The Lifecycle of Firm Takeover Defenses

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Abstract:

We propose and test the hypothesis that takeover defenses confer costs and benefits to a firm's shareholders that change in systematic ways as a firm matures. In particular, the cost of managerial entrenchment increases as a firm's ownership becomes more diffuse, and the benefits of stakeholder bonding via takeover defenses decrease as a firm grows and diversifies. A value-maximizing response to such changes would be for firms to shed takeover defenses as they mature. We document, however, that firms' use of takeover defenses is sticky, as 83% of firms make no changes to their takeover defenses during the 15 years after their IPOs. As a result of such stickiness, takeover defenses that enhance value at the firm's IPO tend to become costly over time. Consistent with this hypothesis, we find that the relation between firm value and the use of defenses is positive, on average, at the IPO and declines monotonically with firm age. The decline is most pronounced among firms that deploy the most sticky defenses, for which the entrenchment costs of antitakeover provisions are high, and for which the bonding benefits are small.

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1. Introduction

Are takeover defenses good or bad for shareholders? The answer seems to depend on whom you ask. Many researchers find support for the view that takeover defenses entrench managers and decrease firm value (e.g., Gompers, Ishii and Metrick (2003), Masulis, Wang, and Xie (2009), Bebchuk, Cohen and Ferrell (2009)). But others find that takeover defenses are associated with improved performance and value (e.g., Linn and McConnell (1983; Caton and Goh, 2008; Chemmanur and Tian, 2013; Smith 2015).

In this paper we propose that previous findings are mixed because takeover defenses confer both costs and benefits that vary across firms and over a firm's lifecycle. Our idea is illustrated in Figure 1. Takeover defenses offer benefits by encouraging long-term investment (Stein, 1988; Cremers and Farrell, 2015) and bonding relationships with important counterparties (Johnson, Karpoff, and Yi, 2015; Cen, Dasgupta, and Sen, 2015). Johnson et al. (2015) show that these benefits tend to be particularly important for young firms because they rely heavily on business relationships with large customers and strategic partners that are vulnerable to hold up problems. Takeover defenses also convey costs, however, by insulating managers from the threat of outside takeover and increasing the cost of agency (e.g., DeAngelo and Rice, 1983). Such costs tend to be low for young firms because their relatively concentrated ownership ameliorates agency problems compared to firms with more diffuse ownership.

In Figure 1, the marginal benefit and marginal cost of additional takeover protection for young firms equate at a relatively high level of takeover protection. As firms mature and rely less heavily on a small number of key customers or strategic partners, we postulate that the marginal benefit of takeover protection declines. Consistent with this argument, Johnson, Kang, and Yi (2006) find that 60% of IPO firms disclose a large customer while Cen, Dasgupta, and Sen (2011) find that 41% of mature firms have a large customer. As firms mature, their ownership also becomes more diffuse, increasing the agency cost of equity and increasing the marginal cost of takeover protection. The marginal benefit and marginal cost of takeover protection for mature firms therefore equate at a low level of takeover protection.

This argument implies that the resulting value-maximizing level of takeover protection decreases as the firm matures. If firms were to optimally adjust, they would shed some takeover defenses as they mature. We observe, however, that the use of takeover defenses is sticky. In our sample of 2,285 firms that went public from 1997 – 2011, 83% do not change their defenses after their IPOs during our sample period. There is some movement, as the average firm in our sample removes its classified boards and adds a poison pill and golden parachute after its IPO. But the average effect is to slightly increase the use of takeover defenses over time, not to remove them. For example, the average E-index at the IPO is 2.40 for firms in our sample, growing to 3.05 ten years later.

There are several reasons firms' use of takeover defenses tends to be sticky. First, many defenses are in the firm's charter or bylaws, and changing them requires a shareholder vote to amend the charter or bylaws. Coates (2001) argues that a power conflict between managers and institutional shareholders typically results in a draw. Managers want more takeover protections while institutional shareholders want fewer such protections. Neither side, however, typically has much success in advancing its agenda because it is checked by the other side.

One reason shareholders find it costly to force the removal of takeover defenses is that they face a free-rider problem. The very diffuseness in share ownership that gives rise to agency costs also increases the cost of making value-improving adjustments (e.g., see Shleifer and Vishny, 1986). The free-rider problem is exacerbated when shareholders do not hold unanimous views about the benefits of a takeover, perhaps because they have different cost bases and would face different tax liabilities in the event of a takeover (e.g., see Rice 2005).

Sticky takeover defenses have consequences for firm value. If our lifecycle hypothesis is correct and the value-maximizing number of defenses decreases as a firm matures, a firm that does not adjust its takeover defenses should experience a decrease in firm value. Suppose, for example, that the marginal cost of takeover defenses increases as the firm matures, driven by the increasing diffuseness of share ownership and the resulting increase in managerial agency costs. Suppose also that the marginal benefit

of takeover defenses decreases, as the firm relies less on the quasi-rents that are generated from large, specific relationships with specific large buyers or strategic partners. A firm that is stuck with the takeover defenses it had in place at its IPO (TD_{young} in Figure 1) will experience a loss in value associated with having too many defenses compared to its optimal level. Furthermore, the loss in value will increase as the firm matures.

This outcome is depicted in Figure 2. At the IPO, TD_{young} creates value. As the firm matures and the optimal takeover defense decreases to TD_{old}, the net benefits of the firm's defenses decreases. The net benefit continues to decrease as the firm matures. Stated differently, the very same takeover defenses that create value when the firm is young become increasingly costly as the firm matures. A takeover defense's contribution to firm value reverses and can even become negative.

In this paper we conduct several experiments to test this "value reversal" implication of the lifecycle hypothesis of takeover defenses. First, we find that the relation between Tobin's q and a firm's use of defenses decreases as the firm ages. This relation holds using three different measures of a firm's takeover defenses – the E-index, the use of a classified board, and an adjusted E-index using results from Karpoff, Schonlau, and Wehrly (2016). The overall pattern – that the relation between q and takeover protection declines with firm age – is robust in univariate comparisons and multivariate tests and to various empirical specifications. In multivariate tests that examine the determinants of q, for example, the coefficient on the E-index is 0.162 at the time of the firm's IPO and is -0.370 ten years after the IPO (both coefficients significant at the 1% level). These coefficients imply that for each additional takeover defense, average firm value increases by $13.2 million at the IPO stage and decreases by $88.7 million when the firm is ten years old.

Next, we construct a measure of a firm's cost of adjusting its takeover defenses based on the empirical frequency with which each of the six provisions in the E-index is, in fact, removed by our sample firms. Consistent with the lifecycle hypothesis, we find that the value reversal occurs primarily among the subset of firms for which the adjustment cost is relatively high. Among firms with relatively

low costs of adjustment, the difference between firms with high and low E-index values generally declines with firm maturity, but the decline is neither monotonic nor statistically significant. These results indicate that the value reversal is most prominent when firms cannot or do not adjust their takeover defenses as they mature.

A major concern with our empirical analysis is that firm value and the use of takeover defenses are endogenous to the firm's competitive environment. We address endogeneity several ways. First, we use each firm's E-index value at the time of its IPO, E^{IPO}, as a proxy for its E-index in future years. Because most firms' takeover defenses are sticky, this proxy is highly correlated with future years' E-index values. But because it is pre-determined relative to any year beyond the year of the IPO, E^{IPO} is less likely to be influenced by contemporary influences on takeover vulnerability and firm performance.

Second, we replicate our test results using a subset of E-index provisions that Karpoff, Schonlau, and Wehrly (2016) find are empirically related to takeover deterrence. KSW (2016) find that this subset of provisions, which they call the D-index, is related to takeover deterrence whether or not one controls for endogeneity. This finding suggests that this subset of provisions, which we call the adjusted E-index, measures takeover deterrence even though it is endogenous with firm characteristics.

Third, we estimate 2SLS models in which we develop instruments for a firm's E-index similar to those used in Johnson, Karpoff, and Yi (2015), which are based on geography and the characteristics of the firm's law firm at the time of its IPO. The results of the first-stage regressions indicate that these instruments are strong and meet the relevance condition. We argue that they also meet the exclusion restriction. Our argument regarding law firm characteristics is based on Coates' (2001) finding that a firm's use of takeover defenses is strongly related to the identity of its law firm. We note that most firms choose their law firms well before they go IPO, and so are pre-determined before the years of analysis in our tests.

Fourth, we use our law firm and geography based instruments as proxy variables for the E-index in reduced form models that examine the relation between firm value and the firm's takeover defenses.

Previous research indicates that reduced form models of this type can serve as robustness checks for inferences taken from 2SLS models (see Angrist and Krueger, 2001; Murray, 2006; and Chernozhukov and Hansen, 2008). The reduced form tests are useful particularly when there is potential 2SLS bias, such as can arise when the exclusion restriction is violated. The reduced form tests also partially mitigate a concern about measurement error when we instrument for the E-index in the 2SLS tests.

The results of all of these tests are consistent with our main findings. Throughout, there is strong evidence of a value reversal as a firm matures. In particular, the relation between firm value and the use of takeover defenses is positive for firms at their IPOs, and declines steadily as the firm matures, becoming negative approximately five years after the IPO.

Finally, we examine cross-sectional differences in firms' value reversals. The lifecycle hypothesis implies that the relation between firm value and takeover defenses declines both because the marginal benefits of takeover protection decline and the marginal costs increase as the firm matures. To measure the benefits of takeover protection, we use data on whether a firm has a large customer that accounts for more than 10% of the firm's sales, or whether a firm has a strategic partner. We find that the value reversal is most pronounced among firms without large customers or strategic partners, especially when the firm previously had a large customer or strategic partner at the time of its IPO.

To measure the marginal cost of takeover protection, we use two measures of the diffuseness of shareholdings, insider share ownership and block ownership. We posit that the importance of the outside threat of takeover to control managers, and therefore the cost of takeover protection, is negatively related to the shares controlled by insiders and the shares controlled by blockholders. Insider ownership is negatively related to the importance of the outside market for corporate control because managers' insider shareholdings provide a direct incentive to economize on managerial perquisites and to maximize firm value. Blockholdings are negatively related to the importance of the outside market for control because blockholders have both the incentive and ability to directly monitor managers, thus providing a substitute mechanism to control agency conflicts. We find that the value reversal is most pronounced among firms

that do not have significant insider shareholdings or blockholdings, that is, among firms for which the agency cost of equity tends to be relatively high.

This paper is organized as follows. Section 2 develops the lifecycle view of takeover defenses and its testable hypotheses. Section 3 describes the data we use to test these hypotheses. In Section 4 we report on firms' use of takeover defenses from the time of their IPO through 15 years later. Section 5 reports on our main tests of the lifecycle hypothesis, particularly the proposition that the positive relation between firm value and the use of takeover defenses reverses as the firm matures. Section 6 reports on tests in which we examine cross-sectional differences in the value reversal pattern across firms. Section 7 reports on robustness tests, and Section 8 concludes.

2. The lifecycle hypothesis of takeover defenses

Although many researchers have investigated the value impact of takeover defenses, the evidence remains mixed.[1] To unpack the reasons for such disparate findings, we propose that it is useful to model firm value q as a function of its takeover defenses E, age since IPO t, and other control variables X:

$$q = \mathrm{f}(E, t, X)$$

Previous research (e.g., Loderer, Stulz, and Waelchli, 2013) shows that firm value, as measured by q, tends to decrease with firm age, i.e., $\partial q/\partial t < 0$. Our question, and the subject of much debate in the literature, is whether $\partial q/\partial E$ is positive or negative. The lifecycle hypothesis, as illustrated in Figure 1 and discussed in the introduction, implies that $\partial^2 q/\partial E \partial t < 0$. This implies our first hypothesis.

> **Hypothesis 1 (Value reversal):** The relation between firm value and the firm's use of takeover defenses declines with the firm's age since its IPO.

[1] For a survey, see Straska and Waller (2013). In an earlier survey, Burkart and Panunzi (2006) conclude that "…there is still little consensus about the effects of takeover defenses on shareholder wealth, despite the large number of papers on this topic."

We call the hypothesis that $\partial^2 q/\partial E \partial t < 0$ the *value reversal* hypothesis. It implies that the value created by the use of takeover defenses declines with firm maturity.

Notice that Hypothesis 1 does not require takeover defenses to be sticky. Even if firms optimally adjust by shedding takeover defenses as they mature, the remaining defenses' contribution to firm value will decrease. (This can be seen visually by examining the size of the firm's surplus – the area under the MB curve and above the MC curve in Figure 1 if the maturing firm optimally adjusts from TD_{young} to TD_{old}.) The fact that firms do not, on average, shed defenses as they mature, however, indicates that either the lifecycle hypothesis is false or takeover defenses are sticky. We propose that the joint hypothesis of lifecycle effects and sticky defenses best characterize firms' takeover defenses and their value impacts, and that this joint hypothesis offers a resolution to the previous and conflicting evidence about the relation between firm value the use of takeover defenses.

With sticky defenses, the decline in $\partial q/\partial E$ as the firm matures becomes more pronounced. That is, $\partial^2 q/\partial E \partial t << 0$. In Figure 1, this is illustrated by a combination of the decreasing surplus as the optimum shifts from TD_{young} to TD_{old}, plus the shaded area loss from suboptimally sticking at TD_{young} number of defenses. With a rapid decline in $\partial q/\partial E$ as the firm matures, it is possible that $\partial q/\partial E$ becomes negative at some $t > 0$. In such a case the value reversal is so pronounced that takeover defenses that contribute to firm value when the firm is young end up decreasing firm value when the firm matures.

