Insider ownership and firm value: is sample selection clouding our vision?

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Abstract

We examine the influence of sample selection on the observed relationship between insider ownership and firm value. An extensive review of the literature reveals that the ownership-firm value relationship appears to be concave for prominent index-listed firms, convex for less prominent and off-index firms, and insignificant for a mixture thereof. We confirm this pattern using a comprehensive sample of US firms. Further, the observed differences in the ownership-firm value relationship cannot be ascribed to firm age or firm size. Index listing appears to be a neglected yet powerful driver of these differences.

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1. Introduction

How does the ownership of insiders affect the value of a firm? Despite the importance of the topic and the significant number of studies attempting to address it, a definitive answer to this question has eluded researchers. McConnell and Servaes (1990) find an inverted U-shaped (concave) relationship between firm valuation and insider ownership for a sample of prominent firms, while Himmelberg, Hubbard, and Palia (1999) find an insignificant one for a random sample. Our extensive literature review suggests that these two influential papers fit into a larger picture of a concave relationship between ownership and firm value for samples of index-listed firms and no relationship for random samples.[1] In this paper, we employ a comprehensive sample of U.S. firms to further explore this pattern.

Using a sample of all firms listed on CRSP and Compustat, we document a U-shaped (convex) relationship between insider ownership and firm value. The same pattern is observed for firms in the S&P 600 SmallCap index and for off-index firms.[2] However, for the most prominent firms (as represented by the constituents of the S&P 500 index), we find a concave relationship, in line with a good portion of the existing research. Finally, for firms that are part of the S&P 400 MidCap index, we fail to find any significant relationship. Our results suggest that there exists a wide range of ownership-firm value (OFV) relationships – from convex to insignificant to concave. Further, the shape of the OFV relationship depends on the degree of index listing. To the extent that a random sample of firms, such as that used by Himmelberg, Hubbard, and Palia (1999), is likely to have been drawn from various underlying OFV relationships, it is not surprising that studies using such a sample tend to find an insignificant relationship. Sample selection appears to be a neglected yet powerful driver of the differences that have troubled the debate on this topic.

[1] A fairly small number of studies that have focused on less prominent firms have found a significant convex relationship.

[2] We define "off-index" firms to be those that are not constituents of any of the S&P 500, S&P 400 MidCap, and S&P 600 SmallCap indices.

Having shown that the observed OFV relationship varies based on the degree of index listing, we further investigate whether firm age and firm size – two of the most prominent features of index-listed firms – could account for the observed differences in the OFV relationships. In other words, are we actually picking up an underlying firm size or age effect as opposed to an effect of index listing? We find that this is not the case – larger or older firms that are not listed in the S&P 500 index continue to show a convex OFV relationship.

Finally, we conduct a simulation using two hypothetical scenarios – one in which researchers are able to conduct studies using the entire universe of public firms, and another for the more frequent case where the data employed is limited to index-listed firms. We find that in the first scenario, the researcher is overwhelmingly likely to find a convex relationship, while in the second, the observed relationship is relatively more likely to be linear or concave.

Our paper is related to and has implications for three streams of research. First, we contribute to the large literature on the relationship between insider ownership and firm value. We show that there exists not one but a whole spectrum of possible OFV relationships and that the observed one depends on the degree of index listing of sample firms. While the relationship itself is undoubtedly important, the debate over its shape is perhaps superseded by an even more pressing question that emerges from our study: *why* do we observe such a wide variation in the relationship? Our findings suggest that a fruitful place to begin such an exploration would be to examine why index listing seems to have such a dramatic influence on the observed relationship between ownership and firm value. Is it an outcome of monitoring by index funds (see, e.g., Appel, Gormley, and Keim, 2016)? Or does the presence of index funds increase the threat of disciplinary trading, thus changing the incentives of insiders (Edmans and Manso, 2010)? The answers to these questions could help us to better understand how the influence of insider ownership changes based on the wider environment in which the firm operates.

Second, we contribute to the literature on index additions by showing that index listing has a profound impact on the way in which ownership influences firm value. While the examination of the reasons for such an impact is beyond the scope of this paper, we believe that it is an important research

question and we look forward to future research that can shed a new light on these issues. Finally, we contribute to a growing literature that highlights the role of sample selection in distorting the debate in more than one topic in corporate finance. As is the case for the literatures on mergers (Netter, Stegemoller, and Wintoki, 2011), boards of directors (Cashman, Gillan, and Jun, 2012), executive compensation (Cadman, Klasa, and Matsunaga, 2010), and stock option repricing (Carter and Lynch, 2001), we find that a hitherto-neglected discussion on the role of sample selection has unfortunately skewed the debate on the relationship between ownership structure and firm value.

The remainder of the paper is organized as follows. Section 2 examines the existing literature on the relationship between ownership and firm value, Section 3 describes our data and sample selection, and Section 4 provides our empirical analysis and results. Section 5 concludes.

2. Sample selection and the influence of ownership on firm value

Although the relationship between ownership structure and firm value has attracted the attention of researchers for several decades, one of its main issues was recognized over two hundred years earlier in the works of Adam Smith, who noted that: "The directors of such companies, however, being the managers rather of other people's money than of their own, it cannot well be expected that they should watch over it with the same anxious vigilance with which the partners in a private copartnery frequently watch over their own." Despite several theoretical analyses of the relationship that have since followed in this vein, the question has ultimately remained an empirical one.[3] Specifically, Morck, Shleifer, and Vishny (1988) and McConnell and Servaes (1990) focus on two potential consequences of an increase in insider ownership.[4] On one hand, such increases would result in insiders internalizing a larger share of any change in firm value and would thus increase their incentive to enhance firm value (the incentive alignment effect). Alternatively, an increase in equity ownership could increase the power of insiders and

[3] The current interest in the influence of ownership structure on firm value is often traced to the work of Berle and Means (1932). Jensen and Meckling (1976) and Stulz (1988) provide the theoretical basis for much of the empirical work that has followed.

[4] We discuss the empirical findings of Morck et al. (1988) and other papers that use a piecewise specification in section 4.2.2 of the paper.

render them less vulnerable to discipline from the market for corporate control. In this scenario, an increase in ownership would increase the incentives for insiders to expropriate from minority shareholders and thereby reduce the observed value of the firm (the entrenchment effect).

McConnell and Servaes (1990) evaluate the relative merits of these two opposing forces by regressing firm value – as proxied by Tobin's Q – on both the equity ownership of insiders and the square of such ownership. This quadratic specification is intuitively appealing in that it allows the data to reveal the relative importance of the incentive alignment and entrenchment effects at various levels of ownership. They find that the estimated curve has a concave shape, indicating that the incentive alignment effect dominates at lower levels of ownership while the entrenchment effect dominates at relatively higher levels of ownership. This narrative has been extremely influential and has been echoed in a number of studies that have since followed (see, e.g., Anderson and Reeb, 2003, Kim and Lu, 2011).

An alternative perspective regarding the relationship between ownership and firm value has emerged from the works of Demsetz (1983), Demsetz and Lehn (1985), and Himmelberg, Hubbard, and Palia (1999). As these authors point out, it is entirely possible that the nature or value of a firm determines the optimal level of insider ownership, possibly by influencing the decision of insiders to take on a larger or smaller part of the equity ownership. In such a situation, insider ownership is endogenous and some form of correction would be required in the statistical estimation. In one of the several papers addressing this issue, Himmelberg et al. (1999) employ a random sample of firms to examine the relationship between managerial ownership and Tobin's Q, using quadratic specifications both with and without firm fixed effects controlling for unobserved firm characteristics.[5] In both cases, the coefficient estimates on the linear and squared terms are insignificant when industry and other controls are included. Overall, they conclude that there is no statistically significant relationship between ownership structure and firm performance.

