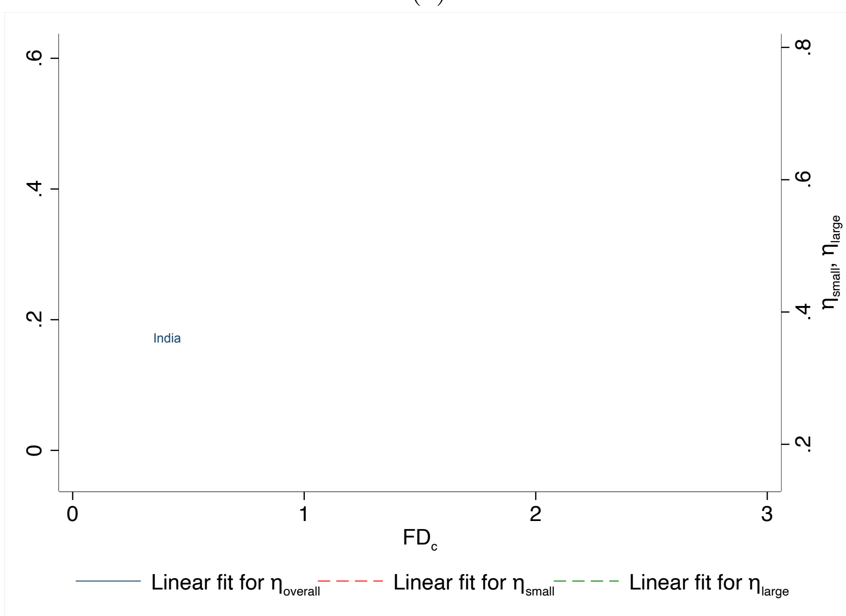
(b)

Figure 3.9: Relationship Between Allocative Efficiency and Financial Development for Overall Sample and Small and Large Firms

This figure shows the relationship between the country-specific estimates of overall investment elasticity to sales (the left vertical axis), and that among small firms, η_{Small} and among large firms η_{Large} (the right vertical axis) with the total size of the debt and stock markets. The scatter plots the overall η of a country against its financial market size, and the solid line depicts the linear fit. The green and red dashed lines are the linear fits of η_{Small} and η_{Large} to the financial market size. (a) and (b) separate small and large firms according to whether the number of employees are less than 250 and whether the total assets are less than ten million dollars, respectively.



(a)



(b)

Figure 3.10: Relationship Between Allocative Efficiency and Financial Development for Overall Sample and Top and Bottom Twenty Percentile by Size

This figure shows the relationship between the country-specific estimates of overall investment elasticity to sales (the left vertical axis), and that among small firms, η_{Small} and among large firms η_{Large} (the right vertical axis) with the total size of the debt and stock markets. The scatter plots the overall η of a country against its financial market size, and the solid line depicts the linear fit. The green and red dashed lines are the linear fits of η_{Small} and η_{Large} to the financial market size. (a) and (b) define small (large) as the bottom (top) twenty percentile in terms of number of employees and total assets, respectively, within a country in a given year.

Table 3.1: Variable Definition and Resources

Variable	Definition and Calculation	Data Resources
η	A measure of capital allocation efficiency among firms or industries for a region. It is measured as investment elasticity to growth opportunities, and more specifically, the slope coefficients of Equation 3.1 for each country or region.	Author's calculation
$ln\frac{Sales_{i,t}}{Sales_{i,t-1}}$	Log growth of sales of a firm as a proxy for growth opportunities, which is measured as $ln\frac{Sales_{i,t}}{Sales_{i,t-1}}$. For robustness check, we also use average annual growth in the past two years and three years, respectively.	*Compustat North America* and *Compustat Global* Databases
$ln\frac{I_{i,t}}{I_{i,t-1}}$	Log growth of investment of a firm, which is measured as $ln\frac{I_{i,t}}{I_{i,t-1}}$. For robustness check, I also use average annual growth in the past two years and three years, respectively.	*Compustat North America* and *Compustat Global* Databases
EMP	Number of employees (COMPUSTAT: EMP).	*Compustat North America* and *Compustat Global* Databases
AT	Total assets (COMPUSTAT: AT).	*Compustat North America* and *Compustat Global* Databases
$Small$	A dummy variable equals one if a firm is classified as a small firm. Two classification approaches are applied. One is following the conventional US Small and Medium Sized firms (SMEs) standard to designate a firm as small if its total assets are less than 100 million USD or its total number of employees is less than 250. The other approach is to classify firms based on the size distribution of a region, which assigns a firm as "Small" if it falls into the bottom twenty percentile of that region-year in terms of total assets or total employees.	*Compustat North America* and *Compustat Global* Databases

Table 3.1 continued from previous page

Variable	Definition and Calculation	Data Resources
$CashFLow$	Calculated as sum of income (COMPUSTAT: IB) and depreciation (COMPUSTAT: DP) following Whited (1992).	*Compustat North America* and *Compustat Global* Databases
Dependence	A measure of external dependence. Calculated as the difference between the capital expenditures (COMPUSTAT: CAPX) and available internal funds, where the latter is calculated as funds from operation (COMPUSTAT: FOPT or FSRCOPT) minus the increase in account payables (COMPUSTAT: AP), minus the increase in inventory (COMPUSTAT: INVT) and plus the decrease in account receivables (COMPUSTAT: RECT), following Rajan and Zingales (1996)	*Compustat North America* and *Compustat Global* Databases
STK	A measure of the development of the stock market. Calculated as $ln(1 + \frac{STK}{GDP})$, the log growth of stock market size to GDP ratio, and the stock market size to GDP ratio is measured as the total value of publicly traded shares in stock markets as a percentage of a region's GDP.	For country-level measures, I use data from Wurgler (2000). I also construct country-year measures based on data from the Global Financial Development Database (2021) of The World Bank
$CRED$	A measure of the development of the credit market to the private sector. Calculated as $ln(1 + \frac{CRED}{GDP})$, the log growth of $CRED/GDP$, and the $CRED/GDP$ is the total domestic credit to private sector as a percentage of GDP	For country-level measures, I use data from Wurgler (2000). We also construct country-year measures based on data from the Global Financial Development Database (2021) of The World Bank

Table 3.1 continued from previous page

Variable	Definition and Calculation	Data Resources
FM	A measure of the overall financial market development in the private sector. Calculated as $ln(1+\frac{FD}{GDP})$, the log growth of FM, and FD is measured as the aggregation of stock market capitalization and domestic private credit to GDP ratio.	For country-level measures, I use data from Wurgler (2000). I also construct country-year measures based on data from the Global Financial Development Database (2021) of The World Bank.
$RuleLaw$	Rule of Law index constructed by Porta et al. (1998)	For country-level data, I use data fromPorta et al. (1998). I also obtain country-year data from (Group et al., 2010).
$Eff.Rights$	$Eff.Rights$ is measured as the interactions of the Rule of Law Index (0-1 scale) and the count of shareholder protections (six in total) and senior debt holders protections (four in total) in a country's commercial code.	Constructed based on data from Porta et al. (1998).
$Synch$	A measure of the extent to which that individual stocks return moves harmoniously. We adopt the two measures in Morck et al. (2000). One is the average R^2 of firm-level regressions of bi-weekly stock returns on local and U.S. market indexes for each country in 1995, and the other is the fraction of stocks that move in the same direction in a given week averaged across 1995.	Country level data is from Morck et al. (2000).

Table 3.2: Summary Statistics for Main Analysis

This table reports the summary statistics for variables defined in 3.1, where $ln\frac{I_{i,t}}{I_{i,t-1}}$ is the log growth of investment, including capital expenditures and R&D spending; $ln\frac{Sales_{i,t}}{Sales_{i,t-1}}$ is the log growth of sales revenues; EMP is the total number of employees. AT is the total assets in Billions; $Small$ is a dummy variable equal to one if a firm has less than 250 employees and zero otherwise; $CashFLow$ is the sum of income and depreciation; $Dependence$ is the differences between capital expenditures and a firm's available internal funds; STK and $CRED$ measures the fraction of stock market capitalization to GDP and fraction of credits to private sectors to GDP, respectively; FM measures the overall size of the financial market, equal the sum of STK and $CRED$; $RuleLaw$ measures the quality of law enforcement; $Eff.Rights$ measures the effective protection of external investors, including both shareholders and senior debt holders; $Synch$ is the average R^2 of firm-level regressions of bi-weekly stock returns on each country's local and U.S. market index. The sample includes 37050 firms across 32 countries from 1987 to 2020 in all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999). We exclude observations with either the log investment growth or log sales growth exceeding one to focus on the normal growth firms.