As discussed in the introduction, firms can ameliorate the value reversal by shedding takeover defenses as they mature, i.e., by moving toward TD_{old} in Figure 1. Such changes, in turn, are facilitated if the firm deploys defenses that can be removed at sufficiently low cost. In Section 4 we develop a measure of the stickiness of a firm's defenses, the F-measure, based on the empirical likelihood that each type of defense is, in fact, removed during our sample period. It is important to note that our F-measure is not based on any theoretical assertion about which types of defenses should or should not be easy to

remove. We also do not take a position on why certain defenses tend to be removed more than others.[2] The fact that firms deploy defenses that differ in their tendencies to be removed, however, implies our second hypothesis.

> **Hypothesis 2 (Sticky defenses):** The decline in $\partial q/\partial E$ as the firm matures is most pronounced among firms that deploy sticky takeover defenses, i.e., defenses that empirically are removed as relatively low rates.

Finally, the lifecycle hypothesis implies that the size of the value reversal depends on firm-specific characteristics that affect the costs and benefits of takeover defenses. Research by Johnson et al. (2015), Cen, Dasgupta, and Sen (2015), and Cremers and Litov (2015) indicates that takeover defenses yield benefits particularly when the firm has important business relationships with large customers or strategic partners. In terms of Figure 1, the MB curve for such firms will sit to the right of the MB curve for firms without large customers or strategic partners. Similarly, takeover defenses should be costly particularly for firms with diffuse ownership, as the absence of insider holdings or large blockholdings exacerbates the managerial agency problem. These observations motivate our third hypothesis.

> **Hypothesis 3 (Firm characteristics):** The decline in $\partial q/\partial E$ as the firm matures is most pronounced among firms that do not have large customers or strategic partners, and among firms with diffuse share ownership.

[2] For example, in Section 4 we show that classified boards are more likely to be removed than other defenses. Such changes likely reflect investor pressure and the advocacy of such groups as the Harvard Shareholder Rights Project. The F-measure picks up the stickiness of a firm's takeover defenses by measuring the within-sample likelihood that the defenses do not change – regardless of the reasons for any changes or lack thereof.

3. Data and sample

Our sample of firms starts with the universe of IPOs going public between 1997 and 2011. We begin our sample in 1997 to ensure that the firms have annual reports, proxies, and prospectus filings available in the SEC's EDGAR database. We eliminate all REITS, ADRs, funds, firms without CRSP and COMPUSTAT coverage, firms incorporated outside the US, and firms with a dual share class structure. In addition, we merge in data from Jay Ritter's web site on firm founding dates.[3] This yields a sample of 2,285 IPO firms with sufficient data on stock prices from CRSP, accounting data from COMPUSTAT, and takeover defense data in the firm's SEC filings. For each firm in the sample we create a panel dataset based on how long the firm remains in COMPUSTAT. For each firm-year observation, we hand collect the holdings of insiders disclosed in the SEC filings of the firm (predominantly the proxy statements). In addition, we use the Thompson Reuters 13f filing database to collect the shareholdings of institutional shareholders in the firm after its IPO.

We then use the SEC's EDGAR database to collect the takeover defenses of the firm in the IPO year and each year the firm remains in the COMPUSTAT database. Because we hand-collect the takeover defense data, we focus on the six takeover defenses determined by Bebchuk, Cohen, and Ferrell (2009) to be particular important to shareholders and firm valuation, and that constitute the E-index. These provisions include board classification, poison pills, supermajority requirements to change firm bylaws, supermajority requirements to change the firm charter, golden parachutes, and supermajority requirements to approve mergers.

To collect the takeover defenses, we begin in the IPO year by examining the IPO firm prospectus with its attached bylaws and charter. This allows us to collect the full suite of takeover defenses adopted at the IPO stage, similar to Johnson, Karpoff, and Yi (2015). We then proceed through the annual proxy statements, annual reports, and (where necessary) press releases of the firm for all the years the firm remains in COMPUSTAT to track all changes to the takeover defenses adopted at the IPO stage. For

[3] We thank Jay Ritter for generously providing this data at https://site.warrington.ufl.edu/ritter/ipo-data/.

further details of the takeover defense collection, please see Data Appendix I. This process allows us to create a panel of 15,740 firm-year observations where we have full COMPUSTAT data as well as the firm takeover defenses.

4. The use of takeover defenses as a firm matures

Table 1 reports on the sample by IPO year. Consistent with Gao, Ritter, and Zhu (2013), our sample contains more IPO firms per year before 2001 than afterward. The year with the largest number of IPOs is 1999 with 410 and the year with the fewest is 2008 with 16.

Table 2 reports summary statistics on several firm characteristics at the IPO and at several points after the IPO. At the IPO, the total assets average $867 million with a post IPO market capitalization of $825 million. Among surviving firms, the average firm size increases substantially, measured either by the book value of assets or market capitalization. The average firm 15 years old at the time of its IPO and, among firms that continue as publicly traded firms 15 years after their IPOs, the average firm age is 31.28 years. None of the firms in our sample were in the S&P 500 at when they went public, but by year 15 five percent of the firms are in the S&P 500. At IPO, 79% of IPO firms are incorporated in Delaware, declining to 63% at year 15. Cremers and Sepe (2015) find that more firms move to incorporate in Delaware than reincorporate out of Delaware, so this result most likely reflects Delaware firms disproportionately leaving our sample through acquisition or delisting. Likewise, we find that insiders hold 42% of the firm shares at the time of the IPO, declining to 14% by year 15. Finally, we find that 8% of the shares are held by large institutional shareholders at the IPO stage, increasing to 50% at year 15.

It is important to note, however, that this preliminary examination over time may result in what appear to be changes in firm characteristics caused not by individual firm changes, but rather by survivorship bias. We will address this issue more formally in the tests that follow. It is important to note that where the initial sample at the IPO stage includes 2,285 firms, the sample only has 131 IPO firms that

have observations 15 years later. This is caused both by firms leaving the sample, and by the end of our sample period in 2014.

4.1. Changes in takeover defenses over a firm's life

Table 3 reports on the firms' use of the six E-index takeover defenses over time. Our first finding is that the average E-index does not decline with firm maturity, but rather, increases slightly. At the IPO, the average E-index value in our sample of 2,585 firms is 2.41. This average increases gradually until it peaks at 3.07 ten years after the IPO, and then declines to 2.74 by year 15.

Much of the increase in the average E-index soon after the IPO firm reflects an increase in the fraction of firms that adopt poison pills. Pills are in place at only 5.34% of IPO firms, increasing to 27.50% in year 10. The use of golden parachutes also increases from an average of 64.5% of firms at the IPO stage to 98.23% of firms in year 10 relative to the IPO. This particular increase, however, seems to be driven by the very high levels of golden parachutes being adopted in the last 5 years.[4]

At the IPO stage, 64.4% of IPO firms adopt a classified board, consistent with the findings in Johnson, Karpoff, and Yi (2015). However, consistent with the general trend of firms removing takeover defenses (Cohen and Wang (2013)), we find that by 15 years after the IPO, only 47% of firms still have a classified board. The fact that IPO firms reduce their use of classified boards after their initial public offering at lower rates than large firms is not surprising since the prior literature has found that small firms are more likely to retain a classified board than large firms.

Supermajority requirements to amend the bylaws and charter of the firm are relatively stable from the IPO stage to later stages. For example, at the IPO stage, only 34% of firms require a supermajority to

[4] As can be seen by the data in Table 3, there is a substantial change in the percent of firms with golden parachutes starting in the 9th year after the IPOs. This substantial increase corresponds to observations after 2007 when IPO firms tend to have golden parachutes for the CEOs and other officers at rates above 90%. To ensure that this is not a coding problem or other difficulty in our data, we randomly select 101 IPO firms after 2007 that are coded as having a golden parachute and examine their annual proxy statements to determine if they do in fact have golden parachutes. We find only one case where the firm was disclosed as having a golden parachute, but in fact did not. We conclude that our data in fact accurately represent the trend in golden parachute use.

amend the firm bylaws and 30% of firms require a supermajority to amend the firm charter. By year 15, these percentages are nearly the same at 32% and 31%, respectively. In contrast, there appear to be larger changes in the supermajority requirement to approve mergers. This figure starts in the IPO year at 41% and by year 15 has increased to 50%.

Since our intent is to study the lifecycle of firms, we wish to avoid as far as possible the impact of macro events and changes in industry practice in the examination of our data. For instance, it is well known that nearly half of all S&P 500 firms who had classified boards in 2000 no longer have them (Cohen and Wang (2013)). Likewise, the trends in golden parachutes or poison pills could also be driven by the fact that most of our observations above year +10 occur after 2000, a time when there was a definite push to eliminate certain takeover defenses.

To help to mitigate some of these concerns, we split our sample into early and later periods. We split the sample at March 2000 as this corresponds to the end of the Internet boom and approximately splits our sample into two equal halves. In Table 3.B we examine the Internet Boom IPOs, finding similar trends in classified board, poison pill, and golden parachutes. Likewise, there is a definite trend in the increase in supermajority requirements to approve mergers. In addition, we find a low e-index at the beginning of the firm's lifecycle (2.05) which peaks at year 10 (3.01) and then declines thereafter (2.77). In Table 3.C we find that the overall trends for post-Internet Boom IPOs are similar, with one exception. Where the earlier classified board trend is downward, the later IPOs tend to have a slight increase in the use of classified boards. Otherwise, the overall data shows similar trends to earlier IPO firms. In untabulated tests, we repeat this tabulation of IPO cohorts by year, once again finding similar results. This implies that our results are mostly lifecycle driven as opposed to driven by a economy-wide trends in the use of takeover defenses.

One difficulty in interpreting the results in Table 3 is in determining if the change in sample characteristics is driven by firms adopting and removing certain takeover defenses or the disappearance of certain firms from our sample who have or do not have certain takeover defenses. For instance, if all IPO

firms without a poison pill are acquired within a certain number of years, the remaining firms will all have poison pills, leading the data to show an increase in poison pills over time.

To assist in interpreting the trends in Table 3, we tabulate the individual firm adoptions (Table 4.A) and removals (Table 4.B) of takeover defenses. Table 4.A shows that, from year 0 to 1, two IPO firms adopted a classified board. In the following year, three firms adopted a classified board. In the subsequent four years, one firm in our sample adopted a classified board each year. These nine observations account for all board classifications within our sample. We find that a substantial number of firms adopt poison pills during the first ten years after their IPOs. However, the rate of poison pill adoption seems to level off thereafter. The table also shows few adoptions of supermajority requirements to amend the bylaws or charter of the firm. But we find substantial numbers of firms incorporating supermajority requirements to approve mergers in the first ten years of the IPO. Likewise, many firms adopt golden parachutes in the early life of the firm. Finally, we see that in cases where any defenses are adopted by the firm, these adoptions tend to occur in the early years after the IPO firm, as reflected in the increase in the average E-index value during these earlier years.

In Table 4.B we examine the removal of takeover defenses. Whereas there are few adoptions of classified boards in our sample, many more firms remove classified boards. There are fewer poison pill removals (75) compared to classified board removals (107). The removal of poison pills tend to be clustered around 10-12 years after the IPO, consistent with the majority of these poison pills being eliminated through a ten-year sunset clause rather than by a direct vote of the directors.[5] More firms remove than adopt supermajority requirements to amend bylaws (34) and charters (27), although these changes do not seem to be clustered in time. The supermajority requirements to amend the bylaws and the

[5] More than 95% of the poison pills are allowed to expire through the sunset clause. A few firms reduce the life of the original ten year subset clause to (for instance) three years and then allow the poison pill to expire. For instance, the board of Biomarin Pharmaceutical authorized a stockholder rights plan in September 2002 and "accelerated the final expiration date of the Company's preferred share purchase rights under the Rights Agreement." After accelerating the expiration of these rights, the board eventually allows the rights to expire. See BioMarin's 2013 Proxy Statement for further details.
http://www.sec.gov/Archives/edgar/data/1048477/000119312513077031/d455570d10k.htm

charter are by far the most stable takeover defenses, with very few changes in these takeover defenses. Supermajority requirements to approve mergers may be clustered early in the firm lifecycle with 11 adoptions in year 1. Finally, golden parachutes have many adoptions (380), but only a few total removals (19) with most occurring within a few years after the IPO.[6]

4.2. The F-measure of takeover defense stickiness

The Table 4 results indicate that firms are more likely to remove some defenses than others during our sample period. Such removals may reflect shareholder pressure, management changes, or attempts to adjust the firm's takeover defenses toward an optimum level. In this section we use the fact that some defenses are removed more frequently than others to create a measure of the stickiness of a firm's takeover defenses, which we call the F-measure. The F-measure is the probability of a firm remaining at its current e-index level rather than removing one or more takeover defenses. The measure is calculated as:

$$\text{F-measure} = 1 - [\text{Prob}_{\text{Classified}} \times I_{\text{Classified}} + \text{Prob}_{\text{Pill}} \times I_{\text{Pill}} + \text{Prob}_{\text{Supermajor - bylaw}} \times I_{\text{Supermajor - bylaw}} + \text{Prob}_{\text{Supermajor - charter}} \times I_{\text{charter}} + \text{Prob}_{\text{Supermajor - merger}} \times I_{\text{Supermajor - merge}} + \text{Prob}_{\text{Golden parachute}} \times I_{\text{Golden parachute}}]$$

where Prob_{n} is the number of observations removing the takeover defense n divided by the total number of firm-year observations with this takeover defense and I_{n} is an indicator variable taking a value of one if the firm has takeover defense n. A high F-measure implies that the firm is unlikely to remove takeover defenses.