[5] Other studies addressing the correction for endogeneity include the works of Hermalin and Weisbach (1991), Agrawal and Knoeber (1996), Loderer and Martin (1997), Cho (1998), McConnell, Servaes, and Lins (2008), Benson and Davidson (2009), and Coles, Lemmon, and Meschke (2012).

We attempt to provide an overall perspective on the literature by highlighting some of the most prominent research on this topic in Table 1. In developing this table, we focus on papers that examine a quadratic relationship between insider ownership and firm value, as proxied by Tobin's Q, and thus allow for the possibility of a trade-off between the incentive alignment and entrenchment effect.[6] In Panel A (B) of Table 1, we include studies that use a quadratic (piecewise linear) specification to examine the relationship between insider ownership and Tobin's Q. In Panel C, we include quadratic-specification studies that employ measures of valuation other than Tobin's Q (e.g., the abnormal returns around an event or accounting-based measures of firm performance).[7]

As can be ascertained from Table 1, the vast majority of the available research in this area uses samples of firms derived from Execucomp, Value Line Investment Survey, Forbes 500, Fortune 500, or the S&P 500, all of which cover large, index-listed firms, and finds a concave relationship between insider ownership and firm value. The studies using random samples of firms (mixing firms of different sizes and types) often find an insignificant relationship. Though far rarer, a few studies that include off-index firms find a *convex* relationship between insider ownership and firm value, indicating that the entrenchment (incentive alignment) effect dominates at lower (higher) levels of ownership for some firms.

It is especially instructive to consider studies of off-index firms as their rarity has contributed to an overall consensus in the literature that an OLS regression of ownership and its square on firm value will tend to reveal a concave relationship. In their study of high-R&D firms on Compustat, Cui and Mak (2002) find a convex relationship between managerial ownership and firm value. Relative to the more commonly-studied firms, these high-R&D firms are more likely to be smaller and have greater insider

[6] We include studies published in The Review of Financial Studies, Journal of Finance, Journal of Financial Economics, Journal of Financial and Quantitative Analysis, Journal of Banking and Finance, Journal of Corporate Finance, Financial Management, Journal of Business (publication ceased in 2006), American Economic Review, Quarterly Journal of Economics, and The Journal of Political Economy. In order to keep the review focused and also to maintain a direct comparability between our results and those of the studies summarized here, we include only studies that examine the relationship between insider ownership and firm value for US firms.

[7] It is worth noting that a number of studies have employed a linear specification to assess this relationship (see, e.g., Mehran, 1995; Villalonga and Amit, 2006; Anderson, Duru, and Reeb, 2009; and Fahlenbrach and Stulz, 2009). Since a linear specification is unable to address a change in the relative strength of the incentive alignment and entrenchment hypotheses, our results are not directly comparable to those found by such studies.

ownership (Cui and Mak, 2002). Gompers, Ishii, and Metrick (2010) find a convex relationship when using voting rights in their sample of dual-class firms, the majority of which are not listed on the S&P 500 index. Basu, Paeglis, and Toffanin (2017) use a sample of all CRSP and Compustat firms and observe a convex relationship between the ownership of the largest blockholder and firm value.

Of the papers listed in Panel C of Table 1, we note the following examples. Slovin and Sushka (1993) find a concave relationship between insider ownership and the abnormal returns for firms announcing the death of an insider blockholder, suggesting that the pre-announcement relationship between insider ownership and firm value was convex. Nagar, Petroni, and Wolfenzon (2011) examine closely-held firms and find an implicit convex relationship with higher profitability levels for firms with low or high levels of primary-owner ownership as compared to those with intermediate levels.[8]

Taken together, the findings in these and other studies seem to converge around sample selection – studies using large, index-listed firms find a concave relationship, while those using younger, off-index firms find a convex one. In studies using a random sample of firms in which both of the previous types are combined, the relationship is insignificant. We thus contend that a significant part of the conflicting results in the literature can be ascribed to sample selection. We explore the validity of this contention in our empirical tests in the following sections of this paper.

3. Data

To examine the influence of sample selection on the observed OFV relationships, we use a comprehensive sample of US firms. Specifically, we start with all firms that are found on the CRSP and Compustat databases in 2004, 2009, and 2014.[9] Following Basu, Paeglis, and Toffanin (2017), we remove foreign firms, utilities, and financial firms as well as those for which the traded security is not common stock. We further remove all firm-years for which firms have a negative book value of equity. We then

[8] Nagar et al. (2011) hypothesize a convex relationship between ownership of the primary owner and firm performance with "less squeeze-out of minority shareholders in firms with shared control as well as in firms with highly concentrated control" (Hypothesis 2, p. 949). Their results are in line with this hypothesis.

[9] The need to have a comprehensive sample with reliable data, has limited the number of data years used in this study.

manually collect the CEO and insider ownership data for these firms from either the proxy statement, 10K, or IPO prospectus closest to and preceding the identified fiscal year end. The manual data collection helps us to avoid any errors (e.g., data entry, double counting, backfilling, etc.) inherent in commercially available databases (see, e.g., Dlugosz, Fahlenbrach, Gompers, and Metrick, 2006; Gillan, Hartzell, Koch, and Starks, 2017). Our final ownership sample consists of 3,395 firms in 2004, 2,601 firms in 2009, and 1,912 firms in 2014, for a total of 7,908 firm-years.

We then create a panel data set by merging each year of ownership data described above with the accounting and stock price data for the preceding, concurrent, and following fiscal years. Our use of multiple years of financial data is motivated by the relatively short time-series dimension of our data, which makes our findings potentially vulnerable to market-wide movements in prices or firm profitability in those particular years. However, as noted by Fahlenbrach and Stulz (2009), ownership is relatively stable from year to year. Consequently, the observed insider ownership is expected to be a fairly accurate approximation of their ownership in the previous and subsequent years. Relevant summary statistics are reported in Table 2. All variables are defined in the Appendix.

4. Empirical tests and results

4.1. The impact of sample selection on the observed relationship between insider ownership and firm value

We begin by examining the relationship between insider ownership and firm value for the entire sample of firms. The dependent variable is *Firm value*, and we first use CEO ownership and its square as our measure of insider ownership. We additionally include the difference between the voting and cash flow rights of the CEO as an independent variable. In choosing control variables, we have attempted to include those most frequently used in the OFV literature: firm size (Coles et al., 2012; Gompers et al., 2010), industry-median Q (Miller et al., 2007), asset tangibility (Cui and Mak, 2002), R&D (Cui and Mak, 2002; Demsetz and Lehn, 1985; Miller et al., 2007), advertising (Gompers, Ishii, and Metrick,

2010) and capital expenditures (Demsetz and Lehn, 1985; Miller et al., 2007), leverage (Kim and Lu, 2011), and ROA (Kim and Lu, 2011).[10]

The results are presented in Table 3. In column 1, the estimated coefficient on the linear term is negative, that on the squared term is positive, and both are significant at the 1% level. Thus, contrary to the findings in much of the literature, we find a convex relationship between ownership and firm value when we use the universe of Compustat firms. We repeat the above test using the total ownership of managers and directors as our measure of insider ownership, as is commonly done in the literature. The results are presented in column 2. As before, we find a convex relationship – the entrenchment effect dominates at lower levels of ownership, while the incentive alignment effect dominates at relatively higher levels. In columns 3 and 4, we re-estimate the results reported in columns 1 and 2 using standard errors clustered at the firm level. The results remain qualitatively unchanged.