Variables	No. of Observations	Mean (S.E.)	Median	Standard Deviation	Min	Max
$ln\frac{I_{i,t}}{I_{i,t-1}}$	360532	0.024 (0.001)	0.031	0.434	-1.000	1.000
$ln\frac{Sales_{i,t}}{Sales_{i,t-1}}$	360532	0.049 (0.000)	0.041	0.244	-1.000	1.000
EMP	278334	6.560 (0.031)	1.054	16.220	0.000	100.000
AT [10]	360524	2.009 (0.010)	0.218	5.963	0.000	39.180
$Small$	278334	0.234 (0.001)	0.000	0.423	0.000	1.000
$CashFLow$	357938	0.022 (0.000)	0.065	0.265	-2.848	0.355
$Dependence$	320231	3.120 (0.083)	-0.169	47.108	-214.091	549.133
STK	360532	0.462 (0.000)	0.560	0.239	0.030	1.230
$CRED$	360532	0.909 (0.001)	0.880	0.478	0.090	2.000
FM	360532	1.371 (0.001)	1.440	0.643	0.130	2.670
$RuleLaw$	360532	0.861 (0.000)	1.000	0.205	0.208	1.000
$Eff.Rights$	360532	5.203 (0.002)	6.000	1.456	0.535	7.710
$Synch$	360532	0.112 (0.000)	0.064	0.101	0.021	0.429

Table 3.3: Differences in the Elasticity of Investment to Sales among Small and among Large firms

This table shows the firm-fixed effects estimation of $ln\frac{I_{i,t}}{I_{i,t-1}} = \alpha + \beta_1 ln\frac{S_{i,t}}{S_{i,t-1}} + \beta_2 ln\frac{S_{i,t}}{S_{i,t-1}} \times Small + \sum_j^J \gamma_j X_{j,i,t-1} + \varepsilon_{i,t}$, where $ln\frac{I_{i,t}}{I_{i,t-1}}$ denotes the log changes of investment, and $ln\frac{S_{i,t}}{S_{i,t-1}}$ is the log changes of sales, and $Small$ is the size dummy indicates small firms. In addition, $X_{j,i,t-1}$ is the vector of control variables which includes Cash flows and the size dummy in this table. Panel A and B use one-year log growth and annualized two-year log growth, respectively. Columns (1) - (4) and (5) - (8) designate a firm is small when its total number of employees is less than 250 and when its employee size resides at the bottom twenty percentile of its country in a given year. Robust standard errors are shown in parentheses. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

Size Dummy equals one if	No. of employees less than 250				Employee size is at bottom 20 percentile			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: One-year Growth								
$ln\frac{S_{c,i,t}}{S_{c,i,t-1}}$	0.552***	0.553***	0.510***	0.510***	0.498***	0.499***	0.458***	0.460***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
Size Dummy	0.013***	0.013***	0.007	0.007	0.005	0.005	-0.006	-0.007
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.0044)
$ln\frac{S_{c,i,t}}{S_{c,i,t-1}} \times Small$	-0.306***	-0.303***	-0.281***	-0.2777***	-0.300***	-0.300***	-0.277***	-0.276***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.009)	(0.009)	(0.009)	(0.009)
$CashFlow$		0.0000		0.0000		0.0001		0.0000
		(0.0002)		(0.0002)		(0.0002)		(0.0002)
Year Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes
No. of Observations	368654	367437	368654	367437	368654	367437	368654	367437
F-Statistics	5722.76	4295.96	296.17	291.84	5453.10	4105.28	287.38	283.68

Table 3.3 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
R-square	0.16	0.16	0.17	0.17	0.16	0.16	0.17	0.17
Panel B: Annualized Two-year Growth								
$ln\frac{S_{c,i,t}}{S_{c,i,t-1}}$	0.757***	0.757***	0.711***	0.712***	0.678***	0.681***	0.635***	0.638***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
Size Dummy	0.005	0.004	-0.001	-0.001	-0.008**	-0.008**	-0.019***	-0.019***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
$ln\frac{S_{c,i,t}}{S_{c,i,t-1}} \times Small$	-0.395***	-0.390***	-0.367***	-0.362***	-0.370***	-0.368***	-0.344***	-0.342***
	(0.007)	(0.008)	(0.007)	(0.007)	(0.009)	(0.009)	(0.009)	(0.009)
$CashFlow$		-0.0002		-0.0001		-0.0002		-0.0002
		(0.0001)		(0.0001)		(0.0001)		(0.0001)
Year Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes
No. of Observations	382895	381630	382895	381630	382895	381630	382895	381630
F-Statistics	10400	7826.20	552.24	544.03	9467.19	7126.4	518.567	512.23
R-square	0.22	0.22	0.23	0.23	0.22	0.22	0.23	0.23

Table 3.4: Allocation Efficiency for Growing and Declining Firms

This table shows the firm-fixed effects estimation of $ln\frac{I_{i,t}}{I_{i,t-1}} = \alpha + \beta_1 ln\frac{S_{i,t}}{S_{i,t-1}} + \beta_2 ln\frac{S_{i,t}}{S_{i,t-1}} \times Small + \sum_j^J \gamma_j X_{j,i,t-1} + \varepsilon_{i,t}$ for observations with growing sales and declining sales separately. $ln\frac{I_{i,t}}{I_{i,t-1}}$ denotes the log changes of investment, and $ln\frac{S_{i,t}}{S_{i,t-1}}$ is the log changes of sales, and $Small$ is the size dummy equals one if the firm has less than 250 employees. In addition, $X_{j,i,t-1}$ is the vector of control variables which includes Cash flows and the size dummy in this table. Panel A and B use one-year log growth and annualized two-year log growth, respectively. Column (1) - (4) use observations with sales increase comparing to the last year, and colum (5) - (8) use observations with decreasing sales only. Robust standard errors are shown in parentheses. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	$GrowingSales$				$DecliningSales$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: One-year growth								
$ln\frac{S_{i,t}}{S_{i,t-1}}$	0.531***	0.531***	0.515***	0.515***	0.460***	0.461***	0.409***	0.410***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.011)	(0.011)	(0.012)	(0.012)
$Small_{i,t}$	0.045***	0.045***	0.04***	0.040***	-0.042***	-0.041***	-0.038***	-0.037***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.009)	(0.009)	(0.009)	(0.009)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Small_{i,t}$	-0.281***	-0.277***	-0.274***	-0.270***	-0.253***	-0.249***	-0.221***	-0.217***
	(0.014)	(0.015)	(0.014)	(0.015)	(0.019)	(0.019)	(0.019)	(0.019)
$CashFlow_{i,t}$		0.0000		-0.0001		0.0015*		0.0014*
		(0.0001)		(0.0002)		(0.0008)		(0.0008)
Year Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes
No. of Observations	224005	223320	224005	223320	132667	132156	132667	132156
F-Statistics	1644.26	1233.18	93.84	92.35	599.48	453.22	41.48	40.93

Table 3.4 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
R-square	0.18	0.18	0.19	0.19	0.22	0.22	0.23	0.23
Panel B: Annualized Two-year Growth								
$ln\frac{S_{i,t}}{S_{i,t-1}}$	0.720***	0.720***	0.694***	0.694***	0.644***	0.644***	0.612***	0.612***
	(0.007)	(0.007)	(0.008)	(0.008)	(0.013)	(0.013)	(0.013)	(0.013)
$Small_{i,t}$	0.047***	0.045***	0.041***	0.040***	-0.054***	-0.052***	-0.052***	-0.050***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.008)	(0.008)	(0.008)	(0.008)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Small_{i,t}$	-0.381***	-0.377***	-0.368***	-0.364***	-0.325***	-0.316***	-0.303***	-0.295***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.020)	(0.020)	(0.020)	(0.020)
$CashFlow_{i,t}$		-0.0001		-0.0001		-0.0005		-0.0005
		(0.0001)		(0.0001)		(0.0004)		(0.0004)
Year Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes
No. of Observations	238279	237544	238279	237544	134727	134206	134727	134206
F-Statistics	3466.60	2598.49	195.66	192.61	1019.34	766.71	64.21	63.31
R-square	0.23	0.23	0.24	0.24	0.25	0.25	0.26	0.26

Table 3.5: Capital Allocation Efficiency and Financial Market Size

This table reports the weighted-least-squared regression of estimated investment elasticity to sales, hereafter denoted as η, on financial markets size and GDP. Panel A and Panel B represent the estimation of η using one-year log growth of investment and sales, and annualized two-year growth, respectively. The dependent variable in columns (1) - (3) is the overall elasticity for each country, and that in columns (4) - (6) and columns (7) - (9) are η among small firms and among large firms for each country, respectively. Small and large firms are separated based on whether the firm has more than 250 employees. The independent variables are from Wurgler (2000), where $CRED_c$ and STK_c measure the private sector credits to GDP and stock market capitalization to GDP, respectively. FD_c denotes the overall financial market size, the sum of the credit market and stock market capitalization. GDP_c is the log form GDP per capita in 1960 for each country. All variables are weighted by the estimated standard error of the corresponding dependent variable to account for the estimation precision of η. Robust standard errors are shown in parentheses. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

