Passive Institutional Investors and Corporate Innovation

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Abstract

We study the effects of passive institutional investors on corporate innovation. The existing literature has shown a negative relation between the two, and in some cases, no relation. When we apply an instrumental variable approach based on Russell 1000/2000 index reconstitution to explore an exogenous variation of passive institutional ownership, we find that higher passive institutional ownership leads to more corporate innovation measured in terms of both patent quantity and quality. These results are in line with the evidence established in the existing literature that passive institutional investors play a key role in influencing corporate governance choices. In addition, we show three more channels: first, passive institutional investors are passive monitors in the sense that their increased presence allows more flexibility and transfers more power to the firm's management; second, passive institutional ownership reduces the likelihood of CEO turnover especially for firms that are outperforming their industry peers; third, greater passive institutional ownership is associated with a wider adoption of non-executive employee stock options, which helps incentivize innovative activities.

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1 Introduction

Innovation plays an important role in the growth of individual firms and the development of overall economy. According to a report issued by OECD in 2015, innovation (including technological progress embodied in physical capital, investment in knowledge-based capital, increased multi-factor productivity growth, and creative destruction) accounts for approximately 50% of a country's GDP growth (He and Tian, 2017). However, motivating innovation is a challenge for most firms, especially publicly traded corporations where ownership and control are separated. Unlike routine tasks, innovation involves a lengthy process of exploration of new, untested approaches that has a high probability of failure (Holmstrom, 1989). Faced with the pressure for quarterly earnings results, risk-averse managers tend to invest less in innovation and put more effort in routine tasks that provide more immediate and certain returns.

Several studies have examined the role of institutional investors in alleviating such managerial agency problem (e.g., Aghion, Van Reenen, and Zingales, 2013; Bushee, 1998). A well accepted view from the established evidence is that: i) a higher ownership by institutional investors who have the incentive to spend efforts and the ability to influence firm governance (i.e. dedicated investors) reduces the likelihood of cutting R&D spending to meet short-term earnings goals and enhances firm innovation; ii) a large proportion of ownership by institutions that have high portfolio turnover and engage in momentum trading (i.e. transient investors) plays the opposite role. However, it remains unclear what impact passive institutional investors, those that follow indexing strategies and hold fragmented diverse portfolios, have on firm innovation. As discussed later in the paper, one cannot draw any concrete conclusion when pooling the different pieces of findings together from existing literature. This paper intends to fill in this gap by studying the effect of passive institutional investors on corporate innovation. This is an important question to examine given that passive institutional investors become an increasingly important and growing component of U.S. equity ownership. According to the 2018 Factbook published by the Investment Company Institute, the share of index funds and index ETFs[1] with respect to the fund market total net assets has grown from 15% in 2007 to 35% in 2017. As noted in Bebchuk and Hirst (2018), the Big Three index fund managers (i.e., BlackRock, State Street Global Advisors, and Vanguard) held more than 4,500 positions of greater than 5% ownership in public companies in 2017.

Institutional investors can affect a firm's governance and operation, either through their voice, which is a direct intervention (Shleifer and Vishny 1986; Huddart 1993), or through the threat to exit which is an indirect intervention (Admita and Pfleiderer 2009; Edmans 2009; Edmans and Manso 2011). In a direct intervention, institutions can exert direct influence on firm governance and decisions by using their voting rights. In an indirect intervention (i.e. "voting by feet"), institutions gather relevant information about managerial decisions and may sell their holdings if managerial decisions do not appeal to them, hence posing a threat to exit and pushing managers to adopt changes as the institutional investors see fit. Institutions that invest in firms with the intention of holding large ownership over a long horizon should have incentives to pay the cost of information gathering and explicit monitoring through governance activities so as to ensure that the firm does not cut profitable R&D investment to meet short-term earnings target at the expense of long-term value destruction. Aghion, Reenen, and Zingales (2013) document that institutional ownership increases innovation output (by reducing managerial career concerns) and that the effect is driven by dedicated (and transient) institutional investors. They argue that passive institutional investors (quasi-indexers) have no impact on corporate innovation. He and Tian (2013) show that when there is an exogenous decrease in the analyst coverage of a firm, the firm generates more patents and patents with greater impact. Attempting to identify the underlying channel, they show that exogenous decrease in analyst coverage leads to an increase in dedicated institutional ownership and a decrease in non-dedicated (i.e., transient and quasi-indexer) institutional ownership. They claim that the negative effect of high analyst coverage is attributable to greater ownership by non-dedicated institutional investors relative to dedicated institutional

[1]Note that the classification of index fund and ETFs here does not include those actively managed funds that closely mimic a particular index.

ownership. In addition, Fang, Tian, and Tice (2014) find that exogenous positive shocks to stock liquidity leads to a reduction in firm innovation. They argue that one of the two potential channels for such an effect to take place is that high stock liquidity attracts transient investors who trade frequently to chase current profits or quasi-indexers who follow passive indexing strategies and fail to monitor. As a result, managers are pressured to cut investment in innovation to boost short-term earnings. Hence, the evidence in the literature collectively seem to suggest that passive institutional investors have either no or a negative impact on firm innovation. However, a common limitation in the prior studies is that passive ownership is endogenously determined. If one cannot identify for an exogenous variation in passive ownership, it is difficult to reach a conclusion on the true causal effect of passive institutional ownership on innovation.

From a theoretical standpoint, the effect of passive ownership on innovation is ambiguous. On one hand, a higher level of passive institutional ownership may decrease long-term intangible investment due to two reasons: first, passive investors do not actively acquire information and a lack of information acquisition may lead to worsening price efficiency; second, passive investors do not monitor the manager to the same extent as dedicated investors, which may cause a deviation from the optimal level of monitoring needed for value increasing investment (Porter 1992). On the other hand, a greater level of passive institutional ownership may also lead to an increase in long-term intangible investment for the following reason: the passive nature of the investment style means that these investors have no exit strategy when the firm is performing poorly, hence these investors may have a stronger incentive and a greater focus on improving corporate governance (Monks and Minow 1995). In fact, passive investors such as Vanguard and BlackRock frequently argue that they are more engaged with firms, as it is their only mechanism for increasing portfolio value. Recently, this latter channel has received growing attention in the strand of literature focusing on the governance role of passive institutional investors (e.g. Appel and Gormley,2019; Crane, Michenaud, and Weston 2016; Schmidt and Fahlenbrach 2017). Theses studies all use the setting of Russell index reconstitution for identification of exogenous differences (or changes) in passive institutional ownership and show that passive institutional investors exert influence on certain corporate governance choices and corporate policies.

In this paper, we apply the Russell 1000/2000 Index reconstruction setting as our identification strategy.[2] We show that the Russell 2000 index inclusion drives a discontinuity in quasi-indexer ownership: top firms in the Russell 2000 have around 8% more quasi-indexers than bottom firms in the Russell 1000. Using the predicated quasi-indexers' ownership to test the impact on innovation, our results show that an exogenous increase in quasi-indexer ownership leads to a significant increase in corporate innovation measured in terms of both patent quantity and quality. In other words, passive institutional ownership has a positive impact on corporate innovation.

We explore the underlying mechanisms for this positive relation between passive institutional ownership and innovation. We show that the positive effect is concentrated in the top-performing firms (i.e. firms with stock return of the most recent fiscal year greater than their industry medians). Firms that outperform their industry peers are less likely to be the target of governance changes through active monitoring, and yet we observe a greater improvement of innovation outcomes among these firms. This finding is consistent with the view that passive institutional investors are passive monitors in the sense that their increased presence allows more flexibility and transfers more power to the firm's management. In addition, we show that quasi-indexers reduce CEO turnover probability, which mitigates CEOs' career concern and allows managers to invest more on innovation. We also find that quasi-indexers appear to pay more attention on relative performance. If a firm's performance is below the industry median, the CEO is more likely to be fired when passive institutional ownership is higher. In addition, we find that an increase in passive institutional investor

[2] Several studies have employed the Russell 1000/2000 cutoff to analyze the price effect of addition and deletion from the Russell index (Chang, Hong, and Liskovich 2015), the association between institutional holding and payout policy (Crane, Michenaud, and Weston 2016), managerial disclosure (Boone and White 2015), acquisition and CEO power (Schmidt and Fahlenbrach 2016), monitoring incentives (Fich, Harford,and Tran 2015), and the effect of passive investors on firm governance (Appel, Gormley, and Keim 2016; Appel, Gormley, and Keim 2019).

ownership leads to more non-executive option grants, which also serves to motivate more innovation.

Our paper contributes to the literature by demonstrating the positive effect of passive institutional investors on corporate innovation. It is worth emphasizing that not only do we study a different outcome variable (i.e. innovation output) using the Rusell index reconstitution setting, but also our findings are not merely derivatives from the established evidence in this literature. In fact, the existing evidence may generate different implications about the effect of passive institutional ownership on innovation.[3] We also provide possible explanations for the mechanism on why passive institutional investors contribute to innovation. We show that the main channel is that passive institutional investors allow managers to take more control of the firms. The other channels are the improved CEO job security and the increase non-executive options grant.

The rest of this paper is organized as follows. Section 2 describes our data sources, sample selection, and summary statistics. Section 3 explains the empirical setup and identification strategy. Section 4 presents the results. Section 5 explores the possible channels underlying the effect of passive institutional ownership on innovation. Section 6 is robustness check. Section 7 concludes.

2 Data

2.1 Sample and Russell index background

Our sample includes firms in the Russell 1000 index and the Russell 2000 index from year 1995 to 2006. Starting 2007 Russell adopted a "banding" policy which introduces noise

[3]For example, it has been shown that an increase in passive institutional ownership leads to improvement in stock liquidity, which may negatively affect innovation. In addition, one may argue that the increase of passive institutional ownership could lead to increased monitoring, which should pose a positive impact on innovation given the longer term horizon of these institutions. If this is the dominant channel then we should expect to find a stronger effect for relatively poorly performing (or poorly governed) firms for which the probability of being targeted for governance change is greater. Yet, we find the opposite.

to the identification strategy. Therefore, we restrict our attention to years prior to the implementation of this banding policy. We obtain index membership data from Bloomberg, and merge it with firm-level financial data from Compustat, institutional ownership data from Thomson Reuters 13F filings, security market data from CRSP, executive compensation data from ExecuComp, and CEO employment data from BoardEx. Institutional investor types are constructed following Bushee and Noe (2000) and Bushee (2001). We obtain patent data from NBER and Leonid Kogan, Dimitris Papanikolaou, Amit Seru, and Noah Stoffman (KPSS) dataset.

During the month of June each year, FTSE Russell ranks, from the largest, all U.S. firms based on their market capitalization on the last trading day in May. The market capitalization is calculated by multiplying the closing price on the last trading day in May and the total number of common shares outstanding. When there are two or more classes of shares, Russell uses the share price of the class with the largest number of float shares. As Figure 1 shows, the first 1000 firms constitute the Russell 1000 index and the next 2000 firms are assigned to the Russell 2000 index. Rank zero indicates the cutoff point which is the 1000th rank in the descending sort of market capitalization. At the end of June each year, Russell Investments publishes the new index list and the financial market will follow the new list from the next trading day till June of the following year.