To examine the influence of sample selection on the OFV relationship, we partition our sample of Compustat firms into four subsamples: (1) S&P 500 index firms, (2) S&P 400 MidCap index firms, (3) S&P 600 SmallCap index firms, and (4) off-index firms which do not belong to any of these three indices. We first repeat the earlier analysis of Table 3 using the three subsamples of index-listed firms. The results are presented in Table 4. When using the S&P 500 subsample (column 1), we find a concave OFV relationship, consistent with the findings of the majority of studies using index-listed firms. For the S&P Midcap 400 firm subsample (column 2), we find that the relationship is insignificant. In column 3, where we use the S&P SmallCap 600 firm subsample, we find that the OFV relationship is significantly convex, consistent with our findings in Table 3 for the full sample of firms. In column 4, we use a sample of firms that are part of any of the three aforementioned S&P indices. We find that the OFV relationship for this

[10] Prior studies have used different combinations of these variables or their variants and our unreported tests indicate that the exact specification of the variables is related to the conclusions. We find that certain specifications make the OFV relationship more convex for all subsamples while others make it more concave. Although the issue of specification is important, we do not discuss it further for two reasons. First, a detailed discussion of the myriad specifications used in the literature and an analysis of their relative merits and demerits is a substantial exercise in its own right and, as a result, is beyond the scope of this paper. Second, our unreported results indicate that although the use of a specific set of control variables does have an important effect on the conclusions of a study, the magnitude of such differences is relatively smaller than those engendered by the sample selection process that is the focus of this paper.

sample is insignificant.[11] Finally, for the off-index firms (column 5), we find a significantly convex OFV relationship. The results using total insider (rather than CEO) ownership are reported in columns 6 through 10. As can be seen, the pattern of a concave relationship for the more prominent firms and a convex one for the least prominent continues to hold.

4.2. Robustness tests

4.2.1. Index listing as a proxy for firm size and firm age

Our results to this point indicate that index listing has a powerful influence on the OFV relationship. In this section, we examine two alternative explanations for these findings. Perhaps it is not index listing itself that is driving the differences in the OFV relationship, but some underlying factor. More specifically, firms that become index-listed, especially those in the S&P 500, are generally larger and older than the average public firm.[12] Thus, the observed relationship differences may not be due to being index-listed but could be driven by firm size or age differences.

To test these alternatives, we partition the full sample of Compustat firms into tertiles based on size and re-run the main regression for each tertile. The results are presented in columns 1 to 3 of Table 5. If the relationship differences observed earlier are due merely to index-listed firms being largest in size, we would expect the tertile consisting of the largest firms (3rd tertile) to exhibit the concave relationship generally found in the literature. However, that is not the case. We find a significantly convex OFV relationship for the smallest and middle tertiles, while that for the largest tertile is insignificant. When we partition the largest tertile into S&P 500-listed and non-S&P 500-listed subsamples and repeat the regressions (columns 4 and 5), we observe that the relationship is insignificant for the non-S&P 500-listed

[11] Except for the backfilling documented by Gillan, Hartzell, Koch, and Starks (2017), the sample used in column 4 comes closest to the Execucomp sample used by a number of prior studies. As documented by Gillan et al (2017), backfilling has a significant influence on the observed OFV relationship for the Execucomp sample – from a significant concave relationship for the full sample to an insignificant (convex) for the backfill-corrected sample.

[12] S&P 500 membership requires unadjusted market capitalization of US$ 6.1 billion or more, while the same figures for the S&P Midcap 400 and S&P SmallCap 600 are $1.6 to 6.8 billion and $450 million to $2.1 billion, respectively. (https://us.spindices.com/documents/methodologies/methodology-sp-us-indices.pdf). However, the median U.S. firm has a market capitalization of merely $120 million (Compustat) or $111 million (CRSP) over the 1980 to 2015 period. In terms of age, the average (median) S&P500-listed firm in our sample is 36.3 (32.1) years old, while the average (median) non-S&P500-listed firm is 16.1 (12.5) years old.

subsample of firms, and significantly concave for the S&P 500-listed subsample. Thus, the concave relationship is not the product of firms being large, but rather being index-listed (S&P 500). The results using total insider ownership (presented in columns 6 to 10 of Table 5) are qualitatively similar to those discussed above.

To test the potential that firm age, rather than index listing, is driving the differences in the observed relationships, we partition the full sample of Compustat firms into tertiles based on age and re-run the main regression for each age tertile. The results are presented in columns 1 to 3 of Table 6. If the relationship differences observed earlier are due merely to index-listed firms being the oldest, we would expect the tertile consisting of the oldest firms (3rd tertile) to exhibit the concave relationship generally found in the literature. However, this again is not the case. We find that the observed OFV relationship for the oldest tertile of firms is significantly *convex*, not concave. When we partition the oldest tertile into S&P 500-listed and non-S&P 500-listed subsamples and repeat the regressions (columns 4 and 5), we observe that the relationship is significantly convex for the non-S&P 500-listed subsample of firms, and significantly concave for the S&P 500-listed subsample. This finding provides evidence that the concave relationship is not the product of firms being the oldest, but rather being index-listed.

Overall, after forming tertiles based on firm size and age, we find that the varied relationships persist. Thus, we argue that index listing is the primary mechanism (or at least the indicator of the mechanism) driving the changes in the relationship between ownership and firm value.

4.2.2. Alternate specifications

Up to this point, in our empirical analysis of the impact of ownership on firm value we have used a quadratic specification. It, however, is not the only specification used in the literature (as can be seen in Panel B of Table 1). One of the earliest studies on this topic is that of Morck, Shleifer, and Vishny (1988), who use a piecewise specification to address the changing impact of ownership on firm value.[13] In their study, Morck, Shleifer, and Vishny (1988) find that firm value first increases (for ownership levels less

[13] Other studies following this approach include those of Hermalin and Weisbach (1991), Cho (1998), Holderness, Kroszner, and Sheehan (1999), Cui and Mak (2002), and Duru, Wang, and Zhao (2013).

than 5%), then decreases (for ownership levels between 5% and 25%), and then increases again (where ownership is greater than 25%). We replicate our analysis using these ownership cut-off points for both the full sample and the subsample of S&P 500 index-listed firms. The results are provided in Table 7. When using the full sample (column 1), we find that, when CEO ownership increases, firm value first decreases (though insignificantly), decreases again, and then increases. When we use the subsample of S&P 500 index-listed firms, however, we find that firm value first increases (though insignificantly), increases again, and then decreases. The results are similar when insider ownership is used instead of CEO ownership (columns 3 and 4). Thus, these results indicate a single inflection point and suggest that our quadratic specification is able to capture the changing impact of ownership on firm value. More importantly, index listing significantly changes the observed relationship between ownership and firm value, regardless of whether a quadratic or piecewise linear specification is used.

4.3. Simulations examining the relationship between ownership and firm value

Thus far, we have shown that the relationship between insider ownership and firm value differs based on the degree of index listing. In order to provide some perspective on how the debate in the literature could be shaped by this issue, we simulate two hypothetical scenarios. In the first scenario, we simulate the case where researchers have access to and the ability to draw on the entire universe of public firms based on the specific goals of their study. In the second scenario, we simulate the case where researchers, whether for the ease of data availability or a desire to focus on the most significant firms given their overwhelming share of the market capitalization, conduct their studies using firms in the S&P 1500 index (Execucomp). Arguably, the latter of the two scenarios is closer to the reality that has confronted finance researchers for the last two decades, while the former depicts the case that researchers

would have ideally preferred in order to make the findings the most applicable to the widest range of firms.[14]

For our simulation, we first define all possible OFV relationship outcomes using a quadratic specification (positive or negative linear and squared terms, each of which can be significant or insignificant). Next, we take 1,000 random draws of 3,000 observations each from either our full sample of Compustat firms or from our sample of S&P 1500 index-listed firms. Using each pseudo-sample, we run the main OFV regression (as reported in Table 3). We then count the number of pseudo-samples that lead to each possible relationship outcome. Table 8 defines the possible outcomes and presents the simulation results.