Dependent Var. =	$\eta_{overall}$			η_{small}			η_{large}		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: One-year growth									
FM_c	0.036*			-0.020			0.056**		
	(0.019)			(0.018)			(0.024)		
$CRED_c$		0.067**			-0.030			0.078**	
		(0.030)			(0.024)			(0.037)	
STK_c			0.005			-0.095			0.075
			(0.041)			(0.086)			(0.054)
GDP_C	0.018***	0.018***	0.020***	0.006*	0.006	0.009*	0.035***	0.036***	0.036***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)
$Constant$	0.180***	0.170***	0.205***	0.179***	0.181***	0.170***	0.200***	0.195***	0.224***
	(0.023)	(0.025)	(0.020)	(0.040)	(0.040)	(0.040)	(0.034)	(0.036)	(0.032)

Table 3.5 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
No. of Observations	42	42	43	32	32	33	41	41	42
F-Statistics	30.15	27.84	19.47	3.15	3.65	1.68	41.04	42.41	33.66
R-square	0.38	0.40	0.35	0.03	0.03	0.07	0.59	0.59	0.57
Panel B: Average two-year growth									
FM_c	0.036*			-0.020			0.056**		
	(0.019)			(0.018)			(0.024)		
$CRED_c$		0.067**			-0.030			0.078**	
		(0.030)			(0.024)			(0.036)	
STK_c			0.005			-0.100			0.075
			(0.041)			(0.086)			(0.054)
GDP_C	0.018***	0.018***	0.020***	0.006*	0.006	0.009*	0.035***	0.036***	0.036***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)
$Constant$	0.180***	0.170***	0.205***	0.179***	0.181***	0.170***	0.200***	0.195***	0.224***
	(0.023)	(0.025)	(0.020)	(0.040)	(0.040)	(0.036)	(0.034)	(0.036)	(0.032)
No. of Observations	42	42	43	32	32	33	41	41	42
F-Statistics	30.15	27.84	19.47	3.15	3.65	1.68	41.04	42.41	33.66
R-square	0.38	0.40	0.35	0.03	0.03	0.07	0.59	0.59	0.57

Table 3.6: Capital Allocation Efficiency and Stock Market Synchronicity and Investors Protection

This table reports the weighted-least-squared regression of estimated investment elasticity to sales, η, on stock market return synchronicity, effective investors protection and controls. Panel A and Panel B use the estimation of η based on one-year log growth of investment and sales, and annualized two-year growth, respectively. The dependent variable in columns (1) - (3) is the overall elasticity for each country, and that in columns (4) - (6) and columns (7) - (9) are η among small firms and among large firms for each country, respectively. Small and large firms are separated based on whether the firm has more than 250 employees. $Synch_c$ denotes the average R^2 of firm-level regressions of bi-weekly stock returns on local and U.S. market index for each country in 1995 retrieved from Morck et al. (2000). $Eff.Rights$ is the effective protection of investors constructed based on Porta et al. (1998). FM_c is the sum of credit and stock market capitalization to GDP ratio for each country from Wurgler (2000). GDP_c is the log GDP of each country in 1960. Robust standard errors are shown in parentheses. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

Dependent Var. =	$\eta_{overall}$			η_{small}			η_{large}		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: one-year growth									
$Synch_c$	-0.664***		-0.559***	-0.352**		-0.575**	-1.294***		-0.939***
	(0.119)		(0.161)	(0.157)		(0.266)	(0.155)		(0.217)
$Eff.Rights$		0.005	-0.019**		0.005	-0.013		0.027	-0.012
		(0.011)	(0.009)		(0.012)	(0.013)		(0.019)	(0.012)
FM_c	0.048**	0.059	0.032	-0.021	-0.013	0.019	0.081**	0.053	0.011
	(0.021)	(0.040)	(0.042)	(0.021)	(0.030)	(0.040)	(0.030)	(0.074)	(0.041)
GDP_c			0.035**			-0.015			0.067***
			(0.016)			(0.019)			(0.020)
$Constant$	0.341***	0.222***	0.111	0.253***	0.183***	0.437**	0.507***	0.265***	-0.020
	(0.039)	(0.040)	(0.137)	(0.029)	(0.051)	(0.173)	(0.044)	(0.065)	(0.200)

Table 3.6 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
No. of Observations	32	37	32	27	30	27	32	37	32
F-Statistics	19.47	2.37	14.52	7.01	0.10	3.74	36.51	4.02	25.37
R-square	0.38	0.13	0.52	0.07	0.00	0.10	0.60	0.20	0.76
Panel B: Annualized Two-year growth									
$Synch_c$	-0.481**		-0.484**	-0.462**		-0.697**	-1.271***		-0.963***
	(0.196)		(0.181)	(0.205)		(0.313)	(0.143)		(0.200)
$Eff.Rights$		-0.004	-0.027***		-0.000	-0.020		0.036**	-0.004
		(0.012)	(0.010)		(0.014)	(0.017)		(0.017)	(0.010)
FM_c	0.056*	0.079*	0.064	0.030	0.035	0.074	0.082***	0.034	0.021
	(0.029)	(0.039)	(0.058)	(0.019)	(0.035)	(0.050)	(0.026)	(0.051)	(0.028)
GDP_c			0.028			-0.009			0.051**
			(0.021)			(0.019)			(0.022)
$Constant$	0.468***	0.394***	0.323*	0.300***	0.250***	0.457**	0.704***	0.445***	0.278
	(0.061)	(0.042)	(0.175)	(0.034)	(0.054)	(0.185)	(0.039)	(0.067)	(0.212)
No. of Observations	32	37	32	27	30	27	32	37	32
F-Statistics	8.44	2.53	10.81	3.07	0.86	2.53	39.63	4.32	16.60
R-square	0.23	0.12	0.38	0.14	0.03	0.20	0.54	0.20	0.61

Table 3.7: Firm-fixed Effects Regression of Log Changes in Investments on Log Changes in Sales and its interactions with Market Synchronicity and Investors Protection

This table reports the firm-fixed effect regression of log change of investment on the log change of sales and its interaction with measures of financial market size, stock market synchronicity and effective protection of investors to investigate the impacts of various measures of financial development on the investment elasticity to sales, which measures the capital allocative efficiency. Panel A reports the results for the overall sample, and Panel B and C are based on subsamples of small firms (firms with less than 250 employees) and large firms (firms have more than 250 employees), respectively. $Synch_c$ denotes the average R^2 of firm-level regressions of bi-weekly stock returns on local and U.S. market index for each country in 1995 retrieved from Morck et al. (2000). $Eff.Rights$ is the effective protection of investors constructed based on Porta et al. (1998). FM_c is the sum of credit and stock market capitalization to GDP ratio for each country from Wurgler (2000). GDP_c is the log GDP of each country in 1960. Column (5) includes both firm- and year-fixed effects and robust standard errors are shown in parentheses. All other columns include only firm-fixed effects and standard errors are clustered by year. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	(1)	(2)	(3)	(4)	(5)
Panel A: Full Sample					
$ln\frac{S_{i,t}}{S_{i,t-1}}$	0.443***	0.478***	0.473***	0.337***	0.310***
	(0.033)	(0.031)	(0.032)	(0.040)	(0.032)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Synch_c$	-0.692***	-0.645***	-0.744***	-0.567***	-0.583***
	(0.056)	(0.054)	(0.055)	(0.061)	(0.057)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Eff.Rights_c$	-0.018***	-0.029***	-0.024***	-0.024***	-0.021***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times FM_c$	0.088***	0.098***	0.097***	0.062***	0.053***
	(0.016)	(0.017)	(0.016)	(0.021)	(0.011)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times CashFlow_{i,t}$	0.244***	0.210***	0.212***	0.194***	
	(0.014)	(0.015)	(0.016)	(0.010)	
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Dependence_{i,t}$		-0.0009***	-0.0004***	-0.0004***	-0.0004***
		(0.0001)	(0.0001)	(0.0001)	(0.0001)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times GDP_{c,t}$		0.029***	0.028***		
		(0.009)	(0.006)		
$CashFlow_{i,t}$	0.089***	0.084***	0.083***	0.078***	
	(0.007)	(0.008)	(0.008)	(0.005)	
$Dependence_{i,t}$		-0.0001***	0.0000	0.0000	0.0000

