Do takeover defenses deter takeovers?*

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Abstract: The G-index and E-index are used extensively in finance research to measure firms' takeover defenses. Yet almost no empirical evidence exists that quantifies whether, or how much, various takeover defenses or combinations of defenses actually affect a firm's takeover likelihood. In simple tests that do not account for endogeneity, the G-index and E-index are not significantly related to takeover likelihood. We account for endogeneity using two new instruments for a firm's use of takeover defenses based on the firm's geography and IPO cohort. Using these instruments, both the G-index and E-index are negatively and significantly related to takeover likelihood. The relation between takeover likelihood and the G-index is driven by a subset of 14 provisions, many of which are not captured by the E-index, and four of which have impacts on takeover likelihood opposite to how they are counted in the G-index. We propose that this empirically driven subset of 14 takeover defenses better reflects a firm's takeover defense posture than previous indices.

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1. Introduction

The G-index and E-index are workhorses of empirical corporate finance research. Each counts the number of takeover defenses a firm has and is often used as a summary measure of the firm's protection from unsolicited takeover bids (see Gompers, Ishii, and Metrick, 2003; and Bebchuk, Cohen, and Ferrell, 2009). But do these indices actually measure takeover deterrence?

This is an important question because a substantial number of empirical findings and their interpretations are based on the assumption that takeover defense indices indeed measure takeover deterrence. For example, researchers have used the G-index and E-index to examine whether takeover defenses are associated with various firm outcomes including low stock returns (e.g., Gompers, Ishii, and Metrick, 2003; Cremers, Nair, and John, 2009; Cremers and Ferrell, 2013), firm value (Bebchuk, Cohen, and Ferrell, 2009; Cremers and Ferrell, 2014), acquisition returns (Masulis, Wang, and Xie, 2007), takeover premiums (Sokolyk, 2011; Kadyrzhanova and Rhodes-Kropf, 2011), increased risk taking (John, Litov and Yeung, 2008), internal capital markets (Duchin and Sosyura, 2013), credit risk and pricing (Cremers, Nair, and Wei, 2007; Klock, Mansi and Maxwell, 2005), operating performance (Core, Guay, and Rusticus, 2006; Giroud and Mueller, 2011), the value and use of cash holdings (Dittmar and Mahrt-Smith, 2007; Harford, Mansi and Maxwell, 2008), and corporate innovation (Atanassov, 2013). Researchers also have used takeover indices to examine whether takeover defenses serve primarily to entrench managers at shareholders' expense (Masulis, Wang, and Xie, 2007), or to increase firm value through bargaining or contractual bonding (Chemmanur and Jiao, 2012; Cen, Dasgupta, and Sen, 2011; Johnson, Karpoff, and Yi, 2014; Humphery-Jenner, 2014). The common basis in all of these tests is the foundational assumption that the G-index and/or E-index measure

takeover deterrence. Even conclusions that takeover defenses increase firm value are based on the assumption that they deter unsolicited acquisitions (e.g., Chemmanur and Jiao, 2012; Humphery-Jenner, 2014).

For such a foundational assumption, however, the notion that takeover defenses deter takeovers has surprisingly little empirical support. If anything, the available evidence indicates that there is no meaningful relation between takeover frequencies and the G-index (see Core, Guay, and Rusticus, 2006; Bates, Becher, and Lemmon, 2008; Kadyrzhanova and Rhodes-Kropf, 2011; Sokolyk, 2011). There is some evidence that isolated provisions in these indices, e.g., classified boards, are associated with lower takeover likelihood (e.g., see Bates, Becher, and Lemmon, 2008; Kadyrzhanova and Rhodes-Kropf, 2011; Sokolyk, 2011), but this evidence also is mixed (e.g., see Comment and Schwert, 1995). Some researchers focus on small subsets of takeover defenses (e.g., Cremers, Nair, and John, 2009; Kadyrzhanova and Rhodes-Kropf, 2011; Harford, Humphery-Jenner, and Powell, 2012), but such individualized choices only underscore the absence of systematic evidence on whether certain takeover defenses do, in fact, deter takeovers, and if so, which ones.

