The Effect of Investor Horizons on Corporate Investment Horizons*

Hwanki Brian Kim[a]

October 31, 2017

Abstract

Using new patent-based industry-level measures of the horizons and values of corporate investment, I find that in response to an increase in long-term institutional ownership firms reallocate their capital toward divisions with long product life-cycle *and* high innovation value, which leads to longer corporate investment horizons and higher investment values at firm level. To disentangle investors' effects from spurious correlations, I employ a widely-adopted identification strategy based on the discontinuity in long-term ownerships around Russell 1000/2000 index thresholds. The effects are strongest among firms with more undervaluation. I also document a possible channel through which investors affect corporate investment horizon - the managerial incentive channel. These results are consistent with the horizon alignment hypothesis that long-term investors could mitigate inefficient corporate short-termisms in real investment decisions among undervalued firms.

Keywords: Corporate investment horizon, Investor horizon, Incentive horizon, Institutional investors, Undervaluation, Regression discontinuity design

JEL classification: G23, G30, G31, G32, G34

*Job Market Paper. I am greatly indebted to my dissertation committee, Heitor Almeida (chair), Mathias Kronlund, Jiekun Huang, Yuhai Xuan, Vyacheslav Fos, for their extensive guidance and support. I also thank Kamran Bilir, Jaewon Choi, Ron Giammarino, Yeejin Jang and seminar participants at the University of Illinois at Urbana-Champaign for valuable comments and suggestions. All errors are my own.

[a] Department of Finance, University of Illinois at Urbana-Champaign. Email: bgkim3@illinois.edu

What determines firms' choices of investment project horizons? This has long been a central question in the world of corporations.[1]. While it is controversial whether short-termism is socially bad or not, corporate short-termism could be inefficient for the firms in certain circumstances, especially when managers choose short-term investment projects over more valuable long-term ones. In the real world, firms manage several projects at the same time and a corporation can be thought of as a portfolio with multiple investment projects with different horizons and values. Therefore, the more specific question would be as following: what affects within-firm capital reallocations across investment projects (or divisions) with different horizons and intrinsic values, thereby the overall horizon and value of corporate investments as well?

This study focuses on investor horizon as the main determinant of corporate investment horizons. Short-term trading behaviors by investors have been suspected to be one of the main causes of short-termisms among firms, if any. For example, the literature has shown that short-term investors pressure firms to temporarily cut R&D expenditures to meet short-term earnings goals (Bushee (1998) and Cremers, Pareek, and Sautner (2016)). Froot, Perold, and Stein (1992) also attempt in their cross-country study to prove this belief on short-term trading practices as a driving force that shortens corporate investment horizons. In this context, it has been proposed that lengthening investor horizons could mitigate such short-term preferences by corporations on investment decisions.[2]

Empirically testing this proposition is challenging mainly because researchers do not observe investment projects within a company, thereby being unable to measure corporate investment horizons. I detour this difficulty using a patent-citation-based product life-cycle length index by industry for the sample of U.S. diversified firms with multiple segments. To measure the product life-cycle length for each industry, I follow Bilir (2014) and pick the median average

[1]For example, the National Academy of Sciences, Engineering, and Medicine published a book in 1992 where discussed are the potential causes of short-term preferences by U.S. firms in deciding among many technological innovation opportunities and possible solutions to such short-termism problems (National Academy of Engineering (1992))

[2]For instance, Hillary Clinton proposed U.S. corporate tax reforms in July 2015 that include doubling the short-term holding period from one year to two years, which could eventually have resulted in a sharp increase in the U.S. capital gains tax rates for investments held for fewer than two years.

forward citation lags across all patents in the industry, where the average forward citation lag for each patent is defined as the average of time lapse between the cited patent's grant date and a subsequent citation across all citing patents. This industry-level product life-cycle length measures the life-span of a new technology and is used as the proxy for investment horizon for each division based on the division's industry. As a firm's overall investment horizon, I use the asset-weighted average of product life-cycle length across all divisions. This firm-level corporate investment horizon varies across time by firms reallocating their capitals across divisions within firm. For the measure of investor horizon, I follow the literature (e.g., Derrien, Kecskes, and Thesmar (2013)) and use the widely-used turnover-based long-term institutional ownership.

Using these investment horizon measures of firms and investors for a panel of firm-year observations of the U.S. conglomerates over a period of 20 years, I find that long-term institutional ownership is positively associated with corporate investment horizon: a one-standard-deviation increase in long-term ownership is associated with eight months and two weeks increase in the average product life-cycle length, which is approximately 49.8% of its standard deviation. I also document a positive relationship between long-term ownership and the value of corporate investment: a one-standard-deviation increase in long-term ownership is associated with an increase in corporate investment value by 4.7%.[3]

I next examine a channel through which investors can influence managers' decisions on investment horizons. If corporate managers' compensations are associated more with short-term performance of their firms, the managers would care more about divisions with short-term investment projects. Therefore, long-term investors could mitigate this short-termism by affecting the managers' compensation structures. To test this implication, I explore grant-level data on CEO compensation. More specifically, I develop a firm-year-level (CEO-year-level) measure of incentive horizon based on the vesting periods of each performance-based grant and repeat the baseline tests replacing the dependent variable with this incentive horizon measure.

[3]I proxy the value of corporate investment by the asset-weighted average of industry-level economic value of innovation across all divisions of the firm, where the industry-level innovation value is the average of Kogan, Papanikolaou, Seru, and Stoffman's (2017) announcement-return-based measure of patent's economic values across all patents in each industry.

The results support the aforementioned implication. For example, a one-standard-deviation increase in long-term ownership is associated with a lengthened CEO incentive horizon by four months and two weeks, which is approximately 53% of the standard deviation of the incentive horizon.

The evidence from these panel regressions is, however, subject to endogeneity issues: either may there be omitted factors that affect both long-term ownership and corporate investment horizon, or it may be the reverse causality that drives the documented horizon alignment effects between investors and firms, that is, long-term investors may actively choose their portfolio stocks of which corporate investment horizons are expected to be long.

To address this endogeneity concern and establish a causal inference on the effect of long-term ownership, I employ an identification strategy based on the sharp discontinuity in long-term institutional ownership around the Russell 1000/2000 indexes threshold. Every year, the largest 3000 stocks are ranked by the Russell based on market capitalization, and the first 1000 and the following 2000 stocks are assigned to the Russell 1000 and 2000 indexes, respectively. Then within each index, the stocks are assigned their index weights based on the market capitalization ranking. Hence, the firms of their stocks on the top of the Russell 2000 index have sharply larger index weights than those of their stocks on the bottom of the Russell 1000 index. On the other hand, there is no significant difference in all other metrics including market capitalization among those firms in a narrow bandwidth around the Russell 1000/2000 threshold. Finally, since the Russell indexes are the most widely-adopted indexes by quasi-indexing institutional investors who are long-term investors at the same time, long-term institutional ownership is sharply higher for the firms slightly below the threshold than those slightly above it. This discontinuity around the index threshold existing only in long-term institutional ownership enables the Russell 2000 index membership to satisfy the exclusion restriction and hence makes it possible to identify the causal effect of long-term institutional ownership.

With this strategy, the results from two-stage least square (2SLS) regressions, by instrumenting the long-term institutional ownership by the Russell 2000 index membership and confining the sample to a narrow bandwidth (± 100) around the Russell 1000/2000 threshold, support the causal effects of long-term ownership on both corporate investment horizon and the value of corporate investment: a one-standard-deviation increase in long-term ownership not only leads to six months and three weeks increase in the average product life-cycle lengths, but also results in an increase in the firm's average economic value of innovative projects by 4.1%, which are approximately 54% and 20% of the standard deviations of the average product life-cycle lengths and the corporate investment value, respectively, for the sample used in these 2SLS specifications. Therefore, long-term institutional investors indeed have positive and (both statistically and economically) significant influence on corporate investment horizons and values. I also document the causal effect of investor horizon on CEO's incentive horizon, which confirms the possible workings of incentive horizon channel: a one-standard-deviation increase in long-term ownership is followed by an increase in the average vesting period of the CEO's performance-based grants by three months and two weeks.

A cross-sectional analysis using several proxies for undervaluation based on residual book-to-markets or future excess returns shows that all these effects become much stronger or even only exist for highly undervalued firms. Moreover, test results from segment-level specifications provide further evidence that firms increase their overall horizons and values of corporate investments in response to an increase in long-term ownerships by raising capital expenditures of divisions with long product life-cycles *and* high innovation values, while reducing those of divisions with short product life-cycles *and* low innovation values, which suggests an internal capital market channel through which managers of multi-segment firms dynamically adjust the horizons and values of investment projects. Finally, I repeat the same 2SLS regressions, but this time decomposing long-term ownership into block and non-block ownerships and instrumenting long-term block ownership by the Russell 2000 index membership, and find that the same positive causal effects hold, which reinforces the plausibility of long-term investors' real effects on managers' incentive plans and their choices of investment projects.

Combined altogether, these results provide empirical evidence that is loosely consistent with implications from a theoretical model developed by Shleifer and Vishny (1990) (SV hereafter). The efficient market hypothesis suggests that horizons should not matter because a firm's stock price is always equal to its fundamental value regardless of the horizons of investments. Therefore, SV's model assumes *misvaluation*: an underpricing of long-term projects takes longer to be eliminated and hence long-term projects are exposed to more noise trader risk than short-term projects. Then, the main prediction from the model is that, to eliminate underpricing and realize their returns as soon as possible, short-term investors funded by liabilities with short maturities prefer short-term investment projects even if long-term projects have higher fundamental values, which in turn, in equilibrium, leads to larger mispricing for long-term projects funded mostly by short-term investors for the costs of arbitrage for short-term and long-term projects to be equal. Then corporate managers whose compensations are partly associated with short-run (stock) performance would choose short-term projects because the stock price being underpriced for a long period of time would hurt their payoffs or even threaten their jobs. This equilibrium short-termism by investors and firms can be mitigated by long-term investors because long-term projects funded by long-term investors would be less mispriced and hence corporate managers would be able to keep pursuing long-term profitable projects without being distracted by pressure for short-term performance.[4]

Furthermore, recent studies have shown that institutional investors influence corporate policies such as governance choices (Appel, Gormley, and Keim (2016)) and payout policies (Crane, Michenaud, and Weston (2016)). Also, Derrien, Kecskes, and Thesmar (2013) and Harford, Kecskes, and Mansi (2016) find that long-term institutional investors affect corporate governance and managerial misbehaviors as well as corporate policies such as investment and financ-

[4]The model implication by Shleifer and Vishny (1990) is consistent with a popular belief among practitioners that long-term investment could be a good way to make profits even though it requires more commitment with higher opportunity costs and takes longer to realize the returns, for example, "*Numerous market players concur with this view. For instance, CalPERS (California Public Employees' Retirement System pension fund) published its 10 investment beliefs; among them is the belief that "a long term investment horizon is a responsibility and an advantage" that leads them to "favor investment strategies that create long-term, sustainable value.""* (Roberge, Flaherty, Jr., Almeida, Jr., and Boyd (2016))

ing decisions. These studies all provide consistent evidence that investors influence management through active monitoring and governance mechanisms. Therefore, my empirical findings are consistent with a new hypothesis combining the aforementioned prediction from SV's model on investors' horizon preferences and managerial short-termism behaviors, and the recent empirical evidences on institutional investors as active owners: in the presence of underpricing corporate managers would increase the horizons of their firms' real investments by reallocating capitals across divisions with different investment horizons in response to an increase of long-term institutional ownership in their firms, because institutional investors with long investment horizons would prefer long-term more valuable investment projects and hence try to mitigate the effect of speculative components in stock prices on managers' biased investment decisions toward short-term projects, subsequently resulting in greater overall economic values of corporate investments. Throughout the paper, I call this hypothesis the *horizon alignment hypothesis*.