Table 3.7 continued from previous page

	(1)	(2)	(3)	(4)	(5)
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
$GDP_{c,t}$		-0.026	-0.021*		
		(0.024)	(0.012)		
Year Fixed Effects	No	No	No	No	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Clustered Std. Err.	Year	Year	Year	Year	No
No. of Observations	357875	319347	317794	317311	317311
F-Statistics	220.17	236.93	220.4	211.61	345.32
R-square	0.15	0.15	0.15	0.15	0.15
Panel B: Employees less than 250					
$ln\frac{S_{i,t}}{S_{i,t-1}}$	0.322***	0.320***	0.324***	0.311***	0.320***
	(0.039)	(0.034)	(0.038)	(0.077)	(0.100)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Synch_c$	-0.374***	-0.339***	-0.396***	-0.381**	-0.440***
	(0.106)	(0.116)	(0.109)	(0.158)	(0.164)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Eff.Rights_c$	-0.007	-0.014*	-0.010	-0.009	-0.011
	(0.007)	(0.007)	(0.008)	(0.008)	(0.010)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times FM_c$	-0.005	0.009	0.005	0.003	0.006
	(0.016)	(0.018)	(0.017)	(0.021)	(0.027)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times CashFlow_{i,t}$	0.117***	0.085***	0.085***	0.079***	
	(0.011)	(0.013)	(0.013)	(0.013)	
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Dependence_{i,t}$		-0.0005***	-0.0003***	-0.0003***	-0.0003***
		(0.0001)	(0.0001)	(0.0001)	(0.0001)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times GDP_{c,t}$		0.002	-0.001		
		(0.017)	(0.017)		
$CashFlow_{i,t}$	0.056***	0.033***	0.033***	0.030***	
	(0.008)	(0.010)	(0.010)	(0.007)	
$Dependence_{i,t}$		-0.0003***	-0.0003***	-0.0002***	-0.0002***
		(0.0000)	(0.0000)	(0.0000)	(0.0000)

Table 3.7 continued from previous page

	(1)	(2)	(3)	(4)	(5)
$GDP_{c,t}$		-0.107***	-0.037		
		(0.038)	(0.067)		
Year Fixed Effects	No	No	No	No	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Clustered Std. Err.	Year	Year	Year	Year	No
No. of Observations	61623	54226	53578	53537	53537
F-Statistics	98.20	119.93	82.74	65.79	35.00
R-square	0.21	0.21	0.22	0.22	0.22
Panel C: Employees more than 250					
$ln\frac{S_{i,t}}{S_{i,t-1}}$	0.574***	0.668***	0.623***	0.248***	0.191***
	(0.046)	(0.045)	(0.044)	(0.062)	(0.059)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Synch_c$	-1.011***	-1.136***	-1.143***	-0.640***	-0.648***
	(0.101)	(0.110)	(0.108)	(0.123)	(0.103)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Eff.Rights_c$	-0.008	-0.017**	-0.017**	-0.021**	-0.020***
	(0.006)	(0.008)	(0.008)	(0.008)	(0.006)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times FM_c$	0.062**	0.065**	0.070**	-0.005	-0.021
	(0.023)	(0.027)	(0.027)	(0.034)	(0.016)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times CashFlow_{i,t}$	0.414***	0.389***	0.391***	0.365***	
	(0.038)	(0.043)	(0.045)	(0.035)	
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Dependence_{i,t}$		-0.001***	-0.001***	-0.001***	-0.001***
		(0.0003)	(0.0003)	(0.0003)	(0.0002)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times GDP_{c,t}$		0.079***	0.087***		
		(0.014)	(0.010)		
$CashFlow_{i,t}$	0.224***	0.245***	0.244***	0.228***	
	(0.016)	(0.015)	(0.016)	(0.012)	
$Dependence_{i,t}$		0.0006***	0.0008***	0.0008***	0.0007***
		(0.0001)	(0.0001)	(0.0001)	(0.0001)
$GDP_{c,t}$		-0.025	-0.106***		

Table 3.7 continued from previous page

	(1)	(2)	(3)	(4)	(5)
		(0.031)	(0.023)		
Year Fixed Effects	No	No	No	No	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Clustered Std. Err.	Year	Year	Year	Year	No
No. of Observations	210631	185415	185079	184806	184806
F-Statistics	381.30	309.052	262.55	206.32	329.71
R-square	0.17	0.17	0.18	0.18	0.18

Table 3.8: Impacts of Financial Market Activities, Market Synchronicity and Investors Protection on the Capital Allocation Efficiency for Growing Firms

This table reports the firm-fixed effect regression of log change of investment on the log change of sales and its interaction with measures of financial market activities (FM_c), stock market synchronicity ($SYNCH_c$) and effective protection of investors ($Eff.Rights_c$) for the sample with positive annual growth in sales. Panel A reports the results for all firms growing in sales, and Panel B and C are based on growing small firms (firms with less than 250 employees) and growing large firms (firms have more than 250 employees), respectively. $Synch_c$ denotes the average R^2 of firm-level regressions of bi-weekly stock returns on local and U.S. market index for each country in 1995 retrieved from Morck et al. (2000). $Eff.Rights$ is the effective protection of investors constructed based on Porta et al. (1998). FM_c is the sum of credit and stock market capitalization to GDP ratio for each country from Wurgler (2000). GDP_c is the log GDP of each country in 1960. Column (5) includes both firm- and year-fixed effects and robust standard errors are shown in parentheses. All other columns include only firm-fixed effects, and standard errors are clustered by year. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	(1)	(2)	(3)	(4)	(5)
Panel A: Full Sample					
$ln\frac{S_{i,t}}{S_{i,t-1}}$	0.471***	0.505***	0.497***	0.308***	0.271***
	(0.042)	(0.052)	(0.052)	(0.089)	(0.065)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Synch_c$	-0.860***	-0.812***	-0.884***	-0.626***	-0.640***
	(0.103)	(0.111)	(0.112)	(0.136)	(0.118)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Eff.Rights_c$	-0.019**	-0.026***	-0.023**	-0.022**	-0.023***
	(0.007)	(0.009)	(0.009)	(0.009)	(0.008)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times FM_c$	0.084***	0.094***	0.091***	0.040	0.032
	(0.025)	(0.027)	(0.027)	(0.035)	(0.022)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times CashFlow_{i,t}$	0.236***	0.153***	0.156***	0.156***	
	(0.018)	(0.022)	(0.022)	(0.024)	
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Dependence_{i,t}$		-0.001***	-0.001***	-0.001***	-0.001***
		(0.0001)	(0.0002)	(0.0002)	(0.0001)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times GDP_{c,t}$		0.040**	0.047***		
		(0.015)	(0.011)		
$CashFlow_{i,t}$	0.048***	0.060***	0.060***	0.053***	
	(0.012)	(0.015)	(0.015)	(0.011)	
$Dependence_{i,t}$		0.0002**	0.0002**	0.0002**	0.0001**
		(0.0001)	(0.0001)	(0.0001)	(0.0001)

Table 3.8 continued from previous page

	(1)	(2)	(3)	(4)	(5)
$GDP_{c,t}$		-0.032	-0.062***		
		(0.022)	(0.017)		
Year Fixed Effects	No	No	No	No	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Clustered Std. Err.	Year	Year	Year	Year	No
No. of Observations	214356	189429	188560	188254	188254
F-Statistics	389.66	379.70	288.19	237.30	109.57
R-square	0.18	0.19	0.19	0.19	0.19
Panel B: Employees less than 250					
$ln\frac{S_{i,t}}{S_{i,t-1}}$	0.487***	0.522***	0.511***	0.457**	0.472**
	(0.107)	(0.102)	(0.110)	(0.187)	(0.218)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Synch_c$	-0.678***	-0.676**	-0.728***	-0.661**	-0.696*
	(0.243)	(0.261)	(0.265)	(0.324)	(0.391)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Eff.Rights_c$	-0.018	-0.032*	-0.025	-0.024	-0.027
	(0.017)	(0.018)	(0.019)	(0.019)	(0.021)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times FM_c$	-0.066*	-0.039	-0.050	-0.058	-0.049
	(0.035)	(0.038)	(0.038)	(0.053)	(0.060)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times CashFlow_{i,t}$	0.147***		0.097***	0.096***	0.096***
	(0.026)		(0.033)	(0.033)	(0.033)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Dependence_{i,t}$		-0.001***	-0.001***	-0.001***	-0.001***
		(0.0001)	(0.0002)	(0.0002)	(0.0002)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times GDP_{c,t}$				0.010	0.007
				(0.038)	(0.038)
$CashFlow_{i,t}$	0.026*		0.013	0.014	0.013
	(0.013)		(0.019)	(0.019)	(0.016)
$Dependence_{i,t}$		-0.0001*	-0.0002**	-0.0002**	-0.0002**
		(0.0001)	(0.0001)	(0.0001)	(0.0001)
$GDP_{c,t}$				-0.089*	0.048