[Figure 1 about here]

For firms around rank 0 which is the cutoff point to determine the index membership, there is a fundamental reason to expect a discontinuous change in institutional ownership. As Figure 1 shows, firms around the threshold have comparable market sizes. Since firms cannot control small variations in market capitalization and its relative rank among firms of similar size on a given date, the assignment to different indexes is, to a certain extent, random. In addition, Russell indexes are value weighted, thus top firms in the Russell 2000 index, which are the largest firms in the Russell 2000 index, receive much higher weights than bottom firms in the Russell 1000 index, which are the smallest firms in the Russell

1000. Figure 2 plots the index weight and the market capitalization rank for firms in Russell 1000 and Russell 2000 around the 500 bandwidth from the cutoff point. We can see that the top firms in the Russell 2000 (rank from 0 to 500) receive much higher weights compared to the bottom firms in the Russell 1000 (rank from -500 to 0). And, as it is closer to the cutoff points, the difference becomes even larger. In fact, the index weight of the largest firm in Russell 2000 is about 10 times of the index weight of the smallest Russell 1000 firm.

[Figure 2 about here]

The Russell indexes attract a large amount of investments.[4] Overall, the dollar amount that passively tracks Russell 1000 index is around two times the dollar amount that tracks Russell 2000 index. Combined with the difference in index weights, the top firms in the Russell 2000 receive a greater dollar amount from index funds compared to the bottom Russell 1000 firms. The institutional holding for top firms in the Russell 2000 is correspondingly higher than the institutional holding for bottom firms in the Russell 1000 index. Figure 3 presents quasi-indexer ownership for firms within ±500-rank bandwidth around the threshold. The figure reveals that there is significant variation in passive institutional ownership for firms around the cutoff point: firms at the top of the Russell 2000 have a higher level of passive institutional holdings compared to the bottom firms in the Russell 1000 by about 8 percentage points. The difference becomes smaller the further away from the cutoff point. This evidence shows that the random assignment into different indexes leads to sharp differences in index weight and a subsequent exogenous change in passive institutional holdings.

[Figure 3 about here]

Since Russell Investment uses its proprietary data to calculate the market capitalization, which cannot be exactly identified using data from CRSP and Compustat, we use the actual

[4]According to Russell Investments' 2008 U.S. Equity Indexes: Institutional Benchmark Survey, the number of investment products benchmarked to the Russell 2000 is about 2/3 compared to the number benchmarked to the S&P 500; the dollar amount is about 1/7 compared to that of the S&P 500; and the ratios are increasing over time.

assignment instead of the end of May market capitalization as the instrument for passive institutional holdings in order to capture the relationship more precisely. In addition, as mentioned earlier in this section, starting from 2007, Russell introduced a "banding" rule to maintain consistency for index constitution. Under this new rule, only if a firm's market capitalization change is larger than a threshold, can it switch to the other index; otherwise, the firm would stay in its current index, which leads to stickiness in index membership.[5] To make sure that the random assignment assumption remains valid, we keep our sample period up to year 2006.

2.2 Summary statistics

Table 1 shows the summary statistics for the full panel of Russell 3000 firms (Panel A), the subsample of restricted bandwidth (±500) around Russell index reconstitution threshold (Panel B), and the subsample of ±300 rank bandwidth around the index reconstitution threshold (Panel C). For the full panel of Russell 3000 firms, on average, institutional holdings account for about 62% percent of a firm's total shares outstanding, and the median is around 64%. We categorize institutional investors based on their investment horizon and portfolio diversification (Bushee and Noe 2000; Bushee 2001) into three types: dedicated investors (long horizon, concentrated portfolio), quasi-indexers (long horizon, diversified portfolio), and transient investors (short horizon and diversified portfolio). For an average firm most of the institutional holdings are held by quasi-indexers, which account for 38% of firms' total shares outstanding. Transient investors account for 15% while dedicated investors account for 8%. Turning to firms' innovation activities, the total number of patents applied by and eventually granted to an average firm per year is around 17.5; for each patent, the number of citation is around 3.17 per year. We observe that for firms around the 25 percentile and the

[5]To be specific, firms are ranked in a descending order based on their end of May market capitalization, and a cumulative market capitalization starting from the largest firm is calculated for each firm. Then, the cumulative market capitalization is divided by total market capitalization of all Russell 3000E firms to get the market capitalization ratio for each firm. The "banding" rule requires that a firm jump into the other index only if its market capitalization ratio is more than ±2.5% away compared to the 1000th firm market capitalization ratio. As a result, this rule reduces the incidences of turnover around index constitution.

median, the patent number and citation per patent are zero, which indicates that innovation activity are mainly concentrated in a subset of firms. Due to the right-skewed distributions of patent counts and citations, we follow the literature and measure the dependent variables as the natural logarithm of one plus the number of patents or citation counts (we add one to the actual values when calculating the natural logarithm in order to avoid losing firm-year observations with zero patents or citations).

[Table 1 about here]

Following the corporate innovation literature, we control for a vector of firm characteristics that may affect innovation productivity. Our control variables include firm size (measured by the natural logarithm of total assets), firm age (measured by the natural logarithm of the number of years since first covered in Compustat), profitability (measured by ROA), investments in innovation (measured by R&D expenditure scaled by total assets), asset tangibility (measured by net PPE scaled by total assets), leverage, capital expenditure (scaled by total assets), product market competition (measured by the Herfindahl index based on sales), market-to-book ratio, and financial constraints (measured by the Kaplan and Zingales (1997) five-variable KZ index). To capture possible non-linear relation between product market competition and innovation (Aghion et al. 2013), we also include the squared Herfindahl index. Variable constructions are described in detail in the Appendix.

3 Methodology

Firms within a small bandwidth around the 1000th market capitalization rank threshold have similar sizes. However, those ranked just above and just below the threshold are assigned to different indexes. Since Russell indexes are value weighted, top firms in the Russell 2000 index have bigger index weights as they are the largest firms in the index, and bottom firms in the Russell 1000 index have smaller weights as they are the smallest firms in Russell 1000. The ratio of the index weights of the top Russell 2000 firms over the index weights of the bottom Russell 1000 firms is around 10:1. On the other hand, the ratio of the dollar amount that passively tracks the Russell 1000 index over the dollar amount that tracks the Russell 2000 index is around 2:1. Combining the two ratios, we find that the firms in Russell 2000 index attracts more investment dollars from passive institutional investors and have higher percentages of passive ownership than bottom firms in the Russell 1000 index. When we restrict our attention to a small bandwidth of firms around the Russell 1000/2000 index threshold, the sharp difference in the level of quasi-indexer ownership can be viewed as exogenous given that firms cannot precisely manipulate their relative market capitalization rankings. To identify a causal relation between quasi-indexer and innovation, we estimate the following two-stage-least-square model:

$$QIX_{i,t} = \alpha + \delta_0 Russell2000_{it} + f(Rank^*_{it}) + \delta_1 FloatAdj_{it} + X_{it}\pi + \sigma_t + \varepsilon_{it} \tag{1}$$

$$Innovation_{i,t+j} = \theta + \gamma_0 \widehat{QIX}_{it} + g(Rank^*_{it}) + \gamma_1 FloatAdj_{it} + X_{it}\rho + \lambda_t + \varepsilon_{it} \tag{2}$$

In the first stage regression equation (1), we use *Russell*2000, which indicates whether a firm belongs to the Russell 2000 after Russell index reconstitution, as the instrument variable for quasi-indexer ownership (QIX). The identifying assumptions are: i) an index assignment is determined by an arbitrary rule surrounding the 1000th largest rank of firm market capitalization, but the membership of the Russell 2000 index is correlated with high quasi-indexer ownership; and ii) whether the firm belongs to the Russell 2000 index is not directly correlated with firms' innovation outcomes. $f(Rank^*_{it})$ is a function of adjusted market capitalization rank ($Rank^*$), where $Rank^* = Rank - 1000$. In the main results, we choose the functional form to be linear, i.e., it includes terms of $(Rank - 1000)$ and $Russell2000 \times (Rank - 1000)$. $FloatAdj$ is a proxy for Russell index float adjustment, computed as the difference between end of May market capitalization rank and the actual rank assigned by Russell Investments in June. By including this variable, we also control the variation in index weight caused by Russell Investments' adjustment on float shares.

X stands for the vector of firm characteristics which includes firm size, market to book ratio, return on assets (ROA), KZ index, leverage, firm age, R&D input, market-to-book ratio, tangibility, Herfindahl index, Herfindahl index squared, as well as transient investor ownership and dedicated investor ownership. We also control for year and industry fixed effects.

In the second stage regression equation (2), we use the predicted values of QIX estimated from the first stage regression to tease out the causal effect of quasi-indexer ownership on firms' innovation outcomes. The outcome variables include the number of patents applied by the firm in the year that are later granted, the total citations of these patents, and the number of citations per patent. We measure the innovation outcomes for both the current year (t) and year t+3 since it may take time for innovation activities to be reflected in patents filings. The same set of controls are also included in the second stage regression. Standard errors are clustered by firm.

4 Empirical results

4.1 Panel regression of quasi-indexers' impact on innovation

We first run panel regressions to test the relation between quasi-indexer ownership and innovation activities based on the full sample of firms in both the Russell 1000 and Russell 2000 indices. Specifically, we run the following regression:

$$Innovation_{i,t+j} = \beta_0 + \beta_1 QIX_{it} + \beta_2 TRA_{it} + \beta_3 DED_{it} + X_{it}\eta + \mu_i + \theta_t + \varepsilon_{it} \qquad (3)$$

Table 2 presents the results. In columns 1 and 2, the dependent variables are patent quantity and are measured as the number of patents applied in the current year t or year t+3 that are later granted;[6] in columns 3 and 4, the dependent variables are citations per

[6]Note that, for all patent variables, we use the transformation of the natural logarithm of 1 plus the patent outcome variable.

patent of the patents applied in the current year t and year t+3; in columns 5 and 6, the dependent variables are the number of total citations of the patents applied in the current year t and year t+3; in column 7, the dependent variable is R&D scaled by assets in the current year t. The number of patents captures the quantity of innovation output, while the citations per patent and the number of total citations capture the quality of innovation output. R&D is a measure of innovation input.

[Table 2 about here]

As is shown, the coefficients of quasi-indexer ownership (QIX) are insignificant in all the regressions. From the results of panel regressions, passive institutional investor do not appear to affect corporate innovation. The coefficients on dedicated ownership (DED) reveal a much clearer pattern: there is a positive and significant effect of dedicated ownership on future innovation outcomes, with the results being stronger for patent counts and citations, but weaker for the quality measure of citations per patent. The results on dedicated institutional investor ownership are consistent with Aghion et al. (2013).

4.2 Firms around the index reconstitution threshold

Firms around the Russell index reconstitution threshold have comparable firm sizes, but are assigned to different indexes. Given that Russell indexes are value weighted, top firms in the Russell 2000 index have much higher index weights than bottom firms in the Russell 1000 index. While the difference in dollar amounts tracking the two indexes is not large enough to offset the index weight diffeerence, top firms in the Russell 2000 index receive more institutional investor dollars compared to bottom firms in the Russell 1000 index. Figure 3 shows this discontinuity around the cutoff point: top firms in the Russell 2000 index have higher quasi-indexers' holdings than bottom firms in the Russell 1000 index

It is also important to compare firm level characteristics between firms ranked at the bottom of the Russell 1000 index and firms ranked at the top of the Russell 2000 index.

Table 3 presents the comparison with statistics to test the difference in means of the two subsamples. When the bandwidth around the threshold is 500, firms on the two sides of the index threshold have significant differences along a number of dimensions. When we restrict the sample to a smaller bandwidth (±300), firms around the threshold become more similar with the only significant differences other than size being R&D spending and Herfindahl index. We include the full vector of firm characteristics in our regressions to control for these differences.