The issue is, of course, endogeneity. Firms that deploy takeover defenses may do so precisely because they are likely to receive unsolicited takeover bids. The absence of an empirical correlation between takeover defenses and firm independence cannot rule out the hypothesis that takeover defenses do in fact deter takeovers, but tend to be deployed by firms with high takeover likelihoods. Stated differently, the lack of an empirical correlation between defenses and takeover frequencies might simply indicate that the defenses are endogenous, not ineffective.

The purpose of this paper is to examine whether takeover defenses, and particularly the G-index and E-index, do in fact measure takeover deterrence. Using standard acquisition likelihood models without controlling for endogeneity, we find that acquisition likelihood is significantly related to firm characteristics and performance, but not to a firm's G-index or E-index. This result for the overall G-index is consistent with previous findings (e.g., see Core, Guay, and Rusticus, 2006; Bates, Becher, and Lemmon, 2008; Kadyrzhanova and Rhodes-Kropf, 2011).

We then account for the endogenous adoption of defenses by deploying two instrumental variables that capture arbitrary variation in firms' use of defenses. The first instrument is based on the defenses deployed by firms with headquarters in the same geographical area as the subject firm, but not in the same industry. The rationale for this instrument is twofold: First, managers of firms in geographical proximity are likely to interact and influence each others' decisions on a broad range of corporate matters, including takeover defenses. Second, firms from the same area are more likely to share law firms who do business in their area. Law firms are known to influence their client firms' use of takeover defenses (see Coates, 2001), so this geographical overlap also indicates that firms from the same area tend to use takeover defenses in similar ways for reasons that are not directly related to their specific takeover likelihoods. Similar arguments for the importance of geographical network effects are made by Davis and Greve (1997) regarding golden parachutes, Kedia and Rajgopal (2009) regarding the adoption of stock option plans, and Parsons, Sulaeman, and Titman (2014) regarding financial misconduct. Consistent with these arguments, we find a strong correlation between a firm's takeover provisions and those of its geographically proximate non-industry peers.

Our second instrument is the number of takeover defenses adopted by firms that went public within one year of the subject firm but that are not in the same industry. Daines and Klausner (2001) and Field and Karpoff (2002) document a strong time component to the adoption of takeover defenses by IPO firms, and Hannes (2006) documents that a firm's use of takeover defenses is sticky over time. These results imply that a firm's use of takeover defenses is strongly influenced by the year it went public. We therefore use the provisions adopted by unrelated firms in a subject firm's IPO cohort to measure arbitrary variation in a firm's takeover defenses that is not directly related to the firm's specific takeover likelihood. Empirically, we find a strong correlation between a firm's takeover provisions and the takeover provisions adopted by that firm's IPO-year-cohort.

Following guidelines discussed in the literature, we test and confirm that both our instruments meet the necessary conditions for the identification of strong instruments. Using these instruments to account for endogeneity has a large effect on our empirical results, as we find that takeover likelihood is negatively and significantly related to both the G-index and E-index. A one-standard deviation increase in the instrumented value of a firm's G-index results in a 9.7% reduction in the probability that the firm will be acquired within one year and a 21.1% reduction in the probability the firm will be acquired within five years. A one-standard deviation increase in the instrumented value of a firm's E-index reduces the probability that the firm will be acquired within one year by 11.0%, and within five years by 19.8%. These results are robust to several different methodological approaches to modeling the relation between takeover likelihood and provision use. These results provide the first direct empirical support for the widespread assumption that takeover defenses do in fact deter takeovers.

