Stock Liquidity and Corporate Diversification: Evidence from Index Reconstitution

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ABSTRACT

Using the Russell index reconstitution as an exogenous shock to stock liquidity, we examine how stock liquidity affects corporate diversification in a regression discontinuity framework. We find that a positive liquidity shock to firms included in the Russell 2000 index reduces diversification. Furthermore, post index-inclusion, these firms also rely less on internal capital markets. The causal inference can be linked to two mechanisms: improvements in the information environment and firm's governance quality, which help to lower financing frictions, manager's wealth diversification needs, and empire-building tendencies. Overall, financial markets by affecting demand for firm-specific information and governance quality can shape a firm's boundaries and its scope.

Keywords: Stock Liquidity, Information Efficiency, Corporate Diversification, Index Reconstitution

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1. Introduction

Corporate diversification is a crucial operational decision that affects long-term profitability and firm value. Substantial variation in the prevalence and extent of diversification across industries and countries has attracted much attention from investors, researchers, and policymakers. Since the assessment of investors on major strategic decisions is eventually reflected in security prices, financial markets become a natural conduit for investors to indicate their preferences and influence corporate decisions such as diversification (e.g., Khanna and Palepu, 2000; Fauver, Houston, and Naranjo, 2003). However, the role of financial markets in influencing diversification decisions is under-examined. This paper examines the effect of stock liquidity, a crucial characteristic of financial markets on corporate diversification.

The prevalence of diversified investor portfolios in well developed financial markets raise concerns about the motivation and utility of firms' corporate diversification. According to modern portfolio theory, investors can maximize returns for a given level of risk by constructing a diversified portfolio (Markowitz, 1952), suggesting that firms with less correlated returns to other firms are valuable additions to a diversified investor portfolio.[2] On the other hand, corporate diversification determines the boundaries of a firm, and generally refers to expansion of business by entering into a completely new segment or investing in a business which is less related to the company's existing product lines, primarily to reduce business risk. Hence, both portfolio and corporate diversification help with risk reduction to the investor, albeit at different levels. This naturally leads to the question, why do firms then pursue diversification if investors

[2] In finance, diversification along with hedging are two general techniques to reduce investment risk. Diversification is the process of allocating capital in a way that reduces the exposure to any particular asset or risk factor. A common approach to diversification is to lower risk or volatility by investing in a variety of assets. If asset prices do not change synchronously, a diversified portfolio will have less variance than the weighted average variance of the constituent assets

themselves can diversify their portfolios, where the latter is made easier through liquid financial markets.

Prior studies have long examined the economic rationale behind corporate diversification in terms of coinsurance effects, information, and agency theories. First, corporate diversification can have a coinsurance effect between the different business segments that helps lower firm risk and increase its debt capacity (Lewellen, 1971). Second, a well-diversified firm can have a robust internal capital market that maximizes the likelihood that profitable investment projects get financed.[3] Third, corporate diversification may also be a consequence of agency problems. Managers may try to entrench themselves, cross-subsidize different segments, or engage in empire building activities.[4] These different motivations for corporate diversification also confound its consequences, i.e., the effect of diversification on firm value.[5]

Among many features of financial markets, stock liquidity measures the market participants' ability to trade an asset in large quantities quickly with little price impact. Although,

[3] Information asymmetry creates a wedge between managers possessing superior information about prospects of potential investment and external investors concerned with agency problems. These conflicts can result in forfeiture of profitable investment opportunities, which is more binding for firms that operate in a single segment (Stein, 1997).

[4] Entrenched managers can extract more rents by expanding the scope of firm operations often into unrelated segments (e.g., Murphy, 1985; Jensen, 1986; Amihud and Lev, 1981; Shleifer and Vishny, 1986). Also, managers can redeploy free cash flow through the internal capital market away from profitable projects (Lamont, 1997) into less profitable projects (Shin and Stulz, 1998), i.e., cross-subsidization across different segments, leading to inefficient investment (Scharfstein, 1998; Scharfstein and Stein, 2000). Poorly monitored managers can engage in self-maximizing decisions such as empire building, hurting operating performance and firm value (Hope and Thomas, 2008).

[5] While many studies argue that there is a diversification discount (Lang and Stulz, 1994; Berger and Ofek, 1995; Servaes, 1996; Servaes and Lins, 1999; Lamont and Polk, 2002), few studies question the causality of diversification on the observed discount, proposing that factors prior to diversification affect firm value rather than the diversification itself. For example, Graham, Lemmon, and Wolf (2002) show that both the target and the diversified firms trade at a discount even prior to the acquisition suggesting there is a selection bias among diversified firms. Hyland (2002) shows that firms with poor performance attempt to grow inorganically through diversification. Few studies also argue that the use of reported segment data can introduce systematic measurement errors in diversification leading to flawed empirical findings (Hyland, 2002; Martin and Sayak, 2003). Furthermore, many studies show that diversification discount is negligible or may diminish across different data samples (Denis, Denis and Sarin, 1997; Dimitrov and Tice, 2006; Santalo and Becerra, 2008; Yan, Yang, and Jiao, 2010; Hovakimian, 2011). Hadlock, Ryngaert, and Thomas (2001) find that equity issues by diversified firms are viewed less unfavorably by the market. Villalonga (2004) criticizes utilization of segment level data and shows that there is a diversification premium in the whole US economy.

stock liquidity refers to trading in the secondary market without any capital flows to firms, prior studies have documented the ability of stock liquidity to influence many corporate decisions (e.g., Fang, Tian, and Tice, 2014). Furthermore, prior studies argue that stock liquidity can affect the information environments and corporate governance of the firms, both of which can influence corporate policies (e.g., Fang, Noe, and Tice, 2009; Brogaard, Li, and Xia, 2017). In our context, stock liquidity by lowering the costs of investor portfolio diversification can alter the investors' preferences for diversified firms as an addition to their portfolio. Given the consistent growth in passive institutional investors (i.e., investors who hold diversified portfolios to replicate performance of benchmark indices), examining the relationship between stock liquidity and corporate diversification can improve our understanding of such investor preferences and how it influences corporate strategies. [6]

Stock liquidity may impede corporate diversification for the following reasons. First, stock liquidity can discourage diversification by increasing stock price efficiency. An efficient stock price incorporates both public and private information. Such efficiency in prices lowers both the idiosyncratic risk of the firm (West, 1988) and the importance of an internal capital market as we describe below, both of which disincentivizes diversification. If the idiosyncratic risk is high, managers will be inclined to pursue diversification to lower the risk of their personal wealth, which is relatively underdiversified since a manager's human capital is tied to the firm more than outside shareholders.[7] However, with an efficient stock price and low idiosyncratic risk, managers will no longer be interested in reducing firm-specific risk any further by pursuing

[6] Appel, Gormley, and Keim (2016) estimate that the assets under management of passively managed U.S. equity mutual funds were at $ 2.7 trillion at the end of 2014, which comprises about 33.5% of all mutual fund assets as compared to 15% of passive funds in 1998.

[7] The literature on optimal compensation contracts explore the relative wedge between the diversification level of shareholders and managers. For example, see Coles, Daniel and Naveen (2006) and Armstrong and Vashishtha (2012).

a costly transaction such as diversification. On the other hand, diversification can allow financing of all profitable projects by fostering a robust internal capital market. As argued by Foucault and Gehrig (2008), an informative stock price fosters better investment decisions and increases firm value. Furthermore, liquid stocks have a wider breadth of investor participation which brings the price close to the fundamental value (Chen, Hong, and Stein, 2002), which discourages diversification that is pursued to increase the firm value or to boost the stock price. Thus, improved investment policy and higher valuation discourage value-decreasing and growth-seeking diversification decisions.

Second, stock liquidity can discourage diversification, especially diversification driven by agency problems through an improvement in corporate governance. By facilitating the entry and exit of large concentrated shareholders, stock liquidity can sharpen the incentives for institutional investors to monitor the firm (Edmans, Fang, and Zur, 2013).[8] Also, stock liquidity has been associated with an increase in analyst coverage, further increasing scrutiny of managerial decisions (Roulstone, 2003). Furthermore, the efficiency of executive compensation also increases with stock liquidity, thus incentivizing the manager to make a value-increasing investment (Fang, Noe, and Tice, 2009). Thus, the increase in the intensity of monitoring facilitates efficient investment decisions and discourages value-decreasing diversification.

Given the theoretical predictions, it remains to be seen whether stock liquidity reduces corporate diversification empirically. Similar to many other papers in corporate finance,

[8] Previous literature also provides a counter-argument that stock liquidity may deter corporate governance through blockholders, since higher stock liquidity lowers the investors' cost to exit. Given the lower exit cost, the blockholders will choose to sell shares when the invested firms face adverse situation in the liquid market, while they will be forced to hold the shares and make effort to exert positive influence on the firms in the illiquid market (Bhide, 1993; Coffee, 1991). However, recent studies propose that stock liquidity enhances corporate governance because the benefit of higher stock liquidity on accumulating large stake which leads to more block formation outweighs the cost of blockholders' easier exit (Kyle and Vila, 1991; Kahn and Winton, 1998; Maug, 1998). Furthermore, the potential selling activities which will hurt managers' interest ex post can induce managers to maximize shareholders' value ex ante (Admati and Pfleiderer, 2009; Edmans, 2009; Edmans and Manso, 2011).

endogeneity arises in our framework, which creates a barrier to make a causal interpretation.[9] In order to overcome such identification issues, we use the Russell index reconstitution as a quasi-natural experiment for stock liquidity and employ two-stage least-squares specifications.[10] The annual reconstitution of the Russell 1000 and the Russell 2000 indices create exogenous variations in stock liquidity, which we exploit to draw causal inferences (e.g., Chang, Hong, and Liskovich, 2015; Dass, Huang, Maharjan, and Nanda, 2016). The largest 1000 firms by market capitalization are assigned to the Russell 1000 index and the following 2000 firms by market capitalization are assigned to the Russell 2000 index. Institutional money managers benchmarked to these two indices have incentives to invest in firms that receive higher weights in the indices to minimize tracking error. Furthermore, the amount of money passively tracking Russell 2000 as a benchmark is also greater than that tracking Russell 1000 (Dass et al., 2016). These incentives of institutional money managers implies that there is a discontinuity in the distribution of institutional demand around the Russell 1000 and the Russell 2000 index thresholds, creating a discontinuity in stock liquidity. Chang, Hong, and Liskovich (2015) show that addition to (deletion from) the Russell 2000 index at the end of calendar month May significantly increases

[9] For example, to the extent unobservable growth opportunities may affect both diversification and stock liquidity, and such misspecification in reduced form equations may influence any inference. Firms operating in mature industries can have poor growth options and therefore show greater inclination to engage in diversifying acquisitions. At the same time, investors may shun stocks in such industries due to the inferior growth prospects, thus endowing those firms with poor liquidity, giving rise to a spurious negative correlation between stock liquidity and corporate diversification.

[10] Recent studies use the discontinuity around the Russell index thresholds as an exogenous shock to institutional ownership (e.g., Boone and White, 2015; Fich, Harford, and Tran, 2015; Crane, Michenaud, and Weston, 2016; Appel, Gormley, and Keim, 2016; Appel, Gormley, and Keim, 2018). For example, Crane, Michenaud, and Weston (2016) use the annual Russell index reconstitution to show the impact of institutional ownership on corporate payout policy. We extend this identification strategy by focusing on the discontinuity in stock liquidity in a similar setting (Chang, Hong, and Liskovich, 2015; Dass et al., 2016). Dass et al. (2016) exploit the discontinuity of stock liquidity around the Russell 1000/2000 indices to show that acquirer's stock liquidity enhances the acquisition likelihood and acquirer announcement return. We provide additional analysis of the residual effect of stock liquidity around the index thresholds after controlling for the effect of indexation on institutional ownership. In Section 3 on our empirical approach, we describe in greater detail about the problems with Russell index as an identification for institutional ownership and how those concerns are mitigated in our setting for stock liquidity.

(decreases) trading volume in calendar month June.[11] In our setting, compared to the smaller firms in the Russell 1000 index, we find that firms just included in the Russell 2000 index have 31.4% higher liquidity (measured by *Amihud liquidity*) among firms that are within a bandwidth of 300 firms around the index thresholds.

In the first stage of our two-stage least squares specifications, stock liquidity is instrumented using whether it is included in the Russell 2000 index or not, and in the second stage, we regress corporate diversification on the instrumented stock liquidity. Our empirical strategy is to directly compare diversification decisions of otherwise similar firms around index thresholds. Using the Russell 2000 index inclusion as an instrument for stock liquidity, we find that stock liquidity impedes corporate diversification, which is computed as cross-divisional investment opportunity correlation following Duchin (2010).[12] This negative effect is robust to alternate stock liquidity measures, i.e., Amihud liquidity and as turnover ratio, alternate time windows, i.e., two and three years after the reconstitution of the index, different measures of corporate diversification, i.e., number of industry segments and the efficiency of internal capital markets, changes in Russell index methodology in 2006, and to the use of specification using changes in diversification on changes in stock liquidity.[13] The results also remain statistically significant to alternate bandwidths near the index threshold including 800 and 300 firms on each side of the threshold and become stronger when we use a more restrictive bandwidth, which strengthens a causal interpretation. Finally, to examine the sensitivity of our findings to the

[11] However, Chang, Hong, and Liskovich (2015) see a non-significant effect on trading volume in the subsequent months, whereas Dass et al. (2016) document that the effect is persistent throughout the year of reconstitution. Our liquidity measures also remain significantly higher for firms in the Russell 2000 index after reconstitution over the year.

[12] Following Lang and Stulz (1994) we mainly focus on investment opportunity (i.e., Tobin's *q*) type of measure rather than stock return or accounting based measure of performance over time. Unlike its alernatives, Tobin's *q* measure is based on the present value of future cash flows divided by the replacement cost of tangible assets, and does not require risk adjustment or normalization when peforming a cross-sectional analysis across firms.

[13] We provide the details of Russell index assignment in Section 4.3.4.

choice of Russell index as a natural experiement, we also make use of stock decimalization in the U.S. as an alternate natural experiement. Our findings remain to be robust.