[Table 3 about here]

To implement the instrumental variable approach, we first test whether firms ranked at the top of the Russell 2000 index have a significantly higher level of institutional holdings, especially the ownership by quasi-indexers, compared to firms ranked at the bottom of the Russell 1000 index. Then we test whether such exogenous variation in quasi-indexer ownership has a causal impact on corporate innovation. Applying regression model of equation (1), we test whether there is exogenous variation in institutional holdings between firms belonging to the two indices, within a small bandwidth around the index threshold. Then we separate institutional holdings into dedicated , quasi-indexer, and transient ownership following the Bushee classification (Bushee and Noe 2000; Bushee 2001). The classification is based on investment diversification and turnover. Dedicated investors have long horizon holdings in a small number of firms. Quasi-indexers have long term investments in diversified firms. And transient investors have high portfolio turnover in diversified firms. So dedicated investors do not benchmark the index membership, instead, they cherry pick the stocks. In contrast, quasi indexers and transient investors have diversified portfolios, which is the main reason we can find an exogenous change in their holdings for top firms in the Russell 2000 compared to bottom firms in the Russell 1000. $f(Rank^*_{it})$ is a function based on firm's end of May market capitalization rank which includes $(Rank - 1000)$, and $Russell2000 \times (Rank - 1000)$, to account for the distance to the index threshold. $FloatAdj$ is the proxy for Russell index float adjustment, computed as the difference between the end of May market capitalization rank and the actual rank assigned by Russell Investments in June. The vector X includes the full set of firm-level controls.

[Table 4 about here]

Table 4 shows the first-stage regression results for different types of institutional investors. Panel A presents the results when the bandwidth is ± 500 while panel B shows the results when bandwidth equals ± 300. In column 1, the dependent variable is total institutional ownership whereas the dependent variables in the next three columns are dedicated institutional investor ownership, quasi-indexer ownership, and transient investor ownership, respectively. From panel A, we can see that in the first column there is a significant difference in institutional holding for firms around the cutoff: top firms in the Russell 2000 on average have 14% more institutional holdings compared to bottom firms in the Russell 1000, and it is statistically significant. Most of the difference comes from quasi-indexers: we can see from column 3, top firms in the Russell 2000 have around 7.4% more quasi-indexer ownership than bottom firms in the Russell 1000. There is no significant difference in holdings by dedicated investors from the results in column 2. From column 4, we can see there is also an exogenous variation in transient investors' holdings: firms in the top of the Russell 2000 have 5.1% more transient investor holdings compared to the bottom firms in the Russell 1000. Since there is significant difference in transient ownership, we also control for transient investors' ownership in the second stage regressions to mitigate the potential concern about transient investors' impact.

Next, we repeat the same regression for the sample of ± 300 bandwidth. Results are presented in panel B. We show that the inclusion in the Russell 2000 leads to a sharp difference in institutional holdings: firms in the top Russell 2000 have 19% more institutional ownership compared to bottom firms in the Russell 1000. Similar to the results in panel A, most of the difference comes from quasi indexers and transient investors, which account for 9% and 8% of the difference respectively. And for dedicated investors, there is no significant effect. As the bandwidth becomes smaller, the magnitude becomes larger since the difference in index weights also becomes larger. Figure 2 and Figure 3 can further explain the underlying reason: as it gets closer to the threshold, the difference of index weights between top firms in the Russell 2000 and bottom firms in the Russell 1000 becomes even larger, therefore the difference of institutional holdings also becomes larger.

4.3 The quasi-indexer effect on innovation

In this section, we test for the impact on firm innovation given the exogenous variation in quasi-indexer ownership around index cutoff. Table 5 shows the results from running a two stage least square regression as modeled in equations (1) and (2) when the dependent variables are the number of patent, the total number of citations, and the number of citations per patent of the patents applied in year t and year t+3. Panel A reports the results using the ±500 bandwidth around the index reconstitution threshold, and Panel B presents the results using the ±300 bandwidth. For all dependent variables, we use $ln(1 + Patent\,Outcome_{t+j})$ to adjust for the right skewness of patent outcome distribution.

[Table 5 about here]

In the first stage, we regress quasi-indexer ownership on $Russell200$, $f(Rank^{*})$, $FloatAdj$ and control variables. In the second stage, we regress patent outcome variables on the predicted values of quasi-indexer ownership from the first stage and other control variables. In general, the coefficients on quasi-indexer ownership are positive and significant. In Panel A where our sample consists of firms within 500 bandwidth of the index reconstitution threshold, a one percentage point increase in quasi-indexer ownership increase the number of patents, the total citations, and the number of citations per patent by 1.1%, 2.7%, and 1.3%, respectively, for all patents applied in year t and later granted. For patents applied in year t+3, a one percentage point increase in quasi-indexer ownership increase the number of patents, the total citations, and the number of citations per patent by 2%, 3.4%, and 1.2%, respectively. Note that the coefficients of the transient investor ownership (TRA) are negative, and significant when the output variables are the number of patents or the total citations. This is consistent with the arguments in Fang et al. (2014) and He et al. (2013) that transient investors exert pressure on firms to focus on the short time and reduce innovation. The results in Panel B where our sample consists of firms within 300 bandwidth of the index reconstitution threshold are qualitatively similar. Quasi-indexer ownership leads to more innovation.

Results in Table 5 show that an increase in passive investor ownership has a positive impact on firms' innovation output, measured both by the quantity and quality of patents filed. It is natural to ask: is there also a positive effect of passive ownership on innovation input? To answer this question, we run the second stage regression where we replace the outcome variable with R&D spending scaled by total assets. Table 6 presents the results. The coefficient on quasi-indexer ownership is positive and significant at the 5% level for the same year R&D input using the smaller bandwidth. Taken together, when passive ownership is higher, firms are motivated to spend more on R&D, file more patents and generate more high-quality patents. In terms of the economic magnitude, when estimated using the ±300 sample, a one percentage point increase in instrumented quasi-indexer ownership leads to an increase in $R\&D/Assets$ that represents 2.9% of its sample mean.

[Table 6 about here]

5 Underlying mechanisms and possible explanations

In this section, we investigate the mechanism through which quasi-indexer ownership enhances corporate innovation. Several potential channels could contribute to this positive casual effect. First of all, Appel, Gormley, and Keim (2016) show that although quasi-indexers are passive investors, they are not passive owners. Better corporate governance due to quasi-indexers could be one channel that increases corporate innovation quantity and quality. Second, we argue that the hands-off approach of passive investors may be beneficial to corporate innovation, especially for those firms who have performed well in the past and for whom the freedom to explore and innovate is important. In addition, we examine whether the existence of quasi-indexer alleviates CEOs' career concerns. Our results suggest that CEO turnover probability will be lower with greater quasi-indexer ownership. Finally, we test whether a higher level of quasi-indexer ownership is associated with a greater amount of non-executive employee stock option grants. Chang et al. (2015) find a positive effect of non-executive employee stock options on the quantity and quality of innovation outcomes. Our test shows that quasi-indexers play positive roles in this channel. The subsections below discuss the three underlying mechanisms in more detail.

5.1 Quasi-indexer and corporate governance

Using the same Russell 1000/2000 index reconstitution setting, Appel, Gormley, and Keim (2016) show that passive institutional investors influence a firms' governance choices: firms with exogeneously higher passive institutional investor ownership have more independent directors on the board and fewer protective takeover provisions. They show that passive institutional investors exert such influence through their large voting blocs. In fact, these two effects have proved to be critical for firms' innovation. On one hand, Balsmeier, Fleming, and Manso (2017) show that firms that transition to independent boards focus on more crowded and familiar areas of technology. They produce more patents and receive more total future citations to their patents. On the other hand, by comparing firms in states which pass antitakeover laws versus those firms located in states without antitakeover laws, Atanassov (2013) finds that the exogenous reduction in the threat of hostile takeovers dampens firms' innovation production not only in quantity but also in quality. In sum, quasi-indexers may enhance corporate innovation through the corporate governance channel given that the claims that increased independent directors and alleviated takeover provision caused by quasi-indexers can improve firms' innovation have been well documented in the prior literature.

5.2 Quasi-indexer as passive monitor

If the governance role of quasi-indexers serves as the dominant driver of our results, then we should expect to see a stronger effect on the relatively under-performing firms because they are more likely to be the subject of attention and face more pressure from passive investors who seek to improve firm performance by enhancing corporate governance. However, interestingly we observed the opposite pattern, i.e. the results are mainly driven by firms with past one-year return being in the top performer group, when we separate our main sample into two groups based on the stock performance measured in the twelve months preceding the end-of-June Russell index reconstitution. Table 7 presents the the subsample tests of the second-stage IV regressions of patent outcome on the instrumented value of QIX for the ±500-firm bandwidth subsample. Columns 1, 3, and 5 present results for the top performing firms; columns 2, 4, and 6 present results for the bottom performing firms. In Panel A, the dependent variable is the number of patents filed by the firm in the year, with the usual transformation of natural logarithm of 1 plus the patent outcome variable. We also use the one-year forward and three-year forward innovation measures to account the time delay for innovation outcome to materialize. In Panel B, the dependent variable is the number of total citation counts. In Panel C, the dependent variable is the number of citations per patent. Regardless of which innovation outcome variable we choose, the coefficients on QIX are significant only for the top performer group. When we further restrict our sample to include only ±300 firms around the index cutoff, we get very similar results and the significance becomes even stronger for the top-performing group.

[Table 7 about here]

The results from these subsample tests are consistent with a passive monitoring role played by the quasi-indexers. These institutional investors are passive longer-term investors and are not actively engaging themselves in changing the operating strategies of their portfolio firms. Nevertheless, the increased presence of such investors provides more flexibility and shift more power to the management team. This allows the managers to make long-term investment decisions that may not enhance short-term profit, or sometimes may even hurt the near-term profitability. This channel is similar to the one studied in Heath et al. (2018) which provides evidence that index funds do not influence firm-level outcomes through the two main monitoring channels, voice and exit, but rather through shifting power to the management.

5.3 Quasi-indexer and CEO turnover

In this part, we test the quasi-indexers' influence on managerial turnover. CEO turnover data comes from Execucomp and Boardex from 1995 to 2015. Stock returns are collected from CRSP. Table 8 shows the results of passive investors' impact on CEO turnover. The dependent variable equals one if the CEO is replaced in the subsequent year t+1. The first three columns show the results based on logit regression, and the last three columns show the results based on linear probability model. The results can be compared to Aghion et al. (2013), in which they show an insignificant correlation between institutional ownership and forced managerial turnover. We find that the proportion of equity owned by passive institutional investors significantly reduces the probability of CEO turnover. What is worth special attention is the interaction term between "idiosyncratic median" and quasi-indexer holdings. Idiosyncratic median is defined as the difference between a firm's annual return and the industry median annual return, and idiosyncratic mean is defined as the difference between a firm's annual return and the industry average annual return. These two measures capture a firm's relative performance with respect to its industry peers. Results from columns 2, 3, 5, and 6 indicate that the interaction term between quasi-indexer ownership and idiosyncratic returns are all negative and significant. which means that when a firm performs better than its peers in a given year, the CEO is less likely to be fired in the subsequent year if the firm has a large percentage of passive institutional investors. In other words, a higher level of passive institutional ownership provides CEOs, especially those who outperform the industry averages, greater job security. This is another piece of evidence that quasi-indexers are passive investors but not passive owners. They do not take it for granted and only focus on the stock returns, but also care about firms' relative performance compared to their industry peers.