While some related studies examine the effects of pressures by short-term investors on managerial choices between short-term earnings management and investments in R&D or tangible assets (e.g., Bushee (1998), Bolton, Scheinkman, and Xiong (2006), and Cremers, Pareek, and Sautner (2016)), the effects of CEO contractual protection on those managerial choices (e.g., Chen, Cheng, Lo, and Wang (2015)), the differential responsiveness to changes in investment opportunities between publicly listed firms and privately held firms due to short-termist pressures by stock markets (Asker, Farre-Mensa, and Ljungqvist (2015)), or the effects of long-term investors on corporate investments and innovations (e.g. Harford, Kecskes, and Mansi (2016)), yet has been attempted to measure the horizons of firms' real investments and sort investments or innovations into short-term or long-term ones. For the following reasons, it is critical to measure the horizons of real corporate investments, which have not been successful in the existing body of literature. First, the existing amount-based measures of long-term investments such as capital expenditures or R&D expenditures cannot tell anything about the actual horizons of the investment projects: it is not always the case that longer-term projects require larger investments than shorter-term projects. Therefore, an increase (decrease) in the amount of such investments cannot be deemed as a lengthened (shortened) corporate investment horizon. Second, the short-term earnings management, often used as a proxy for short-term investment projects, may be a consequence of managers' endogenous intentions to create mispricing. Therefore, comparing short-term earnings management with R&D or capital expenditures cannot correctly test the predictions from SV's model that assumes the presence of mispricing.

This paper is related to the growing literature on managerial short-termism. Bebchuk and Stole (1993) propose theoretical predictions that in the presence of imperfect information managerial short-term objectives could lead to either underinvestment or overinvestment depending on the characteristics of the imperfect information. Milbradt and Oehmke (2015) develop a model predicting that higher cost of external financing for long-term projects could induce managers to make inefficient investment decisions toward short-term projects, thereby generating an equilibrium inefficient short-termism. On the other hand, Thakor (2016) shows that short-termism could be an efficient decision in that it could limit managerial rent-seeking behavior and reveal managerial ability faster. A recent empirical study by Budish, Roin, and Williams (2015) documents an evidence of short-termism by showing that private investments in cancer research are distorted away from long-term projects due to the structure of the patent system where firms file patents at the time of invention rather than commercialization. Chen, Cheng, Lo, and Wang (2015) also document an empirical evidence on the effect of CEO contractual protection on managerial short-termism. My paper differs from these papers because I examine investor horizon as the determinant of managerial horizon on investment decisions while others investigate either consequences of short-termism or other factors such as financing frictions and CEO contracts as the determinants of managerial investment horizons.

This paper is also closely related to the literature on the role of investor horizons in stock markets and corporate policies. However, the previous studies in this literature investigate the effects of investor horizons on variables other than corporate investment horizons: for example, M&A deals and post-merger performance (Gaspar, Massa, and Matos (2005) and

Chen, Harford, and Li (2007)), amplification of negative shocks in the aftermath of the financial crisis (Cella, Ellul, and Giannetti (2013)), catering behaviors by corporate managers (Derrien, Kecskes, and Thesmar (2013)), CEO horizon incentives (Cadman and Sunder (2014)), and investment choices by venture capitals on the life-cycles of innovative firms (Barrot (2016)).

My paper differs from other papers that use quasi-indexed institutions as the source of exogenous variation in institutional ownerships of firms. Unlike Aghion, Van Reenen, and Zingales (2013), Boone and White (2015), Appel, Gormley, and Keim (2016), Crane, Michenaud, and Weston (2016) that use the index membership as an instrumental variable for institutional ownership, it is long-term institutional ownership that I instrument by the index membership. Basically though, what other papers actually instrument by the index membership is also institutional ownership by long-term investors because quasi-indexers are classified into long-term investors (Bushee (1998)).

The rest of the paper is organized as follows. Section I develops the hypotheses. Section II describes the data and the variables used in empirical tests. Section III reports my empirical results from the baseline specifications. Section IV elaborates my identification strategy for causal inference. Section V presents the empirical results from the instrumental variable analysis. Section VI concludes.

I. Hypotheses Development

In this section, I develop hypotheses that I test using my data in this study. In short, I extend and combine the implications from the model in Shleifer and Vishny (1990) (SV hereafter again) and the well-documented empirical evidence in the literature.

Consider a conglomerate which consists of two divisions: a division that has a long-term project and the other division that has a short-term project. This firm dynamically adjust the overall investment horizon at firm level by reallocating its capital across these two divisions. Suppose there are three types of investors in the stock market: short-term smart investors (arbitrageurs), long-term investors, and noise traders, which implicitly assumes that the market is not perfectly efficient at least to some degree. I only consider the case of underpricing here as the other case for overvaluation is symmetric.[5] The key assumption of SV's model is that for short-term investors the cost of arbitrage is higher for long-term investment projects than for short-term investment projects: both fundamental and noise trader risks for short-term investors are more crucial for long-term projects of which the elimination of underpricing takes longer because there is more time for negative news or pessimism among investors to arrive, [6] and these risks cannot be completely shared in the market because the existence of information asymmetry between short-term arbitrageurs and outside lenders imposes credit constraints on short-term investors for borrowing rates, amount, and maturities. Furthermore, due to such credit constraints, short-term investors are additionally subject to opportunity costs of their capital being tied up for long-term projects. In a related context, short-term investors might inherently have shorter maturities of their liabilities from the beginning.[7]

Then the main implication on investors' side from SV's model due to this higher cost of arbitrage and the resulting credit and maturity constraints imposed on short-term investors is that, in order to eliminate underpricing sooner and realize their returns from arbitraging as soon as possible, short-term arbitrageurs would prefer short-term projects even if long-term projects have higher fundamental values.

In equilibrium, the returns to arbitrage on the long-term project and the short-term project must be the same. Since the cost of arbitrage is greater for the long-term project, short-term investors require the long-term project to be more underpriced. Then another implication from SV's model on the side of corporate managers is that the managers would choose the short-term less valuable- over the long-term more valuable investment project because in practice the

[5]As a matter of fact, the case of overvaluation is irrelevant to consider in this model framework because both short-term and long-term investors would immediately liquidate their shares of undervalued firms, hence they are not differentiated.

[6]'Fundamental risk' means that the fundamental value could actually fall before the completion of the project and the elimination of the undervaluation. 'Noise trader risk' implies that the underpricing could become even larger tomorrow than today, so investors would lose money if they liquidate their positions tomorrow.

[7]"For example, pension funds have long-term liabilities and thus long investment horizons whereas mutual funds are subject to large short-term redemptions and thus their investment horizons are also short-term." (Derrien, Kecskes, and Thesmar (2013))

compensation of managers is in part linked to short-term equity performance and hence the managers would want to avoid the stock price to be underpriced for a long time. Therefore, long-term investors could mitigate such inefficient corporate short-termisms, either through corporate manager's observation of longer holding period by equity investors, thereby being less pressured by short-run stock performance, or through a lengthened managerial incentive horizon by activist shareholders with long-term investment horizon affecting executive compensation structures. This leads to the following hypothesis:

- An increase in the long-term ownership of a conglomerate is followed by a lengthened compensation horizon of the firm's manager.
- Such increase in long-term ownership is subsequently followed by within-firm capital reallocations from short-term less valuable to long-term more valuable investment projects.
- Such capital reallocations result in an increase of the overall investment horizon as well as the overall fundamental value of the firm.
- This horizon alignment effect is stronger for firms with greater undervaluation.

In what follows, I directly test these implications through a battery of empirical specifications. I first construct the measures of corporate investment horizon, the value of corporate investment, managerial incentive horizon, and investor horizon. Then I show that the first three measures are positively correlated with the measure of investor horizon, respectively. I establish the causality of those positive relationships by instrumenting the long-term institutional ownership by its discontinuity around the Russell 1000/2000 index threshold and show that the causal relationship is stronger for firms with greater undervaluation. I also show that those effects are the consequences of within-firm capital reallocations.

II. Data and Variables

In this section, I describe how to construct the sample from various data sources, discuss the main variables used in this study, and report summary statistics of them.

A. Data Sources and Sample Construction

The data for this study are compiled from several sources. Firm-level accounting information is obtained from Compustat and data on stock come from the Center for Research in Security Prices (CRSP). Divisional data for U.S. publicly listed firms are acquired from Compustat Historical Segments Data. Patent data used to measure industry-level product life-cycle lengths are collected from the National Bureau of Economic Research (NBER) Patent Citations Data file. Data on the dollar value of each patent are collected from Noah Stoffman's website on patent data.[8] Grant-level data used to calculate the horizons of performance-related CEO compensations are gathered from the Incentive Lab database. Data on institutional common stock holdings are obtained from Thomson Reuters.

The sample construction starts at segment level by excluding all other types of segments except business segments. For the sake of measuring product life-cycle length, I keep only segments where patent data are available for their industries. I also drop segment-years with missing values for capital expenditures or identifiable total assets. Then at firm level, since I concentrate on U.S. conglomerates in this study, among all publicly traded U.S. firms between 1990 and 2010 only those with at least two segments operating in different industries are kept in the sample.[9] I merge the resulting data file with annual firm characteristics from Compustat. Finally, I merge these data with institutional ownership data from Thomson Reuters and drop firm-year observations with missing values for institutional ownership. The final sample for baseline analyses consists of 6,619 firm-year and 21,170 segment-year observations.

[8] https://iu.app.box.com/v/patents

[9] Since companies typically look back three years and review all the information again when reporting segments data, there are occasions that some already recorded entries are updated within three years. To keep any unfinalized data from polluting the test results and to be as conservative as possible by having safety margins, I exclude recent years from the sample.

B. Variables and Summary Statistics

B.1. Corporate Investment Horizons

One of the most challenging parts in empirically testing the horizon alignment hypotheses is to measure corporate investment horizons. Two most critical features of such measure to be desired are: 1) it should measure the actual time horizon of real investments because otherwise there would be no comparative advantage of using it compared to examining managerial choices between short-term earnings management and spending on R&D, and we would be unable to directly test the implications derived from Shleifer and Vishny's (1990) model; 2) it should measure *ex ante* required or expected time length for an investment to come to fruition at the moment of a managerial investment decision rather than *ex post* actual time taken until the fruition of the investment because the question of interest is whether investor horizons influence corporate investment decisions, not the outcome of corporate investments.

To meet such desired features, I use an industry-level technology-based measure of product life-cycle length as the proxy for investment time horizon of each industry. Following Bilir (2014), I measure an industry's product life-cycle length using the NBER Patent Citation Data as follows: 1) for each pair of cited and citing patents, I calculate the time lapse between the cited patent's grant date and the citing patent's citation date, which is called the *forward citation lag* by Bilir (2014); 2) for each patent, I compute the average of the forward citation lags across all subsequent citing patents; 3) then for each three-digit SIC industry, I collect all patents filed for the industry and pick the median of the average forward citation lags which is the measure of product life-cycle length of that industry.

This product life-cycle length varies from approximately six to thirteen years across industries. Table I reports the complete list of product life-cycle lengths for SIC three-digit codes where at least 1,000 patents have been granted over the past forty years. For example, the non-electric heating equipment industry is the one with the longest product life-cycle of approximately thirteen years, and the electronic machinery industry is the one with the shortest product life-cycle of approximately six years. What this industry-level product life-cycle length actually measures is the economic lifetime of a patented technology rather than that of a specific version of a product which a product turnover measure based on product level data, if any, would proxy.[10]

Table I About Here

This measure of industry-level product life-cycle length satisfies the two desired features above of a corporate investment horizon measure. First, it measures the actual time horizon in years rather than just whether a corporate decision is of short-term or long-term view. Second and more importantly, it measures the *ex ante* required or expected time length until an investment starts generating outcomes. Consider an example where there are two industries, that is, one industry with a long product life-cycle of thirteen years and the other industry with a short product life-cycle of six years. Then, on average, the thirteen-year product life-cycle length implies that once a company achieves a patented technology in this industry, it can expect a secured cash-flow-generating time period of thirteen years while the six-year product life-cycle length means such time period of only six years. This equivalently means that the company operating in the long product life-cycle industry can have, on average, longer time for developing a new technology than companies operating in the short product life-cycle industry.