The first two columns of Table 8 provide the simulation results for the hypothetical scenario where researchers have full access to and employ samples from the universe of public firms. A first glance reveals that over 90% of the simulation results fall under the "negative linear and positive quadratic term" subsection of the table, regardless of whether CEO or insider ownership is used. More specifically, when CEO ownership is used in column 1, 43.4% of the 1,000 draws result in a significantly convex relationship, and this proportion increases to 73.6% when insider ownership is used (column 2). The other three possible outcomes in this subsection also have relatively large proportions. Conversely, we find very few "positive linear and negative quadratic term" outcomes and these few are limited to the case where both the linear and squared terms are insignificant. These initial simulation results strongly indicate that, in the ideal scenario of full data availability and utilization, studies using samples from the universe of public firms will find a convex OFV relationship, which directly contrasts with the observed relationships in many existing studies.

Much of the literature, however, has studied the relationship using a relatively specific subset of index-listed firms, rather than randomly selecting from the full sample. Thus, in our second hypothetical scenario, we constrain our random draws to come from the sample of S&P 1500 firms only. The results of

[14] An exclusive reliance on prominent index-listed firms overstates their importance. For example, as pointed out by Nagar, Petroni, and Wolfenzon (2011), "Closely held corporations are also vitally important to the economy: They produce 51% of the private sector output and employ 52% of the labor force".

this simulation are provided in columns 3 and 4 of Table 8 for CEO and insider ownership, respectively. While the largest proportion of outcomes still fall under the "negative linear and positive quadratic term" subsection, indicating a convex relationship, there is a large increase (25.8% versus 1.8%) in the proportion of outcomes exhibiting a concave (though insignificant) relationship. We also find 5 cases result in the significantly concave relationship observed in existing studies using large, index-listed firms. Overall, the use of the full range of firms tends to lead researchers overwhelmingly toward a convex relationship. However, the focus on index-listed firms leads more often toward a linear or a concave relationship.[15]

While these results go a long way toward reconciling the various OFV relationships found in the literature, the simulation approach above is simplistic and cannot capture the true evolution of research on this topic where the nature of subsequent work is not random but is influenced by the findings of prior efforts. However, it does illustrate the possibilities that arise if researchers focus on a particular sample more than others. Arguably, the ease of availability of CEO ownership data on the Execucomp database and the willingness of Dlugosz et al. (2006) to graciously share their hand-collected data on blockholder ownership has resulted in an overwhelming preponderance of studies that rely on index-listed firms to analyze the manner in which various facets of ownership structure affect firm value. As a result, we contend that the state of the debate on the impact of ownership structure on firm value has tended to overemphasize the concave relationship that we find mostly in the S&P 500-listed firms and de-emphasize the convex relationship found in the much more numerous off-index and small cap firms.

[15] We would like to note that our earlier results in Table 4 indicate that the observed concave relationship is largely attributable to the subset of S&P 500 firms. Moreover, random draws from the S&P 1500 group of firms allows the possibility of samples with a higher representation of firms from the S&P 600 SmallCap index and the concomitant convex relationship. Given the disproportionately large representation of studies that employ samples drawn from the S&P 500 index (as shown in Table 1), our simulation results are likely to understate the bias in the literature. Finally, as noted earlier, the lack of the backfill bias in our hand-collected sample (as compared to that of Execucomp) is also likely to make our results more convex (see Gillan et al., 2017).

5. Conclusion

In this paper, we explore the implications of a fascinating pattern in the OFV literature – namely the correlation between the sample used by a specific study and its findings. To better understand this pattern, we analyze a complete cross-section (as well as pertinent subsamples) of all firms in the joint CRSP and Compustat universe. Our results suggest that a significant portion of the conflict in prior research can be explained by sample selection. Specifically, we find that studies that employ samples of firms listed in the more prominent stock indices will tend to observe a concave relationship between insider ownership and firm value while those that focus on off-index firms will tend to observe a convex one. Studies that focus on random samples will fall somewhere in between and thus tend to observe no significant relationship. Our follow-on tests suggest that this observed difference between firms that are listed in a prominent stock index and those that are not is not simply a matter of the size or age of the firm. If such were the case, it would have been fairly easy for future studies to control for these variables.

Our study comes with a significant caveat. In our analysis, we have avoided the issue of endogeneity in both comparing the results of other studies and in our own tests. We do this not because we deny the importance of endogeneity, but because tractability concerns force us to avoid going into the complex issues involved in finding appropriate empirical approaches to addressing it.[16] Our results indicate that the literature's tendency to focus on the drivers of causality has masked an equally important issue: that the sample selection process in any study can result in focusing on a particular group of firms with a specific and non-generalizable OFV relationship. Thus, our findings should be interpreted only to indicate that sample selection is one important factor that influences the relationship observed between ownership and firm value.

Additionally, it is worth noting that the results reported in this paper have been obtained using a relatively recent sample of US firms. As such, it may raise a question of whether we would have obtained

[16] Recent literature has focused on the substantial empirical challenges that result from the complex causality of the relationship between ownership and firm value (see, e.g., Coles, Lemmon, and Meschke, 2012). The resultant discussion, while providing valuable insights in modeling the potential endogeneity of the data-generating process, has also highlighted the substantial empirical challenges in addressing it.

similar results using a sample more concurrent with those used in the earlier literature. While it is impossible to confirm, the empirical evidence suggests that the convex relationship we find for off-index and small cap firms has been present at least as far back as the 1990s (see, e.g., Slovin and Sushka, 1993 and Basu, Dimitrova, and Paeglis, 2009). Thus, the evidence suggests that our findings are not confined only to the relatively more recent time periods that we study.

With these caveats in mind, our results have interesting implications for two distinct strands in the finance literature. First, our results suggest that, depending on the degree of index listing, there exists a whole spectrum of possible relationships between ownership and firm value – from convex to insignificant to concave. While these findings shed new light on the disagreement in the literature, they also raise new, unanswered questions about the reasons for such (apparently contradictory) OFV relationships. Are the differences due to monitoring by index funds? Or are they due to an increased threat of disciplinary trading? We believe that future research in this area will significantly increase our understanding of the factors that influence the OFV relationship.

Second, we also contribute to the literature on index additions. The increase in firm value observed at the time of a stock being added to a prominent index has hitherto mainly been attributed to the information and liquidity implications of index additions.[17] Our results indicate that index listing, and the resulting changes in the underlying ownership structure of the firm around index additions, is also a significant mechanism affecting firm value. We look forward to future research that can help us to better understand these changes and their impact.

[17] See, e.g., Denis et al. (2003), Chen, Noronha, and Singhal (2004), Baran and King (2012), and Chan, Kot, and Tang (2013).

Appendix
Variable description

VARIABLE	DESCRIPTION
	Dependent variable
Firm value	The ratio of the sum of the market value of equity and book value of debt to the total book value of equity and debt
	Ownership variables
CEO own	The percentage of voting rights controlled by the firm's CEO
CEO wedge	The difference between the percentage of voting and cash flow rights controlled by the firm's CEO
CEO own05	*CEO own* if less than 5%; set to 5% if *CEO own* ≥ 5%
CEO own525	*CEO own* - 5% if 5% < *CEO own* < 25%; set to 20% if *CEO own* ≥ 25%; set to 0 if CEO own < 5%
CEO own25	*CEO own* - 25% if *CEO own* ≥ 25%; set to 0 if *CEO own* < 25%
Insider own	The percentage of voting rights controlled by the firm's officers and directors as a group
Insider wedge	The difference between the percentage of voting and cash flow rights controlled by the firm's officers and directors as a group
Insider own05	*Insider own* if less than 5%; set to 5% if *Insider own* ≥ 5%
Insider own525	*Insider own* - 5% if 5% < *Insider own* < 25%; set to 20% if *Insider own* ≥ 25%; set to 0 if *Insider own* < 5%
Insider own25	*Insider own* - 25% if *Insider own* ≥ 25%; set to 0 if *Insider own* < 25%
	Control variables
Ln(Firm size)	The natural logarithm of the book value of total assets
R&D	The ratio of R&D to sales
Leverage	The ratio of book value of long term debt to total assets
Total risk	The standard deviation of stock returns calculated over 100 trading days ending on the day preceding the fiscal year end date; we require at least 30 observations for these calculations
Advertising	Ratio of advertising expenses to sales
PPE	Ratio of total property, plant, and equipment to the book value total assets
CAPEX	Ratio of capital expenditures to sales
ROA	The ratio of net income to the book value total assets
Industry median firm value	Median *Firm value* for all COMPUSTAT firms in the same year and Fama-French 48 industry group