[Table 8 about here]

5.4 Quasi-indexer and non-executive employee stock options

Innovation not only requires motivation and vision from the top management, but also relies on a team of talented people to conduct research and experiments. Tong, Mao, and Tian (2017) show that human capital fixed effect can explain a majority of the variation in innovation performance compared to the firm fixed effect. The last channel we propose is that quasi-indexers may improve corporate innovation by enhancing non-executive employees' incentives to innovate. Non-executive employees include inventors who are directly involved in R&D activities. Existing studies have shown that their incentives and performance play an essential role in the innovation process. For example, Chang et al. (2015) find a positive effect of non-executive employee stock options on the quantity and quality of innovation outcomes through a risk-taking incentive channel. The importance of equity incentive compensation is also emphasized by innovative firms themselves. For example, the 2007 proxy filing (DEF14A) of AMD Corp. includes the following statement: "the Board believes that long-term equity awards in the form of stock options, RSUs and PRSUs are an extremely important way to attract and retain key employees, including a talented executive team, and align the employees' and executives' interests with our stockholders."

We conjecture that passive institutional investors' preferences may be reflected in their portfolio firms' policies towards employee compensation and retention. As stated in the proxy voting guidelines of Vanguard, "compensation policies linked to long-term relative performance are fundamental drivers of sustainable, long-term value for a company's investors." The general view of passive institutional investors towards equity incentive plans is positive, which is evidenced by the statement that "appropriately designed stock-based compensation plans, administered by an independent committee of the board and approved by shareholders, can be an effective way to align the interests of long-term shareholders with the interests of management, employees, and directors." Lending some further support to this conjecture, Chen, Hong, and Lin (2018) use the Russell 1000/2000 index reconstitution setting to test the correlation between quasi-indexer ownership and corporate social responsibility. They find that increased quasi-indexer equity ownership improve firms' community, diversity, employee relation, environment, and product. In our study, we test whether greater quasi-indexer ownership increases non-executive employees' stock option grants. Employee stock options data is collected from Execucomp between 1995 and 2006.[7] We test quasi-indexers' impact on the value of non-executive employee options granted, and the number of non-executive employee options granted. In addition, to be consistent with Chang et al. (2015), we also scale the value and number of non-executive employee options granted by the number of employees, to calculate the corresponding value per employee. The results are presented in Table 9.

[Table 9 about here]

The dependent variables in Table 9 are value of non-executive options granted, the number of non-executive options granted, the value of non-executive options granted per employee, and the number of non-executive options granted per employee in the subsequent fiscal year. The value and number of options granted are measured in the natural logarithm form: ln(1+option value) and ln(1+option number). Column 1 and 2 show that quasi-indexer ownership has a significant positive effect on both the total value and the number of options granted to non-executive employees. Column 3 and 4 report the results for the value and number of options granted scaled by the number of non-executive employees. As shown, the coefficient on quasi-indexer ownership is positive in both columns with the effect

[7] The data sample ends by year 2006 because the key variable used to measure employee stock option grants, PCTTOTOPT (the percentage that each option grant to executives represents of options granted to all employees by a firm), is only available through fiscal year 2006.

being significant for the value of options granted per employee. Given Chang et al. (2015)'s evidence that options granted to non-executive employees enhance firm innovative activities, our finding suggests that the non-executive employee options granted is a possible channel for quasi-indexers' positive effect on firm innovation to take place.

6 Robustness check

To check if our main results are robust to alternative bandwidth choices, we rerun the two-stage least square regressions using a sample of ±250 ranks around index cutoff. Table 10 presents the results for a full set of outcome variables including total patents, total citations, citations per patent, and R&D spending. The effect of quasi-indexer ownership on innovation output and input still largely holds with 5% significance.

[Table 10 about here]

In our main regressions, the forward looking innovation outcomes are measured at year t+3. To verify that the quasi-indexer effect on these outcomes are robust to the choice of time lag, we replace the year t+3 outcome variables in the two-stage least square regressions with patent quantity and quality variables measured at year t+1 and t+2 instead. Table 11 presents the results for the ±300 firm bandwidth sample. As shown, the effect of quasi-indexer ownership on forward 1- and 2-year innovation outcomes remain positive and significant.

[Table 11 about here]

7 Conclusion

Institutional investors are important equity investors in the United States, and passive institutional investors are the fastest growing part among institutional investors. Prior literature shows mixed evidence about the role played by passive institutional investors on corporate innovation. This paper provides evidence that quasi-indexer ownership enhances corporate innovation. By exploiting the exogenous variation of institutional ownership around Russell 1000/2000 index reconstitution, we find that the exogenous increment of passive institutional ownership due to the Russel index assignments result in an increase in patent quantity and quality in both the current year and the subsequent years. This result complements the finding by Aghion et al. (2013), which only find a positive effect by dedicated institutional investors on corporate innovation.

Our study also contributes to the growing literature on passive institutional investors and corporate governance. Our evidence suggest that passive institutional investors are passive monitors in the sense that their increased presence allows more flexibility and transfers more power to the firm's management. We also show that passive institutional investors are perceptive when they evaluate CEO's performance by emphasizing the relative performance. Lastly, we find evidence that quasi-indexer ownership is associated with a greater amount of options granted to non-executive employees. Effective employee incentive is one additional channel we propose for the positive impact of passive institutional ownership on corporate innovation. These channels are not exhaustive, as there could be other mechanisms for passive institutional investors to alleviate managers' concern and encourage risky investment that requires further investigation.

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Figure 1 Russell index market cap

This figure plots the relation between firm market cap and corresponding end of May market cap ranking. The first 1000 firms go to the Russell 1000 and the subsequent 2000 firms go to the Russell 2000. The vertical line corresponds to firm market cap at the end of May. Rank in horizontal line indicates the distance to index threshold. Zero means the 1000th rank, which is the threshold for the index assignment. Negative numbers are for firms in the Russell 1000, and positive numbers are for firms in the Russell 2000.

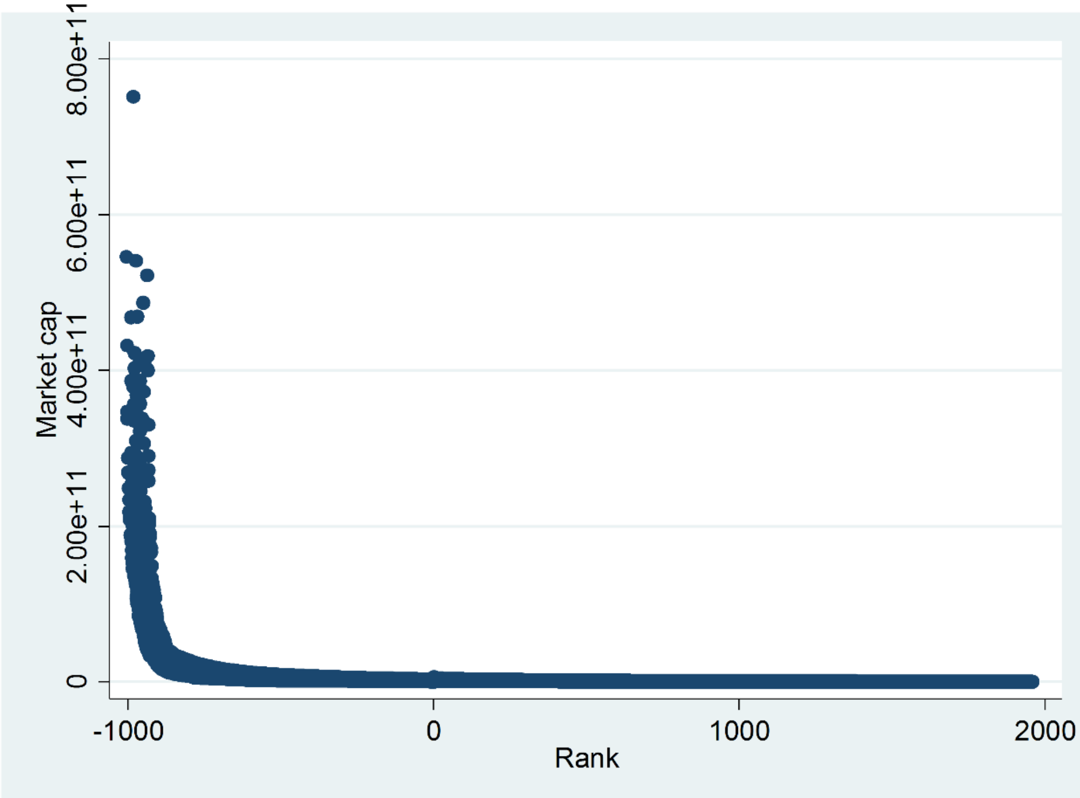

Figure 2 Russell index weight

This figure plots the relation between firm index weight and its market cap rank around threshold. The vertical line is the index weight in percentage and the horizontal line is the distance to the threshold based on market cap rank. Zero means the 1000th rank, which is the threshold for index assignment. Negative numbers are for firms in the Russell 1000, and positive numbers are for firms in the Russell 2000.

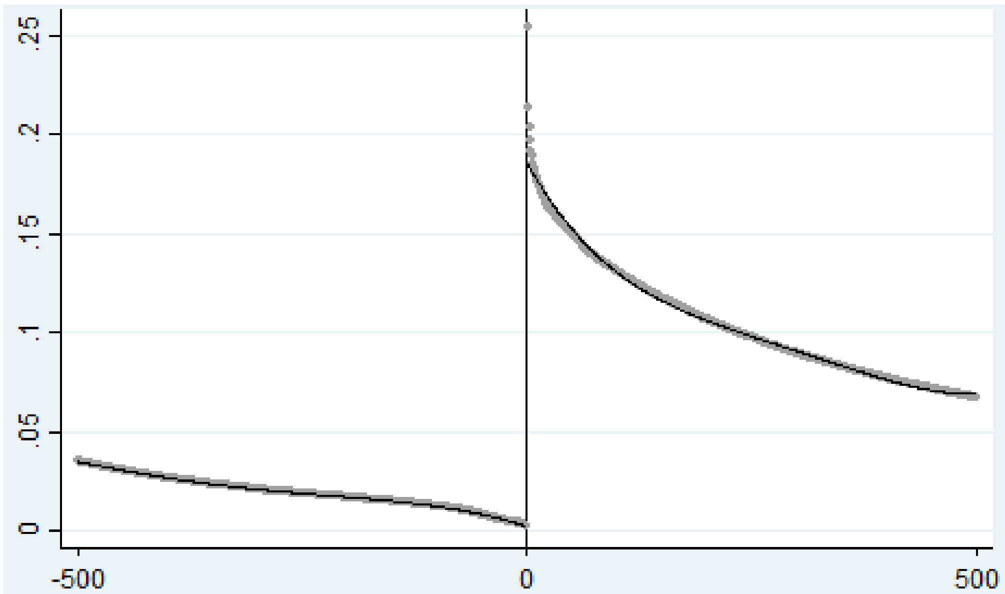

Figure 3 Russell index and quasi-indexer ownership

This figure plots the relation between quasi-indexer holdings and firm market cap rank around the index threshold. The vertical line is quasi-indexer holdings and the horizontal line is the market cap rank. Rank indicates the distance to threshold. Zero means the 1000th rank, which is the threshold for index assignment. Negative numbers are for firms in the Russell 1000, and positive numbers are for firms in the Russell 2000.