To help better understand how this measure of product life-cycle length based only on cross-sectional variations across industries is used for measuring corporate investment horizons at firm-year level, consider again a diversified firm consisting of two segments as exemplified in Section I: a segment that operates in an industry with long product life-cycle and the other segment that operates in another industry with short product life-cycle.[11] The product life-

[10] "*As an illustration of this product definition, consider the example of automobiles. New car models within an automobile product line are introduced annually (termed the model cycle in Bils 2009), but the technological overlap across successive models is substantial... Successive versions of the Honda Accord, for example, are so similar that the BLS substitutes new versions for old (e.g., the 2012 Honda Accord LX is substituted for the 2011 Honda Accord LX, with minimal adjustment) to establish price comparisons underlying official US inflation indexes (Bils 2009).*", Bilir (2014)

[11] Among many other examples of such a diversified firm is Procter & Gamble Co. (P&G) which is a U.S. multinational conglomerate giant manufacturing mainly cleaning agents and personal care products. P&G largely has three major segments where patent data are available: one is its oldest and biggest home-care segment that produces, for instance, dishwashing liquid and laundry detergent brands such as Dawn, Tide, and

cycle length for each industry is exogenously given and time-invariant. Each segment reports its own total assets which dynamically change every year. Then the overall investment horizon of a conglomerate firm for each year is calculated as the asset-weighted average of product life-cycle lengths across segments, that is, simply

$$Corporate\ Invetment\ Horizon_{i,t} = Avg.\ PLC_{i,t} = \frac{\sum_{j=1}^{2} ias_{j,t} \cdot PLC_j}{AT_{i,t}}.$$

$Avg.\ PLC$ stands for average product life-cycle length. PLC_j is the product life-cycle length of the segment j's industry and $AT_{i,t}$ denotes total assets of firm i for the year t. $ias_{j,t}$ denotes identifiable total assets of segment j for the year t which is the main source of cross-sectional and time-series variations in this firm-level corporate investment horizon measure and changes every year as a result of within-firm capital allocations across segments. Another source of time-series variations in the corporate investment horizon is corporate restructuring such as mergers and acquisitions, divestitures, spin-offs, etc. which occur infrequently though, hence is not closely examined in this paper.

B.2. Economic Value of Corporate Investment

Another challenging part in an empirical study on the horizon alignment hypotheses is measuring the fundamental value of corporate investment. Successful execution on this is critical because the horizon should not matter in the first place unless the long-term investment projects have greater fundamental values than short-term projects. This task is extremely difficult because researchers do not directly observe values of corporate investment projects.

Since my measure of corporate investment horizon is based on the industry-level innovation activities, I also use the patent data to measure the values of corporate investment. More specifically, I use the data on economic value of each patent that Kogan, Papanikolaou,

Downy, of which industry has approximately eight years of short product life-cycle; another is the health-care and pharmaceutical segment that produces, for example, cough and cold products such as Vicks or medicines for minor digestive system upset such as Pepto-Bismol, whose industry has approximately ten years of long product life-cycle; and the third is its grooming segment which was recently formed from the acquisitions of Gillette and Braun that manufactures razors and blades of which industry has 11.69 years of very-long product life-cycle.

Seru, and Stoffman (2017) (KPSS hereafter) create in their recently published paper using the announcement-day stock return of each patent. They develop a model that derives the dollar value (deflated to 1982 dollars) of each patent implied from the stock market reaction to the announcement of granting the patent. For each industry, I collect all patents over the six-year period prior to each year and take the average of their KPSS measures of economic value.[12] Then for each conglomerate, I compute the asset-weighted average of this industry-level patent economic value across all segments, which I define as the firm's economic value of investment.

It is worth noting that the patent economic value varies significantly across industries and over time. In addition, at industry-level, the patent economic values of long product life-cycle industries are not necessarily greater than those of short product life-cycle industries. Furthermore, the overall ranking of industries in product life-cycle length and patent economic value does not apply to within-firm rankings in the same manner. For example, the SIC industry '367' for 'Electronic Components and Accessories' has relatively short product life-cycle length of 7.39 years and low average patent economic value of \$9.65 million in 1982 dollars. However, its product life-cycle length and average patent economic value are long and high compared to the SIC industry '383' for 'Electronics Machinery' which has product life-cycle length of 5.99 years and average patent economic value of \$1.6 million in 1982 dollars. Therefore, for a conglomerate operating in both industries, the 'Electronic Components and Accessories' industry is deemed as a long-term valuable industry. These together imply that I need a cross-sectional analysis to see whether long-term investors influence managers to reallocate capitals toward divisions with long-term profitable investment projects, instead of simply checking whether long-horizon industries systematically have greater economic values of investments.

B.3. Managerial Incentive Horizon

To investigate whether long-term investors attempt to make any changes on a firm's executive compensation structure so that the manager of the firm can pursue long-term profitable

[12] When measuring both corporate investment horizon and the value corporate investment, I use the USPTO-SIC concordance to aggregate the USPTO-class-level data at each three-digit SIC.

investment projects without pressures for short-term performance, I explore grant-level data on executive compensation collected from the Incentive Lab. In particular, I focus on CEOs and performance-related incentive plans in their compensation packages to create a firm-level measure of incentive horizon. A CEO's compensation package consists of a number of grants that vary in many dimensions such as the composition of performance targets, vesting schedule, payment method, and so forth. Then each grant again comprises multiple awards that vary in performance metric, evaluation period, payout structure, etc.

I first calculate the average vesting period (or performance evaluation period) for each award and year. More specifically, I compute the exponentially-weighted average of vesting months between the start and the end of the award vesting period, i.e.,

$$Average\ \ Vesting\ \ Period = \frac{\sum_{n=1}^{N} M_n e^{-(N-n)\ln 2/h}}{\sum_{n=1}^{N} e^{-(N-n)\ln 2/h}}.$$

M_n is the nth month between the start month and the end month of the award vesting period. For example, if the start month and the end month of an award are 12th month and 36th month, respectively, 6th month is the 17th month. h denotes the half-life that makes the month that lie h months in the past weigh half as much as the end month. I choose the half life of 6 month assuming that managers would care more about the performance goal as the end of vesting period approaches and they especially would do so most during the last 6 months.[13]

Then at grant level, I compute the value-weighted average of vesting period across all awards in a grant for each year. And finally, I again compute the value-weighted average of this grant-level vesting period across all grants in a compensation package for a CEO, which is my firm-level measure of managerial incentive horizon in months. This measure captures the average time period over which the firm performance is evaluated and hence likely how far in the future a manager whose incentives are tied to the firm performance would care about the success of the firm's investment projects.

[13]When I pick other choices of the half life such as 9 month or 12 month, the results remain largely the same.

B.4. Long-term Institutional Ownership

The main explanatory variable of interest in this study is investor horizon. This paper focuses on investment horizons of institutional investors because their ownerships in stocks have been increased over time, especially more in recent years, and so has been the importance of institutional investors.[14] Many ways to measure investor horizons of institutional investors have been introduced in the literature. Among others, there are two most recently introduced approaches to measure investor horizon: the first one is the measure based on portfolio turnover by institutional investors (e.g., Bushee (1998), Barber and Odean (2000), Gaspar, Massa, and Matos (2005), Polk and Sapienza (2009), and Derrien, Kecskes, and Thesmar (2013)), and the other one is the measure based on stock holding duration (Cremers, Pareek, and Sautner (2016)). The main difference between these two approaches is that the former aggregates all stock holdings at the investor level first and then aggregates the investors at the stock level while the latter only aggregates investors at the stock level without an aggregation at the investor level. This difference enables the latter to look into the holding duration of each stock in an investor's portfolio and allow any investor to be short-term in some stocks and long-term in others, while making the former focus more on the trading patterns of the investor over all stocks in her portfolio. Since both measures of investor horizon have their own pros and cons, one needs to carefully pick a measure that best fits the research design.

For the best interest of the research design in this paper, I choose the turnover-based ownership measure over the stock duration measure. First, the ownership measure based on share turnovers works better for the identification strategy in the later section based on discontinuity around the Russell 1000/2000 index threshold. The exclusion restriction for the IV-2SLS estimations using this identification strategy is based on passive investments by quasi-indexers who do not have controls over the selection of stocks in their portfolios. While it is straightforward that the indexing by long-term quasi-indexers should lead to discontinuity in long-term institutional ownership around the Russell 1000/2000 threshold because stocks in Russell indexes

[14] See Figure 1 in Cremers, Pareek, and Sautner (2016).

are ranked based solely on market capitalizations and those on the top of Russell 2000 are assigned sharply greater index weights than those on the bottom of Russell 1000, it is not clear whether such passive indexing should lead to discontinuity in stock duration of firms around the threshold for the following reasons: there could exist short-term indexers as well, at least to some degree, and stocks that are newly added to Russell 2000 are indeed subject to a reduction rather than an increase in stock duration because they happen to be just included in an indexer's portfolio.[15]

Second, long-term institutional ownership measure fits better the focus of this study, that is, the role of long-term institutional investors as owners of firms rather than arbitrageurs. The main interest of this study is whether monitoring by long-term institutional investors alleviates the negative effect of underpricing on corporate investment horizon, that is, the amplification of short-termism that pressures corporate managers to forgo long-term profitable projects. Stock duration measure is not ideal for this purpose because it tells us little about inherent characteristics of each institutional investor and hence we cannot judge whether any empirical results come from actual intentions of the investors.

To measure long-term institutional ownership at firm level, I follow Derrien, Kecskes, and Thesmar (2013).[16] Using the quarterly data from 13F filings on institutional holdings, I first look back three years, i.e., twelve quarters, and calculate portfolio turnover for each institutional investor, which is the fraction of shares that are no longer held after three years of their purchases. For a given quarter, I compute the mean of this portfolio turnover during the most recent four quarters to keep one extreme quarter from distorting the portfolio turnover. Then I classify each institutional investor as long-term or short-term investor depending on whether the portfolio turnover is less or greater than 35% (cf. Froot, Perold, and Stein (1992)).

[15] As a matter of fact, it is extremely challenging to justify the use of stock duration measure as an exogenous variable in any empirical studies. An investor's decision on the duration of holding a specific stock is fully endogenous and stock duration dynamically varies at investor-stock level. Due to this endogeneity and the complexity in the source of variations, it has been unsuccessful in the literature to come up with an identification strategy that explores exogenous variations in the stock duration.

[16] For the complete procedure to measure long-term institutional ownership step by step, refer to Section III.B of Derrien, Kecskes, and Thesmar (2013).

Finally, for each firm and for a given quarter, I calculate the fraction of shares held by the long-term institutional investors out of the firm's total shares outstanding to come up with the measure of long-term institutional ownership at firm level. Short-term institutional ownership, by construction, can be obtained by subtracting long-term institutional ownership from total institutional ownership of a firm.

The investor-level portfolio turnover represents an investor characteristic, that is, the average turnover across all shares in an institutional investor's portfolio, by looking upon the portfolio as a bundle instead of separately looking into each stock in the portfolio. And Derrien, Kecskes, and Thesmar (2013) show that this investor portfolio turnover is stable over time[17]: each quarter, they sort all institutional investors whose holdings data are available from 13F filings into quartiles based on their portfolio turnovers, calculate the mean portfolio turnovers over the following quarters up to five years, and show that investors remain in their original quartiles over all twenty quarters, which means that short-term investors stay short-term and long-term investors stay long-term over time, and there is no such dramatic conversion that short-term investors become long-term or vice versa. Therefore, the long-term institutional ownership measure based on the investor portfolio turnover implicitly regards institutional investors as having time-invariant investment horizons regardless of which stocks they hold, and this feature is what makes it possible to examine the role and effect of long-term institutional investors while the measure does not separately look into holding duration of each stock in their portfolios.

B.5. Other Variables and Summary Statistics

The definitions of other firm-level variables used in the baseline specifications are as follows. Total institutional ownership (*Institutional ownership*) is defined as the sum of shares held by institutional investors divided by shares outstanding. Blockholder ownership (*Block ownership*) is defined as the sum of shares held by institutional investors with an ownership stake of greater than or equal to 5%. Sales growth (*Sales growth*) is the sales growth rate, which is defined as

[17] See Figure 1 in the paper.

sales minus lagged sales divided by lagged sales. Cash flow (*Cash flow*) is earnings before interest and taxes plus depreciation divided by total assets. Leverage (*Debt*) equals total debt over total assets. Firm size (*Size*) is equal to the natural logarithm of total assets. Tobin's Q (Q) is total assets minus book value of equity plus market value of equity over total assets. Investment (*Investment*) is defined as capital expenditure over total assets and R&D expenditure (*R&D*) is defined as research and development expense divided by total assets. The segment-level cash flow is defined in a slightly different manner as operating profit over total segment assets. All variables are winsorized at the 1% and 99% levels in all analyses.

Table II summarizes both the firm-level (Panel A) and the segment-level (Panel B) data for the sample periods (1990 to 2010) used in my analyses. The mean average product life-cycle (PLC) length at firm level is 9.64 years with the standard deviation of 1.44 years. Long-term institutional ownership is 32.3% on average with the standard deviation of 22.6% and total institutional ownership is 47.2% on average with the standard deviation of 32.1%. It can be observed by comparing with those reported in other work measuring long-term ownership from 13F institutional holding data (e.g., Derrien, Kecskes, and Thesmar (2013)) that the sample means of long-term ownership and institutional ownership in this paper are greater, which indicates that institutional investors, especially those with long investment horizons, are on average more likely to hold stocks of diversified conglomerates.