To calculate the F-measure, we first calculate the unconditional probability of removing each of the six governance provisions in the E-index. For instance, as reported in Table 5.A, there are 107 board declassifications in our sample of 15,740 firm-year observations. However, there are only 10,140

[6] These results do not examine how some firm characteristics included in the e-index as "takeover defenses" affect the likelihood of changing other takeover defenses adopted by a firm. For instance, when a firm adopts a supermajority requirement for charter and bylaws amendments, other takeover defenses adopted by the firm are less likely to change over a firm's life cycle. See the Appendix table 6.

observations where the firm has a classified board. This leads us to calculate a 107 / 10,140 = 1.06% probability of removing the classified board in any one year. Likewise, the likelihood of removing a poison pill is quite high at 2.87%,. In contrast, removing a golden parachute (0.16%), supermajority requirements to amend the bylaws (0.61%), supermajority requirements to approve mergers (0.76%), or the firm charter (0.55%) are less common. Note that the likelihood of remaining with the firm's current mix of takeover defenses (F-measure) declines as a firm has more defenses, by construction.

In Table 5.C we split our sample of firms by those with above the median within their e-index and below their median. It is important to first group firms into their e-index and then calculate medians – otherwise, this split would be firms with low e-index (which by construction are very unlikely to remove defenses) and firms with high e-index. Instead, we are reporting firms that are unlikely to remove defenses (high F-measure) and firms that are more likely to remove their defenses (low F-measure). We can see, examining the 2,285 IPO firms in our sample that firms with a high F-measure reduce their e-index measure at some point during the life of the firm 6.18% of the time where firms with low F-measure reduce their defenses 8.55% of the time (t-stat = 2.03). These results imply that our F-measure does in fact help us predict which firms will change their takeover defenses.

4.3. Changes in firm valuation over time

To better understand the relationship between firm valuation and firm lifecycle, we must first examine the way an IPO firm valuation changes over time. In Table 6 we report mean and median Tobin's Q for the first 15 years of our sample of firms. Note that all firm values for Tobin's Q are winsorized at the 99th percentile.[7] We find that at the IPO stage, the mean (median) Tobin's Q is 4.17 (2.48). This figure is quite high and suggests that IPO firms are considered likely to have quite high growth rates. Subsequent to the IPO, we find that Tobin's Q declines substantially even by year 1, with a

[7] Our results are not appreciably changed by winsorizing at the 95th percentile or by not winsorizing at all. However, unwinsorized values lead to anomalous reported means due to the influence of significant outliers. We choose to winsorize at the 99th percentile to be consistent with Gompers, Ishii, and Metrick (2003).

mean (median) value of 2.50 (1.68). While this may still seem high relative to expectations, industry adjusting the Tobin's Q suggests that this is not the case.

In the final two columns of Table 6, we report the industry median adjusted Tobin's Q. We follow Gompers, Ishii, and Metrick (2003) by taking each firm Tobin's Q and subtracting the industry median Tobin's Q. We then report the mean and median of this value in the table. Our results are similar to the unadjusted Tobin's Q values. We find a substantially higher value at the IPO stage compared to all subsequent years after the IPO. This implies that the markets expect a substantially higher growth rate at the IPO stage relative to in subsequent years (or that expected stock returns are low or that market valuation is irrationally high just after the IPO). It does appear, however, that this initially higher Tobin's Q adjusts by the year after the IPO to be quite similar to the rest of the industry for each firm, as seen by the near zero industry adjusted Tobin's Q medians in the last column of Table 6.

5. The relation between firm value and the use of takeover defenses over time

5.1. Univariate results

In Table 7 we report on the relation between industry adjusted Tobin's Q and the e-index over the lifecycle of the firm. Where some of the prior literature (Johnson, Karpoff, and Yi (2015)) shows a positive relationship between firm valuation and takeover defenses for IPO firms, other literature (Gompers, Ishii, and Metrick (2003) and Bebchuk, Cohen, and Ferrell (2009)) shows a negative relationship for mature firms. To reconcile these inconsistencies in the literature, we examine the Tobin's Q – e-index relationship in all years from the IPO until the end of our sample period.

We separate firms by those with above versus below the median level of e-index and test the significance of the difference in firm values in Table 7.A. We find that for years 0, 1, and 2, there is a significant difference between the firm value with low levels of takeover defenses and high levels of takeover defenses. This result is consistent with takeover defenses causing higher firm valuation.

However, by years 3-4, the relationship is no longer significant. In addition, by years 5-6, the relationship becomes negative and statistically significant. This result is consistent with the prior literature.

However, we wish to show that firms which can easily remove takeover defenses are more likely to do so and as such, will not have a significant level of value reversal. In contrast, firms with defenses that are very difficult to remove are more likely to exhibit value-reversal. In Table 7.B and 7.C, we should that firms with a high F-measure (a high significance of retaining their current e-index), there remains a significant value reversal effect. Firms have a significantly positive relationship between value and e-index early in their life, but a significantly negative and significant relationship later in their life. However, for the firms with below the median F-measure, firms which can more easily modify their takeover defenses, this is not the case. These firms are more likely to have little or no relationship between firm value and takeover defenses. Only as these firms become mature (≥ 10 years old) do we see a significant and negative relationship between firm value and defenses. This result implies that firms with high levels of takeover defenses only show value reversal if these defenses are difficult to remove.

In Table 7.D, 7.E, and 7.F we repeat our analyses using the presence of a classified board as our measure for takeover defenses. While the results are somewhat weaker, we continue to find a distinctive value reversal with classified boards being associated with higher value early in the firm's life and lower value later in the firm's life. In particular, this value reversal seems to be strongest for firms with a high F-measure.

5.2. Multivariate tests

To ensure that our results are not driven by other variables known to be related to Tobin's Q, we conduct a series of tests using a multivariate regression setting. Specifically, we conduct our analyses using the control variables utilized by Gompers, Ishii, and Metrick (2003) plus two other controls.[8] The Gompers, Ishii, and Metrick (2003) variables we include as controls are an indicator variable taking a

[8] In addition, when we repeat our analyses using only the control variables from Gompers, Ishii, and Metrick (2003) without controlling for institutional ownership or insider share holdings, we find almost identical results.

value of one if the firm is incorporated in Delaware, the firm age in years, log (firm assets), and an indicator taking a value of one if the firm is in the S&P 500. In addition, we include the percent of shares held by directors as reported in the firm's SEC filings and the total percent of shares held by institutional shareholders as reported in the firm's 13f filings. In addition, since we cannot obtain the insider holdings in all years, we replace missing values with a zero and add an indicator variable taking a value of one if the insider shareholdings are not available.[9]

In Table 8.A we report our multivariate regression results using industry adjusted Tobin's Q as the dependent variable. These results are similar to Gompers, Ishii, and Metrick (2003) in that they pool each firm-year observation into one large regression. We find in model 1 that there is a negative but insignificant relationship between firm value and e-index. In model 2 we include an indicator variable for observations where it has been more than four years since the firm's IPO. This variable is significantly negative, consistent with the results in Table 7 showing that Tobin's Q tends to decline over time. Finally, in model 3, we examine the interaction between e-index and firms being more than four years from their IPO and find that this interaction is statistically significant and negative at the 1% level. In addition, once we control for firm age and this interaction, we find that the relationship between firm value and e-index becomes positive and significant. This suggest that the prior literature suggesting an unequivocal negative relationship between firm value and takeover defenses only tells part of the story.

In Table 8.B we repeat our analyses using sub-samples of the IPO firms based on how far the firms are from their IPO. Our firm regression in model 1 uses only IPO firms at the state of their IPO. This particular regression is most similar to Johnson, Karpoff, and Yi (2015) which only considers IPO valuation at the IPO stage. But as we move to model 2-7, we go cross-sectionally from the firms having most recently gone through their IPO (model 1) to IPO firms who are one year old (model 2) and so forth. This allows us to simply examine when and if there is a change in the Tobin's Q – takeover defense relationship as the firm matures.

[9] Our results are nearly identical if we eliminate the N=974 observations with missing insider holdings. This accounts for 6.19% of our firm-year observations.

We find in Table 8.B model 1 that there is a positive and statistically significant relationship between Q and e-index. The coefficient of 0.162 implies that at the mean e-index value of 2.40, adding one standard deviation in takeover defenses (1.60) results in an increase in industry adjusted Tobin's Q of 0.25 or 10.4% of firm value. This result is statistically significant at the 1% level. In model 2, we find that there is also a positive and statistically significant relationship between Tobin's Q and the level of takeover defenses adopted by the firm. Thus, it is clear that the IPO firm takeover defenses enhance firm value not just at the IPO stage, but also one year later. In model 3 we find that the relationship between Tobin's Q and the level of takeover defenses is also positive, but is no longer statistically significant. Likewise, in year 3-4 in model 4, we find a positive but statistically insignificant relationship between firm value and takeover defenses.

When we move on through time to years 5-6 after the IPO in model 5, we find a negative and statistically significant coefficient of -0.071, significant at the 5% level. This result implies that starting five years after the IPO of a firm, the takeover defenses will cause a decrease in the value of the firm. Likewise, as we move to years 7-9 (model 6) and year ≥10 (model 7) we find a more negative and more statistically significant relationship between the IPO firm value and e-index. This result is consistent with the negative and robust relationship found by Bebchuk, Cohen, and Ferrell (2009) between firm value and e-index. The sample of firms examined in model 7, IPO firms at least ten years old is the closest to the Bebchuk, Cohen, and Ferrell (2009) sample.

In addition, we plot the year-by-year coefficients for the first 15 years the IPO firm is public in Figure 2. This figure also plots the standard errors of the regression. It is important to note that as the number of observations decreases, particularly after 10 years from the IPO, the standard error increases substantially. The figure clearly shows that for the first two years, the relationship between takeover defenses and firm value is positive and significant. Although the relationship is not statistically significant, the point estimate of the valuation is positive through year three after the IPO. At year 4, the relationship between takeover defenses and firm value becomes negative. However, not until year 6 is the

relationship negative and statistically significant. Subsequently, the relationship remains negative and statistically significant for all future years through year 15.

We then repeat our analyses using firms with above versus below the median f-measure in Table 8.C in models 1 and 2, respectively. We find a negative and statistically significant coefficient for the interaction term between e-index and firms out past 4 years from their IPO for firm with a high f-measure, consistent with our conjecture that the stickiness of defenses is a prime driver of our lifecycle effect. In contrast, we find that the interaction coefficient for firms with below the median f-measure is negative but no longer statistically significant, indicating that there is not a significant lifecycle effect for firms which can more easily change their takeover defenses.

In Table 8.D we repeat the cross-sectional regressions by year from IPO for firms with above the median f-measure. These are firms with a higher likelihood of remaining at their IPO-level of takeover defenses due to the stickiness of these defense measures. Examining the relationship between e-index and firm value by year, we find a positive and significant relationship early in the lifecycle of the firm and a negative and significant relationship in later years. This result is consistent with the conjecture that there is a strong lifecycle effect for these firms.

In contrast, in Table 8.E we find almost no lifecycle effect at all for firms with low f-measure values. This implies that if firms are capable of easily changing their takeover defenses, then they are likely to do so and will show no significant relationship between takeover defenses and firm value. Figure 3 shows these result graphically for the universe of firms, firms with above the median f-measure, and firms with below the median f-measure.

In Table 8.F we repeat our analyses using classified board as the only takeover defense considered. Most importantly, we find our results are quite similar to the results already discussed in Table 8.A. In particular, in model 1 we find that a classified board is negatively (albeit insignificantly) related to firm value. In model 2 we find that as the firm ages, the value of the firm declines as seen by the negative and significant coefficient on the indicator variable for firms more than four years after their IPO. Finally in

model 3 we find that the interaction term between the classified board indicator and the age > 4 years variable is negative and highly statistically significant at the 1% level. Although the level of statistical significance is not identical to Table 8.A using the e-index measure, the results are strikingly similar in Table 8.F.

We then repeat our year-by-year regressions in Table 8.G using classified board as the independent variable of interest. As in Table 8.B using e-index, we find that in the early years of the firm (year=0) the presence of a classified board is positively and significantly related to firm value. As time progresses from year=1 (model 2) to years 5-6 (models 3-5) the coefficients go from being positive to negative and eventually, significant. Moving past years 5-6, we find that the coefficient on a classified board is reliably statistically significant for years 7-9 (model 6) and years ≥10 (model 7). This result is analogous to the result tabulated for e-index and shows a strong decline in the valuation impact of classified boards as the firm ages.

In Tables 8.H-8.J we repeat our major analyses using the f-measure as a determinant of the difficulty in changing takeover defenses and classified board as our measure for takeover defenses. We find qualitatively similar result. Firms which have high f-measure values (difficulty in removing defenses) tend to have a distinctive lifecycle effect. Firms with low f-measure values do not.