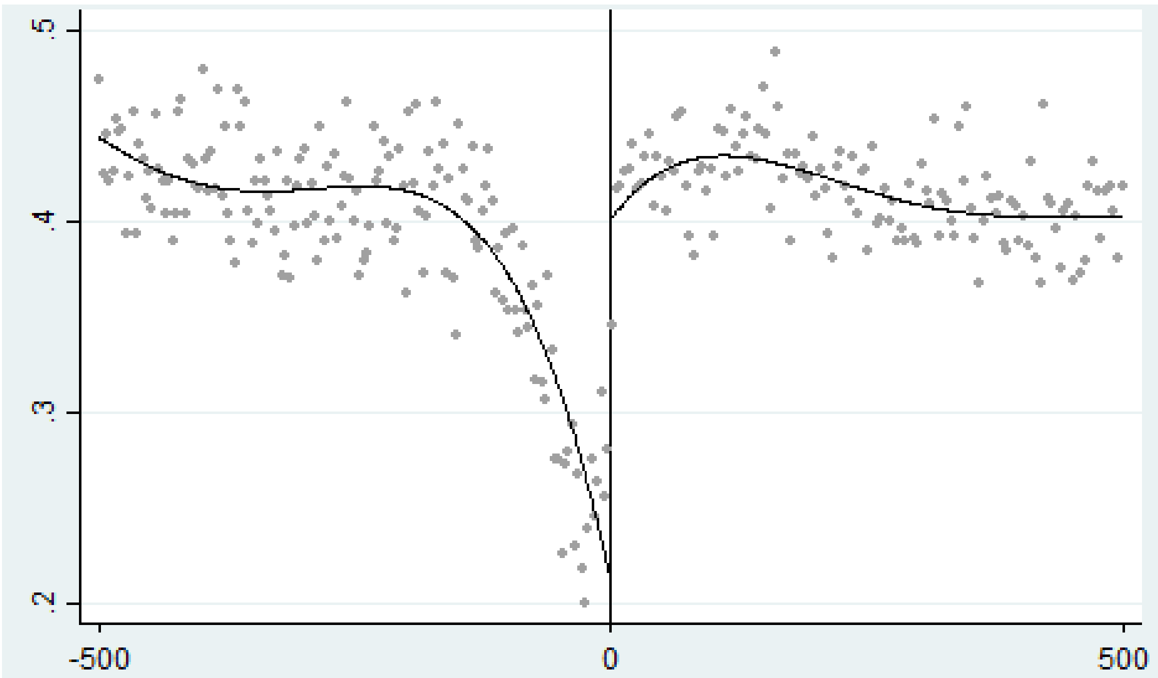

Table 1. Summary Statistics

This table reports the summary statistics of institutional holdings, innovation measures, and firm characteristics for firms in the Russell 1000 and the Russell 2000 indexes, from year 1995 to 2006. Panel A shows the statistics for the whole Russell sample, Panel B shows the statistics when bandwidth is ±500 and Panel C shows the statistics on bandwidth is ±300. The tables show each variable's number of observations, mean, standard deviation, 25 percentile value, median, and 75 percentile value. Variables are defined in the Appendix. All variables are winsorized at 1% levels.

Panel A. Full sample

	N	Mean	p25	p50	p75	Stdev
IO	26336	0.617	0.439	0.642	0.807	0.243
DED	26336	0.085	0.020	0.063	0.125	0.088
QIX	26336	0.380	0.249	0.380	0.499	0.178
TRA	26336	0.156	0.067	0.129	0.218	0.118
Patent	26336	17.579	0.000	0.000	3.000	119.283
Cites	26336	172.613	0.000	0.000	11.000	1598.618
Citepat	26336	3.757	0.000	0.000	2.143	12.925
Ln(Assets)	26336	6.807	5.670	6.645	7.778	1.585
ROA	26336	0.113	0.073	0.127	0.185	0.142
KZ Index	26336	-6.888	-6.040	-1.091	0.737	17.618
Leverage	26336	0.228	0.032	0.202	0.354	0.206
Ln(firm age)	26336	2.718	2.079	2.639	3.497	0.820
R&D/Assets	26336	0.041	0.000	0.000	0.048	0.077
MTB	26336	2.250	1.202	1.644	2.547	1.765
Tangibility	26336	0.282	0.092	0.213	0.421	0.234
CapExp/Assets	26336	0.062	0.023	0.044	0.078	0.060
Herfindahl	26336	0.201	0.084	0.152	0.265	0.162

Panel B. Bandwidth ±500

	N	Mean	p25	p50	p75	Stdev
IO	9590	0.685	0.534	0.720	0.869	0.230
DED	9590	0.096	0.027	0.075	0.138	0.096
QIX	9590	0.416	0.298	0.418	0.528	0.172
TRA	9590	0.180	0.085	0.157	0.248	0.124
Patent	9590	6.936	0.000	0.000	4.000	25.771
Cites	9590	66.397	0.000	0.000	13.000	345.022
Citepat	9590	3.890	0.000	0.000	2.400	13.493
Ln(Assets)	9590	7.135	6.423	7.133	7.807	1.045
ROA	9590	0.136	0.089	0.135	0.191	0.109
KZ Index	9590	-6.093	-5.065	-0.763	0.788	16.605
Leverage	9590	0.243	0.066	0.233	0.360	0.197
Ln(firm age)	9590	2.804	2.197	2.773	3.584	0.800
R&D/Assets	9590	0.030	0.000	0.000	0.034	0.059

MTB	9590	2.203	1.219	1.642	2.446	1.701
Tangibility	9590	0.303	0.107	0.235	0.458	0.240
CapExp/Assets	9590	0.063	0.024	0.046	0.079	0.060
Herfindahl	9590	0.195	0.083	0.147	0.260	0.156

Panel C. Bandwidth ±300

	N	Mean	p25	p50	p75	Stdev
IO	5719	0.678	0.517	0.714	0.870	0.239
DED	5719	0.096	0.026	0.073	0.137	0.099
QIX	5719	0.409	0.287	0.411	0.526	0.176
TRA	5719	0.182	0.084	0.157	0.249	0.127
Patent	5719	5.759	0.000	0.000	3.000	17.679
Cites	5719	52.749	0.000	0.000	10.000	216.033
Citepat	5719	3.825	0.000	0.000	2.000	13.210
Ln(Assets)	5719	7.114	6.462	7.101	7.729	0.984
ROA	5719	0.138	0.089	0.135	0.193	0.107
KZ Index	5719	-6.308	-4.921	-0.711	0.767	17.033
Leverage	5719	0.240	0.063	0.229	0.356	0.198
Ln(firm age)	5719	2.758	2.079	2.708	3.526	0.806
R&D/Assets	5719	0.029	0.000	0.000	0.031	0.059
MTB	5719	2.223	1.209	1.624	2.454	1.766
Tangibility	5719	0.305	0.109	0.237	0.460	0.241
CapExp/Assets	5719	0.064	0.025	0.046	0.080	0.061
Herfindahl	5719	0.195	0.083	0.146	0.259	0.156

Table 2. Panel regression results for institutional investors' effects on firm innovation

This table presents the results from panel regressions of innovation related measures and R&D expenditures on different types of institutional ownership: quasi-indexer, dedicated investor, and transient investors, in addition to firm characteristics, and year, firm fixed effects. Column 1 shows the regression for patent count in year t. Column 2 shows the result for patent number in year t+3. Columns 3 and 4 represent the results for citations per patent (Citepat) in year t and year t+3 , columns 5 and 6 represent the results for the number of citations (Cites) in year t and year t+3, and column 7 shows the results on R&D expenditures. Coefficients are reported with standard error statistics in parentheses. Variables are defined in the Appendix. ***, ** and* indicate significance at the 1%, 5%, and 10% levels using the two-tailed test. Standard errors are clustered at the firm level and reported in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Ln(Patent)	f3.Ln(Patent)	Ln(Citepat)	f3.Ln(Citepat)	ln(Cites)	f3.Ln(Cites)	R&D/Assets
QIX	-0.046	0.008	0.015	-0.042	0.025	0.001	-0.003
	(0.04)	(0.05)	(0.05)	(0.04)	(0.07)	(0.07)	(0.00)
DED	0.011	0.197***	0.052	0.107*	0.060	0.284**	-0.001
	(0.05)	(0.07)	(0.08)	(0.06)	(0.11)	(0.11)	(0.00)
TRA	-0.137***	0.065	0.008	0.119**	-0.091	0.228***	-0.010***
	(0.04)	(0.05)	(0.06)	(0.05)	(0.09)	(0.09)	(0.00)
Ln(Assets)	0.186***	0.122***	0.123***	0.028**	0.323***	0.136***	-0.015***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.00)
ROA	-0.087*	0.175***	0.151**	0.351***	0.007	0.588***	-0.095***
	(0.05)	(0.06)	(0.07)	(0.06)	(0.10)	(0.10)	(0.00)
KZ Index	0.001*	-0.000	-0.001**	-0.002***	-0.001	-0.002**	0.001***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Leverage	-0.133***	-0.206***	-0.319***	-0.183***	-0.499***	-0.381***	-0.005***
	(0.03)	(0.04)	(0.05)	(0.04)	(0.07)	(0.07)	(0.00)
Ln(firm age)	0.025	-0.118***	-0.009	-0.021	0.045	-0.095**	0.006***
	(0.02)	(0.03)	(0.03)	(0.03)	(0.05)	(0.05)	(0.00)
R&D/Assets	0.528***	0.045	1.426***	0.696***	2.014***	0.955***	
	(0.13)	(0.16)	(0.18)	(0.15)	(0.27)	(0.26)	
MTB	0.012***	0.028***	0.052***	0.011***	0.071***	0.036***	0.003***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)
Tangibility	0.354***	0.426***	0.519***	0.410***	0.955***	0.895***	0.036***
	(0.06)	(0.08)	(0.09)	(0.07)	(0.13)	(0.13)	(0.00)
CapExp/Assets	-0.124	0.145	-0.211	0.214*	-0.317	0.375*	0.034***

	(0.11)	(0.13)	(0.15)	(0.12)	(0.22)	(0.22)	(0.01)
Herfindahl	-0.206	0.807***	0.804***	0.895***	1.037***	1.692***	-0.015*
	(0.16)	(0.21)	(0.23)	(0.19)	(0.33)	(0.33)	(0.01)
Herfindahl^2	0.362*	-0.976***	-0.801***	-1.072***	-0.964**	-2.011***	0.018*
	(0.19)	(0.24)	(0.26)	(0.22)	(0.38)	(0.38)	(0.01)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26,336	26,336	26,336	26,336	26,336	26,336	26,336
R-Squared	0.037	0.043	0.175	0.164	0.151	0.129	0.194

Table 3 Firm characteristics comparison around the index threshold

This table compares firm characteristics for firms around the threshold that fall into different indexes. The bandwidth is ±500 for Panel A and ±300 for Panel B. Russell 2000 indicates firms that belong to the Russell 2000 and Russell 1000 indicates firms that belong to the Russell 1000. The last column in each bandwidth indicates difference between the two groups and whether the difference is significant from a t-test.

	Bandwidth= ±500			Bandwidth= ±300		
	Russell 2000	Russell 1000	Difference	Russell 2000	Russell 1000	Difference
Ln(Assets)	6.914	7.765	0.850***	7.066	7.600	0.534***
ROA	0.125	0.135	0.010***	0.130	0.133	0.003
KZ Index	-6.950	-6.499	0.451	-6.819	-7.045	-0.225
Leverage	0.246	0.256	0.009*	0.245	0.252	0.007
Ln(firm age)	2.671	2.815	0.144***	2.710	2.702	-0.008
R&D/Assets	0.029	0.021	-0.008***	0.027	0.022	-0.006***
MTB	2.095	2.151	0.056	2.094	2.176	0.082
Tangibility	0.258	0.275	0.017***	0.264	0.270	0.006
CapExp/Assets	0.059	0.060	0.001	0.059	0.062	0.003*
Herfindahl	0.172	0.184	0.012***	0.171	0.186	0.014***

Table 4 Difference in institutional ownership around Russell index threshold

This table shows the difference in institutional holdings for firms belonging to different indexes around the index threshold. The result represents the first stage estimation and separate institutional holdings into dedicated investors, quasi indexers and transient based on Bushee classification:

$IO_{i,t} = \alpha_t + \delta_0 Russell2000_{it} + f(Rank^*_{it}) + \delta_1 FloatAdj_{it} + X_{it}\pi + \sigma_t + \varepsilon_{it}$

Russell2000 is a dummy variable which indicates whether the firm is included in the Russell 2000 index. The regression includes year and industry fixed effects. Column 1 shows the results on total institutional holdings (IO), column 2 shows the results on dedicated investors (DED), column 3 shows the results on quasi-indexers (QIX), and column 4 shows the results on transient investors (TRA). Panel A represents the results when the window size is ±500, and panel B represents the results when the window size is ±300. Standard errors are clustered at the firm level and reported in parentheses. Variables are defined in the Appendix. ***, ** and* indicate significance at the 1%, 5%, and 10% levels using the two-tailed test.