TABLE II ABOUT HERE

III. Baseline Results

To examine the relationship between investor horizon and corporate investment horizon, I estimate the following firm-level baseline specification using ordinary least squares (OLS) regressions:

$$\begin{aligned} AveragePLCLength_{i,t} &= \alpha + \beta \textit{Long-termOwnership}_{i,t-1} \\ &+ \gamma InstitutionalOwnership_{i,t-1} + \eta' \cdot \mathbf{X}_{i,t-1} + \varphi_i + \tau_t + \varepsilon_{i,t} \end{aligned}$$

where i indexes firms, t indexes years, $\mathbf{X}$ is a vector of control variables based on firm characteristics, φ_i denotes firm fixed effects to control for unobserved time-invariant firm heterogeneity, and τ_t denotes year fixed effects to control for unobserved market-wide shocks for each year. To minimize the risk of simultaneity to bias our estimation results, all explanatory variables lag the data on average product life-cycle length by one year. The coefficient of interest here is β which estimates the marginal changes in the average product life-cycle length in years in response to a one-unit increment in long-term institutional ownership. To solely focus on the effect of investor horizon, total institutional ownership is included in all specifications.

The estimation results are reported in Table III, columns (1) and (2). Consistent with the primary implication of the horizon alignment hypothesis developed in Section I, I find a positive and statistically significant relationship between long-term institutional ownership and corporate investment horizon proxied by average product life-cycle length. For example, in column (2) with both firm and year fixed effects, given that the sample standard deviation of long-term institutional ownership is 23%, a one-standard-deviation increase in long-term institutional ownership is associated with an increase in average product life-cycle length of 0.715 years which is approximately eight months and two weeks. This effect is economically significant as it is approximately 49.8% of the standard deviation of average product life-cycle length.

To investigate the relationship between investor horizon and the value of corporate investments, I repeat the baseline analyses replacing the average product life-cycle length with the average patent economic value (*Average PEV*) as the dependent variable. Table III, columns (3) and (4) report the results that are largely consistent with the horizon alignment hypothesis. The coefficient on the long-term ownership is positive and statistically significant in all specifications, which suggests that an increase in long-term ownership is followed by greater value of overall corporate investment in the following year. For instance, in column (4), a one-standard-deviation increase in long-term institutional ownership is associated with an increase in the average patent economic value by 4.7%. Again, the negative and statistically significant coefficient on institutional ownership supports the short-termism implication of the horizon alignment hypothesis that short-term investors put pressures on manager's investment decisions toward short-term even if it is value-destroying.

As I derive in Section I, the horizon alignment hypothesis suggests the incentive plan channel through which long-term investors can influence managers of conglomerates in making investment decisions (or capital reallocation decisions) across segments with different horizons. To discover this channel, I repeat the baseline analyses, but now with the measure of managerial incentive horizon, i.e., the average CEO grant vesting period (*Average CGV period*) as the dependent variable.

The results from the OLS regressions are reported in Table III, columns (5) and (6). The coefficient of interest on long-term ownership is positive and statistically significant in all columns. These results provide support for the incentive plan channel. For example, in column (6), a one-standard-deviation increase in long-term institutional ownership is associated with an increase in the average CEO grant vesting period by four months and two weeks. This effect is also economically significant as it is approximately 53% of the standard deviation of the average CEO grant vesting period.

Table III About Here

IV. Identification

The positive relationships documented in Section III, between investor horizon and corporate investment horizon, corporate investment value, and managerial incentive horizon, are consistent with the implications of the horizon alignment hypothesis. However, this evidence from the estimations using OLS regressions on large panel data is subject to endogeneity that there may be omitted variables that affect both long-term institutional ownership and corporate investment horizon, which would bias my estimates. Among many others, for example, simultaneity is one of the most severe concerns because long-term institutional investors may self-select stocks with long and more valuable investment projects, which should result in the same empirical evidence above. Addressing this endogeneity concern is critical for the contribution of this study because one of the most important implications in the horizon alignment hypothesis developed in Section I is that investor horizons have causal effects on corporate managerial decisions on the horizon of real investments.

This section discusses an identification strategy which is a 2SLS approach based on an instrumental variable, the Russell 2000 index membership within a narrow bandwidth around the Russell 1000/2000 threshold, and documents evidence on the causality of the results found earlier in Section III as well as on monitoring and governance channel behind the causal relationship. It also discusses, through a cross-sectional analysis, the higher profitabilities of long-horizon investment projects pursued by long-term institutional investors.

To implement the identification strategy discussed in this section, I construct a subsample of U.S. conglomerates ranked near the Russell 1000/2000 threshold. The annual Russell index constituents data are provided by Russell. Since I concentrate on firms around the threshold, I merge my original sample of U.S. conglomerate firms with the Russell data and confine the sample firms to those ranked within the bandwidth of 100 centered on the index threshold, that is, firms ranked between 991 and 1100. Following the literature, I end the sample period in 2006 because Russell started applying the banding policy on their index assignments since 2007 (Boone and White (2015), Appel, Gormley, and Keim (2016), and Crane, Michenaud, and Weston (2016)).[18] The resulting subsample consists of 319 firm-year observations.

A. Discontinuity in Long-term Ownership around the Russell 1000/2000 Threshold

To address the aforementioned endogeneity concern and establish causal inference of the evidence documented so far, I employ an identification strategy based on sharp discontinuity in long-term institutional ownership around the threshold between the Russell 1000 and 2000 indexes. The Russell indexes are reconstituted each year mechanically based on stock prices

[18] For the sake of reducing the index turnover cost, they now make some non-mechanical adjustments to keep consistency in their indexes when the market capitalizations of firms around the threshold are not significant.

as of the last trading day of May: the largest three thousand stocks are ranked based on their market capitalizations from rank 1 to rank 3000, and the first one thousand stocks are assigned to the Russell 1000 index (Russell 1000) and the following two thousand stocks are assigned to the Russell 2000 index (Russell 2000). Within each index, stocks are assigned their index portfolio weights based on this market capitalization ranking. As a result, the firms whose stocks are on the top of Russell 2000 have drastically larger index weights than those whose stocks are on the bottom of Russell 1000. Since the Russell indexes are among the most popular benchmarks that are tracked by the funds operated by quasi-indexing institutional investors[19] who are also classified as long-term investors based on the definition of the measure of long-term institutional ownership used here, long-term institutional ownerships are sharply higher for the firms on the top of Russell 2000 than those on the bottom of Russell 1000.

Figure I graphically shows the discontinuity in long-term institutional ownership around the Russell 1000/2000 threshold. In this figure, I plot the average long-term institutional ownership over stocks in each bin of ten ranks across all years between 1990 and 2006, against the distance from the Russell 1000/2000 threshold which is defined as the actual Russell rank minus 1000.[20] For example, the distance from the threshold of the 999th ranked stock is -1, and that of the 1001st ranked stock is 1. It shows that long-term institutional ownership is increasing in market capitalization, but at the threshold, firms with slightly less market capitalizations have much higher long-term institutional ownership. This discontinuity indicates that, within a narrow bandwidth of firms around the Russell 1000/2000 threshold, the Russell 2000 membership has a clear and strong impact on long-term institutional ownership. Nevertheless, such discontinuity alone cannot fully qualify the Russell 2000 membership as an instrumental variable for long-term institutional ownership. This naturally leads to the next issue.

FIGURE I ABOUT HERE

[19]The Russell 2000 index is the most widely adopted benchmark for small cap stocks while the Russell 1000 index is less commonly benchmarked because it competes against other popular indexes for large and mid caps stocks such as the S&P 500, S&P 400, the CRSP U.S. midcap index, etc.

[20]For this graph, I use the sample of all U.S. public firms instead of conglomerates only.

B. The Exclusion Restriction

Despite the sharp discontinuity in long-term institutional ownership around the Russell 1000/2000 threshold, another condition must be met for the Russell 2000 membership to be used as an instrumental variable - the exclusion restriction. In other words, the Russell 2000 membership must be exogenous to corporate investment horizon, except through its effect on the long-term institutional ownership.

It is the local continuity in potential outcomes around the threshold that enables this identifying assumption to be plausible: other than for the long-term institutional ownership, firms on the bottom of Russell 1000 are similar to those on the top of Russell 2000, hence on average there would have been no difference in potential outcomes including corporate investment horizon between the two groups in the absence of the discontinuity in index weights and long-term ownership. This is a reasonable assumption because the index assignments by Russell are completely mechanical as explained earlier in the previous section, and there is no reason to expect systematic and sharp differences in potential outcomes around the threshold.

Unfortunately, it is impossible to directly test the exclusion restriction using the existing data. I, however, perform a robustness check through an investigation into pretreatment effects to further support the plausibility of the exclusion restriction (Angrist and Pischke (2009)). Any observed pretreatment effects of the Russell 2000 membership on firm characteristics including corporate investment horizon would potentially imply the existence of omitted variables or sample selection bias. Specifically, by regressing the lagged variables on the Russell 2000 membership dummy for the firms ranked within a narrow bandwidth around the threshold, I estimate the mean differences in the main explanatory variable, i.e., the long-term institutional ownership and the dependent variable, i.e., the average product life-cycle length as well as other firm characteristics in the year prior to the index assignment between firms slightly above the threshold and those slightly below the threshold. Table VIII presents the results. Each cell of the table reports the estimated coefficient on the Russell 2000 membership dummy from each OLS regression and its t-statistic in the parenthesis. Each column corresponds to the pre-treatment firm characteristic examined in each regression and each row corresponds to the bandwidth of firms used in each regression. The results largely show that no significant differences are observed in various potential outcomes and other firm characteristics between firms slightly above and below the index cutoff, which supports the plausibility of the local continuity assumption around the Russell 1000/2000 threshold and subsequently the exclusion restriction as well.

Table IV About Here

Therefore, the sharp discontinuity between the firms on the bottom of Russell 1000 and those on the top of Russell 2000 exists only on long-term institutional ownership[21], which motivates the use of the IV-2SLS approach.

C. IV-2SLS Estimations

Based on the mechanical index assignments by Russell and the pretreatment analysis, it can be reasonably assumed that the discontinuity around the Russell 1000/2000 threshold is present only on index weights and eventually on long-term institutional ownership, which subsequently implies that the Russell 2000 membership only affects long-term institutional ownership while it is not correlated with any other factors that may influence corporate investment horizon in a narrow bandwidth around the threshold. Therefore, using a dummy variable for the assignment to the Russell 2000 index as an instrumental variable for the long-term institutional ownership, I estimate the following two-stage least square (2SLS) specification:

$$\begin{aligned} LTO_{i,t} &= \alpha + \delta_1 STO_{i,t} + \delta_2 Russell2000_{i,t} + \delta_3 (Rank*_{i,t} - 1000) \\ &+ \delta_4 Russell2000_{i,t} (Rank*_{i,t} - 1000) + \delta_5 FloatAdj_{i,t} + \tau_t + \varepsilon_{i,t} \end{aligned}$$

$$\begin{aligned} AveragePLCLength_{i,t} &= \theta + \beta_0 \hat{LTO}_{i,t} + \beta_1 STO_{i,t} + \beta_2 (Rank*_{i,t} - 1000) \\ &+ \beta_3 Russell2000_{i,t} (Rank*_{i,t} - 1000) + \beta_4 FloatAdj_{i,t} + \varsigma_t + \nu_{i,t}. \end{aligned}$$

[21]Note that the discontinuity in long-term institutional ownership originates from the mechanical discontinuity in index weights.

$Russell2000$ is a dummy variable indicating whether the firm belongs to Russell 2000 in a given year t. $Rank*$ is the rank of the firm based on market capitalization as of the last trading day in May each year, and $Rank * -1000$ represents the rank distance from the index threshold. Both the rank distance, $Rank * -1000$, and its interaction with the Russell 2000 dummy, $Russell2000 \times Rank * -1000$, are included to control for any size-related effects and to focus on the variation near the threshold. $FloatAdj$ is the difference between the market capitalization-based rank and the actual rank assigned by Russell. I follow previous studies exploring the same discontinuity around the Russell index cutoff and include this variable to control for the variation in index weights attributed to non-mechanical float adjustments made by Russell on the last day of June (e.g., Appel, Gormley, and Keim (2016) and Crane, Michenaud, and Weston (2016)).[22] The coefficient of interest is β_0 which estimates the marginal changes in average product life-cycle length in response to a one-unit increase in the instrumented long-term institutional ownership.