5.3. Multivariate results accounting for endogeneity

As Gompers, Ishii, and Metrick (2003) and others point out, correlation between firm value and its use of takeover defenses need not be causal. To explore causality, in this section we report on 2SLS tests in which we use data on the firm's law firm and headquarters location to create instruments for the firm's use of takeover defenses. Our specific instruments are indicator variables for the firm's law firm at the time of its IPO and an indicator variable if the firm is located in California. These instruments for takeover defenses are used by Johnson, Karpoff, and Yi (2015), who discuss the reasons why these instruments plausibly satisfy the exclusion restriction.

In Table 9.A we report the second stage regressions from a 2SLS using law firm indicators and a California indicator as our instruments. We find in model 1that the e-index is insignificantly correlated with firm value in the overall sample of firm-year observations. When we add in an indicator variable for firms more than four years from their IPO in model 2, the coefficient on e-index becomes positive and marginally significant at 0.075. In model 3, we include both the instrumented e-index measure plus the interaction between this measure and firms more than four years from their IPO. Importantly, the coefficient on the instrumented interaction term is -0.456 and is significant at the 1% level. This result confirms that our prior OLS results from Table 8 are not driven by endogeneity or omitted variables. Our results suggest that there is a causal relationship with e-index causing higher firm valuations early in the firm lifecycle but causing lower firm valuations later in the firm lifecycle.

In Table 9.B we repeat our analyses using 2SLS year-by-year regressions using the same instrumental variables as in Table 9.A. We find qualitatively similar results with higher firm valuations early in the life cycle of the firm and lower valuations later. For instance, in model 1 we examine the IPO year results and we find that controlling for endogeneity, the coefficient on the instrumented e-index is 0.294, significant at the 10% level. The reduction in power due to the reduced sample size largely accounts for the significance only at the 10% level. Moving through time to year 1 in model 2, we find the coefficient is 0.114, but is no longer statistically significant, moving to later years, the coefficient generally moves from positive to negative. In model 6 (years 7-9) we find a negative coefficient of -0.110, significant at the 10% level. We find that in years beyond this, the coefficient is -0.120, but is not statistically significant. These results show that the apparent value reversal associated with the life cycle theory is not driven by endogeneity.

As an alternative method of controlling for endogeneity, in Table 9.C and 9.D we repeat our analyses using the IPO-stage e-index as our measure for takeover defenses for all firm-years in our sample. As long as the IPO-stage e-index is predetermined compared to contemporaneous information such as Tobin's Q at years after the IPO, this measure for takeover defenses can be considered as

exogenous. We find in Table 9.C and 9.D that our major results are quite similar when we repeat our analyses using the IPO-stage level of takeover defenses. Finally, we then repeat our analyses using a modified e-index measure which is derived from the d-index from Karpoff, Schonlau, and Wehrly (2016). This measure is useful since it is correlated with takeover probability even if we do not control for endogeneity. We find that our results do not change appreciably using the modified d-index.

6. Cross-sectional differences in the benefits and costs of takeover defenses

To understand the mechanism of firm value enhancement, we need to get a better handle on what happens to the firm needs over the lifecycle of the firm. Our life cycle hypothesis of takeover defenses argues that a commitment benefit of takeover defenses is greater at the IPO stage and diminishes over a firm's life cycle while the agency cost of takeover defenses is small at the IPO stage and increases over a firm's life cycle. In this section, we empirically examine whether and to what degree the commitment benefit of takeover defenses evolves over a firm's life cycle and how this evolution affects the firm value. A firm's need for takeover defenses as a commitment mechanism toward stakeholders is greatest at the IPO stage because of an IPO firm's lack of reputation in the production input markets and limited resources to build wide distribution channels. Empirical evidence supports this. Johnson, Kang, and Yi (2010) and Cen, Dasgupta, and Sen (2011) provide some hint for some of these changes. Where Johnson, Kang, and Yi (2006) find that 60% of IPO firms disclose a large customer at the time of the IPO of a firm, Cen, Dasgupta, and Sen (2011) find that 41% of firms have a large customer as mature firms. This result implies that there may be a changing reliance on large customers as the firm matures. Specifically, it appears that at the IPO stage, large customers are quite common and important, but as the firm matures, these relationships become significantly less common or less important.[10] Likewise, Johnson, Karpoff,

[10] Johnson, Kang, and Yi (2010) also document that the presence of a large customer significantly increases the value of the IPO firms when they go public.

and Yi (2015) suggest that strategic alliances are another important value-enhancing relationship for IPO firms.[11]

To document this significant change in the importance of founder CEOs, large customers, and strategic alliances, we track the percent of IPO firms with large customers from the IPO stage to the end of our sample period. Note that at the IPO stage, we find that 26.7% of IPO firms have a founder CEO. Ten years later, this number had dropped to 12.0%. Also at the IPO stage, we find that 45% of IPO firms have a large customer at the IPO stage of the firm. However, at the later lifecycle stages, we find that the percent of IPO firms with large customers drops to 10% after ten years. Note that the beginning and ending levels are somewhat lower than those documented in the prior literature. The difference is due to the change in the kinds of firms going public in the Internet boom years (through 2000) compared to the kinds of firms going public after 2005. We find results similar to Johnson, Karpoff, and Yi (2015) if we restrict our sample to pre-2005 IPO firms. Likewise, we find that 18.7% of IPO firms announce strategic alliances in the IPO year, but only 12.4% do ten years later. These results suggest that the parties that most benefit the firm in the presence of takeover defenses: founder CEOs, large customers, and strategic alliance partners are all declining as the firm ages.

In addition, we suspect that the percent of insider ownership is very high at the IPO stage, but declines over time. Table 10 confirms this conjecture: at the IPO stage, insiders own 41.7% of the company, but at year ten, they own 14.4%. This dilution of insider ownership results in a large change in the alignment between manager incentives and shareholder incentives. In Table 11 we run multivariate regressions examining the interaction between the e-index and the characteristics which should cause a shift in the value curve of the firm. We find that firm firms with a founder CEO, a large customer, joint venture announcements, or above median institutional ownership, there is a positive and statistically significant relationship between firm value and takeover defenses. This result implies that the value

[11] In addition, Johnson, Karpoff, and Yi (2015) examine the presence of a dependent supplier in their analyses. We omit this particular kind of relationship with IPO firms for two reasons. First, suppliers dependent upon IPO firms are not all that common. Second, it is ambiguous as to whether an IPO firm would have more dependent suppliers as it ages or fewer.

reversal we are seeing is being caused by the reduction in founder CEOs, large customers, strategic alliances. The presence of higher insider ownership and the presence of higher institutional ownership both help to shift the benefits curve increasing the value of takeover defenses for the firm higher.

7. Robustness tests

7.1. Alternative measures of firm value

To confirm the robustness of our general results, we repeat our major tests using various measures of Tobin's Q. For instance, we repeat all our lifecycle tests using raw (unadjusted) Tobin's Q instead of the industry adjusted Tobin's Q reported in the paper. We find qualitatively similar results. In addition, we repeat our analyses using Tobin's Q adjusted by industry median results that are not winsorized. The major results tabulated in the paper all utilize industry median adjusted Tobin's Q winsorized at the 99th percentile. When we repeat our analyses using industry adjusted Tobin's Q without winsorizing, we find remarkably consistent results. Likewise, when we repeat our analyses using winsorized values at the 95th or the 90th percentile, we find similar results. In all cases, we find a striking pattern of value increase with takeover defenses early in the lifecycle of the firm and value decrease with takeover defenses later in the lifecycle of the firm.

We also examine the industry clustering of the lifecycle effect to determine if our results are disproportionately caused by financial firms, technology firms, or other kinds of firms. We find that the lifecycle effect persists even in financial firms (sic code 6000-6999), technology firms (as defined by Loughran and Ritter (2004) Appendix 4), and many other industry definitions. Likewise, our results are robust to the elimination of all utilities IPO firms. We repeat our analyses for each of the Fama and French (1997) 10 industry definitions and find that in all cases but one, when there are more than 20 observations, the coefficient on e-index goes from positive at time=0 and remains positive for 1-2 years before turning negative in the later years of the firm lifecycle. Most of these coefficients are not significant, however, due to the limited sample size in these regressions. These results suggest that our

results are not driven by any industry per se, but are driven by a general trend in the data across all industries.

In addition, we repeat our analyses on subsamples of IPO firms from before and after the Internet boom period of 2000. Repeating our analyses on only IPOs from before or only after the Internet boom period results in qualitatively similar results. In the early years after the IPO, there is a strong and significant relationship between the level of takeover defenses and firm value as measured by Tobin's Q. However, in later years, there is a strong negative and significant relationship between takeover defenses and Tobin's Q. Thus, it appears that our major results are not driven by any particular time period for the IPOs in our sample.

7.2 Alternative measures of takeover defenses

Likewise, we repeat our analyses examining the e-index measure without golden parachute. Because golden parachute goes from being adopted at the IPO stage 64% of the time to nearly 100% of the time, perhaps our results are driven by the change in this particular takeover defense. We therefore repeat our analyses using an e-index without the golden parachute measure. When we do so, we find that there is still a strong and significant lifecycle effect. In the early years after an IPO, the firms still have a positive and significant relationship between takeover defenses and Tobin's Q but in later years, the relationship becomes negative and significant.

We also repeat our analyses on the subset of IPO firms with missing insider holdings. Even on this subset of firms, we find a positive and significant relationship between takeover defenses and firm value early in the life of the firm. Late in the life of these firms, we find a negative relationship between takeover defenses and firm value, although the relationship is not statistically significant due to the small sample size of the firms. In addition, we repeat our analyses for the subset of firms with above (below) the median level of insider holdings and find a significant value reversal for these firms. Likewise, when

we repeat our analyses for firms with only above (below) the median level of institutional shareholders, we find a significant value reversal.

7.3 Alternative measures of firm maturity

We now move on to measures of firm maturity other than the number of years since the IPO. One problem with splitting our sample by years after the IPO is the arbitrary nature of this measure of IPO firm maturity.

We begin by using the age of the IPO firm – simply the number of years from the time of IPO founding to the present time. While firm age is linked to years since IPO, there are many firms that are quite old at the time of the IPO. Therefore, firm age and years since the IPO only have a correlation of 0.18. Loughran and Ritter (2002) provide the founding dates of IPO firms and use this measure as a proxy for the uncertainty of the IPO firms. Note that in this regression format we can only observe the firm after it is public. This implies that if a firm is founded many years before our sample, we can only observe such a firm as a mature firm. Nevertheless, we feel that a firm that is founded and goes through an IPO relatively quickly (within 0-2 years) is certainly less mature than a firm that was private for many years and subsequently went public.

In Appendix Table 1.A we tabulate our regression results using IPO firm age in years in separating firms by their level of maturity. We include all the control variables utilized in prior regressions, but do not tabulate them for brevity. Note that because of the discontinuous nature of firm age, the number of observations is not perfectly consistent across all the models in Appendix Table 1.A. We find that in the early life of the firm the relationship between e-index and firm value is positive and significant at the 1% and 10% level in models 1 and 2. But starting as an IPO firm age of 8 years and above, the relationship between firm value and takeover defenses becomes negative and marginally significant at the 10% level. Finally for firm ages 12-14 (model 4), ages 15-18 (model 5), and ages 19-23 (model 6) we find a consistently negative and statistically significant relationship between firm value and

takeover defenses. We do find in model 7 that when a firm is older than 24 years, the relationship between firm value and takeover defenses is no longer statistically significant, but the coefficient remains negative. Other than model 7's insignificant coefficient, our results are entirely consistent with our prior assertion that there is a lifecycle relationship in the takeover defense relationship with firm value.

We then move on to industry-specific measures of firm maturity. An industry where the average firm is quite young is likely to be an immature industry where an industry with the mean firm age being old will likely be more mature. We therefore repeat our analyses using average industry firm age to break our sample into early, middle, and mature lifecycle industries. We first calculate the Fama and French (1997) 48 firm industry classification age. We define age as the first time the firm has a non-zero assets value on COMPUSTAT.[12] We report our results in Appendix Table 1.B. We find that firm age and industry mean age have a correlation of 0.36. We find in model 1 that firms in an industry where the mean industry age is 0-7 years has a positive and statistically significant relationship between the e-index and the firm valuation. As we move to industries where the average age goes up, the coefficient on e-index becomes negative, albeit insignificant. Starting at year 15-17 (model 6) we find a negative and statistically significant relationship between e-index and firm value. Finally, in model 7 we find that firms in an industry where the mean firm age is above 17 years are a negative and statistically significant relationship. These results show that both firm-specific and industry-specific measures of firm maturity show consistent results to our prior patterns. Firms early in their lifecycle show a positive relationship between firm value and e-index. Firms later in their lifecycle show a negative relationship between firm value and e-index.

We then look at the sales growth rate of the firms in our sample. As with firm age, we calculate the sales growth rate for both the individual firm and the Fama and French (1997) 48-industry group of firms. For firms in an immature industry, the sales growth rate should be quite high (Klepper and Grady

[12] We recognize that utilizing the actual firm ages would be preferable to using ages based on when firms show up in the in COMPUSTAT database. However, the prior literature has found that using the COMPUSTAT listing as the founding date of firm existence is a reasonable proxy for firm age.

(1990)). However, as the firm and the industry matures, the growth rate of sales show slow down. This allows us to use sales growth rate as a measure of firm lifecycle for both the IPO firm and its industry as a whole.