Panel A. Bandwidth=±500

	(1) IO	(2) DED	(3) QIX	(4) TRA
Russell2000	0.142***	0.010*	0.074***	0.051***
	(0.01)	(0.01)	(0.01)	(0.01)
(Rank-1000)	-0.174***	-0.012	-0.099***	-0.053***
	(0.03)	(0.02)	(0.03)	(0.02)
(Rank-1000)*Russell2000	-0.134***	-0.019	-0.036	-0.066***
	(0.04)	(0.02)	(0.03)	(0.02)
FloatAdj	0.525***	0.050**	0.223***	0.224***
	(0.04)	(0.02)	(0.02)	(0.01)
Ln(Assets)	0.012*	0.019***	-0.008	-0.000
	(0.01)	(0.00)	(0.00)	(0.00)
ROA	0.283***	-0.010	0.226***	0.080***
	(0.04)	(0.02)	(0.02)	(0.02)
KZ Index	0.001*	0.000	0.000***	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Leverage	0.057**	0.014	-0.002	0.049***
	(0.02)	(0.01)	(0.02)	(0.01)
Ln(Firm age)	0.004	0.004	0.031***	-0.028***
	(0.01)	(0.00)	(0.00)	(0.00)
R&D/Assets	0.121	0.063*	-0.022	0.055
	(0.09)	(0.04)	(0.05)	(0.04)
MTB	-0.009***	0.001	-0.019***	0.008***
	(0.00)	(0.00)	(0.00)	(0.00)
Tangibility	-0.077**	0.015	0.028	-0.107***
	(0.03)	(0.02)	(0.02)	(0.01)
CapExp/Assets	0.026	-0.060	-0.091*	0.140***
	(0.07)	(0.04)	(0.05)	(0.04)
Herfindahl	0.096	0.057	0.081	-0.056
	(0.09)	(0.04)	(0.06)	(0.05)

Herfindahl Sq	-0.062	-0.082*	-0.033	0.095
	(0.12)	(0.05)	(0.09)	(0.06)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	9674	9591	9590	9672
R-squared	0.381	0.099	0.374	0.263

Panel B. Bandwidth=±300

	(1) IO	(2) DED	(3) QIX	(4) TRA
Russell 2000	0.189***	0.011	0.087***	0.077***
	(0.02)	(0.01)	(0.01)	(0.01)
(Rank-1000)	-0.313***	-0.013	-0.100***	-0.169***
	(0.06)	(0.03)	(0.04)	(0.03)
(Rank-1000)*Russell 2000	-0.215***	-0.019	-0.154***	-0.032
	(0.06)	(0.04)	(0.03)	(0.03)
FloatAdj	0.704***	0.055	0.300***	0.301***
	(0.06)	(0.03)	(0.03)	(0.02)
Ln(Assets)	0.013	0.022***	-0.005	-0.005
	(0.01)	(0.01)	(0.01)	(0.00)
ROA	0.244***	-0.023	0.202***	0.067***
	(0.04)	(0.02)	(0.03)	(0.02)
KZ Index	0.000	0.000	0.000**	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Leverage	0.054**	0.006	-0.006	0.058***
	(0.03)	(0.01)	(0.02)	(0.01)
Ln(firm age)	0.003	0.005	0.029***	-0.028***
	(0.01)	(0.00)	(0.00)	(0.00)
R&D/Assets	0.123	0.074	-0.043	0.047
	(0.10)	(0.05)	(0.06)	(0.05)
MTB	-0.010***	0.001	-0.018***	0.005***
	(0.00)	(0.00)	(0.00)	(0.00)
Tangibility	-0.090**	0.021	0.014	-0.105***
	(0.04)	(0.02)	(0.03)	(0.02)
CapExp/Assets	0.088	-0.057	-0.010	0.116**
	(0.09)	(0.05)	(0.06)	(0.05)
Herfindahl	0.113	0.063	0.073	-0.046
	(0.11)	(0.04)	(0.07)	(0.06)
Herfindahl Sq	-0.054	-0.094*	0.008	0.096
	(0.15)	(0.06)	(0.11)	(0.08)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	5773	5720	5719	5771
R-squared	0.400	0.100	0.392	0.276

Table 5. Quasi-indexer's impact on firm innovation activities: IV estimates

This table represents the two-stage instrumental variable regression based on the equations as below: first stage uses whether firm is belonging to Russell 2000 as an instrument to predict quasi-indexer ownership:

$$QIX_{i,t} = \alpha_t + \delta_0 Russell2000_{it} + f(Rank^*_{it}) + \delta_1 FloatAdj_{it} + X_{it}\pi + \sigma_t + \varepsilon_{it}$$

The second stage regression uses the predicted QIX obtained from the first stage to test the effects on firm innovation activities which include patent number, citation and citation per patent:

$$Innovation_{i,t+j} = \theta_t + \gamma_0 \widehat{QIX_{it}} + g(Rank^*_{it}) + \gamma_1 FloatAdj_{it} + X_{it}\rho + \lambda_t + \epsilon_{it}$$

All results are estimated using ranks implied by firms' end of May market capitalization within the assigned index as of the index assignment date. Panel A is for bandwidth ±500, and Panel B is for bandwidth ±300. Column 1 shows the regression for patent count in year t. Column 2 shows the result for patent number in year t+3. Columns 3 and 4 represent the results for the number of citations (Cites) in year t and year t+3, and columns 5 and 6 represent the results for citations per patent (Citepat) in year t and year t+3 accordingly. Both stages include year and industry fixed effect. Standard errors are clustered by firm and reported in parentheses. Variables are defined in the Appendix. ***, ** and* indicate significance at the 1%, 5%, and 10% levels using the two-tailed test.

Panel A. Bandwidth=±500

	(1)	(2)	(3)	(4)	(5)	(6)
First stage	QIX	QIX	QIX	QIX	QIX	QIX
Russell 2000	0.074***	0.074***	0.074***	0.074***	0.074***	0.074***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
	Ln(Patent)	f3.Ln(Patent)	Ln(Cites)	f3.Ln(Cites)	Ln(CitePat)	f3.Ln(CitePat)
QIX	1.146*	2.044***	2.681**	3.371***	1.256**	1.228**
	(0.67)	(0.68)	(1.10)	(1.06)	(0.59)	(0.49)
TRA	-0.435***	-0.383**	-0.670**	-0.552*	-0.145	-0.105
	(0.17)	(0.19)	(0.29)	(0.29)	(0.15)	(0.13)
DED	-0.321	-0.380**	-0.553*	-0.608**	-0.223	-0.270**
	(0.20)	(0.19)	(0.31)	(0.27)	(0.14)	(0.11)
(Rank-1000)	-0.001***	-0.001***	-0.001***	-0.001***	-0.000***	-0.000***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
(Rank-1000)*Russell2000	0.000*	0.000	0.001**	0.000	0.000***	0.000*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
FloatAdj	0.000**	0.000	0.000	0.000	-0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln(Assets)	0.204***	0.206***	0.333***	0.267***	0.129***	0.080***
	(0.04)	(0.04)	(0.06)	(0.05)	(0.03)	(0.02)

ROA	-0.331	-0.191	-0.321	-0.040	-0.098	0.062
	(0.23)	(0.26)	(0.39)	(0.40)	(0.21)	(0.18)
KZ Index	0.002*	-0.000	0.001	-0.001	-0.001	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Leverage	-0.296***	-0.387***	-0.656***	-0.559***	-0.392***	-0.262***
	(0.11)	(0.11)	(0.18)	(0.16)	(0.09)	(0.07)
Ln(firm age)	0.055	0.014	0.003	-0.043	-0.015	-0.019
	(0.04)	(0.04)	(0.07)	(0.06)	(0.03)	(0.03)
R&D/Assets	6.537***	5.070***	9.824***	7.063***	4.062***	2.666***
	(0.55)	(0.60)	(0.90)	(0.89)	(0.45)	(0.38)
MTB	0.010	0.054***	0.083***	0.092***	0.067***	0.036**
	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.01)
Tangibility	-0.190	-0.319*	-0.310	-0.468*	-0.123	-0.158
	(0.16)	(0.17)	(0.26)	(0.25)	(0.13)	(0.11)
CapExp/Assets	0.916***	0.713**	1.563***	1.164**	0.643**	0.424*
	(0.32)	(0.35)	(0.56)	(0.54)	(0.31)	(0.25)
Herfindahl	-0.614	-0.598	-0.822	-0.806	-0.327	-0.185
	(0.47)	(0.50)	(0.77)	(0.76)	(0.38)	(0.33)
Herfindahl Sq	0.819	0.457	0.935	0.517	0.432	0.117
	(0.62)	(0.67)	(1.03)	(1.04)	(0.50)	(0.44)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9590	9590	9590	9590	9590	9590
R-squared	0.477	0.337	0.417	0.283	0.348	0.249

Panel B. Bandwidth=±300

	(1)	(2)	(3)	(4)	(5)	(6)
First stage	QIX	QIX	QIX	QIX	QIX	QIX
Russell 2000	0.087***	0.087***	0.087***	0.087***	0.087***	0.087***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
	Ln(Patent)	f3.Ln(Patent)	Ln(Cites)	f3.Ln(Cites)	Ln(CitePat)	f3.Ln(CitePat)
QIX	1.699**	1.915**	3.747***	3.309***	1.902***	1.391**
	(0.76)	(0.77)	(1.30)	(1.21)	(0.72)	(0.57)
TRA	-0.485**	-0.400*	-0.808**	-0.622*	-0.217	-0.159
	(0.21)	(0.23)	(0.38)	(0.36)	(0.21)	(0.16)
DED	-0.268	-0.338*	-0.585*	-0.550*	-0.258	-0.224*
	(0.21)	(0.20)	(0.35)	(0.31)	(0.17)	(0.13)
(Rank-1000)	-0.001***	-0.001**	-0.001***	-0.001***	-0.001***	-0.000***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
(Rank-1000)*Russell2000	0.000	0.000	0.001	0.001	0.001**	0.000**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
FloatAdj	0.000	0.000	0.000	0.000	-0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln(Assets)	0.214***	0.198***	0.357***	0.247***	0.142***	0.071***
	(0.04)	(0.04)	(0.07)	(0.06)	(0.03)	(0.03)
ROA	-0.553**	-0.341	-0.454	-0.226	-0.028	-0.015
	(0.26)	(0.28)	(0.44)	(0.44)	(0.25)	(0.20)
KZ Index	0.002	0.001	0.000	-0.000	-0.001	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Leverage	-0.427***	-0.437***	-0.837***	-0.565***	-0.426***	-0.252***
	(0.13)	(0.13)	(0.21)	(0.19)	(0.11)	(0.08)
Ln(firm age)	0.003	-0.013	-0.086	-0.074	-0.053	-0.037
	(0.04)	(0.04)	(0.07)	(0.07)	(0.04)	(0.03)
R&D/Assets	6.662***	5.222***	10.137***	7.277***	4.442***	2.756***
	(0.62)	(0.68)	(1.03)	(1.00)	(0.53)	(0.43)
MTB	0.032*	0.059***	0.103***	0.094***	0.067***	0.035**
	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)
Tangibility	-0.196	-0.253	-0.378	-0.363	-0.176	-0.098