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Table 1
Summary of the literature
The journals surveyed include The Review of Financial Studies, The Journal of Finance, Journal of Financial Economics, Journal of Financial and Quantitative Analysis, Journal of Banking and Finance, Journal of Corporate Finance, Financial Management, Journal of Business (publication ceased in 2006), The American Economic Review, The Quarterly Journal of Economics, and The Journal of Political Economy. Panel A summarizes the results for papers that regress Tobin's Q on some measure of insider ownership and its square. Panel B summarizes the results for papers that regress an alternative measure of firm value on some measure of insider ownership and its square. Panel C summarizes the results for papers that regress an alternative measure of firm value on some measure of insider ownership and its square. In all three panels, the relation is first reported and then the significance of the results reported in parentheses. In situations where the relationship cannot be summarized as concave or convex, the order of coefficient estimates reported is first linear and then quadratic (for quadratic specifications) and starting with lower levels of ownership and moving to higher levels of ownership (for piecewise specifications).

Panel A: Quadratic specifications with Tobin's Q as the dependent variable

No.	Authors	Journal	Pub. Year	Sample	Ownership Measure	Relationship
1	J.J. McConnell; H. Servaes	JFE	1990	Value Line Investment Survey	Insider	Concave
2	J.J. McConnell; H. Servaes	JFE	1995	Value Line Investment Survey; 2 yrs McConnell & Servaes (1990)	Insider	Concave
3	A. Agrawal; C.R. Knoeber	JFQA	1996	Forbes 800 subsample	Insider	+ (sign); – (insign)
4	C. Loderer; K. Martin	JFE	1997	Loderer & Martin (1990) + Martin & McConnell (1991) tender offers + domestic acquisitions 1985-1988	Insider	– (sign); + (insign)
5	R.C. Anderson; D.S. Lee	JFQA	1997	Q-File, Corporate Text, Value Line, and Compact Disclosure	Insider	Concave
6	C.P. Himmelberg; R.G. Hubbard; D. Palia	JFE	1999	Random Compustat	Insider	Insignificant (various)
7	N. Vafeas	JFE	1999	Largest 350 firms listed in Forbes	Insider	Concave
8	R. Daines	JFE	2001	Fortune 500	Insider	– (insign); + (insign)
9	D. Palia	RFS	2001	Hall & Liebman (1998)	CEO	Concave
10	H. Cui, Y.T. Mak	JCF	2002	Compustat firms in high R&D industries	Insider	Convex
11	W.T. Callahan; J.A. Millar; C. Schulman	JCF	2003	Subsample of Fortune 1000	Insider	Concave
12	R.C. Anderson; D.M. Reeb	JF	2003	S&P500	Family	Concave
13	M.A. Habib; A. Ljungqvist	JB	2005	Execucomp	CEO	Concave
14	L.A. Bebchuk; A. Cohen	JFE	2005	IRRC	Insider	Concave
15	R.B. Adams; H. Almeida; D. Ferreira	RFS	2005	Fortune 500/Execucomp	CEO	Concave
16	W.K.A. Cheung; K.C.J. Wei	JCF	2006	Compact Disclosure	Insider	+ (insign); – (insign)
17	D. Miller; I. Le Breton-Miller; R.H. Lester; A.A. Cannella Jr.	JCF	2007	Fortune 1000 (at 2001)	Family	Concave
18	Z. Tong	JBF	2008	Execucomp	CEO (deviation from optimal)	Implied concave
19	E. Devos; A. Prevost; J. Puthenpurackal	FM	2009	Corporate Library	Insider	+ (insign); – (insign)
20	B.W. Benson; W.N. Davidson III	JCF	2009	Execucomp	CEO pay-perf. semi-elasticity	Concave

21	J. Brookman; P.D. Thistle	JCF	2009	Execucomp	Insider	+ (insign); – (insign)
22	M.J. Rose	JCF	2009	Dlugosz et al. (2006)/IRRC	Sum inside blockholders	+ (sign); – (insign)
23	L. Bebchuk; A. Cohen; A. Ferrell	RFS	2009	IRRC/Execucomp for levels	Insider	+ (insign); – (insign)
24	J.D. Chi; D.S. Lee	JBF	2010	IRRC/Execucomp	Mgr. delta	+ (insign); – (insign)
25	Y. Jiao	JBF	2010	KLD social (S&P500; Domini 400)/Execucomp	Insider	+ (insign); – (insign)
26	L. Fauver; A. Naranjo	JCF	2010	Compustat firms reporting derivative usage/non-usage	Insider	Concave
27	P.A. Gompers; J. Ishii; A. Metrick	RFS	2010	SDC/IRRC dual-class firms	Insider	Convex (with voting rights)
28	R.W. Masulis; S. Mobbs	JF	2011	IRRC	CEO	Convex
29	L.A. Bebchuk; K.J.M. Cremers; U.C. Peyer	JFE	2011	Execucomp	Insider	+ (insign); – (insign)
30	E.H. Kim; Y. Lu	JFE	2011	Execucomp	CEO	Concave
31	J.L. Coles; M.L. Lemmon; J.F. Meschke	JFE	2012	Execucomp	CEO	Concave
32	S. Ahn; K. Shrestha	JBF	2013	IRRC/Execucomp	CEO	– (sign); + (insign)
33	I. Paeglis; P. Veeren	JCF	2013	VC-backed IPO firms	Founder	Concave
34	R.W. Masulis; S. Mobbs	JFE	2014	RiskMetrics (S&P 1500)	CEO	– (insign); + (sign)
35	B. Francis; I. Hasan; Q. Wu	FM	2015	IRRC	Insider	– (insign); + (insign)
36	N. Basu; I. Paeglis; M. Toffanin	JCF	2017	Compustat/CRSP	Largest indiv. blockholder	Convex
37	S.L. Gillan; J.C. Hartzell; A. Koch; L.T. Starks	RFS	2017	Execucomp	Insider	– (sign); + (insign)

Panel B: Piecewise linear specifications with Tobin's Q as the dependent variable

No.	Authors	Journal	Pub. Year	Sample	Ownership Measure	Relationship
38	R. Morck; A. Shleifer; R.W. Vishny	JFE	1988	Fortune 500	Board	+ (sign); – (insign); + (insign)
39	B.E. Hermalin; M.S. Weisbach	FM	1991	Subsample of Forbes 500	CEO	+ (sign); – (sign); + (sign); – (sign)
40	S.R. Kole	JCF	1995	Compact Disclosure, Value Line, proxy statements	Insider	+ (sign); – (sign); + (insign)
41	M.H. Cho	JFE	1998	Fortune 500	Insider	+ (sign); – (sign); + (insign)
42	C.G. Holderness; R.S. Kroszner; D.P. Sheehan	JF	1999	Compact Disclosure	Insider	+ (sign); – (insign); + (insign)
43	H. Demsetz; B. Villalonga	JCF	2001	Random sample from Demsetz & Lehn (1985)	Insider	– (insign); + (insign); – (insign)
44	R.K. Aggarwal; A.A. Samwick	JCF	2006	Execucomp	Mgr pay-performance sensitivity	+ (insign); + (insign); + (insign)
45	O. Faleye; V. Mehrotra; R. Morck	JFQA	2006	SEC/Compustat	Insider	+ (insign); – (sign); – (insign)
46	A. Duru; D. Wang; Y. Zhao	JBF	2013	RiskMetrics/Execucomp	Insider	– (sign); + (sign); – (insign)