We separate sales growth into quintiles and regress industry adjusted Tobin's Q onto e-index plus the control variables we have been using.[13] We find in Appendix Table 1.C that for high growth firms (model 1) there is a positive and statistically significant relationship between firm value and e-index. However, as sales growth declines from quintile 5 to 4, the coefficient turns negative. Moving across quintiles to 3, 2, and 1, the coefficient always becomes more negative and starting in the second quintile, becomes significantly negative. Finally, in quintile 1, the lowest sales growth for the IPO firms, we find that the relationship between firm value and e-index is negative and statistically significant at the 1% level. This result implies that as a firm matures as measured by its growth rate, the relationship between firm value and e-index becomes more negative.

We repeat our results in Appendix Table 1.D using sales growth rates by industry and find qualitatively similar results. Once again, at the highest growth rates (quintile 5) we find a positive and statistically significant relationship between firm value and e-index. Moving from quintile 5 to lower quintiles of industry sales growth rates, we find qualitatively similar results as for firm sales growth rates. As the growth rate declines, implying the firm matures, the relationship between firm value and e-index first becomes negative and then statistically significant. Both quintile 3 and quintile 4 have a negative and statistically significant relationship between firm value and e-index. While the lowest industry sales growth rate does not show a statistically significant relationship between firm value and e-index, the coefficient remains reliably negative. On the whole, these results imply a strong lifecycle impact for firms on the value-takeover defense relationship.

Additional tests and robustness checks are contained in the appendix.

[13] For the IPO firms, we use firm growth rate as ($sale_{t+1}/sale_t$ -1) since sales in the year before the IPO (t-1) are not available in COMPUSTAT. We find qualitatively similar results using ($sale_t/sale_{t-1}$ -1) but have fewer observations in our regressions using this measure.

8. Conclusions

In this paper, we propose and empirically examine a life cycle hypothesis of takeover defenses which suggests that the bonding benefits and the agency costs of takeover defenses affect the valuation effect of takeover defenses differently at different stages of a firm's life cycle. The life cycle hypothesis of takeover defenses predicts that there is a reversal in the sign of a relationship between takeover defenses and firm value as a firm matures from a positive one to a negative one. Consistent with the life cycle hypothesis of takeover defenses, we find that there is a reversal in the relationship between takeover defenses and firm value over a firm's life cycle. We also find that the bonding benefit which is especially valuable at the IPO stage and the agency costs of takeover defenses which aggravate managerial moral hazard as manager ownership declines are two significant determinants of the valuation effect of takeover defenses over a firm's life cycle. We also find that there are two categories of takeover defenses which exhibit different dynamic patterns of adoption and removal, which suggests that individual takeover defenses are adopted and removed at different stage in a firm's life for different purposes. Since aggregate score takeover defense indices including G-index and e-index cannot capture this systematic differences in the nature of individual takeover defenses, we devise a c-index and find that it is hard-to-revise takeover defenses which have a commitment nature that causes a reversal in the relationship between takeover defenses and firm value over a firm's life cycle. Furthermore, we find that a firm's need for promoting important customer-supplier relationships and strategic alliances is greater at the IPO stage and takeover defenses enhance firm value at the IPO stage by satisfying the bonding needs of a firm. Also, we find that the agency cost of takeover defenses increase over a firm's life and agency cost of takeover defenses make takeover defenses value-destroying at a later stage of a firm's life. All the aforementioned findings support the life cycle hypothesis of takeover defenses. Our empirical investigation of the life cycle hypothesis of takeover defenses reconciles inconsistencies in the empirical results reported in the previous literature and sheds new light on some aspect of the corporate governance implications of

takeover defenses which have attracted less academic attention in the previous literature. Furthermore, our paper explains how it is possible that a value-maximizing firm may adopt takeover defenses while takeover defenses are value destroying.

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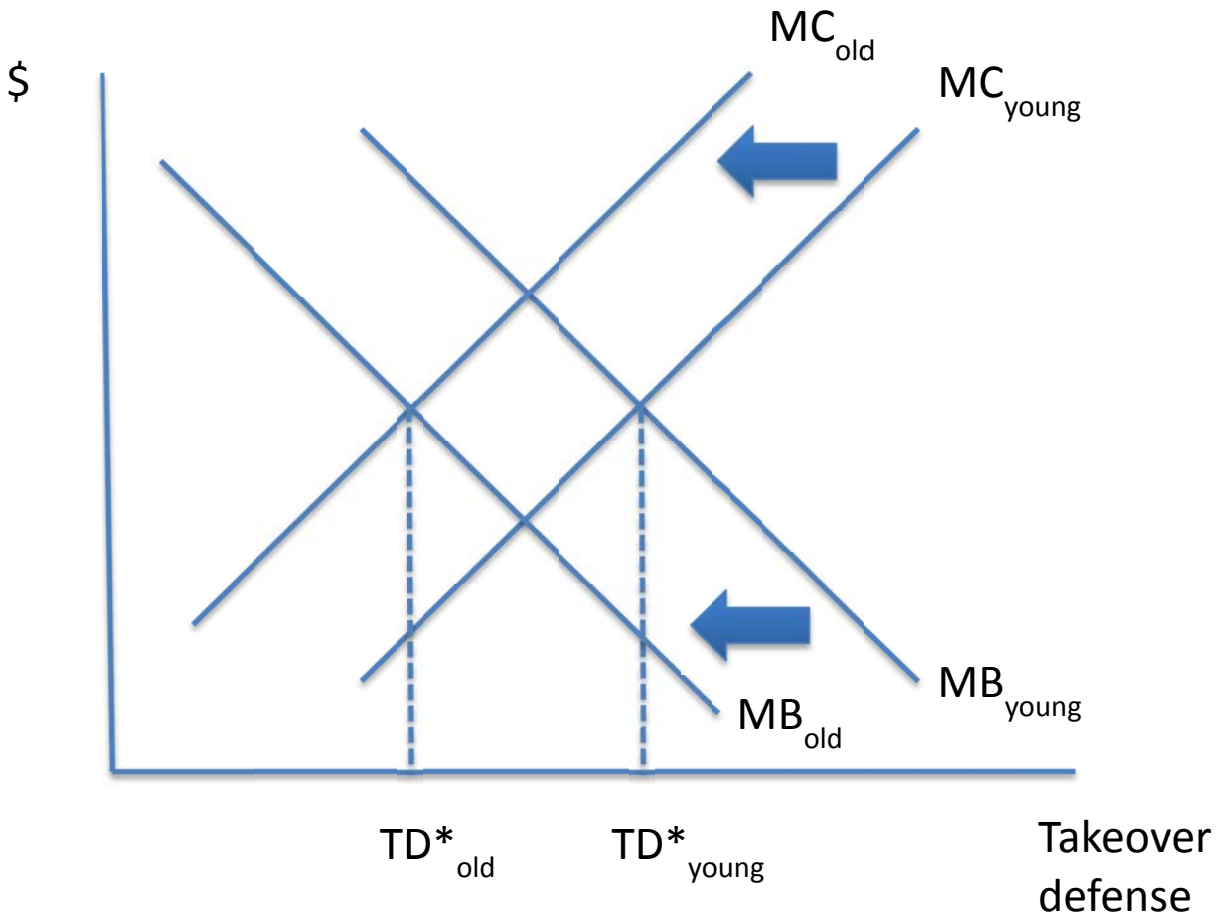

Figure 1. This figure shows the marginal cost and marginal benefits of the use of takeover defenses for a firms at two stages in its life-cycle.

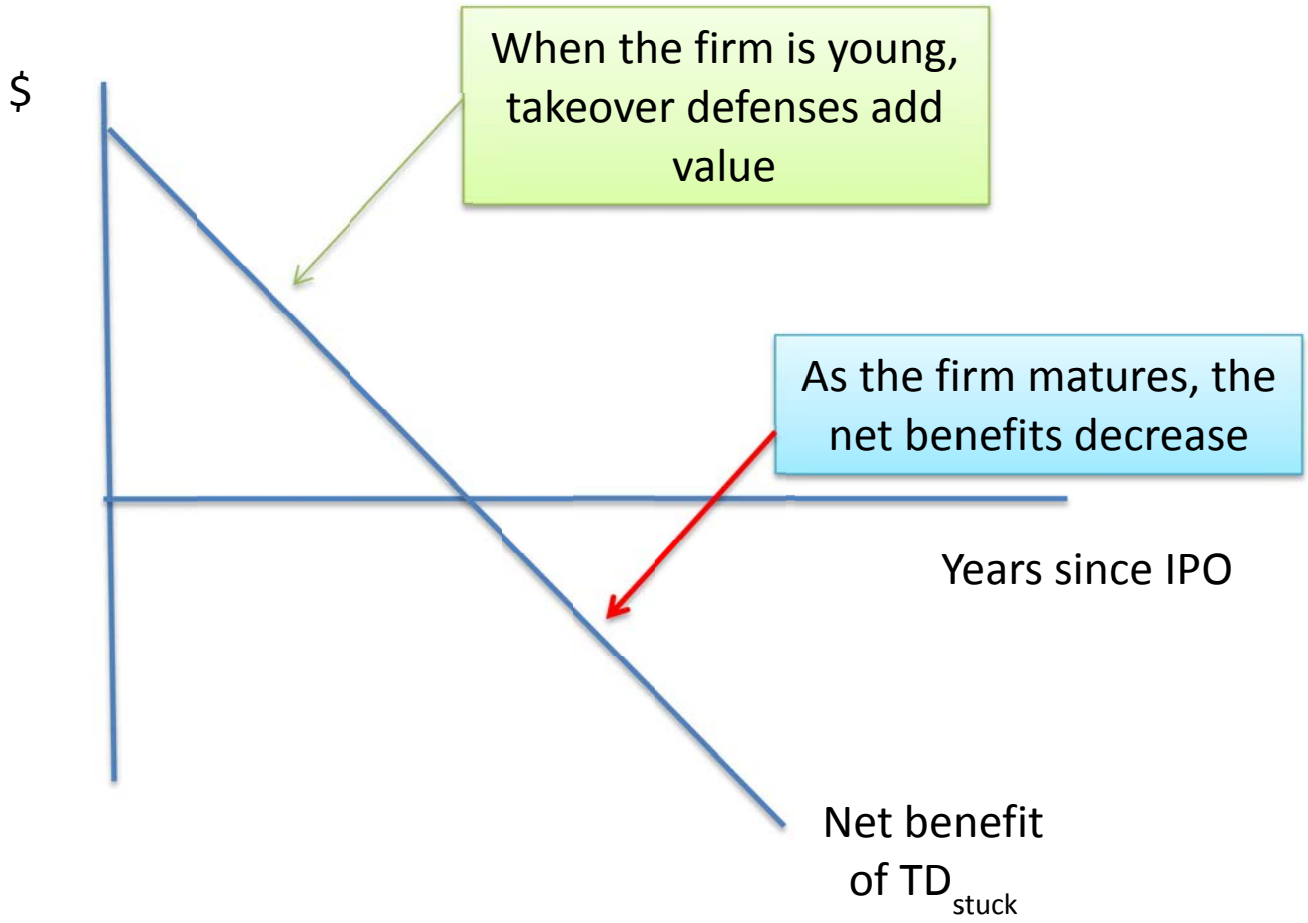

Figure 2. This figure illustrates the value reversal effect of a fixed level of takeover defense (labeled here as TD_{stuck}) as a firm matures. As the firm matures, the benefits of takeover defenses decrease and the costs increase. A level of defense that created value at early stages of the firm's life becomes more costly as the firm matures.

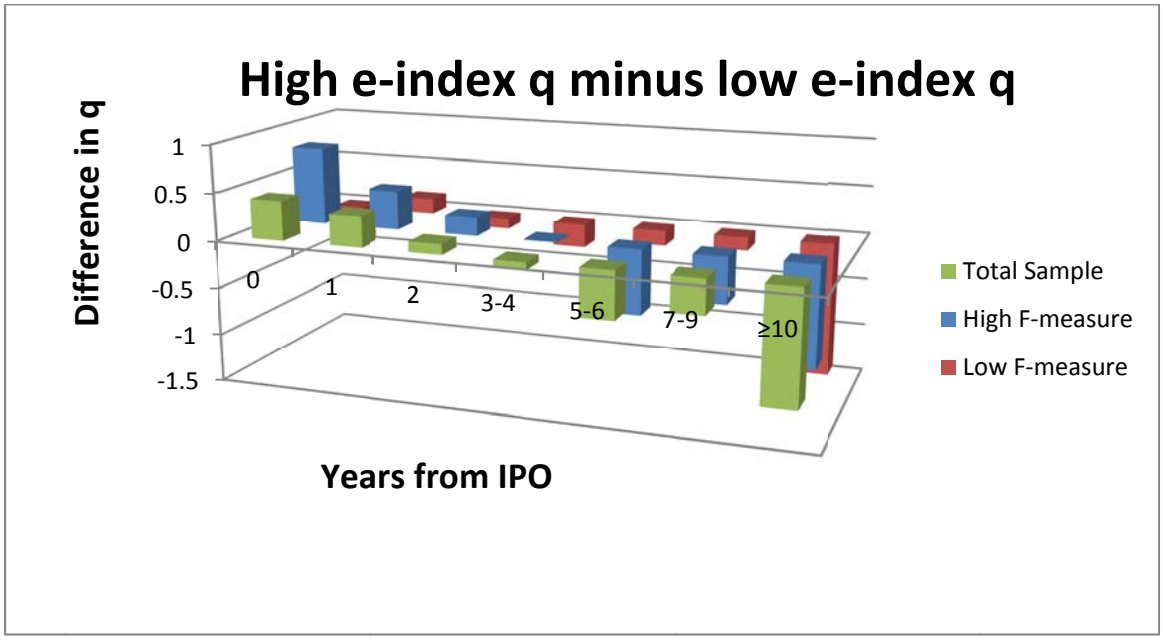

Figure 3. This figure shows relationship between the firm value measured by Tobin's Q and the number of takeover defenses as the firm goes from the IPO date to 15 years later. Standard error bars are also reported showing that the point estimates are only statistically different from zero in years 0, 1, and 6-15.