We then explore two potential channels through which stock liquidity can negatively affect corporate diversification. First, when information efficiency of the firm increases the motivation to develop a robust internal capital market is diminished, thereby making diversification less necessary. To that extent, we examine how various proxies of information efficiency are affected by the inclusion in the Russell 2000 indices. Specifically, we regress the probability of informed trading (*PIN*), price delay, and idiosyncratic volatility on our measure of instrumented liquidity. We find a statistically significant decrease in all the three measures, suggesting that information efficiency does increase with stock liquidity, consistent with the findings of Brogaard, Li, and Xia (2017). Second, good corporate governance can curtail poor diversification decisions, especially those that are undertaken due to agency problems of the manager and shareholders. To that extent, we examine how inclusion in the Russell 2000 index affects analyst coverage, board composition, and institutional ownership concentration. We find a significant increase in analyst coverage, an increase in the proportion of independent directors on the board, and a decrease in institutional ownership concentration.[14] Consistent with Boone and White (2015), these findings suggest that non-dedicated institutional ownership increases the demand for information production, thereby lowering information asymmetry and hence mitigate corporate diversification.

Our paper makes the following contributions to the existing literature. First, we add to the growing literature on the real effects of financial markets (e.g., Morck, Shleifer, and Vishny,

[14] Consistent with the literature (e.g., Crane, Michenaud, and Weston, 2016; Appel, Gormley, and Keim, 2016; 2018), in untabulated results, we find a significant increase in institutional ownership, especially due to an increase in the presence of transient and quasi-indexers after the inclusion in the Russell 2000 index. However, since we control for Institutional ownership in our 2SLS, our results illustrate the residual effect of stock liquidity over and above the effect of institutional ownership on diversification.

1990; Bond, Edmans, Goldstein, 2012; Edmans, Goldstein, Jiang, 2012; Campello, Ribas, and Wang, 2014). Understanding the real effect of financial markets on corporate strategy, information environment and the firm's governance quality is essential for a stable and well-performing financial market. Starting from Morck, Shleifer, and Vishny (1990), who examine the interaction between the stock market and corporate investment activities, various papers demonstrate the influence of stock market dynamics on real investment decisions, rejecting the null hypothesis that the stock market is merely a sideshow. By demonstrating that stock liquidity, an essential feature of the stock market, affects the motivation for diversification and thus shapes firm boundary and operational scope, we provide new evidence of the real effect of financial markets on corporate policy choices.

Second, we expand the corporate diversification literature by identifying stock liquidity as an important determinant of corporate diversification decisions. While a few empirical studies examine the effect of corporate diversification on stock liquidity, their results are not conclusive. Gilson, Healy, Noe and Palepu (2001) show that a decrease in corporate diversification increases stock liquidity by enhancing public information quality and reducing adverse selection costs. On the other hand, Huson and MacKinnon (2003) find that transaction costs and the price impact of trades are higher following spinoffs, which implies that stock liquidity decreases after spinoffs. By employing the Russell index reconstitution as a quasi-natural experiment, we mitigate the concern about endogeneity in examining the relationship between stock liquidity and corporate diversification, and provide causal evidence on the relationship. Furthermore, we provide substantial evidence on the impact of stock liquidity on information environment, which enhances our understanding of cross-sectional variation in diversification levels. These important findings highlight the feedback effects of financial markets to the real economy (Bond, Edmans and Goldstein, 2012), which can influence our understanding of the benefits and costs of corporate diversification to shareholders.

The rest of the paper is organized in the following manner. Section 2 describes sample and variable construction. Section 3 provides empirical design. Section 4 presents empirical results, and section 5 gives channel analyses. Section 6 concludes.

2. Data and Summary Statistics

2.1. Sample and variable construction

Our sample consists of constituents of the Russell 1000 index and the Russell 2000 index during the period of 1995-2016. We obtain the data for the Russell index constituents from Bloomberg. This data is merged with historical business segment data and annual fundamental data from Compustat, and stock return data from CRSP. We exclude financial and utility firms. The final sample includes 26,090 firm-year observations of 3,954 unique firms.

2.2. Measures of Stock Liquidity

We use two measures to calculate stock liquidity. *Amihud liquidity* is the negative of the logarithm of one plus Amihud (2002) illiquidity, defined as the average ratio of the daily absolute return to the dollar trading volume on that day. This measure reflects the absolute price change per one million dollars of daily trading volume, consistent with the concept of illiquidity in Kyle's (1985).[15] As an alternative measure of stock liquidity, *Trading volume* is the logarithm

[15] The measure is widely used among studies on stock liquidity (Cesari et al., 2012;, Jain et al., 2016; Jiang, Ma, and Shi, 2017; Kang, Wang and Eom, 2017; Brogaard, Li, and Xia, 2017; Goyenko, Holden and Trzcinka, 2009) run a horse-race of annual and monthly estimates of stock liquidity measure against high-frequency stock liquidity benchmarks, and they find that Amihud illiquidity does well in measuring price impact. Because Amihud illiquidity is highly skewed, we use log-transformed Amihud illiquidity as stock liquidity measure, which is calculated as Log (1+Amihud illiquidity).

of the stock's average daily dollar trading volume (Brennan, Chordia, Subrahmanyam, 1998). Both stock liquidity variables are measured in the next three months after the annual reconstitution in each year, from June to August.

2.3. Measures of Corporate Diversification

Our main measure of corporate diversification is cross-divisional correlations in investment opportunities *Diversification*, following Duchin (2010).[16] Specifically, we use the two-digit standard industrial classification (SIC) codes to identify industry divisions where a firm operates, and Tobin's *q* to proxy for the investment opportunity. Then, we estimate the difference in volatility of a firm's investment opportunities between imperfect and perfect cross-divisional correlations, over a 10-year rolling window. The volatility with perfect cross-divisional correlations captures the "no-diversification" average volatility of investment opportunity by assuming pair-wise correlations of one between all segments. Since it is less than or equal to zero and measures the difference between volatility with imperfect and perfect correlation, for the convenience of interpretation, we add a negative sign to the cross-divisional investment opportunity correlation. Higher values of this measure imply higher corporate diversification.

We use several alternative measures of corporate diversification. First, following Opler et al. (1999), we use the number of business segments based on four-digit SIC codes, *Log(number of industry divisions)*, to measure the degree of corporate diversification. While the measure is weak especially when there is a high correlation among segments where a firm operates, this method is still widely used in corporate diversification literature (Matvos, Seru, and Silva, 2018).

[16] Appendix 1 provides detailed description of this variable construction.

Second, we use the absolute and relative value added by internal capital market allocation (Rajan, Servaes, and Zingales, 2000). The absolute value added by internal capital market allocation is calculated as the asset-weighted sum of the product of each segment's industry-adjusted investment rate and the median market-to-assets ratio of single-segment firms in the same industry minus one, across all the segments in a firm. The relative value added by internal capital market allocation is calculated as the sum of the asset-weighted *Transfer* to a segment by the difference between a segment's *q* (proxied by the average industry *q* of single segment firms in the industry) and the average firm *q*, where *Transfer* is measured as the difference between the investment made by a segment in a diversified firm and the average investment of single segment firms in the same industry, where investment is scaled by lagged assets. *Transfer* is adjusted by subtracting the average asset-weighted transfers across all segments in the diversified firm.

2.4. Descriptive analysis

Table 1 presents the summary statistics of stock liquidity measures, corporate diversification measures, and other firm variables. Panel A consists of firms in the Russell 1000 and the Russell 2000 indices during the period between 1995 and 2016. Panel B consists of a subsample of firms with market capitalizations closer to the Russell index assignment thresholds for the Russell 1000/2000 estimated as of index assignment date (±300 firms). The mean of stock liquidity measures, *Amihud liquidity*, and *Trading volume*, of our sample firms, are -0.52 and 15.59, respectively. Our sample firms have mean (median) of 1.20 (1.00) industry divisions and 2.50 (1.00) business segments. The subsample comparison in Panel B shows that stock liquidity measures are greater in the Russell 1000 index firms than the Russell 2000 index firms, on average. Also, the average total book assets of the Russell 1000 index constituents are 3.6 times larger than those of the Russell 2000 index constituents, and the number of industry division and business segments is greater for the Russell 1000 index sample firms. These are inherent differences by the definition of the Russell 1000 and 2000 index. For other characteristics, firms in the Russell 1000 index tend to have higher *q*, and lower cash level than firms in the Russell 2000 index. The mean (median) of Tobin's *q* is 1.98 (1.69) and 1.95 (1.65) for the Russell 1000 and 2000 index firms, respectively. However, note that the cash level is greater for the Russell 2000 index firms than the Russell 1000 index firms.

[Table 1 is about here.]

3. Empirical Approach

Corporate diversification decisions need not be random in nature but may be highly correlated with unobservable firm characteristics that affect stock liquidity. It is also possible that corporate diversification affects stock liquidity (i.e., reverse causality). For example, Gilson et al. (2001) show that a decrease in corporate diversification increases stock liquidity by enhancing public information quality and reducing adverse selection costs. Huson and MacKinnon (2003) find that transaction costs and the price impact of trades are higher following spinoffs, and the results are stronger for spinoffs where parent firms divest unrelated subsidiaries implying that stock liquidity decreases after spinoffs. Furthermore, Lipson and Mortal (2007) show that firm characteristics including firm size, number of analysts, number of shareholders, which are associated with corporate diversification, affect stock liquidity.

In order to address this endogeneity problem, our main regression analyses adopt a regression discontinuity framework to capture the effect of stock liquidity on corporate diversification (e.g., Chang, Hong, and Liskovich 2015; Dass et al., 2016). We focus on the annual reconstitution of the Russell 1000 index and the Russell 2000 index and use two-stage least-squares specifications to do empirical tests. In the first stage, the empirical specification is a sharp regression discontinuity design which models stock liquidity as a function of inclusion in the Russell 2000 index around the threshold of the Russell 1000 and the Russell 2000 indexes.

The Russell 1000 index and the Russell 2000 index are value-weighted indexes of U.S. listed firms. They are reconstituted annually based on the market capitalization on the rank day at the end of May.[17] The largest 1,000 firms are assigned to the Russell 1000 index and the following 2,000 firms are assigned to the Russell 2000 index. The assignment is based only on the market capitalization ranking. At the threshold of the Russell 1000 index and the Russell 2000 index, since the difference in market capitalization is small and firms cannot control market capitalization precisely (exclusion restriction), especially when the threshold is dependent on other firms' market capitalization, it is reasonable to consider index assignment near the threshold as random assignment.

The difference in the index weights causes a great discontinuity in stock liquidity. Institutional investors which benchmark performance against the Russell indexes tend to hold large positions in firms with large index weights and hold extremely small or zero positions in firms with tiny index weights to reduce tracking error. For the firms around the threshold of the Russell 1000 index and the Russell 2000 index, firms that are just included in the Russell 2000 index have greater index weights. In addition, the Russell 2000 index is one of the most popular index benchmarks for mid and small-cap funds. While compared with the S&P 500 index, the

[17] We use a regression discontinuity design in the first stage following the previous literature that exploits the Russell 1000/2000 index reconstitution. We use the May 31st unadjusted market capitalization rankings based on data from CRSP and use the actual assignment in regression to make the instrument variable valid and the inference unbiased by the errors in rankings calculated by CRSP data.

Russell 1000 index is a less popular benchmark for large-cap funds. This leads to a larger amount of institutional assets benchmarked against the Russell 2000 index than the Russell 1000 index. Thus, compared with firms in the bottom of the Russell 1000 index, firms in the top of the Russell 2000 index are more likely to be held by institutional investors (e.g., Boone and White, 2015; Fich, Harford, and Tran, 2015; Crane, Michenaud, and Weston, 2016; Appel, Gormley, and Keim, 2016; Appel, Gormley, and Keim, 2018). The increasing demand of institutional holders, especially index funds, makes the firm's stock liquidity increase.[18]

In the first stage, the stock liquidity is estimated by the function of inclusion in the Russell 2000 index:

$$Stock\ liquidity_{i,t} = \alpha_t + \tau Ru2000_{i,t} + \delta_1 Rank_{i,t} + \delta_2 Ru2000_{i,t} * Rank_{i,t} + \delta_3 Controls_{i,t} + \varepsilon_{i,t} \quad (1)$$

where stock liquidity variables (*Amihud liquidity* and *Trading volume*) are measured in the next three months after annual reconstitution in each year. *Ru2000* is an indicator variable that takes the value of one if the firm belongs to the Russell 2000 index and a value of zero if the firm belongs to the Russell 1000 index. $Rank_{i,t}$ is the market capitalization ranking of firms in the Russell 1000 and the Russell 2000 indices computed as actual rank minus 1000 as of index assignment date (i.e., end of May). The sample is restricted to firms included in the Russell 1000 index or the Russell 2000 index within a narrow bandwidth around the thresholds (i.e., larger bandwidth with ±800 firms and smaller bandwidth with ±300 firms). To isolate the discontinuity in stock liquidity at the threshold, we control $Rank_{i,t}$ and $Ru2000_{i,t} * Rank_{i,t}$. As to the relevance

[18] Previous literature demonstrates the effect of inclusion in index on stock liquidity. For example, Becker-Blease and Paul (2006) use the addition to the S&P 500 index as the exogenous liquidity shock to examine the relation between stock liquidity and investment opportunities. Hegde and McDermott (2003) find that firms added to the index experience a significant permanent increase in stock liquidity. More recent works by Chang, Hong, and Liskovich (2015) and Dass et al. (2016) provide the evidence of positive discontinuity in stock liquidity around the border of Russell 1000/2000 indices once a firm is included in the Russell 2000 index.

of instrument variable and stock liquidity, we show there is a discontinuity in stock liquidity graphically and using regression. Following Matvos, Seru and Silva (2018), $Controls_{i,t}$ includes firm size, profitability, Tobin's q, and book leverage. Appendix 2 provides detailed descriptions of control variables. Following Crane, Michenaud, and Weston (2016), we also control for *Float adjustment*, the difference between the implied rank by the market capitalization by the May 31st and the actual rank by Russell in June.[19] Lastly, we include both year and industry fixed effects based on the Fama-French 12 industry classification to control for any common time trends affecting stock liquidity and time-invariant industry-specific characteristics, respectively.

In the second stage, the corporate diversification is estimated by the function of instrumented stock liquidity.

$$Diversification_{i,t} = \theta_t + \beta \widehat{Stock\ liquidity}_{i,t} + \gamma_1 Rank_{i,t} + \gamma_2 Ru2000_{i,t} * Rank_{i,t}$$

$$\gamma_3 Controls_{i,t} + \eta_{i,t} \qquad (2)$$

where *Diversification* is measured in the current year if the fiscal year-end is after August and in the next year if the fiscal year-end is before August. The regression includes instrumented stock liquidity and the control variables that are included in the first stage. Our empirical strategy is to directly compare stock liquidity otherwise similar firms located in proximate The Russell 2000 index threshold. This identification strategy enables us to estimate the effect of stock liquidity on corporate diversification after controlling for unobserved heterogeneity.