Table 3.8 continued from previous page

	(1)	(2)	(3)	(4)	(5)
				(0.047)	(0.093)
Year Fixed Effects	No	No	No	No	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Clustered Std. Err.	Year	Year	Year	Year	No
No. of Observations	33273	29055	28718	28695	28695
F-Statistics	73.71	87.37	72.68	62.16	11.34
R-square	0.27	0.28	0.28	0.28	0.28
Panel C: Employeesmore than 250					
$ln\frac{S_{i,t}}{S_{i,t-1}}$	0.591***	0.680***	0.661***	0.439***	0.339***
	(0.058)	(0.067)	(0.069)	(0.113)	(0.116)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Synch_c$	-1.091***	-1.186***	-1.209***	-0.922***	-0.891***
	(0.155)	(0.164)	(0.156)	(0.213)	(0.201)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Eff.Rights_c$	-0.013	-0.024*	-0.023*	-0.024*	-0.028**
	(0.010)	(0.012)	(0.012)	(0.012)	(0.012)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times FM_c$	0.066*	0.071*	0.073*	0.030	0.011
	(0.036)	(0.038)	(0.038)	(0.049)	(0.031)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times CashFlow_{i,t}$	0.235**		0.099	0.104	0.110
	(0.101)		(0.116)	(0.117)	(0.076)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Dependence_{i,t}$		-0.003***	-0.003***	-0.003***	-0.003***
		(0.0004)	(0.0004)	(0.0004)	(0.0005)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times GDP_{c,t}$				0.045*	0.069***
				(0.023)	(0.020)
$CashFlow_{i,t}$	0.220***		0.260***	0.258***	0.238***
	(0.032)		(0.035)	(0.036)	(0.024)
$Dependence_{i,t}$		0.0009***	0.0011***	0.0011***	0.0010***
		(0.0001)	(0.0001)	(0.0001)	(0.0001)
$GDP_{c,t}$				-0.037	-0.138***

Table 3.8 continued from previous page

	(1)	(2)	(3)	(4)	(5)
				(0.029)	(0.030)
Year Fixed Effects	No	No	No	No	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Clustered Std. Err.	Year	Year	Year	Year	No
No. of Observations	128869	112139	111937	111756	111756
F-Statistics	341.66	222.40	227.43	243.06	103.41
R-square	0.19	0.20	0.20	0.20	0.21

Table 3.9: Impacts of Financial Market Activities, Market Synchronicity and Investors Protection on the Capital Allocation Efficiency for Declining Firms

This table reports the firm-fixed effect regression of log change of investment on the log change of sales and its interaction with measures of financial market activities (FM_c), stock market synchronicity ($SYNCH_c$) and effective protection of investors ($Eff.Rights_c$) for the sample with lower current sales than the previous year (declining sales). Panel A reports the results for all declining firms, and Panel B and C are based on declining small firms (firms with less than 250 employees) and declining large firms (firms have more than 250 employees), respectively. $Synch_c$ denotes the average R^2 of firm-level regressions of bi-weekly stock returns on local and U.S. market index for each country in 1995 retrieved from Morck et al. (2000). $Eff.Rights$ is the effective protection of investors constructed based on Porta et al. (1998). FM_c is the sum of credit and stock market capitalization to GDP ratio for each country from Wurgler (2000). GDP_c is the log GDP of each country in 1960. Column (5) includes both firm- and year-fixed effects and robust standard errors are shown in parentheses. All other columns include only firm-fixed effects, and standard errors are clustered by year. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	(1)	(2)	(3)	(4)	(5)
Panel A: Full Sample					
$ln\frac{S_{i,t}}{S_{i,t-1}}$	0.329***	0.350***	0.351***	0.066	0.059
	(0.059)	(0.055)	(0.054)	(0.100)	(0.084)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Synch_c$	-0.521***	-0.466***	-0.567***	-0.207	-0.216
	(0.112)	(0.113)	(0.113)	(0.127)	(0.142)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Eff.Rights_c$	-0.010	-0.022**	-0.016*	-0.015*	-0.011
	(0.008)	(0.008)	(0.008)	(0.008)	(0.010)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times FM_c$	0.087***	0.101***	0.094***	0.024	0.011
	(0.018)	(0.020)	(0.019)	(0.028)	(0.025)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times CashFlow_{i,t}$	0.234***		0.264***	0.269***	0.245***
	(0.023)		(0.025)	(0.025)	(0.025)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Dependence_{i,t}$		-0.0002	0.0004**	0.0004**	0.0004***
		(0.0001)	(0.0002)	(0.0002)	(0.0001)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times GDP_{c,t}$				0.061***	0.055***
				(0.021)	(0.014)
$CashFlow_{i,t}$	0.131***		0.148***	0.150***	0.140***
	(0.010)		(0.011)	(0.011)	(0.012)
$Dependence_{i,t}$		0	0.0003***	0.0003***	0.0003***
		(0.0001)	(0.0001)	(0.0001)	(0.0001)

Table 3.9 continued from previous page

	(1)	(2)	(3)	(4)	(5)
$GDP_{c,t}$				0.034	0.009
				(0.028)	(0.021)
Year Fixed Effects	No	No	No	No	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Clustered Std. Err.	Year	Year	Year	Year	No
No. of Observations	133963	121161	120500	120353	120353
F-Statistics	67.13	42.19	47.36	41.23	51.29
R-square	0.21	0.21	0.21	0.21	0.22
Panel B: Employees less than 250					
$ln\frac{S_{i,t}}{S_{i,t-1}}$	0.211	0.204	0.179	0.418**	0.431
	(0.135)	(0.133)	(0.144)	(0.204)	(0.268)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Synch_c$	-0.147	-0.153	-0.134	-0.485	-0.559
	(0.354)	(0.388)	(0.384)	(0.480)	(0.454)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Eff.Rights_c$	0.019	0.011	0.023	0.025	0.023
	(0.025)	(0.026)	(0.026)	(0.026)	(0.026)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times FM_c$	-0.058	-0.045	-0.057	-0.004	-0.018
	(0.045)	(0.051)	(0.046)	(0.071)	(0.072)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times CashFlow_{i,t}$	0.113***		0.107***	0.106***	0.096***
	(0.024)		(0.029)	(0.029)	(0.035)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Dependence_{i,t}$		-0.0001	0.0001	0.0001	0.0001
		(0.0002)	(0.0002)	(0.0002)	(0.0002)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times GDP_{c,t}$				-0.051	-0.051
				(0.040)	(0.047)
$CashFlow_{i,t}$	0.075***		0.059***	0.057***	0.053***
	(0.015)		(0.018)	(0.017)	(0.018)
$Dependence_{i,t}$		-0.0002***	-0.0001	-0.0001	-0.0001
		(0.0001)	(0.0001)	(0.0001)	(0.0001)
$GDP_{c,t}$				-0.110**	-0.188

Table 3.9 continued from previous page

	(1)	(2)	(3)	(4)	(5)
				(0.044)	(0.119)
Year Fixed Effects	No	No	No	No	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Clustered Std. Err.	Year	Year	Year	Year	No
No. of Observations	23345	20633	20347	20331	20331
F-Statistics	25.94	19.07	20.49	22.13	6.41
R-square	0.28	0.29	0.29	0.29	0.30
Panel C: Employeesmore than 250					
$ln\frac{S_{i,t}}{S_{i,t-1}}$	0.499***	0.541***	0.510***	-0.041	-0.030
	(0.071)	(0.073)	(0.070)	(0.140)	(0.145)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Synch_c$	-0.778***	-0.784***	-0.811***	-0.109	-0.168
	(0.172)	(0.186)	(0.190)	(0.269)	(0.251)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Eff.Rights_c$	-0.012	-0.014	-0.013	-0.018	-0.013
	(0.011)	(0.012)	(0.012)	(0.012)	(0.015)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times FM_c$	0.066**	0.064**	0.063**	-0.040	-0.051
	(0.026)	(0.030)	(0.029)	(0.046)	(0.037)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times CashFlow_{i,t}$	0.455***		0.579***	0.576***	0.537***
	(0.065)		(0.075)	(0.075)	(0.069)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times Dependence_{i,t}$		0.0016***	0.0023***	0.0022***	0.0021***
		(0.0005)	(0.0006)	(0.0006)	(0.0006)
$ln\frac{S_{i,t}}{S_{i,t-1}} \times GDP_{c,t}$				0.115***	0.103***
				(0.029)	(0.0250)
$CashFlow_{i,t}$	0.267***		0.331***	0.331***	0.313***
	(0.029)		(0.030)	(0.030)	(0.024)
$Dependence_{i,t}$		0.0012***	0.0016***	0.0016***	0.0015***
		(0.0002)	(0.0002)	(0.0002)	(0.0002)
$GDP_{c,t}$				0.067	-0.023

Table 3.9 continued from previous page

	(1)	(2)	(3)	(4)	(5)
				(0.041)	(0.042)
Year Fixed Effects	No	No	No	No	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Clustered Std. Err.	Year	Year	Year	Year	No
No. of Observations	76102	68060	67935	67852	67852
F-Statistics	78.04	85.41	85.46	93.89	51.47
R-square	0.22	0.22	0.22	0.22	0.23

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Appendix

Appendix 1A: Market Value and Replacement Value for Marginal q Estimation

I estimate the market value V_{it} and the replacement value A_{it} of capital assets of firm i at time t as:

$$V_{it} = CS_{it} + PS_{it} + LTD_{it} + STD_{it} - STA_{it} \tag{1A.1}$$

$$A_{it} = K_{it} + K_{it}^{intan} \tag{1A.2}$$

where all parts are adjusted for inflation and in 2012 dollar value, and the nominal value of each part is constructed as:

CS_{it}	is the market value of outstanding common shares at the end of fiscal year t, and equals the multiplication of the common share's outstanding (CSHO) and the stock price at the end of the fiscal year (PRCC_F).
PS_{it}	is the estimated market value of preferred shares using the dividends paid on preferred equity (DVP) divided by the Moody's Baa Corporate Bond Yiled. Alternatively, I use the redemption value of the preferred stock (PSTKRV).
LTD_{it}	is the value of long-term debt (DLTT). Alternatively, I estimate the market value of long-term debt following B. H. Hall (1990) to adjust for the age-structure.
STD_{it}	is the book value of short-term debt (DLC).
STA_{it}	is the book value of current assets (ACT).
K_{it}	is the estimated replacement value of a firm's tangible capital stock.
K_{it}^{intan}	is the estimated replacement value of a firm's intangible capital stock, which is the sum of the estimated firm's knowledge capital value, organization capital value following Peters and Taylor (2017) and intangible investment (INTAN).