Table 1.

Sample of firms

Our sample consists of 2,285 IPO firms from 1997-2011. We eliminate all REITS, ADRs, funds, firms without CRSP and COMPUSTAT coverage, firms incorporated outside the United States, firms with a dual class share structure, and firms not in Jay Ritter's database of firms with a founding date. In addition, we eliminate all IPO firms that do not have prospectus filings, annual reports, and proxy statement filings available in the SEC's EDGAR database.

IPO Year	N
1997	384
1998	249
1999	410
2000	310
2001	64
2002	49
2003	59
2004	153
2005	129
2006	138
2007	153
2008	16
2009	36
2010	76
2011	59
Total	2,285

Table 2.

IPO firm summary statistics at the time for the IPO and in subsequent periods

Our sample consists of 2,285 IPO firms from 1997-2011. We eliminate all REITS, ADRs, funds, firms without CRSP and COMPUSTAT coverage, firms incorporated outside the United States, firms with a dual class share structure, and firms not in Jay Ritter's database of firms with a founding date. In addition, we eliminate all IPO firms that do not have prospectus filings, annual reports, and proxy statement filings available in the SEC's EDGAR database.

Variable	Mean At year = 0	Mean At year = 5	Mean At year = 10	Mean At year = 15
N	2,285	1,179	509	131
Total Assets ($ millions)	867.22	1,948.10	5,110.10	2,136.12
Market capitalization ($ millions)	824.92	914.19	1,573.19	2,737.23
Firm age	15.00	21.41	25.46	31.28
S&P 500 firm (indicator)	0.00	0.02	0.06	0.05
Delaware incorporation (indicator)	0.79	0.79	0.76	0.63
Insider holdings	0.42	0.21	0.16	0.14
Institutional shareholder holdings	0.08	0.41	0.50	0.50

Table 3.

Percent of IPO firms with takeover provisions by years from IPO

Our sample consists of 2,285 IPO firms from 1997-2011. We eliminate all REITS, ADRs, funds, firms without CRSP and COMPUSTAT coverage, firms incorporated outside the United States, firms with a dual class share structure, and firms not in Jay Ritter's database of firms with a founding date. In addition, we eliminate all IPO firms that do not have prospectus filings, annual reports, and proxy statement filings available in the SEC's EDGAR database.

Panel A. Individual takeover defenses and e-index for IPO firms from 1997-2011

Years from IPO	N	Classified board	Poison Pill	Supermajority to amend bylaw	Supermajority to amend charter	Supermajority to approve mergers	Golden Parachute	e-index
0	2,285	66.43%	5.34%	33.83%	30.07%	40.61%	64.46%	2.41
1	2,098	66.49%	9.10%	34.94%	31.27%	42.23%	65.63%	2.50
2	1,829	66.59%	12.52%	36.52%	32.64%	44.51%	67.91%	2.61
3	1,568	65.94%	15.94%	35.91%	32.02%	46.05%	70.34%	2.66
4	1,351	65.06%	18.50%	36.27%	32.20%	47.08%	71.72%	2.71
5	1,179	64.89%	21.20%	36.81%	32.74%	48.43%	73.79%	2.78
6	1,055	64.55%	22.94%	36.68%	32.04%	48.82%	74.50%	2.80
7	901	62.15%	24.08%	35.85%	31.30%	51.50%	79.25%	2.84
8	755	63.05%	26.49%	35.36%	30.99%	53.91%	84.50%	2.94
9	615	61.95%	26.83%	34.80%	29.59%	55.28%	89.59%	2.98
10	509	62.08%	27.50%	34.18%	28.88%	55.99%	98.23%	3.07
11	443	61.40%	25.73%	33.63%	28.89%	57.11%	97.97%	3.05
12	387	59.43%	23.51%	32.82%	27.65%	55.81%	98.19%	2.97
13	331	58.61%	23.56%	32.02%	26.89%	55.89%	97.58%	2.95
14	235	53.62%	18.30%	33.19%	30.21%	55.32%	97.02%	2.88
≥ 15	199	47.74%	16.08%	32.16%	31.16%	49.75%	96.98%	2.74
Total	15,740	64.42%	16.61%	35.26%	31.15%	47.34%	74.85%	2.70

Panel B. Individual takeover defenses and e-index for IPO firms from January 1997-March 2000

Years from IPO	N	Classified board	Poison Pill	Supermajority to amend bylaw	Supermajority to amend charter	Supermajority to approve mergers	Golden Parachute	e-index
0	1,140	62.28%	5.96%	28.07%	22.54%	33.16%	53.86%	2.05
1	1,021	62.29%	10.28%	29.19%	23.51%	34.28%	53.87%	2.13
2	866	62.36%	13.86%	31.52%	25.40%	36.95%	54.04%	2.24
3	751	62.85%	17.84%	32.36%	26.63%	39.28%	54.59%	2.33
4	659	62.22%	21.24%	32.78%	27.16%	40.52%	56.75%	2.40
5	580	62.24%	23.62%	33.79%	28.28%	42.07%	58.28%	2.48
6	525	63.43%	25.52%	34.48%	29.14%	43.24%	58.48%	2.54
7	477	61.22%	24.31%	33.75%	28.72%	43.82%	61.43%	2.53
8	435	60.46%	25.29%	34.48%	29.66%	49.89%	73.10%	2.72
9	387	58.14%	25.84%	33.59%	28.94%	52.20%	83.72%	2.82
10	355	58.87%	25.35%	33.80%	29.30%	56.62%	97.75%	3.01
11	325	57.23%	24.31%	33.23%	29.23%	56.92%	97.54%	2.98
12	299	55.52%	21.74%	33.11%	28.43%	56.19%	97.66%	2.92
13	272	55.15%	20.96%	32.35%	28.31%	55.51%	97.06%	2.89
14	231	53.25%	18.18%	32.90%	29.87%	54.98%	96.97%	2.86
≥ 15	199	50.38%	16.08%	32.06%	29.77%	51.15%	97.71%	2.77
Total	8,522	60.67%	17.94%	31.95%	26.79%	42.71%	66.10%	2.46

Panel C. Individual takeover defenses and e-index for IPO firms from April 2000 – December 2011

Years from IPO	N	Classified board	Poison Pill	Supermajority to amend bylaw	Supermajority to amend charter	Supermajority to approve mergers	Golden Parachute	e-index

0	1,145	68.30%	4.72%	39.56%	37.55%	48.03%	74.93%	2.73
1	1,077	68.43%	7.99%	40.39%	38.63%	49.77%	76.69%	2.82
2	963	68.33%	11.32%	41.02%	39.15%	51.30%	80.27%	2.91
3	817	66.10%	14.20%	39.17%	36.96%	52.26%	84.70%	2.93
4	692	65.03%	15.90%	39.60%	36.99%	53.32%	85.98%	2.97
5	599	64.94%	18.86%	39.73%	37.06%	54.59%	88.65%	3.04
6	530	63.21%	20.38%	38.87%	34.91%	54.34%	90.38%	3.02
7	424	60.61%	23.82%	38.21%	34.20%	60.14%	99.29%	3.16
8	320	63.75%	28.13%	36.56%	32.81%	59.38%	99.69%	3.20
9	228	65.35%	28.51%	36.84%	30.70%	60.53%	99.56%	3.21
10	154	64.94%	32.47%	35.06%	27.92%	54.55%	99.35%	3.14
11	118	66.95%	29.66%	34.75%	27.97%	57.63%	99.15%	3.16
12	88	65.91%	29.55%	31.82%	25.00%	54.55%	100.00%	3.07
≥ 13	63	71.19%	34.92%	30.51%	20.34%	57.63%	100.00%	3.15
Total	7,218	66.25%	15.03%	39.19%	36.30%	52.80%	85.09%	2.95

Table 4.

Number of IPO firms adopting and removing takeover defenses by years from IPO

Our sample consists of 2,285 IPO firms from 1997-2011. We eliminate all REITS, ADRs, funds, firms without CRSP and COMPUSTAT coverage, firms incorporated outside the United States, firms with a dual class share structure, and firms not in Jay Ritter's database of firms with a founding date. In addition, we eliminate all IPO firms that do not have prospectus filings, annual reports, and proxy statement filings available in the SEC's EDGAR database.

Panel A. IPO firms adopting new takeover defenses

Years from IPO	N	Classified board	Poison Pill	Supermajority to amend bylaw	Supermajority to amend charter	Supermajority to approve mergers	Golden Parachute	e-index
0	2,285	2	20	0	0	0	0	22
1	2,098	3	81	0	0	11	39	134
2	1,829	1	66	1	1	14	35	118
3	1,568	1	44	0	0	20	47	112
4	1,351	1	35	0	0	9	21	66
5	1,179	1	28	0	0	5	17	51
6	1,055	0	15	0	0	11	16	42
7	901	0	4	0	0	34	59	97
8	755	0	12	1	1	31	55	100
9	615	0	6	0	0	13	38	57
10	509	0	6	1	0	21	52	80
11	443	0	5	0	0	0	0	5
12	387	0	5	0	0	0	0	5
13	331	0	3	0	0	1	0	4
14	235	0	1	0	0	0	0	1
≥ 15	199	0	3	0	0	0	0	3
Total	15,740	9	334	3	2	170	380	898

Panel B. IPO firms removing takeover defenses

Years from IPO	N	Classified board	Poison Pill	Supermajority to amend bylaw	Supermajority to amend charter	Supermajority to approve mergers	Golden Parachute	e-index
0	2,285	0	0	0	0	0	0	0
1	2,098	5	0	2	2	12	0	21
2	1,829	0	1	1	2	1	4	9
3	1,568	6	0	3	4	4	3	20
4	1,351	9	2	0	0	3	1	15
5	1,179	4	0	2	2	3	2	13
6	1,055	10	0	3	3	4	1	21
7	901	8	1	2	0	4	2	17
8	755	8	5	4	3	7	0	27
9	615	9	2	4	2	4	2	23
10	509	12	11	3	1	8	1	36
11	443	9	14	4	4	2	0	33
12	387	8	17	2	1	3	1	32
13	331	9	10	1	1	0	1	22
14	235	7	8	1	1	0	0	17
≥ 15	199	3	4	2	1	2	1	13
Total	15,740	107	75	34	27	57	19	319

Table 5.

Number of IPO firms removing takeover defenses by F-measure of takeover defenses

Our sample consists of 2,285 IPO firms from 1997-2011. We eliminate all REITS, ADRs, funds, firms without CRSP and COMPUSTAT coverage, firms incorporated outside the United States, firms with a dual class share structure, and firms not in Jay Ritter's database of firms with a founding date. In addition, we eliminate all IPO firms that do not have prospectus filings, annual reports, and proxy statement filings available in the SEC's EDGAR database. Panel B contains the mean and median likelihood of reducing the e-index of the firms which is calculated as follows:

$$\text{F-measure} = 1 - [\text{Prob}_{\text{Classified}} \times I_{\text{Classified}} + \text{Prob}_{\text{Pill}} \times I_{\text{Pill}} + \text{Prob}_{\text{Supermajor - bylaw}} \times I_{\text{Supermajor - bylaw}} +$$
$$\text{Prob}_{\text{Supermajor - charter}} \times I_{\text{charter}} + \text{Prob}_{\text{Supermajor - merger}} \times I_{\text{Supermajor - merge}} +$$
$$\text{Prob}_{\text{Golden parachute}} \times I_{\text{Golden parachute}}]$$

where Prob_{n} is the number of observations removing the takeover defense n divided by the total number of firm-year observations with this takeover defense and I_{n} is an indicator variable taking a value of one if the firm has takeover defense n. Panel C reports the likelihood of a firm removing a takeover defense during its lifetime if the firm has above (below) the median F-measure at its IPO stage.

Panel A. IPO firms removing takeover defenses

	Classified board	Poison Pill	Supermajority to amend bylaw	Supermajority to amend charter	Supermajority to approve mergers	Golden Parachute
Observations removed	107	75	34	27	57	19
Total firm-year observations with defense	10,140	2,614	5,550	4,903	7,451	11,775
Probability of removing defense	1.06%	2.87%	0.61%	0.55%	0.76%	0.16%

Panel B. IPO firm likelihood of removing takeover defenses by e-index at the time of the IPO

e-index level	N	Mean F-measure Likelihood of not removing defenses	Median F-measure Likelihood of not removing defenses
0	188	100.00%	100.00%
1	621	99.41%	99.84%
2	567	98.57%	98.78%
3	268	97.58%	97.89%
4	294	97.02%	97.19%
5	317	96.38%	96.55%
6	30	93.26%	93.26%
Total Sample	2,285	98.23%	98.78%

Panel C. IPO firms reducing takeover defenses by e-index

	N	Firms with high F-measure (High defense stagnation) Percent reducing defenses	Firms with low F-measure (low defense stagnation) Percent reducing defenses	t-stat
Percent of firms removing defenses	2,285	6.18%	8.55%	2.03**

Table 6.