The results from the first-stage regression reported in Table V, columns (1) and (2) (columns (3) and (4)), formalize the sharp discontinuity in long-term (block) institutional ownership around the Russell 1000/2000 threshold described in Section IV.A.[23] The positive and statistically significant coefficients on the dummy variable, $Russell2000$, indicate that, on average, firms slightly below the threshold exhibit sharply larger long-term institutional ownership than those slightly above the threshold. For instance, in column (2), the mean long-term institutional ownership is 13.07% higher for the firms on the top of Russell 2000 than for the firms on the bottom of Russell 1000. This mean difference is economically significant as it is approximately 66% of the standard deviation and 24% of the average of long-term institutional ownership over the subsample firms used in the identification specifications. Thus, for firms within a narrow

[22]Russell's float calculation to determine the market capitalizations of firms to be used for assigning the index weights is unobservable to researchers. It is mostly about determining which price to be used in case of multiple share classes. However, it does not invalidate any empirical designs including mine because the Russell index memberships can be observed by researchers and the variation in index weights caused by the Russell's undisclosed float calculations can be controlled by the actual ranks assigned by Russell which is also observable to researchers.

[23]I report the discontinuity in long-term *and* block institutional ownership for an additional test on the effect of long-term investors with potentially more intervenient power.

bandwidth around the threshold, the Russell 2000 membership has a strong positive impact on long-term institutional ownership.

Table V About Here

Table VI presents the results from the second stage regressions of the average product life-cycle length, the average patent economic value, and the average CEO's grant vesting period, respectively in columns (1)-(2), (3)-(4), and (5)-(6), on the instrumented long-term institutional ownership predicted from the first-stage regression. The results in all specifications confirm that the positive relationships documented in Section III are causal, that is, an increase of long-term institutional ownership causes the corporate investment horizon, the value of corporate investment, and managerial incentive horizon to increase. The estimated coefficient 3.2568 in column (2) implies that, in the small bandwidth of ± 100, a one-standard-deviation increase in long-term institutional ownership due to the index assignment to Russell 2000 leads to an increase in average product life-cycle length by 0.565 years which is approximately six months and three weeks. This effect is economically significant as it is approximately 54% of the standard deviation of the average product life-cycle length. In addition, the coefficient estimates in columns (4) and (6), respectively, indicate that a one-standard-deviation increase in long-term ownership due to the index assignment to Russell 2000 results in a 4.1%-increase in the average patent economic value and a longer average CEO's grant vesting period by three months and two weeks.

In sum, the estimation results from IV-2SLS regressions here establish the causality of the evidence of the horizon alignment hypothesis documented through the baseline analysis in Section III, which can be interpreted as an increased long-term institutional ownership causing firms to increase their investment horizons and values as well as managerial incentive horizons.

Table VI About Here

D. Horizon Alignment and Mispricing

To test another implication from the horizon alignment hypothesis that underpricing is the main driving force of the horizon alignment effect and hence the effects documented earlier are more pronounced for highly undervalued firms, I divide the sample into above-median- and below-median-undervaluation groups based on some proxies for undervaluation and conduct the IV-2SLS regressions separately for each subsample.

To measure the degree of undervaluation, I use four different proxies introduced in the literature: residual book-to-market ratio by regressing book-to-market on firm age, dividend payment dummy, leverage, size, return volatility, and return on equity (ROE) for each year (Pástor and Veronesi (2003)), residual book-to-market ratio by regressing book-to-market on size, ROE if positive, ROE if negative, and leverage for each industry and each year (Rhodes-Kropf, Robinson, and Viswanathan (2005)), future excess returns (Baker, Stein, and Wurgler (2003) and Polk and Sapienza (2009)), and raw book-to-market ratio (Derrien, Kecskes, and Thesmar (2013)). The first two proxies based on residual book-to-market capture the deviation of the observed book-to-market ratio from the (expected) fundamental book-to-market ratio. Future excess return captures price correction in the future conditional on current misvaluation. The use of raw book-to-market is motivated by the purpose of capturing not only firm-specific relative mispricing but also industry-wide or market-wide absolute mispricing. For all these proxies for mispricing, the greater the value is, the more the firm is undervalued.[24]

Table VII presents the estimation results for this cross-sectional analysis. Columns (1)-(2), (3)-(4), (5)-(6), and (7)-(8) report the results using the Pástor and Veronesi (2003) residual book-to-market, the Rhodes-Kropf, Robinson, and Viswanathan (2005) residual book-to-market, future excess returns, and raw book-to-market as the proxy for mispricing, respectively. The estimated coefficients from 2SLS regressions of each dependent variable - average product life-cycle length, average patent economic value, and average CEO's grant vesting period, on the long-term institutional ownership instrumented by Russell 2000 index membership are re-

[24]To save space, I refer the reader to each paper for the details of estimating each proxy.

ported. In all specifications for the subsamples with above-median degrees of undervaluation, I find positive and statistically significant coefficients on the instrumented long-term ownership. The effects are economically substantial. For instance, in column (2) with average product life-cycle length as the dependent variable using the Pástor and Veronesi (2003) undervaluation proxy, given that the sample standard deviation of long-term institutional ownership is 17.4%, a one-standard-deviation increase in long-term institutional ownership is followed by an increase in average product life-cycle length of 0.607 years which is seven months and one week. It is approximately 57% of the standard deviation of average product life-cycle length. On the other hand, for the subsamples of firms with below-median degrees of undervaluation, the estimated coefficients are much smaller in magnitude or are not statistically significant. The evidence from this cross-sectional analysis implies that the effects of long-term ownership on corporate investment horizon, the value of corporate investment, and managerial incentive horizon are stronger for highly undervalued firms, which is consistent with the horizon alignment hypothesis developed in Section I.

TABLE VII ABOUT HERE

E. Investment Horizon and Capital Allocations

To investigate the capital allocation channel for the adjustment of corporate investment horizon in response to an increase in long-term institutional ownership, I estimate the following segment-level IV-2SLS specification:

$$
\begin{aligned}
LTO_{i,t} &= \alpha + \delta_1 STO_{i,t} + \delta_2 Russell2000_{i,t} + \delta_3 (Rank^*_{i,t} - 1000) \\
&+ \delta_4 Russell2000_{i,t}(Rank^*_{i,t} - 1000) + \delta_5 FloatAdj_{i,t} + \tau_t + \varepsilon_{i,t}
\end{aligned}
$$

$$
\begin{aligned}
INV_{i,j,t} &= \theta + \beta_0 \hat{LTO}_{i,t} + \beta_1 LongPLC_{i,j} + \beta_2 LTO_{i,t-1} \times LongPLC_{i,j} + \gamma_1 STO_{i,t} \\
&+ \gamma_2 (Rank^*_{i,t} - 1000) + \gamma_3 Russell2000_{i,t}(Rank^*_{i,t} - 1000) + \gamma_4 FloatAdj_{i,t} \\
&+ \psi_{i,k} + \varsigma_t + \nu_{i,j,t}.
\end{aligned}
$$

where i indexes firms, j indexes segments, k indexes industries, t indexes years, INV is segment investment, which is capital expenditures of a segment over its identifiable total assets, $LongPLC$ is a dummy variable that equals one if the segment operates in an industry with above-median product life-cycle length, ς_t is year fixed effect, and $\psi_{k,t}$ denotes industry-firm fixed effects to control for unobserved heterogeneity at the industry-firm level.[25] The coefficients of interest in this segment-level specification are β_0 and $\beta_0+\beta_2$ which estimate the marginal effects of the firms long-term institutional ownership on the segments investment if the segment's industry has short and long product life-cycles, respectively.

The results are presented in columns (1) and (2) of Table VIII. In both regressions, the coefficient on long-term institutional ownership (β_0) is negative and statistically significant, suggesting that segments with short product life-cycles reduce their investments in physical assets in response to an increase in long-term ownership of their firms. On the other hand, the coefficient on the interaction term (β_2) is positive and statistically significant. Combining these two coefficients, i.e., by $\beta_0+\beta_2$, I find that an increase in long-term institutional ownership of a firm is followed by an increase in investments for long product life-cycle segments. For example, the coefficient of -0.0072 on long-term ownership in column (2) indicates that a one-standard-deviation increase in long-term institutional ownership is associated with a reduction in capital expenditures of approximately 1.6% of total assets for short product life-cycle segments, which is approximately \$2.14 million cut on average given that the sample mean of segment assets is \$134 million. The sum of the two coefficients on long-term ownership and the interaction term, -0.0072 + 0.0086 = 0.0014, indicates that for long product life-cycle segments a one-standard-deviation increase in long-term institutional ownership is associated with an increase in capital expenditures of approximately 0.32% of segment assets, which is approximately \$428,800 raise on average.[26] The economic magnitudes of this differential effect for short and long product

[25]Segment fixed effects cannot be included because Compustat Segment Data File does not provide a unique segment identifier across time. Firm fixed effects cannot be included either because it is not guaranteed that a firm is included in the sample in consecutive years within a narrow band-width around the index cutoff.

[26]It is worth noting that the overall decline in investments following an increase in long-term institutional ownership at the firm level found here is consistent with the evidence documented in Harford, Kecskes, and Mansi (2016).

life-cycle segments are significant. The coefficient of 0.0086 on the interaction term implies difference in capital expenditures of approximately 1.95% of segment assets in response to a one-standard-deviation increase in long-term ownership, and this is nearly 34% of the standard deviation of segment investment.

To additionally examine whether these capital reallocations are made toward long-term *and* profitable segments, I execute cross-sectional analyses by interacting the aforementioned segment-level specification with another indicator variable for segments with greater values of investment projects, i.e., *High PEV*, which is defined as a dummy variable equal to one if the patent economic value of the segment's industry is above-median among all segments within the firm. The results are reported in columns (3) and (4) of Table VIII. In both specifications, the coefficient on the interaction term, $LTO \times LongPLC \times HighPEV$, is positive and statistically significant, which implies that the documented capital reallocation effect of long-term ownership toward long-term segments in columns (1) and (2) is more pronounced among segments with high value of investment projects. Together with the negative and statistically significant coefficient on long-term ownership (LTO), this result shows that firms reallocate their capital from short-term *and* less profitable segments to longer-term *and* more profitable segments in response to an increase in long-term institutional ownership.

Overall, the results in this segment-level analysis suggest that, when there is an increase in long-term institutional ownership, conglomerate firms reallocate their capital toward segments with long-term profitable investment projects, which is consistent with the horizon alignment hypothesis.

Table VIII About Here

F. The Horizon Alignment through Long-term Block-holders

As mentioned earlier, the literature has evolved to look at institutional investors as the owners of firms rather than just trading agencies. Investors holding a large block of shares of a firm likely have more influence on the firm's choice of investment projects either because the firm's manager might observe changes in ownership by those investors thereby modifying the firm's investment policies due to tightened or relaxed pressures for short-run stock performance, or because the block shareholders are active enough to participate in the firm's board meetings and directly influence the firm's investment decisions or try to indirectly affect the corporate investment policies by voting for the changes in executive compensation structures.

To examine whether long-term investors with likely more intervenient power are more influential for the changes in managerial incentive horizon and a firm's choices of investment projects, I calculate the ownership by long-term institutional investors who own 5% or more of total shares of the firm. Then I repeat the same 2SLS regressions in section IV.C replacing long-term ownership with this long-term block ownership. Many studies have shown that block shareholders in general indeed influence management and corporate policies (e.g., Holderness (2003), Chen, Harford, and Li (2007), Cronqvist and Fahlenbrach (2009), and Becker, Cronqvist, and Fahlenbrach (2011)). In addition, Brav et al. (2008) and Brav, Jiang, and Kim (2015) find that 13D filings by activist hedge funds with a large stake lead to higher firm value as well as improved firm-level operating performance and plant-level productivity.[27] Thus, a positive coefficient on long-term block ownership would support the aforementioned arguments on the potential channels through which long-term investors influence firms' investment project choices.

The estimation results from the 2SLS specifications on long-term block ownership are presented in Table IX. The positive coefficients on the instrumented long-term block institutional ownership are both statistically and economically significant in all specifications. In column (2) for example, with the average product life-cycle length as the dependent variable, a one-standard-deviation increase in long-term institutional ownership due to the index assignment to Russell 2000 leads to an increase in average product life-cycle length by 0.376 years which is approximately four months and two weeks. These results strengthen the plausibility of the

[27]Edmans (2014) reviews theoretical papers as well as other empirical papers supporting this view on block shareholders as active monitors rather than passive traders.

documented causal horizon alignment effects.