Although Russell index reconstitution is utilized in many other studies as a quasi-natural experiment for the changes in institutional ownership (e.g., Boone and White, 2015; Fich, Harford, and Tran, 2015; Crane, Michenaud, and Weston, 2016), recent papers have raised concerns about potential problems in using it as an identification strategy (e.g., Appel, Gormley,

[19] Crane, Michenaud, and Weston (2016) describes the potential concern about the Russell float adjustment. Since Russell uses unobservable float calculation, the market capitalizations used for ranking and the index weights can be different between May 31st and the end of June.

and Keim, 2018). Though index inclusion in the Russell indices is based on total market capitalization rankings at the end of the calendar month May every year, the index weights assigned to each firm in June upon inclusion is based on the float-adjusted market capitalization of the firm. This weighting scheme suggests that firms with greater insider holdings (and hence lower institutional ownership) receive lower index weights. Thus, comparing firms around the index thresholds suggests that we are technically comparing firms with lower institutional ownership (in Russell 1000) against firms with higher institutional ownership (in Russell 2000), thereby violating the assumption of exogeneity in institutional ownership. Furthermore, Appel, Gormley, and Keim (2016) show that there is no significant difference in institutional ownership around the index threshold, except passive institutional ownership which seems higher in firms in the Russell 2000.

We overcome these issues in the following manner. First, using the Russell index reconstitution as a setting for changes in stock liquidity avoids getting into the debate about the effect on institutional ownership altogether. Irrespective of the level of stock liquidity prior to index inclusion, firms in the Russell 2000 with higher weights (compared to firms in the Russell 1000 near index thresholds with lower weights) increases stock liquidity through 1) arbitrageurs trading in index stocks against index futures and options 2) traders buying (selling) index stocks in order to create (redeem) Exchange Traded Funds (ETF) units from the ETF's market maker 3) passive mutual funds replicating the index portfolios. All such trading is contingent on index composition and is unlikely to be driven by the pre-indexation level of stock liquidity or institutional ownership, thereby still satisfying the exogeneity of stock liquidity. Second, we also consider wider bandwidths of 800 and 300 around the index thresholds, which can reduce the impact of such float-adjusted sorting of firms on any causal interpretation. For example, by considering 800 firms in the Russell 1000 (and the Russell 2000), we are including firms with a large cross-sectional variation in stock liquidity and institutional ownership. Third, we control for a float-adjustment factor to explicitly account for the reason that some of our findings may be influenced by the float adjustment by Russell in computing index weights for the firms (Crane, Michenaud, and Weston, 2016).

4. Empirical Results

4.1. Russell Index Threshold and Stock Liquidity

Figure 1 shows there is a discontinuity in stock liquidity around the threshold of the Russell 1000 and the Russell 2000 indexes graphically. The dots represent average stock liquidity measures and *Rank* is the market capitalization ranking of firms in the Russell 1000 and the Russell 2000 indices computed as actual rank minus 1000 as of index assignment date (i.e., positive rank for sample firms in the Russell 2000 index). Figure 1 shows that *Amihud liquidity* is decreasing in firm's ranking in general and the scatter points for each firm are higher on the Russell 1000 index than on the Russell 2000 index side of the threshold on average. However, firms just included in the Russell 2000 index have higher *Amihud liquidity* compared with firms just included in the Russell 1000 index. Similarly, large firms in the Russell 2000 index have larger dollar trading volume than firms in the Russell 1000 index around the threshold. To ensure that firms in the Russell 1000 index are valid counterfactuals for those on the Russell 2000 side, the sample is restricted to sufficiently narrower band of 300 on both sides of the Russell 2000 threshold. The significant difference in the intercept of the plot lines constitutes graphical evidence of discontinuity in stock liquidity.

[Figure 1 is about here.]

In addition to the graphical analysis, we run the regressions to identify the estimates of the causal effect of inclusion in the Russell 2000 index on stock liquidity. We run the sharp regression discontinuity design defined by the equation (1). Table 2 presents results of the discontinuity in stock liquidity around the Russell 1000/2000 index thresholds within the bandwidth of ±300 ("Small bandwidth"). In columns (1) and (2), we find that the inclusion to the Russell 2000 index leads to an increase in stock liquidity. Regression discontinuity estimates for the large bandwidth sample show that inclusion in the Russell 2000 index promotes an increase in stock liquidity of about 35.7 percentage points (=0.075/0.21) for *Amihud liquidity* and 2.2 percentage points (=0.366/16.28) for *Trading volume* during the sample period. As to the regression results estimated using the smaller bandwidth of ±300, we get the consistent results in columns (3) and (4) of Table 2. *Amihud liquidity* and *Trading volume* are higher for firms just included in the Russell 2000 index around the threshold. The coefficients are significant at 1% level.

[Table 2 is about here.]

4.2. The Effect of Stock Liquidity on Corporate Diversification

In this section, we test our hypothesis that the improvement of stock liquidity decreases corporate diversification. Figure 2 plots the average of corporate diversification measures around the Russell 2000 index threshold, along with the fitted lines on both sides of the threshold for the period of 1995-2016. To ensure that firms on the Russell 1000 index are valid counterfactuals for those on the Russell 2000 index, the sample is restricted to narrower band of 300 firms on both sides of the Russell 1000/2000 indices threshold. Figure 2 shows that the scatter points for each bandwidth are higher on the Russell 1000 side than on the Russell 2000 side of the threshold.

The significant difference in the intercept of the fitted lines constitutes graphical evidence of discontinuity in corporate diversification.

[Figure 2 is about here.]

Table 3 presents the second stage results of instrumented variable regressions of diversification on stock liquidity using a sample of firms near the Russell 1000/2000 index inclusion thresholds during the period between 1995 and 2016. In the second stage, the dependent variable diversification, *Diversification,* is measured as the difference in volatility of investment opportunities between imperfect and perfect cross-divisional correlations over a 10-year rolling window (Duchin, 2010). Our key independent variables of interest are *Amihud liquidity* and *Trading volume*, which are instrumented by index membership in the Russell 2000 index based on market capitalization as of index assignment date.[20] In Table 3, we find that stock liquidity decreases corporate diversification. Across all specifications, we find that the coefficients on instrumented stock liquidity measures are negative and significant at the 1-10% level, suggesting that higher stock liquidity reduces the motivation of corporate diversification. The results remain robust to small (±300) bandwidth and the inclusion of additional firm controls and industry fixed effects.

[Table 3 is about here.]

4.3. Additional Robustness Tests

In the section, we test the robustness of the Russell index reconstitution based empirical results by 1) using the number of industries as corporate diversification measure, 2) using alternate bandwidths to examine the discontinuity in diversification 3) controlling for index methodology changes 4) estimating a specification using changes in measures 5) conducting

[20] The first stage results are reported in Table 2.

dynamic effect analysis, and 6) employing internal capital market as corporate diversification outcome.

4.3.1. Alternative Measures of Corporate Diversification

We first examine our baseline results using alternative measures of corporate diversification. We use the difference in volatility of investment opportunities between imperfect and perfect cross-divisional correlations over a 5-years rolling window and the number of industry divisions where a firm operates as our dependent variables for corporate diversification. Panel A of Table 4 presents the coefficients on instrumented stock liquidity measures are negative and significant at the 1-10% level. In untabulated results, we find that our results are robust to the use of alternative definition of industry divisions such as the number of industry groups and industry major groups.

[Table 4 is about here.]

4.3.2. Subsample of Diversified Firms near Index Thresholds

We examine the robustness of our findings in a sample of diversified firms in Panel B of Table 4. To ensure that our finding is not driven by unobserved characteristics that may be correlated with corporate diversification decisions, we only focus on the diversified firms. The results demonstrate that there is negative effect of stock liquidity on corporate diversification for diversified firms. Overall, our empirical results demonstrate a causal effect of stock liquidity on corporate diversification. Exogenous changes in stock liquidity due to the inclusion in the Russell 2000 index encourage firms to decrease corporate diversification, with the effects present even at the intensive margin (i.e., diversified firms) rather than only at the extensive margin (i.e., decision to diversify).

4.3.3. Effect of Indexation on Corporate Diversification using Alternate Bandwidth

To mitigate the concern that our findings in Table 3 might be influenced by choice of bandwidth, we reestimate the specification by using a different bandwidth around the Russell index thresholds. Specifically, we choose a significantly larger bandwidth of 800 firms each, on either side of the index threshold, as it enables us to examine how consistent is the effect of the index reconstitution on corporate diversification. Also, as discussed earlier, considering a broader bandwidth can help overcome the impact of Russell's float adjustment to compute index weights using float-adjusted market capitalization instead of absolute market capitalization that Russell uses at the end of the month of May to assign firms to indices. This kind of adjustment can induce systematic differences in liquidities, especially among a narrow bandwidth of firms around the index threshold. However, when we consider a broader bandwidth of 800 firms, we will compare firms with non-trivial weights and hence higher free-floating number of shares in the Russell 1000 with those of Russell 2000 firms.

Panel A of Table 5 presents the results using a bandwidth of 800 around index thresholds. In the first two columns using the specification from columns (3) and (4) of Table 2, we examine the discontinuity in liquidity measures. We find that both the measures of liquidity are higher for firms in the Russell 2000 index when compared to the Russell 1000 index, significant at the 1% level even considering a broader bandwidth of firms. An inclusion in the Russell 2000 index promotes an increase in stock liquidity of about 25.8 percentage points (=0.062/0.24) for *Amihud liquidity* and 1.7 percentage points (=0.278/16.10) for *Trading volume* during the sample period.

Columns (3) and (4) present the second stage results of instrumented variable regressions of *Diversification* (measured as the difference in volatility of investment opportunities between imperfect and perfect cross-divisional correlations over a 10-year rolling window (Duchin, 2010)) on the two measures of stock liquidity, respectively. Using the same specification as in columns (3) and (4) of Table 3, we find that stock liquidity decreases corporate diversification in both the columns and the instrumented measures are significant at least at the 10% level. However, in terms of both significance and magnitude, the results in the second stage are weaker when compared to the findings in Table 3, suggesting that the effect of stock liquidity on diversification is more pronounced near index thresholds.

[Table 5 is about here.]

4.3.4. Controlling for the Effect of Index Methodology Change on the Relationship between Stock Liquidity and Corporate Diversification

Starting from June 2007, Russell instituted a change in their methodology to minimize portfolio turnover for institutions benchmarked to their indices. Specifically, they modified the index assignment routines to lower the likelihood of firms near the index thresholds to switch indices on reconstitution (Heath et al., 2019). When firms' market capitalization falls within a band of ±2.5 % of the index threshold, they are retained in the existing indices rather than being switched. Thus, the bar for switching indices, i.e., either moving from the Russell 1000 to the 2000 or vice versa requires the market capitalization to change 2.5% beyond the index threshold for that year. Similar concerns are echoed by Ben-David et al. (2018) on the vailidity of Russell index based natural experiments after the assignment rule change in 2006. Therefore, a shift in the index methodology could mean that our estimation of the Russell constituents might be incorrect during the 2007-2016 period and thus influence our findings. To overcome this concern, we perform two sets of analyses. First, we examine our findings using a sample period of 1995-2006. Second, for the whole sample period of 1995-2016, we modify our index assignment to incorporate the banding for the post-2007 sample. The findings are reported in Panels B and C of Table 5.

Using the same specification as in Panel A of Table 5, we reestimate the regressions using a sample of Russell index constituents during the sample period between 1995-2006 using a small bandwidth of ±300 firms near index thresholds. We find our results are qualitatively similar to the findings in Table 3. In Panel B of Table 5, we redefine *Ru2000* indicator to take into account the banding. Specifically, we retain the assignment of Ru2000 as the previous year's assignment if the market capitalization of the firm is within ±2.5 % of the index threshold in the current year. With this new Ru2000 measure, we reestimate the regressions of Table 3. Our results remain remarkably similar to the findings in Table 3. Thus, the findings in Panels B and C of Table 5 convincingly mitigate the concern that our empirical results are influenced in any manner by the changes in the index methodology of Russell in the year 2007.

4.3.5. Change Regression Analyses

Following Fang, Noe, and Tice (2009) and Edmans, Fang, and Zur (2013), we conduct a change regression analysis to examine changes in diversification around the Russell 2000 inclusion period, using the changes in key explanatory and control variables around the inclusion in the Russell 2000 index. Using a changes specification helps further overcome reverse causality concerns and also allows us to mitigate concerns concerning the 10-year rolling window estimation used in the computation of our main diversification measure (*Diversification*). To estimate the change regression, we compute the dependent variable as the changes in

Diversification from one year before inclusion in the Russell index to the year of inclusion. Similarly, we measure the changes in *Amihud liquidity* and *Trading volume* between the index inclusion year and the previous year. Using both the samples based on both larger and smaller bandwidth around Rusell 1000/2000 index thresholds, we estimate the two-stage least squares regression as in Table 3 and present the results in Panel E of Table 5. We use the same instrumental variable, i.e., *Ru2000* indicator in the first stage for stock liquidity measures. For the sake of brevity, we do not report the first stage results. In the second stage we regress the changes in *Diversification* on the instrumented measures of changes in *Amihud liquidity* and *Trading volume*. In columns (1) and (2) (columns (3) and (4)), we use a large (small) bandwidth of ±800 (±300). In both the samples, we find that the changes in stock liquidity is negatively associated with the changes in diversification, with the relationship being significant at least at the 10 % level.

4.3.6. Dynamic Analysis

Next, we examine the dynamic treatment effect in Table 6 to alleviate potential reverse causality. We run the analogous test in Table 3 but using the seven-year window around the year of index membership and confirm that the effect of stock liquidity on diversification is negative and significant. Specifically, the sample is restricted only to those firms that experience a change in index membership when compared to the previous three years. *Post* is an indicator variable that takes the value of one for observations in years +1, +2, and +3, and zero otherwise. Year 0 is the year of observed index membership. $Before^{23}$ is an indicator variable that takes the value of one for observations in years -3 and -2, and zero otherwise. *Current* is an indicator variable that takes the value of one for observations in year 0, and zero otherwise. $After^{1}$ is an indicator variable that takes the value of one for observations in year +1, and zero otherwise. *After*[23] is an indicator variable that takes the value of one for observations in year +2 and +3, and zero otherwise. In columns (3) and (4) of Table 6 with a smaller bandwidth around the threshold, the results show that the negative effects of index membership on diversification is concentrated in post-index membership period. We find that the interaction terms with the pre-index membership year are insignificant, supporting that our results cannot be explained by non-parallel trends between the firms in the Russell 1000 and 2000 in non-event years. Our results are robust to considering other dynamic analysis windows.

[Table 6 is about here.]