IPO firm Tobin's Q and industry adjusted Tobin's Q by years from IPO

Our sample consists of 2,285 IPO firms from 1997-2011. We eliminate all REITS, ADRs, funds, firms without CRSP and COMPUSTAT coverage, firms incorporated outside the United States, firms with a dual class share structure, and firms not in Jay Ritter's database of firms with a founding date. In addition, we eliminate all IPO firms that do not have prospectus filings, annual reports, and proxy statement filings available in the SEC's EDGAR database. We report the mean and median industry adjusted Tobin's Q for the years after the IPO. Tobin's Q is winsorized at the 99th percentile.

Years from IPO	N	IPO firm Q mean	IPO firm Q median	Industry adjusted Q mean	Industry adjusted Q median
0	2,285	4.17	2.48	2.25	0.58
1	2,098	2.50	1.68	0.73	0.02
2	1,829	2.28	1.49	0.57	-0.02
3	1,568	2.29	1.52	0.59	-0.01
4	1,351	2.34	1.60	0.62	0.00
5	1,179	2.48	1.62	0.73	0.00
6	1,055	2.50	1.72	0.64	0.01
7	901	2.31	1.65	0.49	0.02
8	755	2.25	1.55	0.55	-0.01
9	615	2.28	1.52	0.58	-0.01
10	509	2.39	1.53	0.77	0.00
11	443	2.29	1.36	0.71	-0.02
12	387	2.74	1.43	1.05	-0.01
13	331	2.30	1.47	0.46	-0.03
14	235	3.08	1.45	1.35	-0.01
≥15	199	2.39	1.59	0.52	0.01
Total	15,740	2.65	1.67	0.88	0.03

Table 7.

IPO firm industry adjusted Tobin's Q by years from IPO and takeover defenses

Our sample consists of 2,285 IPO firms from 1997-2011. We eliminate all REITS, ADRs, funds, firms without CRSP and COMPUSTAT coverage, firms incorporated outside the United States, firms with a dual class share structure, and firms not in Jay Ritter's database of firms with a founding date. In addition, we eliminate all IPO firms that do not have prospectus filings, annual reports, and proxy statement filings available in the SEC's EDGAR database. Tobin's Q is winsorized at the 99th percentile. F-measure is the likelihood the firm will not remove a takeover defense in the next year as calculated in equation 1.

Panel A. Industry adjusted Tobin's Q by e-index and years from IPO						
Years from IPO	N	Industry adjusted Q Below median e-index Firms	Industry adjusted Q Above median e-index Firms	Difference	t-stat	Mann-Whitney test (z-stat)
0	2,285	2.08	2.52	0.44	2.04**	1.97**
1	2,098	0.59	0.92	0.33	3.23***	3.06***
2	1,829	0.52	0.63	0.11	1.04	1.68*
3-4	2,919	0.63	0.58	-0.05	-0.61	0.35
5-6	2,234	0.90	0.48	-0.42	-3.67***	-2.86***
7-9	2,271	0.70	0.40	-0.30	-3.42***	-3.14***
≥10	2,104	1.41	0.35	-1.06	-5.66***	-4.44***
Total	15,740	0.99	0.77	-0.22	-4.25***	-2.49**
Panel B. Industry adjusted Tobin's Q by e-index and years from IPO, high f-measure firms						
Years from IPO	N	Industry adjusted Q Below median e-index Firms	Industry adjusted Q Above median e-index Firms	Difference	t-stat	Mann-Whitney test (z-stat)
0	1,618	1.83	2.56	0.73	2.91**	2.69***
1	1,477	0.57	0.92	0.41	2.91**	3.24***
2	1,298	0.53	0.64	0.21	1.00	1.59
3-4	2,052	0.66	0.61	-0.05	-0.38	0.15
5-6	1,566	1.01	0.47	-0.54	-3.64***	-2.94***
7-9	1,539	0.77	0.33	-0.44	-3.87***	-3.53***
≥10	1,427	1.20	0.17	-1.08	-4.74***	-3.65***
Total	10,977	0.95	0.78	-0.17	-2.74***	-1.72*
Panel C. Industry adjusted Tobin's Q by e-index and years from IPO, low f-measure firms						
Years from IPO	N	Industry adjusted Q Below median e-index Firms	Industry adjusted Q Above median e-index Firms	Difference	t-stat	Mann-Whitney test (z-stat)
0	667	2.69	2.41	-0.28	-0.68	-0.48
1	621	0.64	0.93	0.29	1.48	0.72
2	531	0.50	0.60	0.10	0.52	0.89
3-4	867	0.54	0.49	-0.05	-0.38	0.54
5-6	668	0.59	0.51	-0.08	-0.48	-0.62
7-9	732	0.46	0.50	0.04	0.28	-0.93
≥10	677	2.37	0.58	-1.89	-4.35***	-2.51**
Total	4,763	1.14	0.70	-0.44	-3.72***	-2.01**

Panel D. Industry adjusted Tobin's Q by classified board and years from IPO

Years from IPO	N	Industry adjusted Q No Classified Board Firms	Industry adjusted Q Classified Board Firms	Difference	t-stat	Mann-Whitney test (z-stat)
0	2,285	1.83	2.47	0.64	2.89***	1.83**
1	2,098	0.74	0.73	-0.01	-0.08	-0.22
2	1,829	0.68	0.51	-0.17	-1.61*	-0.97
3-4	2,919	0.61	0.60	-0.01	-0.14	1.07
5-6	2,234	0.95	0.55	-0.40	-3.41***	-1.50
7-9	2,271	0.66	0.46	-0.20	-2.16**	-1.14
≥10	2,104	1.36	0.40	-0.96	-5.07***	-0.60
Total	15,740	0.97	0.84	-0.14	-2.60***	0.17

Panel E. Industry adjusted Tobin's Q by classified board and years from IPO, high f-measure firms

Years from IPO	N	Industry adjusted Q No Classified Board Firms	Industry adjusted Q Classified Board Firms	Difference	t-stat	Mann-Whitney test (z-stat)
0	1,618	1.82	2.34	0.51	2.06**	0.81
1	1,477	0.74	0.70	-0.04	-0.33	0.31
2	1,298	0.66	0.52	-0.14	-1.22	-0.66
3-4	2,052	0.63	0.65	0.02	0.16	0.66
5-6	1,566	0.98	0.57	-0.41	-2.76***	-1.93*
7-9	1,539	0.70	0.42	-0.28	-2.52**	-2.08**
≥10	1,427	1.14	0.26	-0.88	-4.06***	-1.47
Total	10,977	0.95	0.81	-0.14	-2.27*	-1.19

Panel F. Industry adjusted Tobin's Q by classified board and years from IPO, low f-measure firms

Years from IPO	N	Industry adjusted Q No Classified Board Firms	Industry adjusted Q Classified Board Firms	Difference	t-stat	Mann-Whitney test (z-stat)
0	667	1.91	2.69	0.79	1.40	0.64
1	621	0.71	0.77	0.06	0.23	0.13
2	531	0.82	0.50	-0.32	-1.14	0.26
3-4	867	0.47	0.52	0.05	0.32	1.62*
5-6	668	0.74	0.50	-0.24	-1.14	0.78
7-9	732	0.38	0.52	0.13	0.77	0.83
≥10	677	2.42	0.60	-1.82	-4.32***	0.20
Total	4,763	1.11	0.87	-0.24	-1.92**	1.41

Table 8.

Multivariate regressions of industry adjusted Q on takeover defenses by years from IPO

Our sample consists of 2,285 IPO firms from 1997-2011. We eliminate all REITS, ADRs, funds, firms without CRSP and COMPUSTAT coverage, firms incorporated outside the United States, firms with a dual class share structure, and firms not in Jay Ritter's database of firms with a founding date. In addition, we eliminate all IPO firms that do not have prospectus filings, annual reports, and proxy statement filings available in the SEC's EDGAR database. The dependent variable is industry median adjusted IPO firm Tobin's Q, winsorized at the 99th percentile. Standard errors are reported below the regression coefficients.

Panel A. Regressions of industry adjusted Tobin's Q in all years after IPO

	(1)	(2)	(3)
Delaware (indicator)	0.457***	0.430***	0.428***
	(0.061)	(0.061)	(0.061)
Firm age (years)	-0.002*	-0.002	-0.002
	(0.001)	(0.001)	(0.001)
Log(assets)	-0.468***	-0.474***	-0.474***
	(0.016)	(0.016)	(0.016)
S&P 500 firm (indicator)	2.008***	2.062***	2.127***
	(0.178)	(0.178)	(0.178)
Insider ownership	1.008***	0.876***	0.854***
	(0.127)	(0.129)	(0.129)
Missing insider ownership (indicator)	0.706***	0.769***	0.747***
	(0.109)	(0.109)	(0.109)
Institutional ownership	0.473***	0.559***	0.556***
	(0.081)	(0.083)	(0.083)
e-index	-0.022	-0.018	0.076***
	(0.016)	(0.016)	(0.020)
Time from IPO >4 (indicator)		-0.268***	0.385***
		(0.054)	(0.101)
e-index x Time from IPO>4			-0.239***
			(0.031)
Constant	2.574***	2.717***	2.489***
	(0.106)	(0.110)	(0.114)
N	15,740	15,740	15,740
Adj R^2	7.716	7.84	8.19

Panel B. Regressions of industry adjusted Tobin's Q by years from IPO

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Year = 0	Year = 1	Year=2	Year=3, 4	Year = 5-6	Year = 7-9	Year≥10
Delaware (indicator)	0.817***	0.161	0.306**	0.141	0.193	0.269***	0.160
	(0.257)	(0.130)	(0.122)	(0.094)	(0.132)	(0.101)	(0.195)
Firm age (years)	-0.023***	-0.004	-0.002	-0.001	0.003	0.001	0.016***
	(0.005)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)
Log(assets)	-0.245***	-0.154***	-0.267***	-0.403***	-0.682***	-0.436***	-1.064***
	(0.080)	(0.038)	(0.033)	(0.024)	(0.033)	(0.026)	(0.050)
S&P 500 firm (indicator)	7.117	0.346	1.449***	1.648***	2.447***	1.737***	3.765***
	(4.861)	(0.849)	(0.551)	(0.310)	(0.366)	(0.224)	(0.379)
Insider ownership	2.473***	0.505**	-0.150	-0.389**	-0.679**	-0.033	-0.576
	(0.455)	(0.250)	(0.247)	(0.197)	(0.309)	(0.259)	(0.578)
Missing insider ownership		0.006	0.468*	0.342*	0.831***	0.712***	0.227
(indicator)		(0.339)	(0.284)	(0.188)	(0.209)	(0.146)	(0.266)
Institutional ownership	-2.383***	0.861***	1.180***	1.013***	1.131***	0.808***	1.686***
	(0.651)	(0.204)	(0.165)	(0.121)	(0.166)	(0.126)	(0.283)
e-index	0.162***	0.075**	0.012	0.004	-0.071**	-0.106***	-0.370***
	(0.066)	(0.032)	(0.030)	(0.023)	(0.033)	(0.027)	(0.059)
Constant	1.933***	0.857***	1.341***	2.269***	3.815***	2.482***	6.267***
	(0.471)	(0.233)	(0.210)	(0.158)	(0.222)	(0.179)	(0.375)
N	2,285	2,098	1,829	2,919	2,234	2,271	2,104
Adj R^2	5.03	1.81	5.24	10.21	19.12	15.47	22.34

Panel C. Regressions of industry adjusted Tobin's Q in all years after IPO by f-measure

	(1)	(2)
	High f-measure	Low f-measure

e-index	0.109***		-0.049
	(0.022)		(0.046)
Time from IPO >4 (indicator)	0.546***		-0.185
	(0.116)		(0.212)
e-index x Time from IPO>4	-0.279***		-0.047
	(0.034)		(0.071)
Controls	Yes		Yes
N	10,461		5,279
Adj R^2	9.26		6.25

Panel D. Regressions of industry adjusted Tobin's Q by years from IPO, high f-measure only

	(1) Year = 0	(2) Year = 1	(3) Year=2	(4) Year=3, 4	(5) Year = 5-6	(6) Year = 7-9	(7) Year≥10
e-index	0.245***	0.082**	0.032	0.021	-0.076*	-0.107***	-0.380***
	(0.071)	(0.035)	(0.032)	(0.027)	(0.041)	(0.031)	(0.062)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,574	1,419	1,235	1,916	1,422	1,456	1,439
Adj R^2	5.20	1.93	5.62	12.58	23.89	19.03	22.40

Panel E. Regressions of industry adjusted Tobin's Q by years from IPO, low f-measure only

	(1) Year = 0	(2) Year = 1	(3) Year=2	(4) Year=3, 4	(5) Year = 5-6	(6) Year = 7-9	(7) Year≥10
e-index	-0.147	0.094	-0.054	-0.060	-0.021	-0.057	-0.236
	(0.162)	(0.078)	(0.073)	(0.048)	(0.055)	(0.056)	(0.159)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	711	679	594	1,003	812	815	665
Adj R^2	4.75	2.22	4.09	5.92	6.21	7.72	22.17