	(0.17)	(0.18)	(0.28)	(0.26)	(0.15)	(0.11)
CapExp/Assets	0.995***	0.556	2.008***	0.926	0.929**	0.323
	(0.38)	(0.40)	(0.67)	(0.62)	(0.39)	(0.29)
Herfindahl	-0.773	-0.533	-1.016	-0.527	-0.367	0.018
	(0.50)	(0.53)	(0.87)	(0.82)	(0.46)	(0.37)
Herfindahl Sq	0.911	0.280	0.847	-0.073	0.267	-0.260
	(0.67)	(0.70)	(1.16)	(1.10)	(0.60)	(0.49)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5719	5719	5719	5719	5719	5719
R-squared	0.451	0.321	0.373	0.264	0.309	0.228

Table 6. Institutional ownership effects on R&D expenditures: IV estimates
This table represents the two-stage least square regressions. The first stage uses whether firm is belonging to Russell 2000 as an instrument to predict quasi-indexer ownership:

$$QIX_{i,t} = \alpha_t + \delta_0 Russell2000_{it} + f(Rank^*_{it}) + \delta_1 FloatAdj_{it} + X_{it}\pi + \sigma_t + \varepsilon_{it}$$

The second stage regression uses the predicted QIX obtained in the first stage to test the effects on firm R&D expenditure:

$$(\frac{R\&D}{Assets})_{i,t+j} = \theta_t + \gamma_0 \widehat{QIX_{it}} + g(Rank^*_{it}) + \gamma_1 FloatAdj_{it} + X_{it}\rho + \lambda_t + \epsilon_{it}$$

All results are estimated using ranks implied by firms' end of May market capitalization within the assigned index as of the index assignment date. Columns 1 and 2 show the results for bandwidth equals ±500 while columns 3 and 4 show the results for bandwidth equals ±300. Both stages include year and industry fixed effect. Standard errors are clustered by firm and reported in parentheses. Variables are defined in the Appendix. ***, ** and* indicate significance at the 1%, 5%, and 10% levels using the two-tailed test.

	(1)	(2)	(3)	(4)
	Bandwidth=±500		Bandwidth=±300	
	R&D/Assets	f3.(R&D/Assets)	R&D/Assets	f3.(R&D/Assets)
QIX	0.050*	0.054	0.090**	0.071*
	(0.03)	(0.03)	(0.04)	(0.04)
TRA	0.002	0.006	-0.008	0.002
	(0.01)	(0.01)	(0.01)	(0.01)
DED	0.012	0.008	0.012	0.007
	(0.01)	(0.01)	(0.01)	(0.01)
(Rank-1000)	-0.027***	-0.032***	-0.044***	-0.044***
	(0.00)	(0.01)	(0.01)	(0.01)
(Rank-1000)*Russell 2000	0.012*	0.019***	0.029***	0.036***
	(0.01)	(0.01)	(0.01)	(0.01)
FloatAdj	0.008	0.015**	0.012	0.020**
	(0.01)	(0.01)	(0.01)	(0.01)
Ln(Assets)	-0.018***	-0.017***	-0.018***	-0.017***
	(0.00)	(0.00)	(0.00)	(0.00)
ROA	-0.218***	-0.234***	-0.215***	-0.224***
	(0.01)	(0.02)	(0.02)	(0.02)
KZ Index	0.000**	-0.000***	0.000	-0.000***
	(0.00)	(0.00)	(0.00)	(0.00)
Leverage	-0.008	-0.008	-0.002	-0.001
	(0.01)	(0.01)	(0.01)	(0.01)
Ln(firm age)	-0.002	-0.005***	-0.004*	-0.005***
	(0.00)	(0.00)	(0.00)	(0.00)
MTB	0.007***	0.006***	0.008***	0.006***
	(0.00)	(0.00)	(0.00)	(0.00)
Tangibility	-0.024***	-0.026***	-0.030***	-0.028***
	(0.01)	(0.01)	(0.01)	(0.01)

CapExp/Assets	0.033**	0.034*	0.026	0.036
	(0.02)	(0.02)	(0.02)	(0.02)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	9590	8099	5719	4823
R-squared	0.505	0.487	0.451	0.454

Table 7. Subsample tests based on firm performance

This table reports the subsample tests of the second-stage IV regressions of patent outcome on instrumented value of QIX. The ±500 rank bandwidth sample is equally divided into two groups based on the stock performance measured in the twelve months preceding the end-of-June Russell index reconstitution. Columns 1, 3, and 5 present results for the top performing firms; columns 2, 4, and 6 present results for bottom performing firms. In Panel A, the dependent variable is Ln(Patent), forward one-year patent number f1.ln(patent), and forward three-year patent number f3.Ln(Patent). In Panel B, the dependent variable is Ln(Cites), forward one-year citation number f1.ln(cites), and forward three-year citation number f3.Ln(Cites). In Panel C, the dependent variable is Ln(CitePat), forward one-year citation per patent f1.ln(Citepat) and forward three-year Citation per patent f3.Ln(CitePat). All results are estimated using ranks implied by firms' end of May market capitalization within the assigned index as of the index assignment date. Both stages include year and industry fixed effect. Standard errors are clustered by firm and reported in parentheses. Variables are defined in the Appendix. ***, ** and* indicate significance at the 1%, 5%, and 10% levels using the two-tailed test.

Panel A. Results on Ln(Patent)

	Top	Bottom	Top	Bottom	Top	Bottom
	(1)	(2)	(3)	(4)	(5)	(6)
	Ln(Patent)	Ln(Patent)	f1.Ln(Patent)	f1.Ln(Patent)	f3.Ln(Patent)	f3.Ln(Patent)
QIX	1.233*	0.856	1.782**	0.969	2.332***	1.438
	(0.72)	(0.85)	(0.73)	(0.84)	(0.76)	(0.89)
(Rank-1000)	-0.554***	-0.673***	-0.486***	-0.613***	-0.456***	-0.720***
	(0.14)	(0.16)	(0.14)	(0.16)	(0.16)	(0.15)
(Rank-1000)*Russell2000	0.233	0.368*	0.272	0.255	0.183	0.337*
	(0.19)	(0.20)	(0.19)	(0.20)	(0.20)	(0.20)
FloatAdj	0.242	0.392**	0.172	0.335*	0.197	0.258
	(0.16)	(0.19)	(0.16)	(0.19)	(0.17)	(0.20)
TRA	-0.373**	-0.320	-0.318*	-0.331	-0.324*	-0.365
	(0.17)	(0.29)	(0.18)	(0.30)	(0.19)	(0.32)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4750	4921	4750	4921	4750	4921

Panel B. Results on Ln(Cites)

	Top	Bottom	Top	Bottom	Top	Bottom
	(1)	(2)	(3)	(4)	(5)	(6)
	Ln(Cites)	Ln(Cites)	f1.Ln(Cites)	f1.Ln(Cites)	f3.Ln(Cites)	f3.Ln(Cites)
QIX	3.231**	1.956	3.340***	1.715	4.140***	2.115
	(1.26)	(1.39)	(1.22)	(1.35)	(1.21)	(1.36)
(Rank-1000)	-0.788***	-1.064***	-0.645***	-0.967***	-0.670***	-1.036***
	(0.24)	(0.25)	(0.23)	(0.24)	(0.24)	(0.22)
(Rank-1000)*Russell2000	0.646*	0.650**	0.613*	0.501	0.245	0.607**
	(0.33)	(0.32)	(0.32)	(0.31)	(0.32)	(0.29)
FloatAdj	0.037	0.426	0.029	0.304	0.268	0.264
	(0.28)	(0.31)	(0.27)	(0.30)	(0.27)	(0.29)
TRA	-0.525*	-0.677	-0.288	-0.690	-0.397	-0.641
	(0.31)	(0.51)	(0.31)	(0.48)	(0.31)	(0.47)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4750	4921	4750	4921	4750	4921

Panel C. Results on Ln(Cites/Patent)

	Top	Bottom	Top	Bottom	Top	Bottom
	(1)	(2)	(3)	(4)	(5)	(6)
	Ln(CitePat)	Ln(CitePat)	f1.Ln(CitePat)	f1.Ln(CitePat)	f3.Ln(CitePat)	f3.Ln(CitePat)
QIX	1.800**	0.718	1.450**	0.520	1.711***	0.547
	(0.74)	(0.74)	(0.66)	(0.70)	(0.61)	(0.62)
(Rank-1000)	-0.294**	-0.429***	-0.185	-0.386***	-0.281**	-0.362***
	(0.14)	(0.12)	(0.12)	(0.11)	(0.11)	(0.09)
(Rank-1000)*Russell2000	0.395**	0.320**	0.324**	0.272*	0.156	0.246*
	(0.19)	(0.16)	(0.16)	(0.15)	(0.15)	(0.13)
FloatAdj	-0.125	0.088	-0.095	0.032	0.072	0.097
	(0.16)	(0.16)	(0.15)	(0.15)	(0.13)	(0.13)
TRA	-0.120	-0.143	0.060	-0.204	-0.057	-0.149
	(0.18)	(0.26)	(0.16)	(0.24)	(0.15)	(0.20)

Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4750	4921	4750	4921	4750	4921

Table 8. The relation between quasi-indexer and CEO turnover

This table shows the results on quasi-indexer's effect on CEO turnover. Dependent variable is a dummy variable indicating next period CEO turnover. *Indmedian* is the industry median return, and *idomedian* is the difference between a firm's year return and the industry median return. *Indmean* is the industry average return, and *idomean* is the difference between a firm's year return and the industry mean return. Columns 1, 2, and 3 are applying logit regression, and columns 4, 5, and 6 are using linear panel regression model. Standard errors are reported in the parenthesis. Control variables are defined in detail in the Appendix. ***, ** and* indicate significance at the 1%, 5%, and 10% levels using the two-tailed test.