Appendix 1B: Additional Results

Table 1B.1: Weighted Least Squares Regression of Firms' Capital Budgeting Efficiency on Quasi-indexer Ownership and Control Variables Using Inverse Standard Errors of Mariginal Q as Weights

This table reports the weighted least squared regressions of a firm's capital budgeting inefficiency on its quasi-indexer ownership and various control variables. The dependent variables for column (1) to (3) and colum (4) to (6) are the distance of estimated marginal q from the theoretical optimal level, i.e. one, ($|\dot{q}-1|$) and from industry average level ($|\dot{q} - \text{FF48 Average}|$), respectively. All variables are as defined in Table 1.1 and all independent variables lag dependnet variables for one year. All observations are weighed by the inversed standard error of estimated marginal q following Saxonhouse (1976). Firm-fixed effects and year-fixed effects are included in all models. The sample is an unbalanced panel of U.S. firms listed in NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019. All variables are in 2012 dollar and are winsorized at 1% and 99% level. T-statistics are shown in parentheses, and standarded errors are clustered at firm level. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

Dependent Var =	$\lvert\dot{q}-1\rvert$					$\lvert\dot{q} - \text{FF48 Average}\rvert$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Quasi-index Ownership	-0.996***	-0.470***	-0.457***	-0.458***	-0.856***	-0.326**	-0.309**	-0.310**
	(-4.61)	(-3.18)	(-3.08)	(-3.09)	(-4.18)	(-2.39)	(-2.27)	(-2.27)
Leverage	-0.025*	-0.004	-0.006	-0.006	-0.006	0.015	0.011	0.011
	(-1.92)	(-0.32)	(-0.52)	(-0.53)	(-0.49)	(1.31)	(0.96)	(0.95)
Cash Flow	0.716***	0.212	0.139	0.142	0.726***	0.218	0.124	0.126
	(2.85)	(0.95)	(0.61)	(0.62)	(2.95)	(1.02)	(0.57)	(0.58)
Intangible Assets	0.350***	0.064	0.061	0.06	0.295**	0.007	0.002	0.002
	(2.81)	(0.64)	(0.59)	(0.59)	(2.27)	(0.07)	(0.02)	(0.02)

Table 1B.1 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Size	0.091***	-0.167***	-0.167***	-0.167***	0.051*	-0.209***	-0.208***	-0.208***
	(2.85)	(-6.12)	(-6.02)	(-6.02)	(1.69)	(-7.81)	(-7.71)	(-7.71)
Diversification	-0.01	0.01	0.01	0.01	0.007	0.027**	0.027**	0.027**
	(-0.57)	(0.80)	(0.79)	(0.80)	(0.38)	(2.08)	(2.05)	(2.06)
E-index	-0.001	0.022	0.023	0.023	-0.009	0.015	0.015	0.015
	(-0.03)	(1.26)	(1.27)	(1.29)	(-0.38)	(0.89)	(0.92)	(0.93)
Average q		0.339***	0.337***	0.337***		0.342***	0.340***	0.340***
		(14.12)	(14.00)	(14.02)		(15.08)	(14.94)	(14.96)
External dependence			0.012**	0.012**			0.016***	0.016***
			(2.32)	(2.32)			(3.01)	(3.01)
HHI Index				-0.203				-0.14
				(-0.62)				(-0.47)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	19969	19969	19929	19929	19969	19969	19929	19929
No. of Firms	2227	2227	2225	2225	2227	2227	2225	2225
R-square	0.54	0.57	0.57	0.57	0.51	0.54	0.54	0.54
F-Statistics	67.61	73.09	71.93	70.09	35.14	38.89	38.63	37.66

Table 1B.2: Nonlinear Regression of Capital Budgeting Efficiency on Quasi-indexer Ownership and Control Variables

This table reports nonlinear maximum likelihood regression of capital budgeting efficiency on quasi-indexer ownership and control variables. This method estimates the optimal marginal q, $\hat{h}$, simultaneously with coefficients of quasi-indexers ownership and other controls. The dependent variables are the absolute deviation of estimated marginal q from the simultaneously estimated optimal level. All control variables are as defined in Table 1.1. The sample is an unbalanced panel of 5,507 U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) during the period 1980 to 2019. All variables are in 2012 dollars and are winsorized at 1% and 99% levels. *T-statistics* are shown in parentheses. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	$\|\dot{q} - h\|$				$(\dot{q} - h)^2$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Quasi-index Ownership	-0.171**	-0.182**	-0.192**	-0.214***	-0.162***	-0.145***	-0.128***	-0.130***
	(-2.24)	(-2.32)	(-2.47)	(-2.78)	(-3.12)	(-3.16)	(-2.72)	(-2.74)
Leverage	-0.005	-0.009*	-0.013***	-0.013***	0.003	0.004	-0.004	-0.005
	(-1.16)	(-1.83)	(-2.59)	(-2.81)	(0.57)	(0.84)	(-1.07)	(-1.08)
Cash Flows	0.526***	0.202	0.159	0.053	0.157	-0.350***	-0.386***	-0.415***
	(3.50)	(1.41)	(1.13)	(0.36)	(1.51)	(-3.78)	(-4.13)	(-4.39)
Intangible Ratio	0.091***	0.054**	0.037	0.051*	0.100***	0.020	0.013	0.023
	(3.42)	(2.13)	(1.44)	(1.69)	(3.96)	(0.89)	(0.57)	(0.83)
Size	-0.012*	-0.024***	-0.025***	-0.025***	0.012**	-0.015***	-0.014***	-0.014***
	(-1.90)	(-3.63)	(-3.81)	(-3.91)	(2.19)	(-3.27)	(-3.19)	(-3.19)
Diversification	-0.005	0.003	0.005	0.004	-0.037***	-0.012***	-0.011**	-0.011**
	(-0.72)	(0.42)	(0.65)	(0.55)	(-6.67)	(-2.63)	(-2.50)	(-2.47)

Table 1B.2 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
E-index	0.001	0.006	0.008	0.008	-0.011*	0.004	0.005	0.004
	(0.08)	(0.71)	(0.85)	(0.83)	(-1.71)	(0.60)	(0.77)	(0.76)
Average q		0.116***	0.110***	0.112***		0.147***	0.145***	0.145***
		(7.03)	(6.97)	(7.23)		(14.08)	(13.78)	(13.78)
External Dependence			0.021***	0.020***			0.023***	0.023***
			(5.60)	(5.63)			(5.33)	(5.31)
Lerner Index				0.045*				0.013
				(1.84)				(0.89)
$\hat{h}$	1.056+	1.025+	1.041+	1.040+	1.070+	1.071+	1.077+	1.077+
	(109.62)	(106.24)	(110.78)	(111.73)	(57.71)	(66.31)	(68.57)	(68.70)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	19373	19373	19344	19337	21480	21480	21444	21442
Adj. R-square	0.83	0.84	0.84	0.84	0.85	0.87	0.87	0.87
Log-likelihood	1798.2	2435.3	2601.9	2632.9	-14728.1	-13219.3	-12961.1	-12958

Appendix 2A: Market Value and Replacement Value for Marginal q Estimation

I estimate the market value V_{it} and the replacement value A_{it} of capital assets of firm i at time t as:

$$V_{it} = CS_{it} + PS_{it} + LTD_{it} + STD_{it} - STA_{it} \tag{2A.1}$$

$$A_{it} = K_{it} + K_{it}^{intan} \tag{2A.2}$$

where all parts are adjusted for inflation and in 2012 dollar value, and the nominal value of each part is constructed as:

CS_{it}	is the market value of outstanding common shares at the end of fiscal year t, and equals to the multiplication of the common share's outstanding (CSHO) and the stock price at the end of fiscal year (PRCC_F).
PS_{it}	is the estimated market value of preferred shares using the dividends paid on preferred equity (DVP) divided by the Moody's Baa Corporate Bond Yiled. Alternatively, I use the redemption value of preferred stock (PSTKRV).
LTD_{it}	is the value of long-term debt (DLTT). Alternatively, I estimate the market value of long-term debt following B. H. Hall (1990) to adjust for the age-structure.
STD_{it}	is the book value of short-term debt (DLC).
STA_{it}	is the book value of current assets (ACT).
K_{it}	is the estimated replacement value of a firm's tangible capital stock.
K_{it}^{intan}	is the estimated replacement value of a firm's intangible capital stock, which is the sum of estimated firm's knowledge captial value, organization capital value following Peters and Taylor (2017) and intangible investment (INTAN).