Panel F. Regressions of industry adjusted Tobin's Q in all years after IPO

	(1)	(2)	(3)
Delaware (indicator)	0.444***	0.420***	0.413***
	(0.060)	(0.060)	(0.060)
Firm age (years)	-0.002*	-0.002	-0.001
	(0.001)	(0.001)	(0.001)
Log(assets)	-0.469***	-0.475***	-0.475***
	(0.016)	(0.016)	(0.016)
S&P 500 firm (indicator)	1.993***	2.049***	2.032***
	(0.178)	(0.178)	(0.178)
Insider ownership	1.019***	0.879***	0.856***
	(0.127)	(0.129)	(0.129)
Missing insider ownership (indicator)	0.704***	0.766***	0.728***
	(0.109)	(0.109)	(0.109)
Institutional ownership	0.467***	0.556***	0.548***
	(0.081)	(0.083)	(0.083)
Classified board (indicator)	-0.029	-0.040	0.242***
	(0.051)	(0.051)	(0.067)
Time from IPO > 4 (indicator)		-0.274***	0.137*
		(0.054)	(0.084)
Classified board x Time from IPO > 4			-0.655***
			(0.102)
Constant	2.551***	2.710***	2.542***
	(0.106)	(0.111)	(0.113)
N	15,740	15,740	15,740
Adj R^2	7.70	7.84	8.08

Panel G. Regressions of industry adjusted Tobin's Q by years from IPO

	(1) Year = 0	(2) Year = 1	(3) Year=2	(4) Year=3, 4	(5) Year = 5-6	(6) Year = 7-9	(7) Year≥10
Delaware (indicator)	0.874***	0.216*	0.332***	0.146	0.163	0.199**	0.009
	(0.254)	(0.128)	(0.120)	(0.092)	(0.130)	(0.100)	(0.195)
Firm age (years)	-0.022***	-0.004*	-0.003	-0.001	0.003	0.001	0.016***
	(0.005)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)
Log(assets)	-0.244***	-0.145***	-0.261***	-0.402***	-0.684***	-0.445***	-1.063***
	(0.080)	(0.038)	(0.033)	(0.024)	(0.032)	(0.026)	(0.050)
S&P 500 firm (indicator)	6.979	0.459	1.470***	1.650***	2.370***	1.667***	3.577***
	(4.859)	(0.849)	(0.549)	(0.309)	(0.365)	(0.225)	(0.381)
Insider ownership	2.452***	0.499**	-0.182	-0.395**	-0.719**	0.027	-0.344
	(0.454)	(0.251)	(0.248)	(0.198)	(0.309)	(0.260)	(0.580)
Missing insider ownership		-0.009	0.450	0.342*	0.811***	0.715***	0.277
(indicator)		(0.339)	(0.284)	(0.188)	(0.209)	(0.148)	(0.267)
Institutional ownership	-2.373***	0.899***	1.193***	1.015***	1.121***	0.800***	1.689***
	(0.650)	(0.203)	(0.165)	(0.121)	(0.165)	(0.126)	(0.285)

Classified board (indicator)	0.635***	0.021	-0.171*	-0.021	-0.307***	-0.139*	-0.683***
	(0.216)	(0.108)	(0.102)	(0.077)	(0.108)	(0.084)	(0.171)
Constant	1.852***	0.937***	1.447***	2.287***	3.867***	2.353***	5.651***
	(0.474)	(0.235)	(0.212)	(0.159)	(0.223)	(0.179)	(0.354)
N	2,285	2,098	1,829	2,919	2,234	2,271	2,104
Adj R^2	5.14	1.56	5.38	10.21	19.24	14.99	21.50

Panel H. Regressions of industry adjusted Tobin's Q in all years after IPO by f-measure

	(1) High f-measure	(2) Low f-measure
Classified board	0.243***	0.217
	(0.079)	(0.135)
Time from IPO >4 (indicator)	0.171*	-0.052
	(0.101)	(0.162)
Classified board x Time from IPO>4	-0.647***	-0.407**
	(0.123)	(0.190)
Controls	Yes	Yes
N	10,461	5,279
Adj R^2	8.93	6.26

Panel I. Regressions of industry adjusted Tobin's Q by years from IPO, high f-measure only

	(1) Year = 0	(2) Year = 1	(3) Year=2	(4) Year=3, 4	(5) Year = 5-6	(6) Year = 7-9	(7) Year≥10
Classified board	0.603**	0.072	-0.155	-0.012	-0.279*	-0.173	-0.795***
	(0.249)	(0.125)	(0.116)	(0.095)	(0.147)	(0.110)	(0.201)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,574	1,419	1,235	1,916	1,422	1,456)	1,439
Adj R^2	4.84	1.58	5.69	12.56	23.90	18.51	21.22

Panel J. Regressions of industry adjusted Tobin's Q by years from IPO, low f-measure only

	(1) Year = 0	(2) Year = 1	(3) Year=2	(4) Year=3, 4	(5) Year = 5-6	(6) Year = 7-9	(7) Year≥10
Classified board	0.357	-0.155	-0.286	0.051	-0.085	0.140	-0.317
	(0.477)	(0.233)	(0.222)	(0.135)	(0.152)	(0.134)	(0.354)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	711	679	594	1,003	812	815	665
Adj R^2	4.72	2.08	4.27	5.78	6.23	7.72	22.00

Table 9.

Multivariate regressions of industry adjusted Q on takeover defenses controlling for endogeneity

Our sample consists of 2,285 IPO firms from 1997-2011. We eliminate all REITS, ADRs, funds, firms without CRSP and COMPUSTAT coverage, firms incorporated outside the United States, firms with a dual class share structure, and firms not in Jay Ritter's database of firms with a founding date. In addition, we eliminate all IPO firms that do not have prospectus filings, annual reports, and proxy statement filings available in the SEC's EDGAR database. The dependent variable is industry median adjusted IPO firm Tobin's Q, winsorized at the 99th percentile. Standard errors are reported below the regression coefficients. Panel A and Panel B report 2SLS regression results utilizing law firm indicator variables plus a California indicator variable as instruments for takeover defense adoption. Panel C and Panel D utilize the IPO-stage e-index for all observations of firm e-index throughout the life of the firm. Panel E and Panel F use a modified d-index from Karpoff, Schonlau, and Wehrly (2015) where

$$\text{d-index} = [I_{\text{Classified}} + I_{\text{Supermajor - merge}} - I_{\text{Golden parachute}}]$$

Panel A. 2SLS regressions of industry adjusted Tobin's Q on instrumented e-index

	Second Stage Regression (1)	Second Stage Regression (2)	Second Stage Regression (3)
Instrumented e-index	0.067	0.075*	0.261***
	(0.042)	(0.041)	(0.072)
Time from IPO > 4 (indicator)		-0.287***	0.960**
		(0.055)	(0.399)
Instrumented e-index x Time from IPO > 4			-0.456***
			(0.144)
Control variables	Yes	Yes	Yes
N	15,740	15,740	15,740
R^2	7.52	7.64	7.66

Panel B. 2SLS regressions of industry adjusted Tobin's Q on instrumented e-index

	(1) Year = 0	(2) Year = 1	(3) Year=2	(4) Year=3, 4	(5) Year = 5-6	(6) Year = 7-9	(7) Year≥10
Instrumented e-index	0.294*	0.114	0.000	0.033	-0.027	-0.110*	-0.120
	(0.169)	(0.081)	(0.075)	(0.058)	(0.082)	(0.026)	(0.109)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	2,285	2,098	1,829	2,919	2,234	2,271	2,104
Adj R^2	4.86	1.74	5.23	10.16	19.05	15.47	21.68

Panel C. OLS regressions of industry adjusted Tobin's Q on IPO-stage e-index

	Second Stage Regression (1)	Second Stage Regression (2)	Second Stage Regression (3)
IPO stage e-index	-0.004	-0.007*	0.096***
	(0.016)	(0.016)	(0.020)
Time from IPO > 4 (indicator)		-0.273***	0.334***
		(0.054)	(0.092)
IPO stage e-index x Time from IPO > 4			-0.250***
			(0.031)
Control variables	Yes	Yes	Yes
N	15,740	15,740	15,740
Adj R^2	7.70	7.84	8.22

Panel D. OLS regressions of industry adjusted Tobin's Q on IPO-stage e-index

	(1) Year = 0	(2) Year = 1	(3) Year=2	(4) Year=3, 4	(5) Year = 5-6	(6) Year = 7-9	(7) Year≥10
IPO stage e-index	0.126**	0.085***	0.016	0.016	-0.073**	-0.095***	-0.277***
	(0.066)	(0.032)	(0.030)	(0.023)	(0.033)	(0.026)	(0.055)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	2,285	2,098	1,829	2,919	2,234	2,271	2,104
Adj R^2	5.03	1.87	5.24	10.23	19.13	15.39	21.84

Panel E. OLS regressions of industry adjusted Tobin's Q on d-index

	(1)	(2)	(3)
d-index	-0.027	-0.034	0.131***
	(0.029)	(0.029)	(0.037)
Time from IPO > 4 (indicator)		-0.275***	-0.129**
		(0.054)	(0.058)
IPO stage e-index x Time from IPO > 4			-0.422***
			(0.058)
Control variables	Yes	Yes	Yes
N	15,740	15,740	15,740
Adj R^2	7.70	7.85	8.14

Panel F. OLS regressions of industry adjusted Tobin's Q on d-index

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Year = 0	Year = 1	Year=2	Year=3, 4	Year = 5-6	Year = 7-9	Year≥10
d-index	0.341**	0.080	0.008	-0.014	-0.211**	-0.102***	-0.559***
	(0.118)	(0.059)	(0.056)	(0.042)	(0.061)	(0.050)	(0.113)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	2,285	2,098	1,829	2,919	2,234	2,271	2,104
Adj R^2	5.12	1.64	5.23	10.21	19.38	15.05	21.81

Table 10.

IPO firms and takeover defense cost shifting by years from IPO

Our sample consists of 2,285 IPO firms from 1997-2011. We eliminate all REITS, ADRs, funds, firms without CRSP and COMPUSTAT coverage, firms incorporated outside the United States, firms with a dual class share structure, and firms not in Jay Ritter's database of firms with a founding date. In addition, we eliminate all IPO firms that do not have prospectus filings, annual reports, and proxy statement filings available in the SEC's EDGAR database.

Characteristics which shift the costs and benefits of takeover defenses over time						
Years from IPO	N	Founder CEO	Large customers	Joint venture announcements	Insider ownership	Institutional ownership
0	2,285	26.70%	44.81%	18.73%	41.74%	8.22%
1	2,098	25.79%	42.76%	22.07%	33.79%	27.31%
2	1,829	23.84%	43.08%	16.46%	28.11%	31.83%
3	1,568	20.85%	43.56%	15.50%	24.90%	34.24%
4	1,351	19.10%	42.34%	15.40%	22.54%	37.16%
5	1,179	17.64%	37.83%	16.88%	20.22%	40.68%
6	1,055	15.73%	36.49%	15.73%	18.42%	43.97%
7	901	14.76%	35.74%	16.09%	16.87%	46.46%
8	755	14.70%	36.29%	14.97%	16.24%	48.87%
9	615	13.50%	31.54%	14.15%	15.18%	49.88%
10	509	11.98%	23.18%	12.38%	14.40%	50.28%
11	443	12.42%	16.48%	10.38%	14.70%	49.41%
12	387	12.66%	2.84%	8.79%	12.85%	49.57%
13	331	13.60%	2.42%	12.39%	11.86%	52.20%
14	235	12.77%	2.13%	10.21%	11.30%	52.78%
≥ 15	199	12.06%	0.00%	9.55%	12.04%	55.23%
Total	15,740	19.93%	36.85%	16.39%	25.10%	34.90%

Table 11.

Multivariate regressions of industry adjusted Q on takeover defenses by value increasing characteristics

Our sample consists of 2,285 IPO firms from 1997-2011. We eliminate all REITS, ADRs, funds, firms without CRSP and COMPUSTAT coverage, firms incorporated outside the United States, firms with a dual class share structure, and firms not in Jay Ritter's database of firms with a founding date. In addition, we eliminate all IPO firms that do not have prospectus filings, annual reports, and proxy statement filings available in the SEC's EDGAR database. The dependent variable is industry median adjusted IPO firm Tobin's Q, winsorized at the 99th percentile. Standard errors are reported below the regression coefficients.

Regressions of industry adjusted Tobin's Q in all years after IPO by value increasing characteristics				
	(1)	(2)	(3)	(4)
e-index	-0.039	-0.068***	-0.040**	-0.061***
	(0.017)	(0.020)	(0.017)	(0.021)
Founder CEO	-0.195*			
	(0.118)			
e-index x Founder CEO	0.105***			
	(0.038)			
Large customer		-0.453***		
		(0.097)		
e-index x Large customer		0.120***		
		(0.031)		
Joint venture announced			0.775***	
			(0.131)	
e-index x Joint venture announced			0.085**	
			(0.040)	
Above median insider holdings				-0.538***
				(0.121)
e-index x Above median insider holdings				0.087***
				(0.031)
Controls	Yes	Yes	Yes	Yes
N	15,740	15,740	15,740	15,740
Adj R^2	7.75	7.82	9.08	7.81