Panel C: Quadratic specifications with other dependent variables

No.	Authors	Journal	Pub. Year	Sample	Ownership Measure	Dependent Variable(s)	Relationship
47	J.A. Born	FM	1988	CRSP/Value Line for ownership	Insider	AR	+ (insign); + (insign)
48	M.B. Slovin; M.E. Sushka	JF	1993	Wall Street Journal obituaries	Insider blocks	AR	Concave (implied convex pre-event)
49	W.H. Mikkelson; M.M. Partch; K. Shah	JFE	1997	Investment Dealer's Digest	Insider	Ind. adj. oper. return	– (insign); + (insign)
50	D. Palia; F. Lichtenberg	JCF	1999	Random Compustat	Lagged manager	Log(sales)	– (insign); + (sign)
51	N. Kohers; T. Kohers	FM	2001	SDC M&A of high-tech targets	Insider	Long-run AR	– (insign); – (insign)
52	J.J. McConnell; H. Servaes; K. V. Lins	JCF	2008	Thomson Financial/Compact Disclosure	Insider	AR	Concave
53	U. Malmendier; G. Tate	JFE	2008	Forbes subsample, close to Forbes 500	CEO options	AR	Concave
54	N. Basu; L. Dimitrova; I. Paeglis	JBF	2009	SDC M&A - newly public firms	Family	CAR	Convex (acquirers)
55	O. Harris; C. Glegg	JBF	2009	SDC Repurchases	Insider	CAR/BHAR	+ (insign); – (insign)
56	S.W. Bauguess; S.B. Moeller; F.P. Schlingemann; C.J. Zutter	JCF	2009	SDC M&A	Managerial	Target AR	– (insign); + (sign)
57	E. Elyasiani; J. Jia	JBF	2010	828 S&P1500 firms/704 non-S&P index firms	Insider	ROA	+ (insign); + (insign)
58	V. Nagar; K. Petroni; D. Wolfenzon	JFQA	2011	National Survey of Small Business Finances (NSSBF)	Largest S/H	EBITDA	Implied convex
59	D. Hoechle; M. Schmid; I. Walter; D. Yermack	JFE	2012	Compustat/Execucomp	CEO	Excess value	Concave
60	A. Michel; J. Oded; I. Shaked	JBF	2014	SDC IPO firms	Public float	Long-run returns	Implied convex
61	K.A. Borokhovich; T.J. Boulton; K.R. Brunarski; Y.S. Harman	JCF	2014	Chairman/CEO/President deaths	CEO	AR	– (insign); + (insign) (implied concave pre-event)

Table 2
Summary statistics
All variables are as described in the Appendix. *Leverage* is winsorized at 1. *Firm value* is winsorized at 5. *R&D* is winsorized at 2. *Total risk*, *Advertising*, and *CAPEX* are winsorized at the 99th percentile. *ROA* is winsorized at the 1st and 99th percentiles.

	Mean	Median
Firm value	2.199	1.755
CEO own	0.085	0.020
CEO wedge	0.012	0.000
Insider own	0.191	0.101
Insider wedge	0.018	0.000
Ln(Firm size)	6.130	6.065
R&D	0.140	0.006
Leverage	0.171	0.126
Total risk	0.032	0.027
Advertising	0.012	0.000
PPE	0.235	0.154
CAPEX	0.104	0.031
ROA	-0.031	0.033
Industry median firm value	1.850	1.651

Table 3
The influence of insider ownership on firm value
The dependent variable is *Firm value*. All dependent and independent variables are as defined in the Appendix. The results are estimated using OLS. Heteroskedasticity-adjusted (White) standard errors are used in calculation of t-statistics that are reported in parentheses, except in columns 3 and 4, where they are adjusted for clustering by firm. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
CEO own	-0.658		-0.658	
	(4.79)***		(2.64)***	
CEO own squared	0.917		0.917	
	(4.45)***		(2.50)**	
CEO wedge	-0.742		-0.742	
	(5.82)***		(3.15)***	
Insider own		-0.752		-0.752
		(6.22)***		(3.56)***
Insider own squared		1.102		1.102
		(6.62)***		(3.92)***
Insider wedge		-0.761		-0.761
		(7.43)***		(4.03)***
Ln(Firm size)	-0.021	-0.024	-0.021	-0.024
	(4.17)***	(4.44)***	(2.21)**	(2.39)**
R&D	0.531	0.537	0.531	0.537
	(15.57)***	(15.74)***	(10.71)***	(10.81)***
Leverage	-1.142	-1.145	-1.142	-1.145
	(25.69)***	(25.65)***	(15.81)***	(15.77)***
Total risk	-6.352	-6.417	-6.352	-6.417
	(11.76)***	(11.89)***	(9.44)***	(9.56)***
Advertising	3.499	3.543	3.499	3.543
	(11.93)***	(12.03)***	(6.61)***	(6.64)***
PPE	-0.251	-0.253	-0.251	-0.253
	(7.08)***	(7.14)***	(4.03)***	(4.06)***
CAPEX	0.087	0.086	0.087	0.086
	(2.58)***	(2.55)**	(1.97)**	(1.95)*
ROA	0.248	0.240	0.248	0.240
	(4.17)***	(4.07)***	(3.04)***	(2.95)***
Industry median firm value	0.654	0.656	0.654	0.656
	(38.45)***	(38.57)***	(22.32)***	(22.41)***
Constant	1.655	1.706	1.655	1.706
	(27.19)***	(26.79)***	(16.46)***	(16.22)***
Observations	22,757	22,757	22,757	22,757
Adjusted R-squared	0.27	0.27	0.27	0.27