Table IX About Here

V. Conclusion

In this paper, I study the effect of investment horizons by institutional investors on the horizons of firms' real investments. A battery of analyses looking into institutional holdings and patent citation data provides strong empirical evidence that, in the presence of mispricing, an increase in long-term institutional ownership leads to a lengthened average product life-cycle length of U.S. conglomerate firms. This evidence can be interpreted that, when a stock price of a firm deviates from its fundamental value, the firm increases its corporate investment horizon in response to an inflow of long-term institutional investors as the firm's equity shareholders because it alleviates the equilibrium short-termism by credit- and maturity-constrained short-term arbitrageurs and firms that compensate their managers partly for short-term stock performance.

As a baseline estimation result using a large panel data set, I find a positive relationship between long-term institutional ownership and the average product life-cycle length. This relationship is stronger for firms with greater mispricing, which confirms that this horizon alignment comes from the alleviation of short-term investors' arbitrage-seeking behaviors. A plant-level analysis reveals the within-conglomerate capital reallocation channel behind this horizon alignment. To establish the causality of this baseline relationship, I exploit the firms in a narrow bandwidth around the Russell 1000/2000 index threshold and instrument long-term institutional ownership by the Russell 2000 membership dummy variable based on the sharp discontinuity in long-term ownership around the threshold which is not related to factors that may affect corporate investment horizons. Then, executing IV-2SLS regressions, I document the causal evidence that long-term institutional investors have positive influences on firms' average product life-cycle lengths through governance mechanisms such as large stake holdings or shareholder rights protection. Finally, as an indirect evidence of the higher fundamental value of long-term investment projects, I find that the short-run performance following an increase in long-term institutional ownership is higher for firms with long product life-cycle than for those with short product life-cycle.

To the best of my knowledge, this paper is the first to show that investor horizons affect the horizons of firms' real investments and that there exists horizon alignment between investors and firms. Some previous studies in the literature have already shown that the existence of short-term investors pressures managers to cut R&D spending to boost short-term earnings and thereby short-term stock prices in the spirit of, for example, Bolton, Scheinkman, and Xiong (2006) (e.g., Bushee (1998) and Cremers, Pareek, and Sautner (2016)). However, while they compare the really-short-term earnings management versus overall investments in tangible or intangible assets regardless of their horizons, in this paper I compare real investments in short-term projects versus long-term projects.

This study also sheds light on the role of long-term institutional investors as owners of firms. In particular, the findings in this paper strengthen the view that lengthening investor horizons can mitigate short-termism problems prevailing among U.S. firms and help them pursue more productive long-term investment projects. Moreover, a further evidence that this effect is more pronounced among firms with large blockholder ownerships possibly opposes the argument that short-termism problems can be resolved by investors holding large stakes of the firms without having to induce investors to lengthen their investment horizons (e.g., Edmans (2015)). A compromised view, which is actually the key takeaway from this study, could be that it is the blockholders with long-term investment horizon who can help corporate managers pursue more profitable long-term investment projects without being distracted.

In this spirit, the evidence documented here also has a policy implication that regulations which would discourage short-term trading behaviors by investors could be a remedy to the prevalent short-termism among U.S. corporations, especially in the context of biased managerial decisions toward investment projects with shorter horizon. This implication in turn supports the recent moves by politicians and regulators such as the tax reforms proposed by Hilary Clinton in 2015.

REFERENCES

Aghion, Philippe, John Van Reenen, and Luigi Zingales, 2013, Innovation and institutional ownership, *American Economic Review*, 103, 277-304.

Angrist, Joshua D., and Jrn-Steffen Pischke, 2009, *Mostly harmless econometrics: An empiricist's companion*, Princeton: Princeton University Press.

Appel, Ian R., Todd A. Gormley, and Donald B. Keim, 2016, Passive investors, not passive owners, *Journal of Financial Economics*, 121, 111-141.

Asker, John, Joan Farre-Mensa, and Alexander Ljungqvist, 2015, Corporate investment and stock market listing: a puzzle? *Review of Financial Studies*, 28, 342-390.

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

Barber, Brad M., and Terrance Odean, 2000, Trading is hazardous to your wealth: The common stock investment performance of individual investors, *Journal of Finance*, 55, 773-806.

Barrot, Jean-Nol, 2016, Investor horizon and the life cycle of innovative firms: Evidence from venture capital, *Management Science*.

Bebchuk, Lucian Arye, and Lars A. Stole, 1993, Do short-term objectives lead to under- or overinvestment in long-term projects? *Journal of Finance*, 48, 719-729.

Becker, Bo, Henrik Cronqvist, and Rdiger Fahlenbrach, 2011, Estimating the effects of large shareholders using a geographic instrument, *Journal of Financial and Quantitative Analysis*, 46, 907-942.

Bilir, L. Kamran, 2014, Patent laws, product life-cycle lengths, and multinational activity, *American Economic Review*, 104, 1979-2013.

Bils, Mark, 2009, Do higher prices for new goods reflect quality growth or inflation? *Quarterly Journal of Economics*, 124, 637-675.

Bolton, Patrick, Jose Scheinkman, and Wei Xiong, 2006, Executive compensation and short-termist behaviour in speculative markets, *Review of Economic Studies*, 73, 577-610.

Boone, Audra L., and Joshua T. White, 2015, The effect of institutional ownership on firm transparency and information production, *Journal of Financial Economics*, 117, 508-533.

Brav, Alon, Wei Jiang, and Hyunseob Kim, 2015, The real effects of hedge fund activism: Productivity, asset allocation, and labor outcomes, *Review of Financial Studies*, 28, 2723-2769.

Brav, Alon, Wei Jiang, Frank Partnoy, and Randall Thomas, 2008, Hedge fund activism, corporate governance, and firm performance, *Journal of Finance*, 63, 1729-1775.

Budish, Eric, Benjamin N. Roin, and Heidi Williams, 2015, Do firms underinvest in long-term research? Evidence from cancer clinical trials, *American Economic Review*, 105, 2044-2085.

Bushee, Brian J., 1998, The influence of institutional investors on myopic R&D investment behavior, *Accounting Review*, 73, 305-333.

Cadman, Brian, and Jayanthi Sunder, 2014, Investor horizon and CEO horizon incentives, *Accounting Review*, 89, 1299-1328.

Cella, Cristina, Andrew Ellul, and Mariassunta Giannetti, 2013, Investors' horizons and the amplification of market shocks, *Review of Financial Studies*, 26, 1607-1648.

Chang, Yen-Cheng, Harrison Hong, and Inessa Liskovich, 2014, Regression discontinuity and the price effects of stock market indexing, *Review of Financial Studies*, 28, 212-246.

Chen, Xia, Qiang Cheng, Alvis K. Lo, and Xin Wang, 2015, CEO contractual protection and managerial short-termism, *Accounting Review*, 90, 1871-1906.

Chen, Xia, Jarrad Harford, and Kai Li, 2007, Monitoring: Which institutions matter? *Journal of Financial Economics*, 86, 279-305.

Crane, Alan D., Sbastien Michenaud, and James P. Weston, 2016, The effect of institutional ownership on payout policy: Evidence from index thresholds, *Review of Financial Studies*, 29, 1377-1408.

Cremers, Martijn, Ankur Pareek, and Zacharias Sautner, 2016, Short-term investors, long-term investments, and firm value, Working paper.

Cronqvist, Henrik, and Rdiger Fahlenbrach, 2009, Large shareholders and corporate policies, *Review of Financial Studies*, 22, 3941-3976.

Derrien, Franois, Ambrus Kecsks, and David Thesmar, 2013, Investor horizons and corporate policies, *Journal of Financial and Quantitative Analysis*, 48, 1755-1780.

Edmans, Alex, 2014, Blockholders and corporate governance, *Annual Review of Financial Economics*, 6, 23-50.

Edmans, Alex, 2015, How can we help businesses think long-term? *World Economic Forum.*

Froot, Kenneth A., Andre F. Perold, and Jeremy C. Stein, 1992, Shareholder trading practices and corporate investment horizons, *Journal of Applied Corporate Finance*, 5, 42-58.

Gaspar, Jos-Miguel, Massimo Massa, and Pedro Matos, 2005, Shareholder investment horizons and the market for corporate control, *Journal of Financial Economics*, 76, 135-165.

Gompers, Paul, Joy Ishii, and Andrew Metrick, 2003, Corporate governance and equity prices, *Quarterly Journal of Economics*, 118, 107-156.

Harford, Jarrad, Ambrus Kecskes, and Sattar Mansi, 2016, Do long-term investors improve corporate decision making? Working paper.

Holderness, Clifford G, 2003, A survey of blockholders and corporate control, *Economic Policy Review*, 9, 51-64.

Kogan, Leonid, Dimitris Papanikolaou, Amit Seru, and Noah Stoffman, 2017, Technological innovation, resource allocation, and growth, *Quarterly Journal of Economics*, 132, 665-712.

Milbradt, Konstantin, and Martin Oehmke, 2015, Maturity rationing and collective short-termism, *Journal of Financial Economics*, 118, 553-570.

National Academy of Engineering, 1992, *Time Horizons and Technology Investments*, Washington, DC: The National Academies Press.

Pástor, Ľuboš, and Pietro Veronesi, 2003, Stock valuation and learning about profitability, *Journal of Finance*, 58, 1749-1790.

Polk, Christopher, and Paola Sapienza, 2009, The stock market and corporate investment: A test of catering theory, *Review of Financial Studies*, 22, 187-217.

RhodesKropf, Matthew, David T. Robinson, and S. Viswanathan, 2005, Valuation waves and merger activity: The empirical evidence, *Journal of Financial Economics*, 77, 561-603.

Roberge, Michael W., Joseph C. Flaherty, Jr., Robert M. Almeida, Jr., and Andrew C. Boyd, 2016, Lengthening the investment time horizon, *Massachusetts Financial Services Company White Paper Series.*

Shleifer, Andrei, and Robert W. Vishny, 1990, Equilibrium short horizons of investors and firms, *American Economic Review*, 80, 148-153.

Thakor, Richard T, 2016, A theory of efficient short-termism, Working paper.

Appendix: Variable Definitions

Average PLC length	The asset-weighted average of industry-level product life-cycle length across all business segments of a publicly listed U.S. conglomerate firm. The product life-cycle length is calculated as the industry median of the patent-level average forward citation lag where the average forward citation lag is the average of the time lapse between the cited patent's grant date and a subsequent citation across all citing patents. For the details of the calculation of the average forward citation lag, see Bilir (2014).
Average PEV	The asset-weighted average of industry-level economic value of patents across all business segments of a publicly listed U.S. conglomerate firm. The economic value of patents for each industry is calculated as the average of the Kogan, Papanikolaou, Seru, and Stoffman's (2017) announcement-return-based measure across all patents in the industry over the six-year-period prior to each year.
Ln(Average PEV)	Natural lograithm of *Average PEV*.
Average CGV period	The average CEO grant vesting (CGV) period in months, calculated as the value-weighted average of vesting period across all performance-based grants in a CEO's compensation package, using the data collected from the Incentive Lab. The vesting period for each grant is computed as the exponentially-weighted average (with the half-life of 6 months) of vesting months between the start and the end of the award vesting period.
Long-term ownership	The fraction of shares held by long-term institutional investors whose portfolio turnover is less than or equal to 35%, where the portfolio turnover is calculated as the fraction of shares that are no longer held after three years of their purchases. For the details of the calculation of this measure, see Derrien, Kecskes, and Thesmar (2013).
Institutional ownership	The fraction of shares held by institutional investors in the 13F data.

Block ownership	The fraction of shares held by institutional investors who own 5% or more of total shares outstanding of the firm.
Sales growth	[Sales(t) - sales(t-1)]/sales(t-1).
Cash flow	(Earnings before interest and taxes + depreciation)/total assets.
Debt	Total debt/total assets.
Size	Natural logarithm of total assets.
Q	(Total assets - book value of equity + market value of equity)/total assets.
Investment	Capital expenditure over total assets.
R&D	Research and development expenditure over total assets.
PV B/M	Residual book-to-market (Pástor and Veronesi (2003)).
RRV B/M	Residual book-to-market based on Rhodes-Kropf, Robinson, and Viswanathan (2005).
Future excess return	Future realized return in excess of its expected return based on Baker, Stein, and Wurgler (2003) and Polk and Sapienza (2009).
Raw B/M	The reciprocal of Q.
Market cap.	CRSP price multiplied by the number of shares outstanding as of the last trading day of May.
*Rank**	The rank of each firm based on observed market capitalization as of the last trading day of May.
Float adjustment	The difference between *Rank** and the actual rank assigned by Russell at the end of June.
G-index	The GIM governance index.
ROA	Net income divided by total assets.