4.3.7. Internal Capital Market Efficiency

In this section, we examine the effect of stock liquidity on corporate diversification using the overall value consequence of internal capital allocation by diversified firm. We use the absolute and relative value added by internal capital allocation following Rajan, Servaes, and Zingales (2000), which is described in detail in Section 2.3. An extensive literature studies a cross-subsidization pattern of corporate recourses in investment (e.g., Rajan, Servaes, and Zingales, 2000; Scharfstein and Stein, 2000; Stein, 2003). The absolute and relative value added measures represent the intensity of capital over- or under-allocation relative to the investment opportunities in their segments and firms, respectively.[21] Table 7 shows that instrumented stock liquidity by index membership is negatively associated with both measures of internal capital market efficiency, suggesting that the stock liquidity reduces a major incentive of corporate diversification. The results are robust to the bandwidth size and stock liquidity measures.

[21] Since the relative value-added measure for single-segment firms is zero by construction, the use of this measure is restricted to diversified firms only (e.g., Rajan, Servaes, and Zingales, 2000; Kuppuswamy and Villalonga, 2015). We focus on the absolute value-added as our dependent variable.

[Table 7 is about here.]

5. Evidence using Stock Decimalization

We further substantiate our findings based on the Russell index inclusion using an alternate natural experiment in this section. In 2001, the major U.S. stock exchanges including the NYSE, AMEX, and NASDAQ shifted to a minimum tick size of 1/100th of a dollar from 1/16th of a dollar, which increased stock liquidity sharply as documented by various previous studies (Chordia, Roll, and Subrahmanyam, 2001; Bessembinder, 2003; Furfine, 2003). We follow a standard difference-in-differences (DiD) approach by exploiting decimalization as an exogenous shock to stock liquidity and examine the levels of corporate diversification following it. Our DiD methodology compares the difference in corporate diversification between treatment firms which experience larger increases in stock liquidity related to decimalization and control firms which experience smaller increases, before and after the decimalization event for three years each.[22]

An advantage with stock decimalization as a natural experiment is the the sizeable cross-sectional variation in changes in liquidity around decimalization among different stocks, which is particularly useful for us in isolating firms that face a greater increase in stock liquidity and those that do not (e.g., Fang, Tian, and Tice, 2014; Brogaard, Li, and Xia, 2017). Furthermore, strategic inititatives such as corporate diversification, acquisitions or divestitures all take considerable resources, planning and time. Since index reconstitution happens every year in mid-June, this creates a concern about whether index changes immediately affect corporate policies.

[22] The DiD estimation has multiple advantages compared to standard OLS regression techniques. First, the DiD estimator can rule out any unobservable time trends that can affect both the treatment and control firms. Second, the DiD estimator allows us to perform several additional tests to verify validity and help establish causality. Third, DiD estimator not only controls for firm-specific time-invariant heterogeneity but can also rule out the unobservable but invariant difference between treatment and control firms.

Hence, decimalization helps us to overcome these concerns by providing us another quasi-natural experiement with exogenous variation in stock liquidity

Following Fang, Tian, and Tice (2014), we use a propensity score matching method to construct a control group and a treatment group. Specifically, we first calculate the relative change in liquidity by measuring ($Amihud\ Liquidity_{year+1} - Amihud\ Liquidity_{year-1}$) / $Amihud\ Liquidity_{year-1}$, where the event year is 2001. Second, we divide our sample firms into treatment and control groups based on the relative change in liquidity. Firms within the top tercile of relative change in liquidity are classified in the treatment group, while the remaining firms are classified into the control group. The implicit assumption behind the construction of treatment and control groups is that either the total change in stock liquidity is driven by decimalization or a part of the change in stock liquidity is driven by other factors, which may not directly affect corporate diversification. In order to mitigate the concern that this assumption may be violated, we build a propensity score matched sample to refine control and treatment groups to be similar along with observable factors. In order to implement propensity score matching, we first estimate a logit model on our sample. The dependent variable is an indicator variable that equals one if the firm experiences an increase in stock liquidity in the top tercile and zero otherwise while controlling for all explanatory variables in Table 3. Additionally, we also control for the pre-decimalization level of *Diversification* and the changes in *Diversification* from two years before to the year of decimalization. The inclusion of the level and changes in *Diversification* further helps satisfy parallel trends assumption during the pre-decimalization period.

[Table 8 is about here.]

Using the propensity-score matched sample, we perform the DiD estimation. The results are reported in Panel A of Table 8 using two measures of corporate diversification, namely

Diversification and *Log(number of industry divisions)*. The first column shows the mean difference between treatment and control groups with respect to corporate diversification before decimalization. Using Diversification, we find that pre-decimalization difference is insignificant, suggesting that the parallel trend assumption of DiD estimator is verified. However, using the *Log(number of industry divisions)*, we find that firms in the treatment group have a significantly lesser number of industry divisions as compared to the control group. The second and third column shows the mean difference between treatment and control groups after decimalization event and the DiD estimators, respectively.

The results using three-years around the decimalization as sample period shows that the treatment group experiences a more considerable decrease in *Diversification* (-0.112) and *Log(number of industry divisions)* (-0.042) on average in the three years after decimalization with respect to control group. These effects are sizable when compared to average *Diversification* of 0.16 and average *Log(number of industry divisions)* of 0.78. In the third column, we find that the DiD estimate is significantly negative for *Diversification* and insignificantly negative for *Log(number of industry divisions)*. However, when we perform the analyses again using a five-year window around decimalization, we find that both the DiD estimates are significantly negative. Overall, these findings suggest that firms that witness a larger increase in stock liquidity around decimalization reduce their level of corporate diversification.

In Panel B of Table 8, we perform the analysis of dynamic treatment effect of stock decimalization on corporate diversification. Using the seven-year window around 2001, we define new time variables similar to those in Table 6, but using 2001 as year 0 instead of the year of Russell index inclusion being defined as year 0. Additionally, we also control for industry and year fixed effects. The dependent variable in columns (1) and (2) (columns (3) and (4)) is *Diversification* (*Log(number of industry divisions)*). In column (1), using an indicator for the post decimalization period (*Post*), we find that the interaction between *Post* and *Treat* (*Post* x *Treat*) is negative and significant at the 10% level. In column (2), we use year dummies instead of *Post* and find that the negative effect on diversification is significant only in the year of and years after decimalization, but not in the years before decimalization. The strongest effect seems to be in the immediate year following decimalization (the significantly negative coefficient on $After^1$). The findings in the last two columns using *Log(number of industry divisions)* are similar and show that the effect of stock decimalization on corporate diversification is consistently negative and does not happen in any of the pre-decimalization years.

6. Possible mechanisms

In this section, we investigate possible mechanisms through which stock liquidity can affect corporate diversification. Specifically, we examine two mechanisms including informational efficiency and governance. We find evidence that both these channels play a role in lowering corporate diversification following an exogenous increase in stock liquidity.

6.1. Informational efficiency

Stock liquidity lowers information acquisition costs of speculators and strengthens their incentives for information production, thereby increasing the informational efficiency of stock prices. Although managers have private information about the firm's fundamentals and investment opportunities, outside investors are more informed on macroeconomic and industry related information (Subrahmanyam and Titman, 2001; Brogaard, Li, and Xia, 2017). Feedback theories suggest that managers observe stock prices and learn from them to modify their strategies (Luo, 2005; Bakke and Whited, 2010). Both information production and feedback effects are increasing in stock liquidity, and therefore increase the informational efficiency when stock liquidity increases.

We employ three different measures to capture stock price informational efficiency. The first measure is probability of informed trading (*PIN*) (Easley, Hvidkjaer, and O' Hara, 2002). PIN is an estimate of the likelihood that a trade originates from an informed trader. A high PIN measure suggests greater differences in information set between various investors which implies lower informational efficiency of stock prices.[23] The second measure is a *Price delay* measure i.e., the average delay in stock price movements in response to information (Hou and Mosckowitz, 2005; Brogaard, Li, and Xia, 2017). Price delay is computed as one minus the ratio R-squared of restricted model to R-squared of nonrestricted model, where the nonrestricted model is specified as the weekly market model with four lagged market return terms.

$$r_{i,t} = \alpha_i + \beta_i R_{m,t} + \sum_{n=1}^{4} \delta_i^{-n} R_{m,t-n} + \epsilon_{i,t}$$

using CRSP value-weighted market index in week t. The restricted model does not contain any lagged term in the above equation. The third measure is the *Idiosyncratic volatility* estimated following Ang et al. (2006) as the standard deviation of the residuals from the Fama-French three factor model as below:

[23] Collin-Dufresne and Fos (2015) show that informed investors self-select the timing of their trading to coincide with increased liquidity, and thus conventional measures of informed trading such as *PIN* might be biased downwards in their actual ability to detect informed trading. Thus, in our context, the reduction in *PIN* can be due to the increased success of informed traders in masking their trades to coincide with the higher liquidity, suggesting a mechanical reduction. Although actual information on informed trading can overcome the problem of using proxies, due to constraints on data availability, we present results using the *PIN*. However, the measurement of our other two measures of price efficiency including *Price delay* and *Idiosyncratic volatility* are less likely to be affected simply by the changes in liquidity. Hence, the evidence when viewed together, suggests an increase in price efficiency coinciding with the inclusion in the Russell 2000 index.

$$r_{i,t} = \alpha_i + \beta_{i,MKT} MKT_t + \beta_{i,SMB} SMB_t + \beta_{i,HML} HML_t + \epsilon_{i,t}$$

Idiosyncratic volatility is computed as the $\sqrt{Var(\varepsilon_{i,t})}$ from the above equation that is estimated using daily returns. We convert it into an annualized measure by multiplying with the square root of the number of trading days in the year.

Table 8 presents the second stage results of instrumented variable regressions of different measures of informational efficiency on stock liquidity using a sample of firms near the Russell 1000/2000 index inclusion thresholds during the period between 1995 and 2016. Our key independent variables are *Amihud liquidity* and *Trading volume*, which are instrumented by index membership in the Russell 2000 index based on market capitalization as of index assignment date. All the dependent variables are measured in the year following the index reconstitution. In the first four columns, the dependent variable is the *PIN*. Here we find that the coefficient on both measures of stock liquidity are significantly negative, suggesting that there is a significant decrease in informed trading following an increase in liquidity. In columns (5)-(8), using the *Price delay* measure as the dependent variable, we find that there is a significant decrease in *Price delay* following an increase in liquidity. In columns (9)-(12), the dependent variable is the *Idiosyncratic volatility* and again we find that there is a significantly negative association with stock liquidity. A lower stock specific volatility suggests that the stock price is highly efficient. Alternatively, the lowering in firm specific volatility can also lower diversification by lowering CEO incentives to diversify. Since most of the CEO's wealth is concentrated in the firm and they face restrictions in diversifying their risk away, the CEOs might be inclined to pursue diversification as a means to lower the variability in their wealth. But when the idiosyncratic volatility of the firm is reduced by the increase in stock liquidity, CEOs might be less interested in pursuing diversification, suggesting an alternate mechanism through which an efficient stock price might reduce diversification.

In sum, the results in Table 8 show that an increase in stock liquidity is associated with increase in informational efficiency of the stock price which can lower the incentives for diversification.

[Table 9 is about here.]

6.2. Corporate governance

Stock liquidity can improve corporate governance as it facilitates concentrated ownership, information acquisition once the blocks have been established, and increased trading after information acquisition (Edmans, 2009; Fang, Edmans, and Zur, 2013). Furthermore, the 'exit' of concentrated owners can in itself be a discipling mechanism and thus improve governance. Apart from 'exit', prior studies also suggest that stock liquidity is associated with an increase in effectiveness of 'voice' strategies. For example, liquid firms are more likely to experience hedge fund activist campaigns (Brav et al., 2008) and proxy contests (Fos, 2016) that increase operating performance and firm value. An improvement in corporate governance environment can improve monitoring of managers and reduce diversification to the extent that such activity does not increase firm value or performance.

We employ three different measures to capture corporate governance including *Analyst coverage*, *Proportion of independent directors,* and *Institutional ownership concentration*. Institutional ownership data is obtained from Thomson Reuters 13F Holdings database. *Analyst coverage* is constructed as the natural logarithm of the number of analysts that have provided atleast one forecast during the fiscal year in the Thomson Reuters IBES database. Proportion of independent directors is measured as the fraction of the directors on the board that are considered as independent using data from Institutional Share Holder Services (ISS). By making use of the number of institutional owners in the Thomson Reuters 13F Holdings database, we construct a Herfindahl index of *Institutional ownership (IO) concentration* by summing up the squares of all institutional holdings as a fraction of total shares outstanding.

Table 9 presents the second stage results of instrumented variable regressions of different measures of corporate governance on stock liquidity using a sample of firms near the Russell 1000/2000 index inclusion thresholds during the period between 1995 and 2016. Again, our key independent variables are *Amihud liquidity* and *Trading volume*, each instrumented by index membership in the Russell 2000 index based on market capitalization as of index assignment date. All the dependent variables are measured in the year following the index reconstitution. In columns (1)-(4), we find a significantly positive coefficient, suggesting that there is an increase in analyst coverage following an increase in stock liquidity. In columns (5)-(8), we find that an increase in stock liquidity is associated with an increase in board independence. In columns (9)-(12), we use institutional ownership concentration as the dependent variable and find that there is a significantly negative relationship with stock liquidity. This suggests that the breadth of institutional investor participation is higher and thus the stock price is more likely to be closer to its fundamental value (Chen, Hong, and Stein, 2002).[24]

[Table 10 is about here.]

[24] In untabulated results, we regress the instrumented measures of liquidity on different types of institutional ownership. We find that the increase in stock liquidity is mainly because of an increase in *Transient* institutional ownership and *Quasi-indexers* institutional ownership. There is no significant change in *Dedicated* institutional ownership. Although concentrated institutional ownership like dedicated owners have the highest incentives to monitor the management and thus increase corporate governance, our results still suggest an improvement in corporate governance for the following reasons. First, although liquidity can make it easier for existing blockholders to exit the firm, we do not find a marked reduction in Dedicated institutional ownership, suggesting that such investors may not be exiting and thus unlikely to weaken corporate governance. Second, the increase in liquidity increases the deterrence effect of existing blockholders i.e., the threat of selling can be more credible for managers and thus improve governance (Edmans, 2009).

In sum, the results in Table 9 show that an increase in stock liquidity is associated with an improvement in corporate governance in the form of increases in analyst coverage, board independence and decrease in institutional ownership concentration, all of which can lower the incentives of the firm and the ability of the manager to engage in diversification.

7. Summary and Conclusion

The paper examines the relationship between stock liquidity and corporate diversification. We hypothesize that stock liquidity in the financial market reduces the motivation for corporate diversification by improving the information environment and enhancing corporate governance. Improved stock price efficiency and better governance lower asymmetric information and the idiosyncratic risk of the firm, incentivizing both the firm and the manager to pursue less diversification.