Table 4
Subsample results

The dependent variable is *Firm value*. All dependent and independent variables are as defined in the Appendix. The column headings indicate the subsample used: firms listed on the S&P 500, 400, 600, and 1500 indices, and firms that are not listed on any of these indices, respectively. The results are estimated using OLS. Heteroskedasticity-adjusted (White) standard errors are used in calculation of t-statistics that are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	S&P500	S&P400	S&P600	Index-listed	Off-index	S&P500	S&P400	S&P600	Index-listed	Off-index
CEO own	2.984	0.254	-0.821	-0.112	-0.757					
	(4.46)***	(0.72)	(2.47)**	(0.47)	(4.72)***					
CEO own squared	-3.308	-0.605	1.210	0.179	1.261					
	(5.86)***	(1.07)	(2.29)**	(0.52)	(5.23)***					
CEO wedge	-0.825	-0.268	-0.218	-0.565	-1.039					
	(1.26)	(0.86)	(0.58)	(2.25)**	(6.98)***					
Insider own						0.865	0.373	-0.581	-0.335	-0.686
						(2.22)**	(1.26)	(2.23)**	(1.74)*	(4.61)***
Insider own squared						-1.022	-0.237	1.092	0.784	1.212
						(1.71)*	(0.47)	(2.75)***	(2.57)**	(6.06)***
Insider wedge						-0.144	-0.853	-0.456	-0.799	-1.035
						(0.38)	(2.69)***	(1.64)	(3.92)***	(8.13)***
Ln(Firm size)	-0.222	-0.626	-0.438	-0.054	-0.057	-0.223	-0.619	-0.437	-0.055	-0.056
	(13.89)***	(21.42)***	(18.36)***	(7.15)***	(7.28)***	(14.10)***	(21.30)***	(18.16)***	(7.06)***	(7.05)***
R&D	2.603	1.090	1.111	1.860	0.362	2.586	1.094	1.107	1.857	0.369
	(7.51)***	(3.39)***	(5.57)***	(11.03)***	(10.49)***	(7.34)***	(3.41)***	(5.54)***	(11.04)***	(10.71)***
Leverage	-1.060	-0.540	-0.367	-1.104	-0.784	-1.062	-0.544	-0.347	-1.096	-0.801
	(7.52)***	(4.16)***	(3.29)***	(14.30)***	(13.75)***	(7.51)***	(4.20)***	(3.11)***	(14.21)***	(14.07)***
Total risk	-11.398	-6.429	-8.245	-8.694	-4.439	-10.770	-6.418	-8.260	-8.694	-4.515
	(4.57)***	(2.96)***	(5.66)***	(7.51)***	(7.28)***	(4.34)***	(2.96)***	(5.66)***	(7.54)***	(7.41)***
Advertising	5.882	1.684	3.314	5.465	2.284	5.829	1.641	3.288	5.515	2.254
	(10.17)***	(2.27)**	(4.83)***	(12.52)***	(6.35)***	(9.62)***	(2.23)**	(4.78)***	(12.51)***	(6.27)***
PPE	0.104	-0.181	0.060	-0.040	-0.377	0.080	-0.190	0.044	-0.051	-0.376
	(1.16)	(2.04)**	(0.76)	(0.77)	(8.01)***	(0.89)	(2.15)**	(0.55)	(0.98)	(7.97)***
CAPEX	0.000	0.168	0.176	0.043	0.135	0.025	0.169	0.185	0.045	0.133
	(0.00)	(1.66)*	(1.72)*	(0.58)	(3.81)***	(0.15)	(1.67)*	(1.82)*	(0.61)	(3.73)***
ROA	4.861	4.039	2.806	3.850	-0.200	4.884	4.017	2.795	3.842	-0.216
	(7.56)***	(6.60)***	(10.56)***	(14.27)***	(3.35)***	(7.57)***	(6.58)***	(10.57)***	(14.27)***	(3.62)***
Industry median firm value	0.476	0.318	0.357	0.465	0.686	0.477	0.315	0.357	0.463	0.689
	(11.64)***	(7.03)***	(9.55)***	(18.77)***	(31.40)***	(11.66)***	(7.00)***	(9.51)***	(18.70)***	(31.66)***
Constant	3.592	6.791	4.460	2.077	1.753	3.584	6.738	4.471	2.105	1.766
	(14.57)***	(22.65)***	(23.00)***	(22.40)***	(21.09)***	(14.44)***	(22.52)***	(22.70)***	(21.96)***	(20.62)***
Observations	2,940	2,388	3,849	9,177	13,580	2,940	2,388	3,849	9,177	13,580
Adjusted R-squared	0.46	0.50	0.36	0.35	0.30	0.45	0.50	0.36	0.35	0.30

Table 5
Results by the size tertile
The dependent variable is *Firm value*. All dependent and independent variables are as defined in the Appendix. The sample is split into tertiles by the book value of total assets. The results are estimated using OLS. Heteroskedasticity-adjusted (White) standard errors are used in calculation of t-statistics that are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	1st tertile	2nd tertile	3rd tertile	3rd tertile non-S&P500	3rd tertile S&P500	1st tertile	2nd tertile	3rd tertile	3rd tertile non-S&P500	3rd tertile S&P500
CEO own	-0.921	-0.740	0.292	0.174	3.433					
	(3.82)***	(3.76)***	(1.16)	(0.65)	(5.08)***					
CEO own squared	1.185	1.108	-0.362	0.071	-3.514					
	(3.24)***	(3.76)***	(0.95)	(0.16)	(6.12)***					
CEO wedge	-1.245	-0.579	-0.665	-0.763	-1.260					
	(4.81)***	(2.80)***	(2.81)***	(3.20)***	(1.94)*					
Insider own						-0.856	-0.734	-0.286	-0.082	0.899
						(3.48)***	(3.79)***	(1.67)*	(0.47)	(2.29)**
Insider own squared						1.095	1.529	0.360	0.314	-0.969
						(3.36)***	(5.49)***	(1.54)	(1.28)	(1.61)
Insider wedge						-1.338	-0.984	-0.483	-0.641	-0.253
						(6.19)***	(5.63)***	(3.26)***	(4.35)***	(0.66)
Ln(Firm size)	-0.177	-0.055	-0.032	-0.140	-0.228	-0.171	-0.046	-0.037	-0.141	-0.227
	(9.12)***	(2.23)**	(3.71)***	(8.52)***	(14.26)***	(8.85)***	(1.82)*	(4.16)***	(8.57)***	(14.22)***
R&D	0.347	0.735	2.022	1.614	2.590	0.350	0.749	2.018	1.614	2.571
	(8.59)***	(11.05)***	(7.80)***	(6.00)***	(7.30)***	(8.67)***	(11.26)***	(7.79)***	(6.02)***	(7.13)***
Leverage	-0.932	-0.913	-0.966	-0.694	-1.067	-0.958	-0.916	-0.963	-0.705	-1.067
	(8.91)***	(12.59)***	(13.38)***	(9.31)***	(7.50)***	(9.15)***	(12.56)***	(13.26)***	(9.39)***	(7.49)***
Total risk	-6.221	-5.656	-5.100	-3.973	-11.775	-6.258	-5.881	-5.018	-3.962	-11.053
	(7.69)***	(6.06)***	(5.06)***	(4.07)***	(4.68)***	(7.74)***	(6.35)***	(5.01)***	(4.08)***	(4.41)***
Advertising	2.818	3.034	5.015	2.377	5.894	2.794	2.868	5.161	2.431	5.825
	(5.70)***	(6.55)***	(10.03)***	(3.84)***	(10.22)***	(5.66)***	(6.27)***	(10.34)***	(3.95)***	(9.63)***
PPE	-0.419	-0.250	-0.083	-0.075	0.112	-0.412	-0.249	-0.092	-0.077	0.080
	(5.12)***	(4.21)***	(1.76)*	(1.44)	(1.25)	(5.02)***	(4.18)***	(1.93)*	(1.46)	(0.88)
CAPEX	0.150	0.202	0.019	0.023	0.006	0.146	0.198	0.023	0.021	0.033
	(2.87)***	(3.41)***	(0.32)	(0.46)	(0.04)	(2.80)***	(3.34)***	(0.41)	(0.43)	(0.20)
ROA	-0.302	2.143	3.401	2.125	4.876	-0.313	2.115	3.395	2.120	4.896
	(4.56)***	(14.35)***	(11.17)***	(7.82)***	(7.45)***	(4.75)***	(14.26)***	(11.20)***	(7.83)***	(7.46)***
Industry median firm value	0.628	0.671	0.505	0.446	0.471	0.634	0.674	0.502	0.444	0.471
	(22.11)***	(21.87)***	(18.09)***	(12.60)***	(11.38)***	(22.40)***	(22.09)***	(18.01)***	(12.58)***	(11.41)***
Constant	2.437	1.729	1.608	2.206	3.661	2.464	1.686	1.671	2.229	3.640
	(17.33)***	(9.93)***	(14.76)***	(14.24)***	(14.82)***	(17.09)***	(9.45)***	(14.99)***	(14.29)***	(14.61)***
Observations	7,585	7,585	7,584	4,669	2,915	7,585	7,585	7,584	4,669	2,915
Adjusted R-squared	0.26	0.30	0.36	0.30	0.46	0.26	0.30	0.36	0.31	0.45