		Logit			LPM	
	(1)	(2)	(3)	(4)	(5)	(6)
	CEOturnover	CEOturnover	CEOturnover	CEOturnover	CEOturnover	CEOturnover
QIX	-0.237**	-0.244**	-0.280**	-0.025	-0.022	-0.025
	(0.11)	(0.11)	(0.11)	(0.02)	(0.02)	(0.02)
DED	-0.522***	-0.377***	-0.385***	-0.036***	-0.022***	-0.023***
	(0.04)	(0.08)	(0.08)	(0.00)	(0.01)	(0.01)
TRA	-0.064	-0.072	-0.076	-0.046	-0.046	-0.046
	(0.21)	(0.21)	(0.21)	(0.03)	(0.03)	(0.03)
Stock Return	0.166	0.165	0.165	-0.058**	-0.055**	-0.055**
	(0.19)	(0.19)	(0.19)	(0.03)	(0.03)	(0.03)
QIX*indmedian		0.285			0.016	
		(0.27)			(0.03)	
QIX*idomedian		-0.440**			-0.040**	
		(0.20)			(0.02)	
QIX*indmean			0.134			0.005
			(0.25)			(0.02)
QIX*idomean			-0.405**			-0.038**
			(0.20)			(0.02)
Ln(Assets)	0.050***	0.051***	0.051***	0.009*	0.009*	0.009*
	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
ROA	-0.862***	-0.880***	-0.878***	-0.118***	-0.120***	-0.120***
	(0.15)	(0.15)	(0.15)	(0.02)	(0.02)	(0.02)

KZ Index	0.004***	0.004***	0.004***	0.000*	0.000*	0.000*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Leverage	0.034	0.032	0.034	0.009	0.008	0.009
	(0.10)	(0.10)	(0.10)	(0.02)	(0.02)	(0.02)
Ln(firm age)	0.064**	0.063**	0.064**	0.018	0.018	0.018
	(0.03)	(0.03)	(0.03)	(0.01)	(0.01)	(0.01)
R&D/Assets	-0.800***	-0.810***	-0.801***	-0.082	-0.081	-0.080
	(0.31)	(0.31)	(0.31)	(0.06)	(0.06)	(0.06)
MTB	0.003	0.004	0.003	0.002	0.002	0.002
	(0.02)	(0.02)	(0.02)	(0.00)	(0.00)	(0.00)
Tangibility	-0.236*	-0.234*	-0.236*	0.058*	0.060*	0.059*
	(0.14)	(0.14)	(0.14)	(0.03)	(0.03)	(0.03)
CapExp/Assets	0.182	0.193	0.190	-0.002	-0.001	-0.001
	(0.46)	(0.46)	(0.46)	(0.06)	(0.06)	(0.06)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	-	-	-
Firm FE	No	No	No	Yes	Yes	Yes
N	37241	37241	37241	37426	37426	37426

Table 9. The relation between quasi-indexer and options granted

This table shows the panel regression of quasi-indexer's effect on options granted. Dependent variable is the next period value of non-executive options granted, the number of non-executive options granted, the value of non-executive options granted per employee, and the number of non-executive options granted per employee. For option value and option number, it is in the natural logarithm form: ln (1+option value) and ln (1+option number). Standard errors are reported in the parenthesis. Control variables are defined in detail in the Appendix. ***, ** and* indicate significance at the 1%, 5%, and 10% levels using the two-tailed test.

	(1) ln(othervalue)	(2) ln(othernumber)	(3) ln(othervalue/EMP)	(4) ln(othernumber/EMP)
QIX	0.405**	0.271**	0.296**	0.137
	(0.16)	(0.13)	(0.13)	(0.12)
DED	0.150	-0.032	0.109	-0.092
	(0.23)	(0.19)	(0.23)	(0.20)
TRA	0.969***	-0.077	0.952***	-0.120
	(0.19)	(0.15)	(0.17)	(0.15)
Ln(Assets)	0.662***	0.463***	0.103***	-0.096***
	(0.04)	(0.03)	(0.03)	(0.03)
ROA	0.916***	-0.301*	0.402**	-0.884***
	(0.21)	(0.17)	(0.18)	(0.16)
KZ Index	0.000	0.000	-0.000	-0.003**
	(0.00)	(0.00)	(0.00)	(0.00)
Leverage	-0.668***	-0.238**	-0.508***	-0.052
	(0.13)	(0.11)	(0.11)	(0.10)
Ln(firm age)	-0.616***	-0.283***	-0.794***	-0.454***
	(0.11)	(0.09)	(0.10)	(0.09)
R&D/Assets	0.348	0.409	-0.391	-0.401
	(0.55)	(0.44)	(0.47)	(0.41)
MTB	0.177***	0.060***	0.135***	0.030***
	(0.01)	(0.01)	(0.01)	(0.01)
Tangibility	-0.482**	-0.311	-0.763***	-0.633***
	(0.24)	(0.19)	(0.21)	(0.18)

CapExp/Assets	1.219***	1.160***	1.156***	0.994***
	(0.40)	(0.32)	(0.34)	(0.30)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
N	10104	10119	9597	9597
R-squared	0.154	0.144	0.139	0.111

Table 10. Robustness check using smaller bandwidths

This table represents the second stage results from the two-stage least square regression using a ±250 rank bandwidth sample. All results are estimated using ranks implied by firms' end of May market capitalization within the assigned index as of the index assignment date. Column 1 and 2 shows the result for patent number in year t and year t+3. Columns 3 and 4 represent the results for the number of citations (Cites) in year t and year t+3, columns 5 and 6 represent the results for cites per patent (Citepat) in year t and year t+3 accordingly, and columns 7 and 8 show the results on R&D expenditures (R&D/Assets) in year t and year t+3. Both stages include year and industry fixed effect. Standard errors are clustered by firm and reported in parentheses. Variables are defined in the Appendix. ***, ** and* indicate significance at the 1%, 5%, and 10% levels using the two-tailed test.

	±250							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Ln(Patent)	f3.Ln(Patent)	Ln(Cites)	f3.Ln(Cites)	Ln(CitePat)	f3.Ln(CitePat)	R&D/Assets	f3.(R&D/Assets)
QIX	1.071	1.411	2.831**	2.703**	1.680**	1.257**	0.103**	0.091**
	(0.85)	(0.88)	(1.43)	(1.36)	(0.79)	(0.63)	(0.04)	(0.04)
TRA	-0.328	-0.258	-0.555	-0.505	-0.145	-0.173	-0.011	-0.002
	(0.24)	(0.25)	(0.43)	(0.40)	(0.23)	(0.18)	(0.01)	(0.01)
DED	-0.098	-0.260	-0.403	-0.428	-0.202	-0.171	0.010	0.007
	(0.20)	(0.20)	(0.33)	(0.31)	(0.17)	(0.14)	(0.01)	(0.01)
(Rank-1000)	-0.000*	-0.000	-0.001**	-0.001*	-0.001**	-0.000**	-0.000***	-0.000***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
(Rank-1000)*Russell 2000	0.000	0.000	0.001	0.000	0.001**	0.000*	0.000***	0.000***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
FloatAdj	0.000	0.000	-0.000	0.000	-0.000	0.000	0.000	0.000**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,768	4,768	4,768	4,768	4,768	4,768	4,768	4,016
R-squared	0.479	0.346	0.406	0.286	0.326	0.238	0.450	0.455

Table 11. Robustness check using alternative innovation outcome measures

This table represents the second stage results from the two-stage least square regression using a ±300 rank bandwidth sample. Innovation outcome variables are measured at year t+1 and t+2. All results are estimated using ranks implied by firms' end of May market capitalization within the assigned index as of the index assignment date. Standard errors are clustered by firm and reported in parentheses. Variables are defined in the Appendix. ***, ** and* indicate significance at the 1%, 5%, and 10% levels using the two-tailed test.

	±300					
	(1)	(2)	(3)	(4)	(5)	(6)
	f1.Ln(Patent)	f2.Ln(Patent)	f1.Ln(Cites)	f2.Ln(Cites)	f1.Ln(CitePat)	f2.Ln(CitePat)
QIX	2.185***	1.929***	3.996***	2.623**	1.968***	0.945*
	(0.77)	(0.73)	(1.27)	(1.12)	(0.67)	(0.55)
TRA	-0.537**	-0.457**	-0.893**	-0.613*	-0.283	-0.122
	(0.22)	(0.21)	(0.37)	(0.32)	(0.19)	(0.16)
DED	-0.256	-0.206	-0.619*	-0.461	-0.297*	-0.206
	(0.21)	(0.19)	(0.33)	(0.29)	(0.16)	(0.13)
(Rank-1000)	-0.570***	-0.532***	-1.041***	-0.870***	-0.520***	-0.361**
	(0.21)	(0.20)	(0.34)	(0.31)	(0.17)	(0.15)
(Rank-1000)*Russell 2000	0.223	0.172	0.778*	0.585	0.552**	0.347*
	(0.27)	(0.26)	(0.44)	(0.40)	(0.23)	(0.20)
FloatAdj	0.192	0.270	0.086	0.344	-0.099	0.101
	(0.17)	(0.17)	(0.29)	(0.26)	(0.15)	(0.13)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5719	5719	5719	5719	5719	5719
R-squared	0.397	0.372	0.304	0.328	0.251	0.291
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes

Appendix

Variable Definitions

Variable Name	**Description**
IO	Institutional ownership obtained from 13F
DED	The proportion of dedicated institutional investor holdings based on Bushee classification.
QIX	The proportion of quasi-indexer institutional investor holdings based on Bushee classification.
TRA	The proportion of transient institutional investor holdings based on Bushee classification.
LnPatent	Natural logarithm of one plus firm i's patents that filed and eventually granted in year t
LnCites	Natural logarithm of one plus firm i's citations of patents that filed and eventually granted in year t
LnCitepat	Natural logarithm of one plus firm i's citation per patent that filed and eventually granted in year t
f3.LnPatent	Natural logarithm of one plus firm i's patents that filed and eventually granted in year t+3
f3.LnCites	Natural logarithm of one plus firm i's citations of patents that filed and eventually granted in year t+3
f3.LnCitepat	Natural logarithm of one plus firm i's citation per patent that filed and eventually granted in year t+3
f1.LnPatent	Natural logarithm of one plus firm i's patents that filed and eventually granted in year t+1
f1.LnCites	Natural logarithm of one plus firm i's citations of patents that filed and eventually granted in year t+1
f1.LnCitepat	Natural logarithm of one plus firm i's citation per patent that filed and eventually granted in year t+1
Russell2000	A dummy indicates whether firm belongs to the Russell 2000. If the firm is in Russell 2000, the dummy equals one; if the firm is in Russell 1000, the dummy equals zero.
(Rank-1000)	Firms' end of May marketcap rank minus 1000 which indicates the distance to index threshold.
FloatAdj	Firm end of May market cap rank minus end of June assigned rank.
CEO turnover	A dummy variable indicates whether there is CEO change in the current year. We obtain the CEO relevant data from Compustat and Boardex then identify whether current year CEO is same as last year CEO. If it is different, the dummy equals 1; otherwise, the dummy equals zero.
Stock return	Cumulate monthly stock return to annual stock return based on each fiscal year. The data is obtained from CRSP.
Indmedian	The industry median year return based on first two digits SIC code.
Idomedian	The difference between firm year return and industry median return.
Indmean	The industry average year return based on first two digits SIC code.

Idomean	The difference between firm year return and industry average return.
ln(othervalue)	The natural logarithm value of non-executive employees' option value. By obtaining executives' option value based on Black-Scholes model (blkshval) and executive's percentage of total option granted to employees (pcttotopt) from Compustat, we can calculate the value of total options granted; then subtract the value of executives' options from the value of total options granted, we have the value of non-executive options.
ln(othernum)	The natural logarithm value of the number of non-executive employees' option granted. By obtaining executive option number (numsecur) and executive's percentage of total options granted to employees (pcttotopt) from Compustat, we can calculate the number of total options granted; then subtract the number of executives' options from the number of total option granted, we have the number of non-executive option granted.
ln(othervalue/EMP)	The natural logarithm value of the non-executive employees' option value scaled by the number of employees (emp).
ln(othernum/EMP)	The natural logarithm value of the number of non-executive employees' options granted scaled by the number of employees (emp).
Ln(Assets)	Natural logarithm of firm i's book value of assets
ROA	Firm i's profitability, measured by operating income before depreciation scaled by book value of asset
KZ Index	Kaplan and Zingales index kz is computed as KZ= -1.002*cash flow - 39.36*dividends - 1.315*cash holding +3.139* Leverage +0.283* Tobin's Q
Leverage	Firm i's leverage ratio, defined as book value
Ln(firm age)	Natural logarithm of firm i's age, which is approxiated by the number of years listed on Compustat
R&D/Assets	Research and development expenditure (xrd) scaled by firm i's total asset
MTB	Firm i's market-to-book ratio
Tangibility	Property, plant & equipment divided by book value of total assets
CapExp/Assets	Capital expenditure scaled by book value of total assets
Herfindahl	Herfindahl index of four-digit standard industrial classification (SIC) industry j where firm i belongs, measured at the end of fiscal year t