Consistent with this hypothesis, using inclusion in the Russell 2000 index as an instrument for stock liquidity, we find that an increase in stock liquidity leads to a decrease in corporate diversification. Stock liquidity improves information efficiency of the stock price by lowering the probability of informed trading and price delay, and by reducing idiosyncratic return volatility. We also find that stock liquidity increases analyst coverage, the proportion of independent directors, and decreases institutional ownership concentration. Notably, stock liquidity increases the demand for firm specific information which lowers information asymmetry and facilitates information production. Overall, the results documented in this study provide new evidence on the real effects of financial markets on corporate diversification and thus their effect on shaping firm boundary and operational scope through information and governance channels.

References

Admati, A.R., Pfleiderer, P., 2009. The "Wall Street Walk" and shareholder activism: exit as a form of voice. *Review of Financial Studies* 22: 2445-2485.

Amihud, Y., 2002. Illiquidity and stock returns: cross-section and time-series effects. *Journal of Financial Markets* 5: 31-56.

Amihud, Y., Lev, B., 1981. Risk reduction as a managerial motive for conglomerate mergers. *Bell Journal of Economics* 12: 605-617.

Ang, A., Hodrick, R.J., Xing, Y. and Zhang, X., 2009. High idiosyncratic volatility and low returns: International and further US evidence. *Journal of Financial Economics* 91: 1-23.

Appel, I., Gormley, T., and Keim, D., 2016. Passive investors, not passive owners. *Journal of Financial Economics* 121: 111-141.

Appel, I.R., Gormley, T.A. and Keim, D.B., 2018. Standing on the Shoulders of Giants: The Effect of Passive Investors on Activism. *Review of Financial Studies* 32: 2720-2774.

Armstrong, C.S. and Vashishtha, R., 2012. Executive stock options, differential risk-taking incentives, and firm value. *Journal of Financial Economics* 104: 70-88.

Bakke, T.E. and Whited, T.M., 2010. Which firms follow the market? An analysis of corporate investment decisions. *Review of Financial Studies* 23: 1941-1980.

Becker-Blease, J.R., Paul, D.L., 2006. Stock liquidity and investment opportunities: evidence from index additions. *Financial Management*. 35: 35-51.

Ben-David, I., Franzoni, F. and Moussawi, R., 2018. Do ETFs increase volatility?. *Journal of Finance* 73: 2471-2535.

Berger, P.G., Ofek, E., 1995. Diversification's effect on firm value. *Journal of Financial Economics* 37: 39-65.

Bessembinder, H., 2003. Trade execution costs and market quality after decimalization. *Journal of Financial and Quantitative Analysis* 38: 747-777.

Bhide, A., 1993. The hidden costs of stock market liquidity. *Journal of Financial Economics* 34: 31-51.

Bond, P., Edmans, A., Goldstein, I., 2012. The real effects of financial markets. *Journal of Finance* 67: 933-971.

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

Brav, A., Jiang, W., Partnoy, F. and Thomas, R., 2008. Hedge fund activism, corporate governance, and firm performance. *Journal of Finance* 63: 1729-1775.

Brennan, M.J., Chordia, T., Subrahmanyam, A., 1998. Alternative factor specifications, security characteristics, and the cross-section of expected stock returns. *Journal of Financial Economics* 49: 345-373.

Brogaard, J., Li, D., Xia, Y., 2017. Stock liquidity and default risk. *Journal of Financial Economics* 124: 486-502.

Bushee, B.J., 2001. Do institutional investors prefer near-term earnings over long-run value?. *Contemporary Accounting Research* 18: 207-246.

Campello, M., Ribas, R.P. and Wang, A.Y., 2014. Is the stock market just a side show? Evidence from a structural reform. *Review of Corporate Finance Studies* 3: 1-38.

Cesari, A.D., Espenlaub, S., Khurshed, A., Simkovic, M., 2012. The effects of ownership and stock liquidity on the timing of repurchase transactions. *Journal of Corporate Finance* 18: 1023-1050.

Chang, Y.C., Hong, H. and Liskovich, I., 2015. Regression discontinuity and the price effects of stock market indexing. *Review of Financial Studies* 28: 212-246.

Chen, J., Hong, H. and Stein, J.C., 2002. Breadth of ownership and stock returns. *Journal of Financial Economics* 66: 171-205.

Chordia, T., Roll, R. and Subrahmanyam, A., 2001. Market liquidity and trading activity. *Journal of Finance* 56: 501-530.

Coffee, J., 1991. Liquidity versus control: the institutional investor as corporate monitor. *Columbia Law Review* 91: 1277-1368.

Coles, J.L., Daniel, N.D. and Naveen, L., 2006. Managerial incentives and risk-taking. *Journal of Financial Economics* 79: 431-468.

Collin-Dufresne, P. and Fos, V., 2015. Do prices reveal the presence of informed trading?. *Journal of Finance* 70: 1555-1582.

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

Dass, N., Huang, S., Maharjan, J. and Nanda, V., 2016. The role of stock liquidity in mergers and acquisitions: Evidence from a quasi-natural experiment. *Working paper*.

Dimitrov, V., Tice, S., 2006. Corporate diversification and credit constraints: real effects across the business cycle. *Review of Financial Studies* 19: 1465–1498.

Denis, D.J., Denis, D.K. and Sarin, A., 1997. Agency problems, equity ownership, and corporate diversification. *Journal of Finance* 52: 135-160.

Duchin, R., 2010. Cash holdings and corporate diversification. *Journal of Finance* 65: 955-992.

Easley, D., Hvidkjaer, S. and O' Hara, M., 2002. Is information risk a determinant of asset returns?. *Journal of Finance* 57: 2185-2221.

Edmans, A., 2009. Blockholder trading, market efficiency, and managerial myopia. *Journal of Finance* 64: 2481-2513.

Edmans, A., Fang, V.W., Zur, E., 2013. The effect of liquidity on governance. *Review of Financial Studies* 26: 1443-1482.

Edmans, A., Goldstein, I. and Jiang, W., 2012. The real effects of financial markets: The impact of prices on takeovers. *Journal of Finance* 67: 933-971.

Edmans, A., Manso, G., 2011. Governance through trading and intervention: a theory of multiple blockholders. *Review of Financial Studies* 24: 2395-2428.

Fang, V.W., Noe, T.H. and Tice, S., 2009. Stock market liquidity and firm value. *Journal of Financial Economics* 94: 150-169.

Fang, V.W., Tian, X. and Tice, S., 2014. Does stock liquidity enhance or impede firm innovation?. *Journal of Finance* 69: 2085-2125.

Fauver, L., Houston, J. and Naranjo, A., 2003. Capital market development, international integration, legal systems, and the value of corporate diversification: A cross-country analysis. *Journal of Financial and Quantitative Analysis* 38: 135-158.

Fich, E.M., Harford, J. and Tran, A.L., 2015. Motivated monitors: The importance of institutional investors′ portfolio weights. *Journal of Financial Economics* 118: 21-48.

Fos, V., 2016. The disciplinary effects of proxy contests. *Management Science* 63: 655-671.

Foucault, T. and Gehrig, T., 2008. Stock price informativeness, cross-listings, and investment decisions. *Journal of Financial Economics* 88: 146-168.

Furfine, C., 2003. Decimalization and market liquidity. *Economic Perspectives* 27: 2-12.

Gilson, S.C., Healy, P.M., Noe, C.F., Palepu, K.G., 2001. Analyst specialization and conglomerate stock breakups. *Journal of Accounting Research* 39: 565-582.

Goyenko, R. Y., Holden, C. W., Trzcinka, C. A., 2009. Do liquidity measures measure liquidity? *Journal of Financial Economics* 92: 153-181.

Graham, J.R., Lemmon, M.L., Wolf, J., 2002. Does Corporate Diversification Destroy Value? *Journal of Finance* 57: 695-720.

Hadlock, C.J., Ryngaert, M., Thomas, S., 2001. Corporate structure and equity offerings: are there benefits to diversification? *Journal of Business* 74: 613-635.

Heath, D., Macciocchi, D., Michaely, R. and Ringgenberg, M., 2019. Do Index Funds Monitor?. *Swiss Finance Institute* 19-08.

Hegde, S. P., McDermott, J. B., 2003. The liquidity effects of revisions to the S&P 500 index: an empirical analysis. *Journal of Financial Markets* 6: 413-459.

Hope, O.K. and Thomas, W.B., 2008. Managerial empire building and firm disclosure. *Journal of Accounting Research* 46: 591-626.

Hou, K. and Moskowitz, T.J., 2005. Market frictions, price delay, and the cross-section of expected returns. *Review of Financial Studies* 18: 981-1020.

Hovakimian, G., 2011. Financial constraints and investment efficiency: Internal capital allocation across the business cycle. *Journal of Financial Intermediation* 20: 264-283.

Huson, M.R., MacKinnon, G., 2003. Corporate spinoffs and information asymmetry between investors. *Journal of Corporate Finance* 9: 481-503.

Hyland, D.C., Diltz, J.D., 2002. Why Firms Diversify: An Empirical Examination. *Financial Management* 31: 51-81.

Jain, P., Jiang, C., Mekhaimer, M., 2016. Executives' horizon, internal governance and stock market liquidity. *Journal of Corporate Finance* 40: 1-23.

Jensen, M.C., 1986. Agency costs of free cash flow, corporate finance, and takeovers. *American Economic Review* 76: 323-329.

Jiang, F., Ma, Y., Shi, B., 2017. Stock liquidity and dividend payouts. *Journal of Corporate Finance* 42: 295-314.

Kahn C., Winton, A., 1998. Ownership Structure, Speculation, and Shareholder Intervention. *Journal of Finance* 53: 99-129.

Kang, M., Wang, W., Eom, C., 2017. Corporate investment and stock liquidity: Evidence on the price impact of trade. *Review of Financial Economics* 33: 1-11.

Khanna, T. and Palepu, K., 2000. Is group affiliation profitable in emerging markets? An analysis of diversified Indian business groups. *Journal of Finance* 55:, 867-891.

Kuppuswamy, V. and Villalonga, B., 2015. Does diversification create value in the presence of external financing constraints? Evidence from the 2007–2009 financial crisis. *Management Science* 62: 905-923.

Kyle, A.S., 1985. Continuous Auctions and Insider Trading. *Econometrica* 53: 1315-1335.

Kyle, A.S., Vila, J.L., 1991. Noise trading and takeovers. *Rand Journal of Economics* 22: 54-71.

Lamont, O., 1997. Cash flow and investment: Evidence from internal capital markets. *Journal of Finance* 52: 83-109.

Lamont, O., Polk, C., 2002. Does Diversification Destroy Value? Evidence from Industry Shocks. *Journal of Financial Economics* 63: 51-77.

Lang, L.H.P., Stulz, R.M., 1994. Tobin's q, corporate diversification, and firm performance. *Journal of Political Economy* 102: 1248-1280.

Lewellen, W., 1971. A pure financial rationale for the conglomerate merger. *Journal of Finance* 26: 521-537.

Lipson, M. L., Mortal, S., 2007. Liquidity and firm characteristics: Evidence from mergers and acquisitions. *Journal of Financial Markets* 10: 342-361.

Luo, Y., 2005. Do insiders learn from outsiders? Evidence from mergers and acquisitions. *Journal of Finance* 60: 1951-1982.

Ma, L., Tang, Y., and Gomez. J., 2018. Portfolio manager compensation in the U.S. mutual fund industry. *Journal of Finance*, Forthcoming.

Matvos, G., Seru, A., Silva, R.C., 2018. Financial market frictions and diversification. *Journal of Financial Economics* 127: 21-50.

Markowitz, H., 1952. Portfolio selection. *Journal of Finance* 7: 77-91.

Martin, J.D., Sayrak, A., 2003, Corporate diversification and shareholder value: a survey of recent literature. *Journal of Corporate Finance* 9: 37-57.

Maug, E., 1998. Large shareholders as monitors: is there a trade–off between liquidity and control? *Journal of Finance* 53: 65-98.

Morck, R., Shleifer, A., Vishny, R.W., 1990. The stock market and investment: is the stock market a sideshow? *Brookings Papers on Economic Activity* 1990: 157-215.

Murphy, K.J., 1985. Corporate Performance and Managerial Remuneration: An Empirical Analysis. *Journal of Accounting and Economics* 7: 11-42.

Opler, T., Pinkowitz, L., Stulz, R., and Williamson, R., 1999. The determinants and implications of corporate cash holdings. *Journal of Financial Economics* 52: 3-46.

Rajan, R., Servaes, H. and Zingales, L., 2000. The cost of diversity: The diversification discount and inefficient investment. *Journal of Finance* 55: 35-80.

Roulstone, D.T., 2003. Analyst following and market liquidity. *Contemporary Accounting Research* 20: 552-578.

Santalo, J., Becerra, M., 2008. Competition from specialized firms and the diversification-performance linkage. *Journal of Finance* 63: 851–883.

Scharfstein, D.S., 1998. The Dark Side of Internal Capital Markets II: Evidence from Diversified Conglomerates. *NBER Working papers*

Scharfstein, D.S., Stein, J.C., 2000. The Dark Side of Internal Capital Markets: Divisional Rent Seeking and Inefficient Investment. *Journal of Finance* 55: 2537-2564.

Servaes, H., 1996. The value of diversification during the conglomerate merger wave. *Journal of Finance* 51: 1201-1226.

Servaes, H., Lins, K., 1999. International evidence on the value of Corporate diversification. *Journal of Finance* 54: 2215-2240.

Shin, H.H., Stulz, R., 1998. Are internal capital markets efficient? *Quarterly Journal of Economics* 113: 531-552.

Shleifer, A., Vishny, R.W., 1986. Large shareholders and corporate control. *Journal of Political Economy* 94: 461-88.

Stein, J.C., 1997. Internal capital markets and the competition for corporate resources. *Journal of Finance* 52: 111–133.

Stein, J.C., 2003. Agency, information and corporate investment. In *Handbook of the Economics of Finance* 1: 111-165. Elsevier.

Subrahmanyam, A. and Titman, S., 2001. Feedback from stock prices to cash flows. *Journal of Finance* 56: 2389-2413.

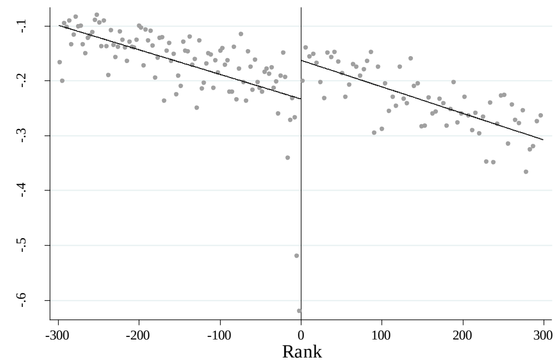
Villalonga, B., 2004. Diversification discount or premium? New evidence from the business information tracking series. *Journal of Finance* 59*:* 479-506.