Table 6
Results by the age tertile
The dependent variable is *Firm value*. All dependent and independent variables are as defined in the Appendix. The sample is split into tertiles by the firm age since going public. The results are estimated using OLS. Heteroskedasticity-adjusted (White) standard errors are used in calculation of t-statistics that are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	1st tertile	2nd tertile	3rd tertile	3rd tertile non-S&P500	3rd tertile S&P500	1st tertile	2nd tertile	3rd tertile	3rd tertile non-S&P500	3rd tertile S&P500
CEO own	-0.196	-1.023	-1.199	-1.077	1.137					
	(0.78)	(4.54)***	(5.76)***	(4.96)***	(1.64)					
CEO own squared	0.369	1.437	1.482	1.423	-1.381					
	(0.98)	(4.06)***	(4.76)***	(4.42)***	(2.13)**					
CEO wedge	-0.438	-0.679	-0.600	-0.465	-0.904					
	(1.54)	(3.07)***	(3.43)***	(2.64)***	(1.65)*					
Insider own						-0.676	-0.995	-0.916	-0.990	0.929
						(3.32)***	(4.73)***	(4.86)***	(4.87)***	(2.39)**
Insider own squared						1.056	1.148	0.972	1.113	-1.145
						(3.82)***	(3.98)***	(3.82)***	(4.14)***	(2.04)**
Insider wedge						-0.323	-0.422	-0.539	-0.331	-1.240
						(1.45)	(2.31)**	(3.94)***	(2.34)**	(3.22)***
Ln(Firm size)	-0.104	-0.018	0.020	-0.014	-0.201	-0.111	-0.027	0.016	-0.021	-0.199
	(9.11)***	(1.94)*	(3.01)***	(1.38)	(11.74)***	(9.56)***	(2.67)***	(2.24)**	(2.02)**	(11.74)***
R&D	0.192	0.829	1.394	1.212	2.495	0.198	0.826	1.380	1.201	2.468
	(4.49)***	(13.38)***	(11.00)***	(9.95)***	(7.08)***	(4.63)***	(13.32)***	(10.89)***	(9.85)***	(7.00)***
Leverage	-1.204	-1.159	-0.814	-0.734	-0.845	-1.210	-1.149	-0.812	-0.717	-0.843
	(15.63)***	(14.99)***	(10.52)***	(8.69)***	(4.68)***	(15.71)***	(14.79)***	(10.50)***	(8.48)***	(4.69)***
Total risk	-7.910	-7.252	-5.606	-4.350	-15.975	-7.932	-7.367	-5.495	-4.262	-15.862
	(8.54)***	(8.15)***	(5.71)***	(4.26)***	(5.02)***	(8.57)***	(8.26)***	(5.62)***	(4.19)***	(5.04)***
Advertising	3.333	1.931	4.554	1.948	5.643	3.303	2.050	4.725	1.984	6.217
	(7.29)***	(4.35)***	(7.19)***	(2.86)***	(6.59)***	(7.22)***	(4.58)***	(7.36)***	(2.91)***	(7.20)***
PPE	-0.420	-0.126	-0.027	0.046	0.017	-0.416	-0.114	-0.039	0.038	0.024
	(6.23)***	(1.99)**	(0.51)	(0.76)	(0.16)	(6.16)***	(1.79)*	(0.73)	(0.62)	(0.22)
CAPEX	0.107	-0.003	0.042	0.045	0.287	0.109	0.000	0.034	0.039	0.285
	(2.54)**	(0.04)	(0.52)	(0.58)	(1.16)	(2.58)***	(0.00)	(0.43)	(0.50)	(1.16)
ROA	-0.019	0.565	1.659	1.213	4.625	-0.018	0.579	1.630	1.197	4.562
	(0.24)	(5.47)***	(9.01)***	(6.92)***	(4.91)***	(0.23)	(5.59)***	(8.94)***	(6.89)***	(4.89)***
Industry median firm value	0.652	0.570	0.565	0.537	0.468	0.654	0.569	0.565	0.539	0.471
	(21.68)***	(19.48)***	(19.84)***	(15.34)***	(9.66)***	(21.77)***	(19.37)***	(19.87)***	(15.47)***	(9.69)***
Constant	2.495	1.746	1.133	1.353	3.572	2.579	1.851	1.201	1.446	3.535
	(19.43)***	(15.80)***	(13.09)***	(12.10)***	(12.65)***	(19.64)***	(15.78)***	(13.10)***	(12.42)***	(12.55)***
Observations	7,585	7,586	7,583	5,612	1,971	7,585	7,586	7,583	5,612	1,971
Adjusted R-squared	0.28	0.27	0.28	0.24	0.44	0.29	0.27	0.28	0.24	0.45

Table 7
Results of piecewise specification
The dependent variable is *Firm value*. All dependent and independent variables are as defined in the Appendix. The results are estimated using OLS. Heteroskedasticity-adjusted (White) standard errors are used in calculation of t-statistics that are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
	Full sample	S&P500	Full sample	S&P500
CEO own05	-0.878	0.244		
	(1.52)	(0.13)		
CEO own525	-0.500	3.544		
	(2.71)***	(3.83)***		
CEO own25	0.297	-1.577		
	(2.37)**	(3.81)***		
CEO wedge	-0.715	-0.184		
	(5.59)***	(0.29)		
Insider own05			-3.305	-3.811
			(5.04)***	(2.95)***
Insider own525			-0.380	2.054
			(2.83)***	(4.03)***
Insider own25			0.329	-0.543
			(4.01)***	(1.48)
Insider wedge			-0.648	-0.134
			(6.38)***	(0.37)
Ln(Firm size)	-0.022	-0.230	-0.031	-0.242
	(4.10)***	(13.87)***	(5.43)***	(14.15)***
R&D	0.531	2.595	0.539	2.573
	(15.56)***	(7.51)***	(15.82)***	(7.27)***
Leverage	-1.142	-1.069	-1.134	-1.052
	(25.59)***	(7.61)***	(25.27)***	(7.45)***
Total risk	-6.363	-11.449	-6.520	-10.977
	(11.77)***	(4.59)***	(12.06)***	(4.39)***
Advertising	3.503	5.877	3.550	5.731
	(11.93)***	(10.05)***	(12.07)***	(9.53)***
PPE	-0.254	0.102	-0.265	0.060
	(7.16)***	(1.13)	(7.44)***	(0.67)
CAPEX	0.088	0.003	0.088	0.042
	(2.62)***	(0.02)	(2.62)***	(0.26)
ROA	0.250	4.866	0.247	4.878
	(4.20)***	(7.57)***	(4.18)***	(7.62)***
Industry median firm value	0.654	0.475	0.654	0.466
	(38.46)***	(11.62)***	(38.46)***	(11.44)***
Constant	1.665	3.690	1.845	3.870
	(26.08)***	(14.57)***	(25.51)***	(14.33)***
Observations	22,757	2,940	22,757	2,940
Adjusted R-squared	0.27	0.46	0.27	0.46

Table 8
Simulation results
The distribution of ownership-firm value relationships, based on the sign and significance of coefficient estimates on linear and square ownership, estimated from 1,000 random draws of 3,000 observations each from either a full sample or index-listed subsample.

		Full sample		**Index-listed subsample**	
Linear term	***Square term***	**CEO**	**Insider**	**CEO**	**Insider**
Negative linear and positive quadratic term					
Negative significant	**Positive significant**	434	736	22	210
Negative significant	Positive insignificant	101	29	27	17
Negative insignificant	Positive insignificant	352	155	466	447
Negative insignificant	**Positive significant**	59	67	19	205
	Subtotal	*946*	*987*	*534*	*879*
Positive linear and negative quadratic term					
Positive insignificant	**Negative significant**	0	0	5	0
Positive significant	Negative insignificant	0	0	8	0
Positive significant	**Negative significant**	0	0	5	0
Positive insignificant	Negative insignificant	18	6	259	20
	Subtotal	*18*	*6*	*277*	*20*
Linear significant relationship					
Positive insignificant	**Positive significant**	0	0	0	1
	Subtotal	*0*	*0*	*0*	*1*
Linear insignificant relationship					
Negative insignificant	Negative insignificant	22	2	91	5
Positive insignificant	Positive insignificant	14	5	98	95
	Subtotal	*36*	*7*	*189*	*100*
Total		**1,000**	**1,000**	**1,000**	**1,000**