Figure I
Long-term Ownership around Russell 1000/2000 Threshold

This figure plots the long-term institutional ownership for the third quarter against the rank distance from the Russell 1000/2000 threshold during 1990-2005, within a narrow bandwidth around the threshold. The stocks are sorted into each bin of ten ranks, and for each bin the long-term institutional ownerships are averaged across all years (y-axis). The distances from threshold are calculated using the actual ranks assigned by Russell (x-axis).

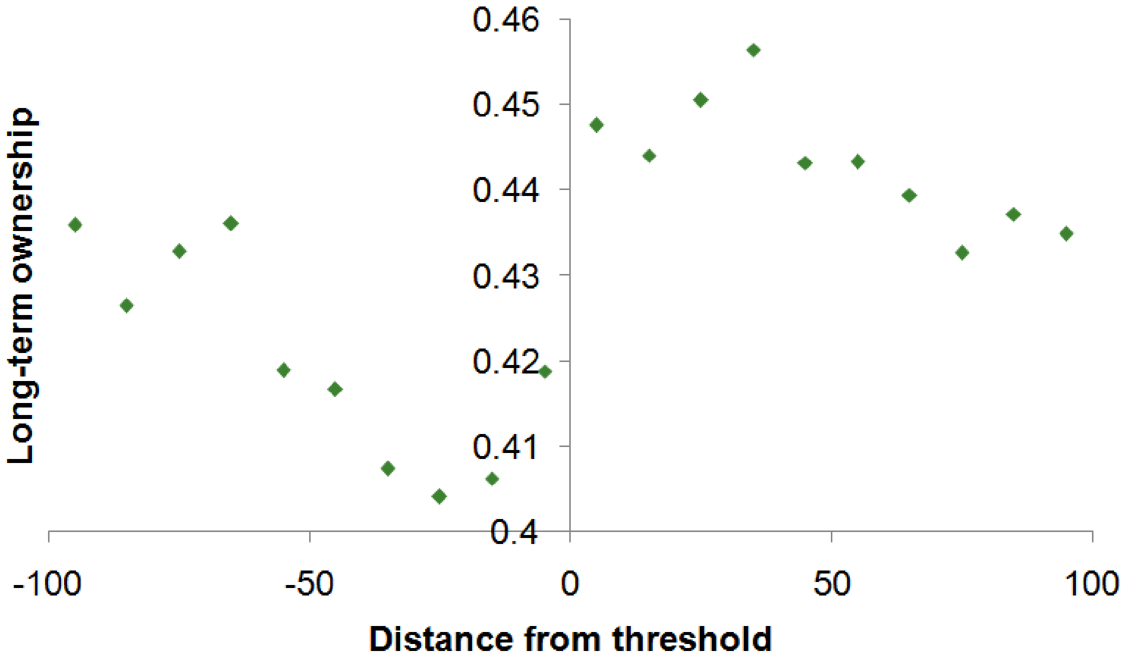

Table I
Product Life-cycle Lengths and Patent Economic Values by Industry

This table lists the product life-cycle length for each SIC 3-digit code.

SIC code	SIC industry name	PLC length
343	Heating Equipment, Except Electric	12.98
341	Metal Cans And Shipping Containers	12.75
345	Screw Machine Products, Bolts, Nuts, Screws	12.53
342	Cutlery, Handtools, And General Hardware	12.36
344	Fabricated Structural Metal Products	12.18
349	Miscellaneous Fabricated Metal Products	12.03
353	Construction, Mining, And Materials Handling	11.90
372	Aircraft and Parts	11.76
358	Refrigeration And Service Industry Machinery	11.62
366	Communications Equipment	11.47
351	Engines And Turbines	11.31
283	Drugs	11.19
369	Miscellaneous Electrical Machinery, Equipment	11.04
335	Rolling, Drawing, Extruding Of Metals	10.91
285	Paints, Varnishes, Lacquers, Enamels	10.75
354	Metalworking Machinery and Equipment	10.62
363	Household Appliances	10.58
352	Farm And Garden Machinery And Equipment	10.43
384	Surgical, Medical, Dental Instruments And Supplies	10.26
289	Miscellaneous Chemical Products	10.15
131	Crude Petroleum and Natural Gas Extraction	10.07
359	Miscellaneous Industrial And Commercial	9.94
371	Motor Vehicles And Motor Vehicle Equipment	9.81
346	Metal Forgings And Stampings	9.70
138	Oil and Gas Field Services	9.62
386	Photographic Equipment And Supplies	9.53
379	Miscellaneous Transportation Equipment	9.46
355	Special Industry Machinery, Except Metalworking	9.37
481	Telephone Communications	9.27
220	Textile mill products	9.15
331	Steel Works, Blast Furnaces, Mills	9.01
737	Programming, Data, and Computer Related Services	8.88
356	General Industrial Machinery and Equipment	8.74
381	Detection and Navigation Instruments, Equipment	8.61
483	Radio and Television Broadcasting Stations	8.46
738	Miscellaneous Business Services	8.30
364	Electric Lighting and Wiring Equipment	8.15

291	Petroleum Refining	8.01
284	Soap, Detergents, Cosmetics	7.83
281	Industrial Inorganic Chemicals	7.62
367	Electronic Components And Accessories	7.39
287	Agricultural Chemicals	7.14
357	Computer and Office Equipment	6.90
365	Household Audio and Video Equipment	6.62
387	Watches, Clocks, Clockwork Operated Devices	6.29
383	Electronics Machinery	5.99

Table II
Summary Statistics

This table reports summary statistics of the variables for the sample that I use to examine how long-term institutional ownership is associated with corporate investment horizon. All variables are defined in Appendix.

	Mean	SD	P25	P50	P75	N
Panel A. Firm-Level Variables						
Average PLC length	9.6409	1.4360	8.3579	9.6530	10.7377	6619
Average PEV	12.8608	4.1883	9.6518	11.6151	13.9902	6619
Ln(Average PEV)	2.5102	0.2838	2.2671	2.4523	2.6384	6619
Average CGV period	12.9456	8.3327	7.8750	11.5000	15.0313	1232
Long-term ownership	0.3228	0.2263	0.0968	0.3494	0.5080	6591
Long-term block ownership	0.1009	0.1107	0.0000	0.0912	0.1788	6591
Institutional ownership	0.4724	0.3213	0.1513	0.5115	0.7475	6591
Sales growth	0.1257	0.4047	-0.0288	0.0758	0.1885	6536
Cash flow	0.0981	0.1708	0.0731	0.1197	0.1672	6557
Debt	0.2199	0.1874	0.0722	0.2026	0.3159	6559
Size	6.4138	2.1904	4.8436	6.3758	7.9578	6569
Q	1.8476	1.4181	1.1250	1.4464	2.0610	6527
Investment	0.0509	0.0472	0.0224	0.0386	0.0647	6472
R&D	0.0539	0.0886	0.0083	0.0265	0.0696	6554
Panel B. Segment-Level Variables						
PLC length	9.5557	1.2362	8.7100	9.7300	10.6100	21170
PEV	16.7895	13.9524	9.7163	11.8385	16.0505	21170
Investment	0.0587	0.0578	0.0225	0.0433	0.0749	21035
Ln(Sales)	5.1674	2.1822	3.7091	5.2376	6.7154	20958
Cash flow	0.1212	0.2349	0.0469	0.1236	0.2119	18991
Size	4.9000	2.2330	3.3405	4.9399	6.5103	21027

Table III
Horizon Alignment between Investors and Firms: Panel Regressions

This table reports the results of panel regressions on the relationship between long-tern institutional ownership and corporate investment horizon, corporate investment value, and managerial incentive horizon, proxied by the average product life-cycle (PLC) lengths, the average patent economic value (PEV), and the average CEO's grant vesting (CGV) period, respectively. All variables are defined in Appendix. I include year fixed effects and/or firm fixed effects in the specifications. In each column, I report estimated coefficients from OLS regression and their t-statistics, calculated using heteroskedasticity-robust standard errors. ***, ** , and * indicate the statistical significance at the 1%, 5%, and 10% levels, respectively. This table documents positive correlations between long-term institutional ownerships and the average PLC length, PEV, and CGV period in the following year.

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. variable	Avg. PLC length		Ln(Avg. PEV)		Avg. CGV period	
LT ownership	3.1923**	3.1577**	0.2123**	0.2055**	37.1639***	19.5515**
	(2.61)	(1.98)	(2.78)	(2.46)	(3.84)	(2.17)
Inst. ownership	-0.8280	-0.8275	-0.2095***	-0.1637**	-15.4475***	-9.2222**
	(-1.01)	(-1.51)	(-3.88)	(-2.25)	(-3.86)	(-2.04)
Sales growth	0.1795***	-0.0117	-0.0525**	0.0028	0.9387	0.8867
	(3.85)	(-0.39)	(-2.40)	(0.25)	(0.53)	(0.67)
Cash flow	0.0014	0.0052	0.0852***	-0.0733	13.5285***	0.9754
	(0.04)	(0.25)	(3.47)	(-1.62)	(4.54)	(0.18)
Debt	0.3612***	0.0796	0.0547	-0.0669*	1.3466	-3.8583
	(7.23)	(1.42)	(1.50)	(-1.69)	(0.67)	(-1.62)
Size	-0.0814***	-0.0416	0.0210***	0.0105	0.3767	-0.0435
	(-15.28)	(-1.27)	(8.27)	(0.69)	(1.66)	(-0.04)
Q	-0.0470***	0.0130	0.0113**	0.0001	-0.2881	-0.3840
	(-3.88)	(1.02)	(2.55)	(0.02)	(-0.91)	(-1.29)
Investment	-1.4071**	-0.1976	-0.0709	-0.0923	-13.4945	9.8252
	(-2.56)	(-1.31)	(-0.64)	(-0.90)	(-1.31)	(0.80)
R&D	-2.2622***	0.1332	0.4869***	-0.0219	-19.4588***	-6.6132
	(-7.79)	(0.76)	(4.94)	(-0.28)	(-4.70)	(-1.15)
Constant	9.6705***	9.5818***	1.7925***	1.8119***	7.8656***	9.3395
	(705.95)	(182.25)	(64.65)	(20.07)	(3.60)	(1.16)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	Yes	No	Yes
N	6,052	6,052	6,052	6,052	1,190	1,190
R^2	0.0826	0.0171	0.0595	0.0066	0.0695	0.1040

Table IV
Pre-treatment sample differences around the Russell 1000/2000 threshold

This table reports the mean differences in various firm characteristics around the Russell 1000/2000 threshold in the year prior to the index assignment. The discontinuity tests are done by regressing each firm characteristic on the dummy variable *Russell 2000* which is equal to one if the firm belongs to the Russell 2000 index, for each subsample with different bandwidths in the neighborhood of the threshold. The bandwidths 20, 25, 30, and 35 indicate the subsamples of firms ranked in [981, 1020], [976, 1025], [971, 1030], and [966, 1035], respectively, based on observed market capitalization from CRSP as of the last trading day of May. All dependent variables are defined in Appendix. ***, ** , and * indicate the statistical significance at the 1%, 5%, and 10% levels, respectively. This table shows that there is no significant differences in observed market capitalization, long-term institutional ownership, sales growth, cash flow, debt ratio, and average product life-cycle length in very small bandwidths around the Russell 1000/2000 threshold in the year prior to the index assignment, which means that firms are very similar on both sides of the threshold.

Dependent variable	(1) Market cap.	(2) Long-term ownership	(3) Sales growth	(4) Cash flow	(5) Debt	(6) Average PLC length
Russell2000 (bandwith = 20)	10.76	0.00	0.00	-0.00	0.01	0.04
	(0.06)	(0.09)	(0.07)	(-0.02)	(0.21)	(0.31)
Russell2000 (bandwith = 25)	13.92	0.00	-0.00	-0.01	0.02	0.04
	(0.10)	(0.08)	(-0.02)	(-0.41)	(0.39)	(0.34)
Russell2000 (bandwith = 30)	-16.27	0.00	-0.00	-0.01	0.00	0.02
	(-0.19)	(0.25)	(-0.03)	(-0.60)	(0.19)	(0.19)
Russell2000 (bandwith = 35)	-71.22	0.01	0.02	-0.02	0.02	0.05
	(-0.94)	(0.73)	(0.33)	(-0.98)	(0.66)	(0.41)

Table V
Differences in Long-term Ownership around the Russell 1000/2000 Threshold: First-Stage Regressions

This table reports the regression discontinuity test results from first-stage regressions on the differences in long-term (block) institutional ownership around the Russell 1000/2000 threshold. *Russell 2000* is defined in Table IV. *Rank** is the rank of each firm based on observed market capitalization as of the last trading day of May. *Float adjustment* is defined as the difference between *Rank** and the actual rank assigned by Russell at the end of June. All other variables are defined in Appendix. I include year fixed effects in all specifications. In each column, I report estimated coefficients from OLS regression and their t-statistics, calculated using heteroskedasticity-robust standard errors. ***, ** , and * indicate the statistical significance at the 1%, 5%, and 10% levels, respectively. This table shows that there is a sharp discontinuity in long-term (block) institutional ownership around the Russell 1000/2000 threshold, i.e., long-term (block) institutional ownerships of firms that are at the top of the Russell 2000 are much larger than those of slightly larger firms at the bottom of the Russell 1000.