West K., 1988, Dividend Innovations and Stock Price Volatility. *Econometrica* 56: 37-61.

Yan, A., Yang, Z., Jiao, J., 2010. Conglomerate investment under various capital market conditions. *Journal of Banking and Finance* 34: 103–115.

Figure 1. Russell 2000 Index Membership and Discontinuity in Stock Liquidity

These figures plot the average of stock liquidity measures (*Amihud liquidity* and *Trading volume* in (a) and (b), respectively) around the Russell 2000 index threshold, along with the fitted lines on both sides of the threshold for the period of 1995-2016. The x-axis (*Rank)* represent the market capitalization ranking of firms in the the Russell 1000 and the Russell 2000 indices computed as actual rank minus 1000 (i.e., 0 represents the smallest firm in the Russell 1000 index) as of index assignment date. The sample is restricted to ranks within narrow bands of 300 to 800 on both sides of the threshold.



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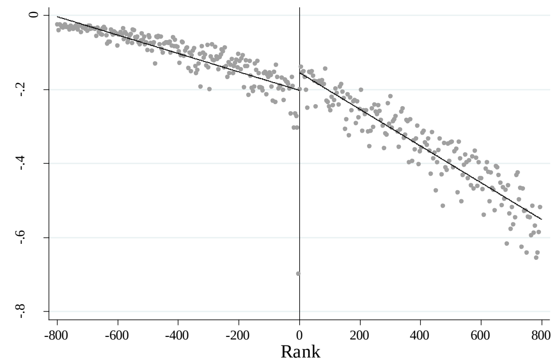

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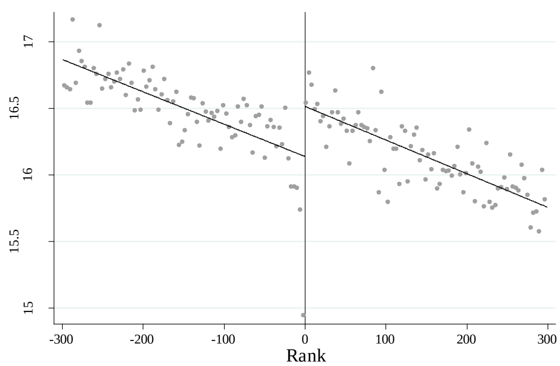
(a) Discontinuity in *Amihud liquidity* around the threshold



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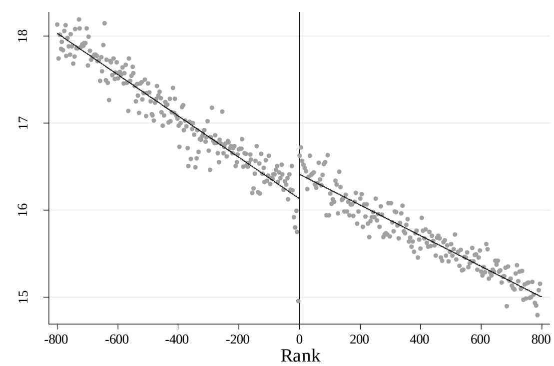

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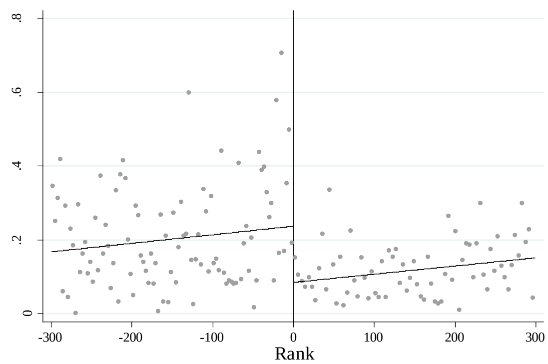
(b) Discontinuity in *Trading volume* around the threshold

Figure 2. Russell 2000 Index Membership and Discontinuity in Corporate Diversification

These figures plot the average of corporate diversification measures (*Diversification* and *Log (Number of industry divisions)* in (a) and (b), respectively) around the Russell 2000 index threshold, along with the fitted lines on both sides of the threshold for the period of 1995-2016. The x-axis (*Rank)* represent the market capitalization ranking of firms in the Russell 1000 and the Russell 2000 indices computed as actual rank minus 1000 (i.e., 0 represents the smallest firm in the Russell 1000 index) as of index assignment date. The sample is restricted to ranks within narrow bands of 300 to 800 on both sides of the threshold. the associated 95% confidence intervals.



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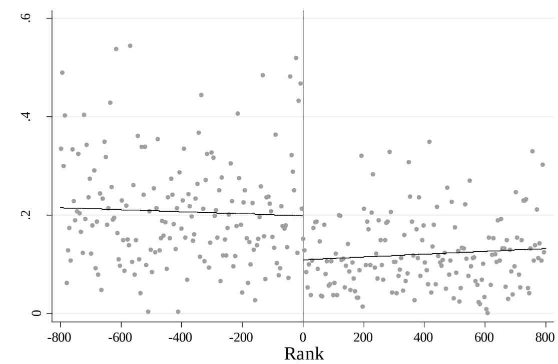

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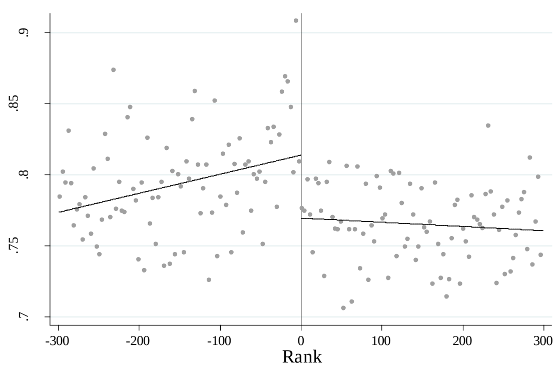
(a) Discontinuity in *Diversification* around the threshold



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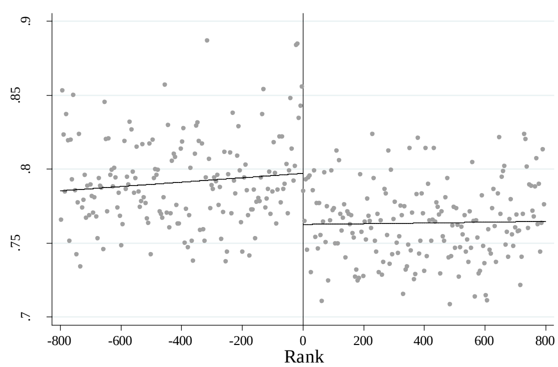

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(b) Discontinuity in *Log (Number of industry divisions)* around the threshold

Table 1: Summary Statistics

This table provides summary statistics for key variables used in the analysis. Panel A consists of firms in the Russell 1000 and the Russell 2000 indices during the period between 1995 and 2016. Panel B consists of a subsample of firms with market capitalizations closer to the Russell index assignment thresholds for the Russell 1000/2000 estimated as of index assignment date (±300 firms). In Panel B, *t*-statistics based on the test of difference in mean of subsamples of firms in the Russell 1000 and 2000 indices, respectively, is reported in parentheses. All the variables are defined in Appendix B. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

Panel A: Full Sample

	Mean	Std. Dev.	25^{th}	50^{th}	75^{th}	Obs.
Amihud liquidity	-0.21	0.25	-0.25	-0.12	-0.06	5,847
Trading volume	16.28	1.03	15.67	16.39	17.01	5,847
Diversification	0.16	0.60	0.00	0.00	0.00	5,847
Diversification (5yr)	0.05	2.42	0.00	0.00	0.00	5,847
Log(number of industry divisions)	0.78	0.19	0.69	0.69	0.69	5,847
Absolute Value Added	0.00	0.05	-0.01	0.00	0.01	2,222
Relative Value Added	0.00	0.02	-0.00	0.00	0.00	2,222
Probability of informed trading	0.12	0.04	0.09	0.11	0.14	4,098
Price delay	0.26	0.25	0.08	0.18	0.37	5,847
Idiosyncratic return volatility	8.36	4.76	5.14	7.18	10.31	5,669
Analyst coverage	2.43	0.60	2.08	2.48	2.83	5,103
Institutional ownership concentration	0.06	0.05	0.04	0.04	0.06	5,802
Board independence	0.69	0.17	0.60	0.71	0.83	2,754
Float adjustment	-0.03	0.09	-0.04	-0.01	0.02	5,847
Institutional ownership	0.74	0.22	0.62	0.77	0.89	5,847
Size	7.10	0.93	6.51	7.14	7.73	5,847
Profitability	0.09	0.13	0.06	0.10	0.14	5,847
Tobin's *q*	1.93	0.96	1.30	1.65	2.28	5,847
Book leverage	0.22	0.20	0.04	0.20	0.33	5,847

Panel B: Subsample of Firms Near the Russell 1000/2000 Index Thresholds

	Russell 2000 index constituents near index thresholds			Russell 1000 index constituents near index thresholds			Test of mean difference
	Mean	Median	Obs.	Mean	Median	Obs.	
Amihud liquidity	-0.24	-0.14	2,982	-0.17	-0.09	2,865	-0.07***
Trading volume	16.10	16.21	2,982	16.47	16.59	2,865	-0.36***
Diversification	0.12	0.00	2,982	0.20	0.00	2,865	-0.09***
Probability of informed trading	0.12	0.12	2,093	0.12	0.11	2,005	0.01***
Price delay	0.26	0.19	2,982	0.26	0.18	2,865	0.00
Idiosyncratic return volatility	8.54	7.46	2,915	8.17	6.92	2,754	0.37***
Analyst coverage	2.35	2.40	2,596	2.51	2.56	2,507	-0.16***
Institutional ownership concentration	0.06	0.04	2,957	0.06	0.05	2,845	-0.00*
Board independence	0.68	0.71	1,301	0.70	0.71	1,453	-0.01*
Institutional ownership	0.73	0.77	2,982	0.74	0.78	2,865	-0.00
Size	6.82	6.84	2,982	7.40	7.47	2,865	-0.57***
Profitability	0.09	0.10	2,982	0.09	0.10	2,865	0.00
Tobin's *q*	1.99	1.68	2,982	1.88	1.59	2,865	0.11***
Book leverage	0.21	0.19	2,982	0.23	0.21	2,865	-0.01***

Table 2: Differences in Stock Liquidity around the Russell 1000/2000 index thresholds

This table presents results of the discontinuity in stock liquidity around Russell 1000/2000 index thresholds. Ru2000 is an indicator variable that takes the value of one if the firm belongs to the Russell 2000 index and zero if the firm belongs to the Russell 1000 index during the period between 1995 and 2016. Index membership in Russell 1000/2000 is estimated using ranking of market capitalizations as of index assignment date. The sample consists of firms within ±300 bandwidth around Russell 1000/2000 index thresholds. *t*-statistics based on standard errors clustered by firm are reported in parentheses. All the variables are defined in Appendix B. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

Independent variable	(1) Amihud liquidity	(2) Trading volume	(3) Amihud liquidity	(4) Trading volume
IV: Ru2000	0.075***	0.366***	0.066***	0.303***
	(5.14)	(6.21)	(4.89)	(5.68)
Rank	-0.425***	-2.308***	-0.455***	-2.295***
	(-6.24)	(-8.99)	(-7.04)	(-9.28)
Ru2000 x Rank	-0.058	-0.131	0.029	0.202
	(-0.74)	(-0.45)	(0.38)	(0.75)
Float adjustment	0.535***	1.480***	0.314***	0.696***
	(6.21)	(7.61)	(3.88)	(3.94)
Institutional ownership			0.312***	1.144***
			(8.95)	(10.57)
Size			0.003	0.037
			(0.35)	(0.89)
Profitability			0.007	-0.649***
			(0.34)	(-6.10)
Tobin's *q*			0.024***	0.206***
			(3.30)	(6.53)
Book leverage			-0.040	-0.021
			(-1.30)	(-0.22)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	5,845	5,845	5,845	5,845
Adjusted R-squared	0.456	0.523	0.517	0.593

Table 3: Stock Liquidity and Corporate Diversification: Instrumental Variable Estimates

This table presents results of instrumented variable regressions of diversification on stock liquidity using a sample of firms near the Russell 1000/2000 index inclusion thresholds during the period between 1995 and 2016. Index membership in the Russell 2000 index is used as an instrument for stock liquidity. Index membership in Russell 1000/2000 is estimated using ranking of market capitalizations as of index assignment date. The dependent variable diversification is measured as the difference in volatility of investment opportunities between imperfect and perfect cross-divisional correlations (Duchin, 2010). The sample consists of firms within ±300 bandwidth around Russell 1000/2000 index thresholds. Industry fixed effects based on the Fama-French 12 industry classification are included in columns (3)-(4). *t*-statistics based on standard errors clustered by firm are reported in parentheses. All the variables are defined in Appendix B. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

	(1)	(2)	(3)	(4)
Independent variables	2nd Stage: Diversification			
Estimated (Amihud liquidity)	-1.966**		-1.898**	
	(-2.42)		(-2.15)	
Estimated (Trading volume)		-0.401***		-0.413**
		(-2.58)		(-2.25)
Rank	-0.617***	-0.707***	-0.680**	-0.763**
	(-2.86)	(-2.97)	(-2.34)	(-2.39)
Ru2000 x Rank	-0.133	-0.071	0.085	0.114
	(-0.42)	(-0.25)	(0.31)	(0.45)
Float adjustment	1.085**	0.626**	0.543*	0.235
	(2.31)	(2.40)	(1.70)	(1.42)
Institutional ownership			0.692**	0.572**
			(2.30)	(2.39)
Size			0.035	0.045
			(0.87)	(1.16)
Profitability			0.009	-0.272**
			(0.12)	(-2.06)
Tobin's *q*			0.017	0.056
			(0.58)	(1.45)
Book leverage			0.008	0.075
			(0.08)	(0.86)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	5,845	5,845	5,845	5,845

Table 4: Stock Liquidity and Corporate Diversification: Alternative Measures of Diversification and Diversified Subsample