Appendix 2B: Additional Results

Table 2B.1: 2SLS Regressions of ROA on Governance Indices and Validity of Instruments

This table represents 2SLS estimation of firms' ROA on instrumental variables for corporate governance indices and control variables. Panel A reports the first-stage regressions of the governance index on the instrumental variables and pre-determined control variables included in the second-stage regression of capital budgeting efficiency on the governance index. Dependent variables are G-Index and E-Index for columns (1),(2),(5),(6) and (2),(3),(7),(8), respectively. Panel B reports the second-stage regression of ROA on the instrumented governance index and control variables. Columns (1)-(2), (3)-(4), (5)-(6), and (7)-(8) use Geo5Gindex, Geo5Eindex, Ipo5Gindex and Ipo5Eindex are instrumental variables for corresponding governance index, respectively. All variables are defined in Table 2.1. Kleibergen-Paap LM statistic (Chi2) and p-value of Chi2 report the LM test of under-identification (relevance of instrumental variables) robust to standard errors clustered by firms, and Kleibergen-Paap Wald F statistic is the F-statistics of weak identification test robust to firm-level clustered standard errors, see Kleibergen (2007). Anderson-Rubin F and P-value of AR F show the weak identification test based on Anderson-Rubin (1949). The sample includes U.S. firms listed on NYSE, NASDAQ or AMEX, and across all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999) and spans 1991-2018. All variables are in 2012 dollars and are winsorized at 1% and 99% level. *T-statistics* for Panel A and *Z-statistics* for Panel B are shown in parentheses. Standard errors clustered by firms are used to compute the *T-statistics* and *Z-statistics*. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: First-Stage Estimation								
Instruments								
Geo5Gindex	0.369***	0.322***						
	(4.44)	(3.92)						
Geo5Eindex			0.392***	0.343***				
			(4.84)	(4.28)				
Ipo5Gindex					0.640***	0.586***		
					(8.90)	(8.43)		

Table 2B.1 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ipo5Eindex							0.477***	0.446***
							(4.22)	(4.12)
Predetermined Variables (Excluded Instruments)								
Leverage	1.068***	0.968**	0.314*	0.25	1.061***	0.901**	0.347*	0.248
	(3.42)	(3.11)	(2.12)	(1.72)	(3.42)	(2.92)	(2.36)	(1.72)
CashFlow	-0.347	-0.321	-0.304	-0.244	-0.193	-0.16	-0.272	-0.207
	(-0.56)	(-0.53)	(-1.03)	(-0.86)	(-0.31)	(-0.27)	(-0.89)	(-0.72)
InstOwn	1.290***	1.361***	0.640***	0.683***	1.604***	1.613***	0.681***	0.722***
	(3.31)	(3.57)	(3.69)	(3.89)	(4.25)	(4.37)	(3.90)	(4.11)
Intan	0.214	0.548	-0.219	-0.212	-0.01	0.397	-0.319*	-0.276
	(0.69)	(1.25)	(-1.52)	(-1.10)	(-0.03)	(0.90)	(-2.23)	(-1.42)
Diversification	0.310***	0.218***	0.063*	0.038	0.213***	0.147*	0.059*	0.033
	(4.98)	(3.55)	(2.38)	(1.38)	(3.49)	(2.42)	(2.24)	(1.24)
Size	0.330***	0.385***	-0.037	-0.021	0.229***	0.282***	-0.049	-0.034
	(5.88)	(6.93)	(-1.51)	(-0.86)	(4.03)	(5.00)	(-1.96)	(-1.33)
Year-fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes

Table 2B.1 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
No. of Obs.	8683	8683	8683	8683	8668	8668	8668	8668
Kleibergen-Paap rk LM statistic (Chi2)	20.58	16.59	23.79	18.86	69.02	62.51	17.79	16.88
P-value of Chi2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kleibergen-Paap rk Wald F statistic	19.68	15.36	23.46	18.32	79.19	71.13	17.82	16.95
Anderson-Rubin F	12.89	2.92	9.20	1.20	34.37	28.11	5.14	2.95
P-value of AR F	0.00	0.09	0.00	0.27	0.00	0.00	0.02	0.09
Pnnel B: Second-Stage Estiamtion								
G-Index	0.013***	0.007			0.011***	0.011***		
	(2.82)	(1.55)			(4.88)	(4.40)		
E-Index			0.024***	0.01			0.024**	0.019
			(2.66)	(1.07)			(1.98)	(1.57)
Leverage	-0.101***	-0.104***	-0.095***	-0.099***	-0.099***	-0.108***	-0.095***	-0.102***
	(-10.82)	(-13.09)	(-10.89)	(-13.67)	(-11.94)	(-13.24)	(-10.48)	(-12.23)
CashFlow	0.473***	0.462***	0.477***	0.462***	0.473***	0.463***	0.477***	0.464***
	(15.40)	(16.29)	(15.01)	(16.19)	(15.45)	(16.04)	(14.73)	(15.57)

Table 2B.1 continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
InstOwn	-0.029***	-0.020**	-0.029***	-0.018*	-0.027***	-0.026***	-0.028**	-0.025*
	(-2.81)	(-2.03)	(-2.75)	(-1.78)	(-2.94)	(-2.66)	(-2.26)	(-1.96)
Intan	0.004	0.006	0.012	0.011	0.004	0.004	0.012	0.013
	(0.55)	(0.64)	(1.59)	(1.30)	(0.56)	(0.39)	(1.48)	(1.38)
Diversification	0	0.001	0.002**	0.002*	0	0	0.002*	0.001
	(0.03)	(0.49)	(2.08)	(1.81)	(0.35)	(-0.30)	(1.88)	(1.18)
Size	-0.001	0.001	0.005***	0.004***	0	-0.001	0.005***	0.004***
	(-0.29)	(0.49)	(3.81)	(3.61)	(-0.11)	(-0.42)	(3.58)	(3.44)
Year-fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
No. of Obs.	8683	8683	8683	8683	8668	8668	8668	8668
R-squared	0.39	0.47	0.40	0.47	0.40	0.43	0.40	0.44
F Stats	48.99	24.58	47.76	29.23	49.85	21.75	47.75	22.81
P-value of F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Appendix 3A: Additional Results

Table 2B.2: Country-Specific Summary Statistics

This table reports the summary statistics of log growth of sales ($ln\frac{Sale_{i,t,c}}{Sale_{i,t-1,c}}$) and log growth of investment ($ln\frac{I_{i,t,c}}{I_{i,t-1,c}}$) used to estimate the region-specific investment elasticity to growth opportunities (η), and the estimated η with robust standard errors in parentheses. For each region, we include all observations with neither the log growth of sales nor the log growth of investment exceeding one in all industries except for Financial industries (SIC code 6000-6999), Utilities (SIC code 4900-4999) and other special regulated firms (SIC code 9000-9999).