	(1)	(2)	(3)	(4)
Dependent variable	Long-term ownership		Long-term block ownership	
Russell2000	0.0635***	0.0612***	0.0310**	0.0331**
	(4.73)	(4.18)	(2.34)	(2.68)
(Rank* - 1000)	-0.0006	-0.0005	0.0003	0.0002
	(-1.38)	(-1.16)	(0.73)	(0.47)
(Rank* - 1000) x Russell 2000	0.0002	0.0001	-0.0006	-0.0005
	(0.64)	(0.43)	(-1.43)	(-1.17)
Float adjustment	0.0003***	0.0003***	0.0001**	0.0001**
	(12.40)	(10.50)	(2.77)	(2.79)
Constant	0.3103***	0.3065***	0.1161***	0.1269***
	(17.20)	(12.78)	(4.37)	(4.92)
Year FE	No	Yes	No	Yes
N	366	366	366	366
R^2	0.1412	0.2157	0.0480	0.0582

Table VI
Horizon Alignment between Investors and Firms: Instrumental Variable Estimates

This table presents the results of 2SLS regressions on the effects long-term institutional ownership on corporate investment horizon, the value of corporate investment, and managerial incentive horizon, proxied by the average product life-cycle (PLC) length, the average patent economic value (PEV), and the average CEO's grant vesting (CGV) period, respectively. 2SLS regressions instrument long-term ownership using the dummy variable *Russell 2000* defined in Table IV. *Rank** and *Float adjustment* are defined in Table V. All other variables are defined in Appendix. I include year fixed effects in all regressions. In each column, I report estimated coefficients from 2SLS regression and their t-statistics, calculated using heteroskedasticity-robust standard errors. ***, ** , and * indicate the statistical significance at the 1%, 5%, and 10% levels, respectively. This table shows that through sharply increased long-term institutional ownerships, the average product life-cycle length, the average PLC length, PEV, and CGV period of the firms at the top of the Russell 2000 are significantly greater than those of the slightly larger firms at the bottom of the Russell 1000.

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. variable	Avg. PLC length		Ln(Avg. PEV)		Avg. CGV period	
Long-term ownership	3.2317**	3.2568**	0.2450**	0.2366**	21.2536**	20.6219**
	(2.52)	(2.47)	(2.58)	(2.40)	(2.54)	(2.50)
(Rank* - 1000)	0.0004	0.0004	0.0010	0.0010	0.1501	0.1522
	(0.34)	(0.35)	(1.43)	(1.27)	(0.54)	(0.59)
(Rank* - 1000) x Russell 2000	-0.0001	-0.0001	-0.0020	-0.0019	-0.2399	-0.2408
	(-0.11)	(-0.12)	(-1.59)	(-1.46)	(-0.53)	(-0.54)
Float adjustment	-0.0001	-0.0001	0.0002	0.0002	0.0236	0.0244
	(-0.64)	(-0.57)	(0.88)	(0.79)	(0.57)	(0.61)
Year FE	No	Yes	No	Yes	No	Yes
N	366	366	324	324	77	77

Table VII
Horizon Alignment between Investors and Firms: Cross-sectional Effects

This table reports the results of IV-2SLS regressions on the effects of long-tern ownerships on corporate investment horizons, the value of corporate investment, and managerial incentive horizon, *separately* for the subsamples of more (above-median) and less (below-median) undervalued firms. Undervaluation is proxied by four different measures: residual book-to-market based on Pástor and Veronesi (2003) (*PV residual B/M*); residual book-to-market based on Rhodes-Kropf, Robinson, and Viswanathan (2005) (*RRV residual B/M*); future excess returns based on Baker, Stein, and Wurgler (2003) and Polk and Sapienza (2009) (Future excess return); and raw book-to-market based on Derrien, Kecskes, and Thesmar (2013) (Raw B/M). Long-term ownership is instrumented by the dummy variable *Russell 2000* defined in Table IV. I control for distance from threshold, float adjustment, and year fixed effects in all specifications. In each column, I report estimated coefficients from 2SLS regression and their t-statistics, calculated using heteroskedasticity-robust standard errors. ***, ** , and * indicate the statistical significance at the 1%, 5%, and 10% levels, respectively. This table shows that the horizon alignment effects are stronger for more undervalued firms.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Undervaluation Proxy							
	PV B/M		*RRV* B/M		Fut. exc. ret.		Raw B/M	
	Low	High	Low	High	Low	High	Low	High
Dep. Var.	Average PLC length							
LTO	2.9128*	3.5014**	2.6687*	3.7870***	2.0776	3.5707***	0.6655	3.2216**
	(1.91)	(2.63)	(1.86)	(2.98)	(0.83)	(3.09)	(0.26)	(2.14)
N	190	175	182	163	157	185	171	192
Dep. Var.	Ln(Average PEValue)							
LTO	-0.1226	0.2408**	0.8950	0.2503**	-0.2502	0.2297**	-0.1195	0.2367**
	(-0.44)	(2.60)	(0.94)	(2.35)	(-0.28)	(2.29)	(-0.26)	(2.44)
N	160	154	158	151	143	169	145	164
Dep. Var.	Average CGV period							
LTO	-7.2935	22.7628***	4.0811	20.6900**	-2.4752	21.9286**	1.5061	22.0803***
	(-0.39)	(3.42)	(0.48)	(2.40)	(-0.24)	(3.44)	(0.16)	(3.24)
N	39	38	37	32	35	42	37	40
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table VIII
Long-Term Institutional Ownership and Investments across Segments

This table reports the results of IV-2SLS regressions on the cross-sectional differences across segments in the effect of long-term institutional ownership (*LTO*) on segment investments depending on the segments' product life-cycle lengths. *Long PLC* is a dummy variable equal to one for the segments with above-median product life-cycle lengths within the firm in a given year. *High Value* is a dummy variable equal to one for the segments with above-median patent economic values within the firm in a given year. Long-term ownership is instrumented by the dummy variable *Russell 2000* defined in Table IV. I control for distance from threshold, float adjustment, firm-industry fixed effects, and year fixed effects in all specifications. In each column, I report estimated coefficients from 2SLS regression and their t-statistics, calculated using heteroskedasticity-robust standard errors clustered by *industry*. ***, ** , and * indicate the statistical significance at the 1%, 5%, and 10% levels, respectively. This table shows that an inflow of long-term institutional investors leads to capital reallocations by firms from short-horizon and less-profitable to long-horizon and more-profitable segments.

	(1)	(2)	(3)	(4)
Dependent variable	Investment			
LTO	-0.0075**	-0.0072**	-0.0079**	-0.0069**
	(-2.02)	(-1.99)	(-2.12)	(-2.06)
Long PLC	0.0004	0.0027*	-0.0042*	-0.0053*
	(0.23)	(1.73)	(-1.77)	(-1.95)
High PEV			0.0053*	0.0062*
			(1.80)	(1.85)
LTO × Long PLC	0.0092**	0.0086**	-0.0002	-0.0030
	(2.08)	(2.04)	(-0.03)	(-0.69)
LTO × High PEV			-0.0032	-0.0045
			(-0.43)	(-0.61)
Long PLC × High PEV			-0.0019	0.0004
			(-0.32)	(0.09)
LTO × Long PLC × High PEV			0.0286***	0.0238**
			(2.66)	(2.19)
Constant	0.0708***	0.0683***	0.0701***	0.0680***
	(55.25)	(54.07)	(45.84)	(45.14)
Controls	No	Yes	No	Yes
Industry x Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	988	988	811	811

Table IX
Horizon Alignment between Block-holders and Firms: Instrumental Variable Estimates

This table presents the results of 2SLS regressions on the effects long-term *block* institutional ownership on corporate investment horizon, the value of corporate investment, and managerial incentive horizon, proxied by the average product life-cycle (PLC) length, the average patent economic value (PEV), and the average CEO's grant vesting (CGV) period, respectively. 2SLS regressions instrument long-term ownership using the dummy variable *Russell 2000* defined in Table IV. *Rank** and *Float adjustment* are defined in Table V. All other variables are defined in Appendix. I include year fixed effects in all regressions. In each column, I report estimated coefficients from 2SLS regression and their t-statistics, calculated using heteroskedasticity-robust standard errors. ***, ** , and * indicate the statistical significance at the 1%, 5%, and 10% levels, respectively. This table shows that through sharply increased long-term *block* institutional ownerships, the average product life-cycle length, the average PLC length, PEV, and CGV period of the firms at the top of the Russell 2000 are significantly greater than those of the slightly larger firms at the bottom of the Russell 1000.

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. variable	Avg. PLC length		Ln(Avg. PEV)		Avg. CGV period	
Long-term block ownership	2.3016**	2.1672***	0.1503**	0.1891**	13.9178**	14.6171**
	(2.33)	(3.10)	(2.11)	(2.46)	(2.31)	(2.39)
(Rank* - 1000)	-0.0044	-0.0018	0.0048	0.0044	0.0815	0.0142
	(-0.77)	(-0.82)	(0.83)	(0.85)	(0.58)	(0.13)
(Rank* - 1000) x Russell 2000	0.0068	0.0029	-0.0068	-0.0063	-0.1513	-0.0384
	(0.89)	(1.05)	(-0.96)	(-0.99)	(-0.68)	(-0.24)
Float adjustment	-0.0003	-0.0002	0.0002	0.0002	-0.0026	-0.0226
	(-0.49)	(-0.75)	(0.34)	(0.31)	(-0.10)	(-0.61)
Year FE	No	Yes	No	Yes	No	Yes
N	366	366	324	324	77	77

Table A.I
Long-Term Ownership and Performance

This table reports the results of 2SLS regressions on the impact of long-term institutional ownership on firm performance measured by return on assets (ROA) separately for the full sample and subsamples based on the average product life-cycle length. *ROA* is defined as net income divided by total assets. In (2)-(3) and (5)-(6), I separate the sample based on whether the average product life-cycle length is above or below the sample median for a given year. *Long-term ownership* is instrumented by the dummy variable *Russell 2000* defined in Table V. *Rank** and *Float adjustment* are defined in Table VI. All other variables are defined in Appendix. I include year fixed effects in all regressions. In each column, I report estimated coefficients from 2SLS regression and their *t*-statistics, calculated using heteroskedasticity-robust standard errors. ***, ** , and * indicate the statistical significance at the 1%, 5%, and 10% levels, respectively. This table shows that long-term institutional ownership has a positive impact on firm performance in the following year and this effect is more stronger for firms with longer investment horizons in that year.

Dependent variable	ROA					
	(1)	(2)	(3)	(4)	(5)	(6)
	Average PLC length			Average PLC length		
	All	Short	Long	All	Short	Long
Long-term ownership	0.1656*	0.0050	0.7165**	0.1578*	-0.0540	0.8073*
	(1.76)	(0.06)	(2.00)	(1.72)	(-0.44)	(1.92)
(Rank* - 1000)	-0.0001	-0.0001	-0.0005	-0.0001	-0.0001	-0.0005
	(-1.04)	(-0.69)	(-1.09)	(-1.00)	(-0.47)	(-1.02)
(Rank* - 1000) x Russell 2000	-0.0000	-0.0001	0.0005	-0.0000	-0.0001	0.0005
	(-0.07)	(-0.16)	(0.94)	(-0.09)	(-0.28)	(0.89)
Float adjustment	-0.0000	0.0000	-0.0002	-0.0000	0.0000	-0.0002
	(-1.02)	(0.01)	(-1.47)	(-0.93)	(0.14)	(-1.40)
Constant	-0.0463	0.0330	-0.3602	-0.0448	0.0387	-0.3844
	(-0.71)	(0.77)	(-1.38)	(-0.64)	(0.74)	(-1.30)
Year FE	No	No	No	Yes	Yes	Yes
N	319	144	175	319	144	175