This table presents results of instrumented variable regressions of an alternate measure of diversification on stock liquidity using a sample of firms near the Russell 1000/2000 index inclusion thresholds during the period between 1995 and 2016. Index membership in the Russell 2000 index is used as an instrument for stock liquidity. Index membership in Russell 1000/2000 is estimated using ranking of market capitalizations as of index assignment date. In Panel A, the dependent variable in columns (1)-(2) is measured as the difference in volatility of investment opportunities between imperfect and perfect cross-divisional correlations over a 5-years rolling window (Duchin, 2010). The dependent variable in columns (3)-(4) is the logarithm of the number of industry divisions in which a firm operates based on the standard industrial classification (SIC) codes at the 3-digit level. In Panel B, we restrict the sample to those firms that have more than one industry group in columns (1)-(2) and more than one industry major group in columns (3)-(4), respectively. The sample consists of firms within ±300 bandwidth around Russell 1000/2000 index thresholds. Industry fixed effects based on the Fama-French 12 industry classification are included in all columns. *t*-statistics based on standard errors clustered by firm are reported in parentheses. All the variables are defined in Appendix B. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

Panel A. Alternative measures of diversification

	(1)	(2)	(3)	(4)
	2nd Stage: Diversification (5yr)		2nd Stage: Log (number of industry divisions)	
Independent variables				
Estimated (Amihud liquidity)	-5.388*		-0.441*	
	(-1.74)		(-1.70)	
Estimated (Trading volume)		-1.171*		-0.096*
		(-1.78)		(-1.73)
Rank	-1.428	-1.665	-0.079	-0.098
	(-1.41)	(-1.47)	(-0.95)	(-1.06)
Ru2000 x Rank	-0.162	-0.080	-0.125	-0.118
	(-0.17)	(-0.09)	(-1.56)	(-1.53)
Float adjustment	1.600	0.726	0.120	0.049
	(1.42)	(1.13)	(1.31)	(0.96)
Institutional ownership	1.890*	1.551*	0.146*	0.119*
	(1.80)	(1.83)	(1.70)	(1.70)
Size	-0.010	0.017	0.028**	0.031**
	(-0.08)	(0.13)	(2.21)	(2.46)
Profitability	-0.169	-0.967**	0.007	-0.058
	(-0.80)	(-2.03)	(0.25)	(-1.44)
Tobin's *q*	0.121	0.232*	0.002	0.011
	(1.34)	(1.85)	(0.17)	(0.77)
Book leverage	0.467	0.658*	-0.028	-0.013
	(1.20)	(1.85)	(-0.90)	(-0.46)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	5,845	5,845	5,845	5,845

Panel B. Subsample of diversified firms near index thresholds

	(1)	(2)	(3)	(4)
	2nd Stage: Diversification			
Independent variables	Number of industry group is greater one		Number of industry major group is greater one	
Estimated (Amihud liquidity)	-3.740**		-4.842**	
	(-1.98)		(-2.03)	
Estimated (Trading volume)		-0.805**		-1.289**
		(-2.07)		(-2.14)
Rank	-1.356**	-1.761**	-1.702**	-2.591**
	(-2.16)	(-2.24)	(-2.16)	(-2.18)
Ru2000 x Rank	0.422	0.926	0.579	1.289
	(0.58)	(1.36)	(0.63)	(1.39)
Float adjustment	0.702	0.217	0.880	0.162
	(0.99)	(0.56)	(0.98)	(0.31)
Institutional ownership	1.699**	1.433**	2.350**	2.334**
	(2.14)	(2.31)	(2.09)	(2.25)
Size	0.034	-0.010	0.042	0.024
	(0.30)	(-0.10)	(0.30)	(0.18)
Profitability	-0.157	-0.938	-0.008	-1.282
	(-0.34)	(-1.56)	(-0.01)	(-1.54)
Tobin's *q*	0.150	0.183	0.191	0.336
	(1.18)	(1.45)	(1.14)	(1.59)
Book leverage	0.233	0.458*	0.137	0.439
	(0.77)	(1.72)	(0.36)	(1.30)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	2,213	2,213	1,871	1,871

Table 5: Stock Liquidity and Corporate Diversification: Robustness Tests

This table presents results of instrumented variable regressions of an alternate measure of diversification on stock liquidity using a sample of firms near the Russell 1000/2000 index inclusion thresholds during the period between 1995 and 2016. Index membership in the Russell 2000 index is used as an instrument for stock liquidity. Index membership in Russell 1000/2000 is estimated using ranking of market capitalizations as of index assignment date. In Panel A, the sample consists of firms within ±800 bandwidth around Russell 1000/2000 index thresholds. In Panels B and C, the sample consists of firms within ±300 bandwidth around Russell 1000/2000 index thresholds. In Panel B, we restrict the sample period to 1995-2006. In Panel C, we nullify index changes when the market capitalization is within 2.5% from the Russell 1000/2000 index thresholds during the 2006-2016 period. In all Panels except Panel E, in columns (1)-(2), we report the first stage regression using Ru2000 as instrument variable and in columns (3)-(4), we report the second stage regression using diversification as dependent variable measured as the difference in volatility of investment opportunities between imperfect and perfect cross-divisional correlations over a 10-years rolling window (Duchin, 2010). In Panel E, we regress changes in diversification (the dependent variable) on the estimated changes in liquidity instrumented by index membership in Russell 1000/2000. All control variables are also measured as changes. In Panel E, in columns (1)-(2) (columns (3)-(4)), the sample consists of firms within ±800 (±300) bandwidth around Russell 1000/2000 index thresholds. Industry fixed effects based on the Fama-French 12 industry classification are included in all columns. *t*-statistics based on standard errors clustered by firm are reported in parentheses. All the variables are defined in Appendix B. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

Panel A. Larger bandwidth (firms within ±800 bandwidth around Russell 1000/2000 index thresholds)

	(1)	(2)	(3)	(4)
	1st Stage		2nd Stage	
Independent variables	Amihud liquidity	Trading volume	Diversification	
Estimated (Amihud liquidity)			-1.321*	
			(-1.95)	
Estimated (Trading volume)				-0.296**
				(-1.99)
IV: Ru2000	0.062***	0.278***		
	(7.30)	(8.23)		
Rank	-0.300***	-2.320***	-0.275	-0.565*
	(-13.59)	(-27.09)	(-1.61)	(-1.85)
Ru2000 x Rank	-0.224***	0.681***	-0.308	0.189*
	(-9.38)	(8.18)	(-1.47)	(1.70)
Float adjustment	0.481***	0.694***	0.693**	0.263**
	(9.44)	(5.46)	(2.15)	(2.29)
Institutional ownership	0.323***	1.033***	0.478**	0.357**
	(13.84)	(12.74)	(2.06)	(2.11)
Size	-0.012*	0.070***	0.055**	0.092***
	(-1.84)	(2.83)	(1.97)	(3.71)
Profitability	-0.033*	-0.564***	-0.088*	-0.211**
	(-1.95)	(-8.22)	(-1.76)	(-2.21)
Tobin's *q*	0.013**	0.218***	0.005	0.053
	(2.49)	(10.93)	(0.28)	(1.53)
Book leverage	-0.033	-0.047	-0.100	-0.071
	(-1.61)	(-0.74)	(-1.46)	(-1.12)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	15,323	15,323	15,323	15,323

Panel B. Using pre-2006 sample period

	(1)	(2)	(3)	(4)
	1st Stage		2nd Stage	
Independent variables	Amihud liquidity	Trading volume	Diversification	
Estimated (Amihud liquidity)			-1.220*	
			(-1.79)	
Estimated (Trading volume)				-0.338*
				(-1.81)
IV: Ru2000	0.064***	0.230***		
	(2.86)	(3.42)		
Rank	-0.628***	-2.454***	-0.844***	-0.907***
	(-6.14)	(-8.22)	(-2.72)	(-2.66)
Ru2000 x Rank	0.174	0.824**	0.420*	0.486**
	(1.40)	(2.30)	(1.83)	(2.12)
Float adjustment	0.193*	0.481**	0.191	0.119
	(1.74)	(2.09)	(0.92)	(0.79)
Institutional ownership	0.484***	1.463***	0.634*	0.538*
	(9.75)	(10.73)	(1.85)	(1.85)
Size	0.011	-0.015	0.069*	0.051
	(0.98)	(-0.33)	(1.72)	(1.29)
Profitability	-0.039	-0.830***	-0.092	-0.325*
	(-1.35)	(-4.57)	(-1.37)	(-1.83)
Tobin's *q*	0.040***	0.223***	0.039	0.065
	(4.13)	(6.16)	(1.11)	(1.39)
Book leverage	-0.055	-0.102	-0.010	0.022
	(-1.57)	(-0.80)	(-0.14)	(0.31)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	3,011	3,011	3,011	3,011

Panel C. Excluding 2.5% bandwidth around Russell 1000/2000 index thresholds

	(1)	(2)	(3)	(4)
	1st Stage		2nd Stage	
Independent variables	Amihud liquidity	Trading volume	Diversification	
Estimated (Amihud liquidity)			-1.828**	
			(-2.02)	
Estimated (Trading volume)				-0.386**
				(-2.12)
IV: Ru2000	0.064***	0.302***		
	(4.79)	(5.76)		
Rank	-0.458***	-2.303***	-0.680**	-0.730**
	(-7.07)	(-9.30)	(-2.30)	(-2.34)
Ru2000 x Rank	0.049	0.242	0.121	0.125
	(0.65)	(0.90)	(0.46)	(0.50)
Float adjustment	0.312***	0.696***	0.522	0.220
	(3.85)	(3.93)	(1.61)	(1.33)
Institutional ownership	0.312***	1.140***	0.670**	0.539**
	(8.92)	(10.51)	(2.18)	(2.29)
Size	0.004	0.039	0.035	0.044
	(0.41)	(0.94)	(0.87)	(1.15)
Profitability	0.007	-0.647***	0.007	-0.256*
	(0.37)	(-6.09)	(0.09)	(-1.94)
Tobin's *q*	0.025***	0.209***	0.016	0.051
	(3.36)	(6.61)	(0.52)	(1.32)
Book leverage	-0.040	-0.022	0.011	0.075
	(-1.30)	(-0.24)	(0.11)	(0.88)

Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	5,834	5,834	5,834	5,834

Panel D. Changes Specification

	(1)	(2)	(3)	(4)
	2nd stage			
Independent variables	Larger bandwidth		Smaller bandwidth	
Estimated (Δ Amihud liquidity)	-0.223**		-0.978*	
	(-2.23)		(-1.66)	
Estimated (Δ Trading volume)		-0.348*		-0.186*
		(-1.92)		(-1.89)
Δ Rank	-0.050**	-0.682*	-0.262*	-0.373**
	(-2.05)	(-1.96)	(-1.93)	(-2.08)
Ru2000 x Δ Rank	-0.081*	0.157*	-0.234	0.059
	(-1.90)	(1.91)	(-1.36)	(1.42)
Δ Float adjustment	0.082**	0.238*	0.228	0.071
	(2.19)	(1.90)	(1.35)	(1.17)
Δ Institutional ownership	0.064**	0.253**	0.208*	0.172**
	(2.44)	(1.99)	(1.80)	(2.09)
Δ Size	-0.011	-0.025	-0.045	-0.018
	(-1.25)	(-1.53)	(-1.45)	(-1.17)
Δ Profitability	0.006	0.017	0.008	0.010
	(0.61)	(0.80)	(0.31)	(0.45)
Δ Tobin's *q*	-0.001	0.028*	0.001	0.013
	(-0.42)	(1.70)	(0.09)	(1.37)
Δ Book leverage	0.015	0.062*	0.060	0.056*
	(0.95)	(1.73)	(1.57)	(1.72)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	12,520	12,520	4,835	4,835

Table 6: Stock Liquidity and Corporate Diversification: Dynamic Analysis

This table presents results of dynamic analysis of diversification on stock liquidity using a sample of firms near the Russell 1000/2000 index inclusion thresholds during the period between 1995 and 2016. The sample consists of firms in the seven-year window around the year of index membership, where *year 0* is the year of observed index membership. The sample is restricted only to those firms that experience a change in index membership when compared to the previous three years. Index membership in the Russell 2000 index is used as a measure for stock liquidity. The dependent variable is diversification in all the columns measured as the difference in volatility of investment opportunities between imperfect and perfect cross-divisional correlations (Duchin, 2010). *Post* is an indicator variable that takes the value of one for observations in *years +1*, *+2*, and *+3*, and zero otherwise. *Before^2* is an indicator variable that takes the value of one for observations in *year -2*, and zero otherwise. *Before^1* is an indicator variable that takes the value of one for observations in year -1, and zero otherwise. *Current* is an indicator variable that takes the value of one for observations in *year 0*, and zero otherwise. *After^1* is an indicator variable that takes the value of one for observations in *year +1*, and zero otherwise. *After^{23}* is an indicator variable that takes the value of one for observations in *year +2* and *+3*, and zero otherwise. Variables including *Ru2000*, *Rank*, *Rank* x *Ru2000*, and *Float adjustment* are measured at the time of index membership in *year 0*. Industry fixed effects based on the Fama-French 12 industry classification are included. *t*-statistics based on standard errors clustered by firm are reported in parentheses. All the variables are defined in Appendix 1. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

	(1)	(2)	(3)	(4)
Independent variables	Diversification			
Post x Ru2000	-0.121***		-0.128***	
	(-2.61)		(-2.71)	
Before^2 x Ru2000		-0.006		-0.013
		(-0.26)		(-0.51)
Before^1 x Ru2000		0.010		-0.012
		(0.37)		(-0.30)
Current x Ru2000		-0.024		-0.051
		(-0.57)		(-0.86)
After^1 x Ru2000		-0.092**		-0.116**
		(-2.07)		(-1.97)
After^{23} x Ru2000		-0.147**		-0.169**
		(-2.32)		(-2.36)
Ru2000	-0.058	-0.052	-0.051	-0.028
	(-0.64)	(-0.54)	(-0.59)	(-0.29)
Post	0.042		0.045	
	(1.35)		(1.50)	
Before^2		0.001		0.004
		(0.05)		(0.22)
Before^1		-0.010		0.000
		(-0.48)		(0.01)
Current		-0.013		-0.001
		(-0.40)		(-0.02)
After^1		0.034		0.044
		(0.94)		(1.12)
After^{23}		0.035		0.046
		(0.80)		(1.00)
Rank	0.810*	0.813*	0.777	0.777
	(1.73)	(1.73)	(1.58)	(1.57)
Ru2000 x Rank	-0.704	-0.719	-0.701	-0.714
	(-1.07)	(-1.08)	(-1.05)	(-1.06)
Float adjustment	0.082	0.085	0.092	0.093
	(0.29)	(0.30)	(0.34)	(0.34)
Other controls in Table 3	Yes	Yes	No	No
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	2,528	2,528	2,528	2,528