Region	Year Range	No. of Obs.	$ln\frac{I_{i,t}}{I_{i,t-1}}$		$ln\frac{Sales_{i,t}}{Sales_{i,t-1}}$		η (S.E.)
			Mean	Std. Dev.	Mean	Std. Dev.	
Argentina	1993 -2020	757	0.017	0.476	0.036	0.243	0.264 (0.097)
Australia	1987 -2020	12743	0.034	0.467	0.054	0.339	0.202 (0.014)
Austria	1995 -2020	1148	0.023	0.385	0.046	0.205	0.614 (0.069)
Bangladesh	2001 -2020	1120	0.000	0.535	0.043	0.240	0.287 (0.077)
Belgium	1994 -2020	1453	0.030	0.397	0.033	0.213	0.442 (0.063)
Brazil	1992 -2020	3751	0.000	0.458	0.026	0.252	0.346 (0.042)
Bulgaria	2003 -2020	389	0.021	0.534	0.041	0.232	-0.042 (0.159)
Canada	1987 -2020	17932	0.032	0.449	0.073	0.289	0.356 (0.014)
Chile	1987 -2020	1948	0.010	0.453	0.033	0.193	0.214 (0.069)
China	1993 -2020	41014	0.055	0.456	0.103	0.240	0.269 (0.011)

Table 2B.2 continued from previous page

Region	Year Range	No. of Obs.	$ln\frac{I_{i,t}}{I_{i,t-1}}$		$ln\frac{Sales_{i,t}}{Sales_{i,t-1}}$		η (S.E.)
			Mean	Std. Dev.	Mean	Std. Dev.	
Colombia	1995 -2020	328	-0.049	0.472	0.021	0.219	0.137 (0.159)
Croatia	1995 -2020	847	0.030	0.477	0.013	0.198	0.320 (0.114)
Cyprus	2000 -2020	519	0.008	0.498	0.015	0.223	0.192 (0.127)
Denmark	1987 -2020	2080	0.033	0.411	0.04	0.207	0.434 (0.054)
Egypt	1997 -2020	926	-0.018	0.506	-0.008	0.250	0.029 (0.098)
Finland	1987 -2020	2340	0.012	0.404	0.034	0.212	0.477 (0.051)
France	1987 -2020	9944	0.020	0.400	0.042	0.206	0.411 (0.026)
Germany	1994 -2020	9223	0.012	0.403	0.038	0.221	0.355 (0.024)
Greece	1996 -2020	2208	-0.021	0.478	-0.001	0.238	0.345 (0.055)
Hong Kong, China	1995 -2020	1912	0.009	0.470	0.028	0.245	0.171 (0.056)
India	1996 -2020	29033	0.010	0.507	0.055	0.254	0.191 (0.014)
Indonesia	1993 -2020	4629	0.013	0.499	0.044	0.246	0.277 (0.038)
Ireland	1987 -2020	1404	0.048	0.384	0.072	0.236	0.527 (0.058)
Israel	1987 -2020	5033	0.036	0.406	0.067	0.262	0.321 (0.026)
Italy	1987 -2020	3562	0.007	0.432	0.03	0.211	0.319 (0.046)
Japan	1987 -2020	47368	0.008	0.400	0.007	0.163	0.329 (0.015)

Table 2B.2 continued from previous page

Region	Year Range	No. of Obs.	$ln\frac{I_{i,t}}{I_{i,t-1}}$		$ln\frac{Sales_{i,t}}{Sales_{i,t-1}}$		η (S.E.)
			Mean	Std. Dev.	Mean	Std. Dev.	
Jordan	1998 -2020	553	-0.042	0.501	-0.018	0.217	0.229 (0.128)
Kenya	2003 -2020	343	0.025	0.464	0.019	0.240	0.016 (0.145)
South Korea	1995 -2020	13909	0.005	0.466	0.022	0.232	0.235 (0.021)
Kuwait	1996 -2020	633	-0.016	0.512	0.022	0.241	0.030 (0.102)
Latvia	1999 -2020	267	0.012	0.509	0.04	0.247	0.122 (0.161)
Luxembourg	1993 -2020	581	0.032	0.382	0.07	0.233	0.591 (0.090)
Malaysia	1990 -2020	10915	-0.015	0.501	0.018	0.268	0.169 (0.021)
Mexico	1987 -2020	1756	0.005	0.446	0.044	0.188	0.354 (0.076)
Morocco	1996 -2020	518	-0.004	0.471	0.018	0.168	0.210 (0.127)
Netherlands	1987 -2020	2963	0.034	0.388	0.048	0.222	0.526 (0.042)
New Zealand	1991 -2020	1670	0.030	0.449	0.059	0.230	0.253 (0.060)
Nigeria	1996 -2020	817	-0.018	0.517	0.017	0.250	-0.035 (0.106)
Norway	1987 -2020	2298	0.031	0.468	0.071	0.271	0.234 (0.045)
Oman	2001 -2020	773	-0.004	0.500	0.047	0.208	0.073 (0.110)
Pakistan	1995 -2020	3229	-0.012	0.523	0.017	0.242	0.091 (0.046)
Peru	1996 -2020	1146	0.028	0.487	0.041	0.223	0.144 (0.073)

Table 2B.2 continued from previous page

Region	Year Range	No. of Obs.	$ln\frac{I_{i,t}}{I_{i,t-1}}$		$ln\frac{Sales_{i,t}}{Sales_{i,t-1}}$		η (S.E.)
			Mean	Std. Dev.	Mean	Std. Dev.	
Philippines	1987 -2020	1828	0.004	0.485	0.039	0.261	0.193 (0.051)
Poland	1997 -2020	4591	0.014	0.503	0.065	0.267	0.227 (0.037)
Portugal	1995 -2020	753	-0.005	0.440	0.017	0.186	0.349 (0.111)
Romania	1999 -2020	501	0.043	0.486	0.007	0.261	0.147 (0.105)
Saudi Arabia	1997 -2020	1254	-0.031	0.482	0.027	0.216	0.154 (0.076)
Singapore	1994 -2020	6602	0.000	0.496	0.034	0.269	0.247 (0.026)
Spain	1987 -2020	1875	0.012	0.427	0.03	0.210	0.316 (0.062)
Sri Lanka	1996 -2020	1726	-0.006	0.494	0.025	0.221	0.195 (0.066)
Sweden	1987 -2020	5964	0.031	0.424	0.067	0.254	0.256 (0.026)
Switzerland	1987 -2020	3720	0.025	0.356	0.027	0.199	0.440 (0.038)
Taiwan, China	1995 -2020	22887	0.003	0.426	0.027	0.247	0.272 (0.013)
Thailand	1995 -2020	6828	0.011	0.504	0.034	0.228	0.221 (0.034)
Tunisia	2003 -2020	396	-0.002	0.509	-0.003	0.169	0.278 (0.189)
Turkey	1995 -2020	2486	-0.002	0.486	-0.006	0.224	0.244 (0.056)
United Arab Emir	1993 -2020	489	-0.034	0.502	0.042	0.249	0.245 (0.113)
United Kingdom	1987 -2020	22965	0.027	0.426	0.06	0.252	0.335 (0.014)

Table 2B.2 continued from previous page

Region	Year Range	No. of Obs.	$ln\frac{I_{i,t}}{I_{i,t-1}}$		$ln\frac{Sales_{i,t}}{Sales_{i,t-1}}$		η (S.E.)
			Mean	Std. Dev.	Mean	Std. Dev.	
United States	1987 -2020	181728	0.040	0.409	0.067	0.251	0.410 (0.005)
Vietnam	2003 -2020	2185	0.001	0.524	0.048	0.250	0.062 (0.054)

Table 2B.3: Weighted Least Squared Estimation of Relationship between Capital Allocation Efficiency and Investors' Protection with controls

This table reports the results of weighted-least-squared regression of estimated investment elasticity to sales for each region, η_c, on stock market return synchronicity, financial market size and measures for investors protection provisions and law enforcement of that region. $RuleLaw$ is an index measuring the law enforcement constructed by Porta et al. (1998). $AntiDirector$ and $SeniorCreditor$ denote the count of provisions protecting shareholders and senior debtors, respectively, written in a region's commercial codes from Porta et al. (1998). $Synch_c$ denotes the average R^2 of firm-level regressions of bi-weekly stock returns on local and U.S. market index for each country in 1995 retrieved from Morck et al. (2000). $RuleLaw$ is the law enforcement index constructed by (Porta et al., 1998). $AntiDirector$ and $SeniorCreditor$ are counts of terms protecting shareholders and creditors against management in the country's bylaw, respectively. FM_c is the sum of credit and stock market capitalization to GDP ratio for each country from Wurgler (2000). GDP_c is the log GDP of each country in 1960. Robust standard errors are shown in parentheses. Statistical significance is indicated at the *** 1%, ** 5%, and * 10% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Synch_c$	-0.275***	-0.431***	-0.357**	-0.341**	-0.400**	-0.472***	-0.479***
	(0.088)	(0.126)	(0.166)	(0.164)	(0.150)	(0.147)	(0.170)
$RuleLaw$	0.181***		0.234**		0.213**	0.106	0.113
	(0.064)		(0.092)		(0.086)	(0.114)	(0.179)
$AntiDirector$		-0.016		-0.025***	-0.021**	-0.026**	-0.026**
		(0.010)		(0.009)	(0.008)	(0.010)	(0.011)
$SeniorCreditor$		-0.0187		-0.008	-0.011	-0.010	-0.011
		(0.011)		(0.011)	(0.010)	(0.009)	(0.010)
FD_c						0.043	0.042
						(0.038)	(0.044)
GDP_c			-0.003	0.012*	-0.003		-0.001
			(0.009)	(0.007)	(0.010)		(0.0115)
$Constant$	0.210***	0.477***	0.188***	0.408***	0.311***	0.361***	0.360***
	(0.056)	(0.051)	(0.050)	(0.067)	(0.052)	(0.083)	(0.087)
No. of Observations	37	37	33	33	33	32	32
F-Statistics	10.81	5.97	9.31	8.11	8.00	11.83	9.49
R-square	0.37	0.34	0.43	0.46	0.52	0.55	0.55