Table 7: Stock Liquidity and Internal Capital Market Efficiency

This table presents results of instrumented variable regressions of different measures of internal capital market efficiency on stock liquidity using a sample of firms near the Russell 1000/2000 index inclusion thresholds during the period between 1995 and 2016. Index membership in the Russell 2000 index is used as an instrument for stock liquidity. Index membership in Russell 1000/2000 is estimated using ranking of market capitalizations as of index assignment date. The sample consists of firms within ±300 bandwidth around Russell 1000/2000 index thresholds. The dependent variable in columns (1)-(2) is the absolute value added by internal capital allocation, computed as the asset-weighted sum of the product of each segment's industry-adjusted investment rate and the median market-to-assets ratio of single-segment firms in the same industry minus one, across all the segments in a firm (Rajan, Servaes, and Zingales, 2000). The dependent variable in columns (3)-(4) is the relative value added by internal capital allocation, computed as the sum of the asset-weighted *Transfer* to a segment by the difference between a segment's *q* (proxied by the average industry *q* of single segment firms in the industry) and the average firm *q*, where *Transfer* is measured as the difference between the investment made by a segment in a diversified firm and the average investment of single segment firms in the same industry, where investment is scaled by lagged assets. *Transfer* is adjusted by subtracting the average asset weighted transfers across all segments in the diversified firm. Industry fixed effects based on the Fama-French 12 industry classification are included in all columns. *t*-statistics based on standard errors clustered by firm are reported in parentheses. All the variables are defined in Appendix B. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

	(1)	(2)	(3)	(4)
Independent variables	2nd Stage: Absolute value added		2nd Stage: Relative value added	
Estimated (Amihud liquidity)	-0.110**		-0.044*	
	(-2.12)		(-1.68)	
Estimated (Trading volume)		-0.023**		-0.009*
		(-2.20)		(-1.73)
Rank	-0.020	-0.029	-0.007	-0.009
	(-1.13)	(-1.38)	(-0.88)	(-1.07)
Ru2000 x Rank	0.010	0.021	0.001	0.005
	(0.46)	(1.03)	(0.16)	(0.57)
Float adjustment	0.032	0.018	0.001	-0.000
	(1.62)	(1.44)	(0.11)	(-0.08)
Institutional ownership	0.040*	0.032*	0.021*	0.016*
	(1.87)	(1.87)	(1.81)	(1.89)
Size	0.006*	0.005	0.002*	0.001
	(1.78)	(1.61)	(1.72)	(1.51)
Profitability	0.019	-0.004	0.007	-0.003
	(1.37)	(-0.26)	(1.37)	(-0.40)
Tobin's *q*	0.011**	0.011**	0.004**	0.004**
	(2.05)	(2.10)	(2.36)	(2.52)
Book leverage	-0.015*	-0.009	0.001	0.004
	(-1.80)	(-1.13)	(0.35)	(1.27)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	2,221	2,221	2,221	2,221

Table 8: Stock Liquidity and Corporate Diversification: Robustness Tests using Decimalization

This table presents the results of difference-in-differences (DiD) analyses that examine how an exogenous shock to stock liquidity due to Decimalization affects corporate diversification using a propensity-score matched sample of firms. To arrive at matched sample, firms are sorted into terciles based on their change in stock liquidity from the pre-decimalization period to the post-decimalization period. Firms in the top tercile (middle and bottom terciles) constitute the treated (control) group. Each treated firm is matched to a control firm by propensity score matching with the nearest neighbourhood algorithm, without replacement. In both the panels, two measures of diversification are used including 1) difference in volatility of investment opportunities between imperfect and perfect cross-divisional correlations (Duchin, 2010), and 2) the logarithm of the number of industry divisions in which a firm operates based on the standard industrial classification (SIC) codes at the 3-digit level. Panel A presents the univariate DiD test results. The differences in the three- and five-year average measures of diversification between the treated and control groups in the pre- and post- decimalization periods are reported. *t*-statistics are reported in parentheses below the mean differences. Panel B reports regressions results of diversification measures surrounding decimalization. *Treat* is an indicator variable that takes the value one for treated firms and zero for control firms. *Post* is an indicator variable that takes the value of one for observations in years +1, +2, and +3, and zero otherwise, where year 0 refers to decimalization year (i.e., 2001). *Before* is an indicator variable that takes the value of one for observations in years -3, -2, and -1, and zero otherwise. $After^{1}$ is an indicator variable that takes the value of one for observations in year +1, and zero otherwise. $After^{23}$ is an indicator variable that takes the value of one for observations in year +2 and +3, and zero otherwise. *t*-statistics based on standard errors clustered by firm are reported in parentheses. All the variables are defined in Appendix 1. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

Panel A: Univariate DiD test

Variable	Mean difference pre-decimalization (treated - control)	Mean difference post-decimalization (treated - control)	Mean DiD estimator (treated - control)
	3 years before and after Decimalization		
Diversification	0.054	-0.112*	-0.166*
	(0.87)	(1.89)	(1.93)
Log (number of industry divisions)	-0.023**	-0.042***	-0.019
	(-2.49)	(-4.83)	(1.52)
	5 years before and after Decimalization		
Diversification	0.053	-0.103**	-0.156**
	(1.04)	(2.19)	(2.25)
Log (number of industry divisions)	-0.021***	-0.040***	-0.020*
	(-2.78)	(-5.91)	(-1.96)

Panel B: Multivariate DiD test

	Diversification		Log (number of industry divisions)	
Variables	(1)	(2)	(3)	(4)
Treat	0.007	0.035	-0.016	-0.003
	(0.177)	(0.819)	(-1.450)	(-0.243)
Post x Treat	-0.027*		-0.020***	
	(-1.867)		(-2.664)	
$Before^{2}$ x Treat		-0.008		-0.009
		(-0.296)		(-0.719)
$Before^{1}$ x Treat		-0.026		-0.012
		(-0.953)		(-0.943)
Current x Treat		-0.062*		-0.025**
		(-1.894)		(-1.999)
$After^{1}$ x Treat		-0.065**		-0.031**
		(-2.084)		(-2.328)
$After^{23}$ x Treat		-0.050*		-0.034**
		(-1.726)		(-2.570)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	4,016	4,016	3,868	3,868
Adjusted R-squared	0.078	0.078	0.041	0.041

Table 9: Information Efficiency Mechanism

This table presents results of instrumented variable regressions of different measures of information efficiency on stock liquidity using a sample of firms near the Russell 1000/2000 index inclusion thresholds during the period between 1995 and 2016. Index membership in the Russell 2000 index is used as an instrument for stock liquidity. Index membership in Russell 1000/2000 is estimated using ranking of market capitalizations as of index assignment date. The sample consists of firms within ±300 bandwidth around Russell 1000/2000 index thresholds. The dependent variable in the first two columns is the probability of informed trading (PIN), an estimate of the likelihood that a trade originates from an informed trader. In columns (3)-(4), the dependent variable is price delay computed as 1 - (R^2 of restricted model/R^2 of unrestricted model). In columns (5)-(6), the dependent variable is idiosyncratic volatility, computed as the annualized measure of daily stock return residuals using a Fama-French three factor model. Industry fixed effects based on the Fama-French 12 industry classification are included in all columns. *t*-statistics based on standard errors clustered by firm are reported in parentheses. All the variables are defined in Appendix B. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Independent variables	PIN		Price delay		Idiosyncratic return volatility	
Estimated (Amihud liquidity)	-0.120***		-0.500**		-7.398*	
	(-3.79)		(-2.50)		(-1.86)	
Estimated (Trading volume)		-0.030***		-0.109**		-1.711*
		(-4.51)		(-2.53)		(-1.71)
Rank	-0.006	-0.012	-0.128*	-0.150**	1.507	0.993
	(-0.46)	(-0.96)	(-1.87)	(-1.99)	(1.10)	(0.57)
Ru2000 x Rank	-0.008	-0.004	0.045	0.053	-3.472**	-3.350**
	(-0.63)	(-0.36)	(0.61)	(0.74)	(-2.38)	(-2.16)
Float adjustment	0.020*	0.002	0.156*	0.075	1.798	0.631
	(1.70)	(0.25)	(1.92)	(1.49)	(1.10)	(0.53)
Institutional ownership	0.021	0.011	0.131**	0.099*	0.293	-0.012
	(1.51)	(1.12)	(2.03)	(1.88)	(0.24)	(-0.01)
Size	0.001	0.000	-0.009	-0.007	0.509**	0.542*
	(0.53)	(0.30)	(-1.02)	(-0.72)	(1.97)	(1.89)
Profitability	0.025***	0.005	0.012	-0.062*	-7.909***	-9.061***
	(5.22)	(0.82)	(0.50)	(-1.65)	(-8.87)	(-7.60)
Tobin's *q*	-0.002	0.001	0.011	0.022*	1.631***	1.802***
	(-1.25)	(0.41)	(1.23)	(1.78)	(7.45)	(6.09)
Book leverage	0.010**	0.017***	0.039	0.057**	0.316	0.536
	(2.03)	(5.35)	(1.54)	(2.58)	(0.62)	(1.04)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,098	4,098	5,845	5,845	5,599	5,599

Table 10: Corporate Governance Mechanism

This table presents results of instrumented variable regressions of different measures of corporate governance mechanisms on stock liquidity using a sample of firms near the Russell 1000/2000 index inclusion thresholds during the period between 1995 and 2016. Index membership in the Russell 2000 index is used as an instrument for stock liquidity. Index membership in Russell 1000/2000 is estimated using ranking of market capitalizations as of index assignment date. The sample consists of firms within ±300 bandwidth around Russell 1000/2000 index thresholds. The dependent variables are the natural logarithm of the number of analysts covering the firm (columns (1)-(2)), the Herfindahl index of Institutional ownership concentration computed as the sum of the squares of individual Institutional ownership holdings (columns (3)-(4)), and the fraction of independent directors among the board of directors in the firm (columns (5)-(6)). Industry fixed effects based on the Fama-French 12 industry classification are included in all columns. *t*-statistics based on standard errors clustered by firm are reported in parentheses. All the variables are defined in Appendix 1. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Independent variables	Analyst coverage		Institutional ownership concentration		Board independence	
Estimated (Amihud liquidity)	1.401*		-0.173***		0.219	
	(1.79)		(-2.95)		(0.60)	
Estimated (Trading volume)		0.280*		-0.038***		0.036
		(1.92)		(-2.78)		(0.60)
Rank	-0.375*	-0.308	-0.030*	-0.038**	0.099	0.098
	(-1.67)	(-1.27)	(-1.85)	(-1.96)	(1.08)	(1.09)
Ru2000 x Rank	0.144	0.062	-0.019	-0.017	-0.051	-0.087
	(0.58)	(0.28)	(-0.96)	(-0.83)	(-0.46)	(-1.09)
Float adjustment	-0.371	-0.100	-0.012	-0.041*	0.080	0.130
	(-1.25)	(-0.56)	(-0.44)	(-1.71)	(0.53)	(1.41)
Institutional ownership	0.225	0.260	0.024	0.012		
	(1.10)	(1.48)	(1.04)	(0.61)		
Size	-0.071*	-0.068*	0.008**	0.009**	0.022	0.024*
	(-1.80)	(-1.84)	(2.52)	(2.52)	(1.44)	(1.76)
Profitability	-0.321***	-0.137	-0.021***	-0.047***	-0.072	-0.036
	(-2.67)	(-1.07)	(-3.20)	(-3.71)	(-1.50)	(-0.40)
Tobin's *q*	-0.015	-0.031	0.009***	0.012***	0.002	0.002
	(-0.44)	(-0.85)	(2.85)	(2.92)	(0.11)	(0.12)
Book leverage	0.165**	0.154**	-0.013*	-0.006	0.038	0.042
	(2.02)	(2.03)	(-1.69)	(-0.91)	(1.16)	(1.35)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,398	4,398	5,800	5,800	2,537	2,537

Appendix 1. Variable Definition

Variable	Definition
Amihud liquidity	Measured as -log(AMIHUD) where AMIHUD is computed as the sum of the ratio of the absolute value of daily stock return to daily total dollar volume in the stock divided by the number of trading days in the year and scaled by million, as below: $Amihud_{it} = \frac{1}{D_{it}} \sum_{d=1}^{D_{it}} \frac{\lvert R_{itd} \rvert}{Dollar\ volume_{itd}} 10^6$
Absolute Value Added	The asset-weighted sum of the product of each segment's industry-adjusted investment rate and the median market-to-assets ratio of single-segment firms in the same industry minus one, across all the segments in a firm (Rajan, Servaes, and Zingales (2000)
Analyst coverage	The natural logarithm of the number of analysts covering the firm
Board independence	The fraction of independent directors among the board of directors in the firm
Book leverage	Sum of short-term and long-term debt divided by total assets
Diversification	Difference in volatility of investment opportunities between imperfect and perfect cross-divisional correlations, where the correlations are estimated over a 10-year rolling window (Duchin, 2010)
Diversification (5yr)	Difference in volatility of investment opportunities between imperfect and perfect cross-divisional correlations, where the correlations are estimated over a 5-year rolling window (Duchin, 2010)
Float Adjustment	Difference between the market capitalization implied rank as of end of May and the actual rank implied by Russell index weightages on index implementation date in June
Idiosyncratic return volatility	the annualized measure of daily stock return residuals using a Fama-French three factor model
Institutional ownership	Ratio of shares held by institutional investors to total shares outstanding
Institutional ownership concentration	the Herfindahl index of Institutional ownership concentration computed as the sum of the squares of individual Institutional ownership holdings
Log (number of industry divisions)	The logarithm of the number of industry divisions in which a firm operates based on the standard industrial classification (SIC) codes at the 3-digit level
Price delay	Price delay computed as 1 - (R^2 of restricted model/R^2 of unrestricted model)
Probability of informed trading	Estimate of the likelihood that a trade originates from an informed trader
Profitability	Ratio of sum of income before extraordinary items and depreciation and amortization to total assets
Rank	Market capitalization ranking of firms in the Russell 1000 and Russell 2000 indices computed as actual rank minus 1000 as of index assignment date (i.e., end of May), divided by 1000 for readability
Relative Value Added	The sum of the asset-weighted *Transfer* to a segment by the difference between a segment's *q* (proxied by the average industry *q* of single segment firms in the industry) and the average firm *q*, where *Transfer* is measured as the difference between the investment made by a segment in a diversified firm and the average investment of single segment firms in the same industry, where investment is scaled by lagged assets. *Transfer* is adjusted by subtracting the average asset weighted transfers across all segments in the diversified firm.
Size	Logarithm of book assets
Tobin's *q*	Ratio of sum of total assets and market value of equity minus book value of equity and deferred taxes, to total assets
Trading volume	Logarithm of the stock's average daily dollar trading volume