To compare the ability of the G-index or E-index to characterize a firm's takeover deterrence, we conduct several additional tests. First, we document that an index constructed from the provisions that are included in the G-index but excluded from the E-index – which Straska and Waller (2014) label the Other Index or O-index – is significantly and negatively related to takeover likelihood. In fact, the predictive power of the O-index is more than half as large as that of the E-index, as a one-standard deviation increase in the instrumented value of a firm's O-index is associated with a 7.9% reduction in the probability that the firm will be acquired within one year and a 17.5% reduction in the probability the firm will be acquired within five years. These results indicate that the provisions included in the G-index but excluded from the E-index are, as a group, also associated with takeover deterrence.

Next, we use our approach to address endogeneity to investigate the effects of each individual provision on takeover likelihood. For each provision, we use a firm's non-industry geographic peer firms' incidence of that provision as one instrument and the firm's non-industry IPO-year cohorts' incidence of that provision as a second instrument. These instruments identify variation in the use of these provisions that is strongly correlated with the incidence of the provision at the subject firm but that is not related to the anticipated takeover likelihood for that specific firm. Using this approach, we then test for the relation between each provision and takeover likelihood while controlling for the rest of the provisions. We find that 14 of the original 24 provisions in the G-index are individually related to takeover deterrence. Of these, ten have the expected sign suggesting they deter takeovers while four have the opposite sign, indicating that they positively affect takeover likelihood.

The ten provisions that deter takeovers after controlling for endogeneity are anti-greenmail provisions, classified boards, director indemnification, limitations on director liability,

directors' duties provisions, director contracts, fair price restrictions, cashout laws, supermajority requirements, and unequal voting rights.[1] The provisions that are positively related to takeover likelihood are compensation plans with change-in-control provisions, golden parachutes, limitations on written consent, and straight (i.e., not cumulative) voting. The fact that these four provisions are positively related to takeover likelihood runs counter to the assumptions behind the widespread use of the G-index. The results for the two compensation-related provisions have intuitively appealing interpretations: if offered generous payouts once their firm is acquired, managers are more likely to seek acquirers or agree to be acquired.

Finally, we use our empirical results for the individual provisions to aggregate and construct a new empirically-based index of takeover defenses and show that it is strongly related to takeover deterrence. We construct this new index by adding 1 to the index total for each of the 10 provisions that has a negative relation to takeover incidence. Unlike the G-index and E-index, however, we add 1 to the index for each of the four provisions that is positively related to takeover incidence if the provision is absent. We call the resulting subset of strong takeover defenses the Deterrence index or D-index, and show that the D-index strongly predicts takeover likelihood with or without corrections for endogeneity. Furthermore, of the 24 provisions in the G-index (or the six provisions in the E-index), the only subsets of provisions that are statistically related to takeover incidence are those that are included in the D-index. After correcting for endogeneity, all of the predictive power in the G-index and E-index (as well as two other indices used in other papers) for takeover deterrence is attributable to those provisions that overlap with the D-index.

[1] This list notably excludes poison pills, a finding that is consistent with arguments that virtually all firms have at least latent, or shadow, poison pills (e.g., Coates, 2000). As discussed in Appendix A, however, our evidence regarding poison pills' empirical relation to takeover likelihood is mixed. In Table 6 we therefore consider an augmented version of the D-index in which poison pills are included as one of the provisions that deter takeovers.

Our investigation draws upon previous findings that the G-index and E-index are not empirically related to takeover likelihood (Core, Guay, and Rusticus, 2006; Bates, Becher, and Lemmon, 2008; Kadyrzhanova and Rhodes-Kropf, 2011; Sokolyk, 2011). Bates, Becher, and Lemmon (2008) argue that these findings have wide-ranging implications, as they "…challenge the common perception that these factors, independently or as indexed, provide a reliable proxy for managerial entrenchment or a firm's exposure to the market for corporate control." Our paper, in contrast, provides empirical support for the widespread use of the G-index and E-index to measure takeover deterrence.

Our paper also is related to several papers that use various identification strategies to examine the relation between takeover defenses and outcome variables such as Tobin's q and takeover premiums. Goktan and Kieschnick (2012) use a Heckman probit model approach with a selection equation to try to address selection issues. Straska and Waller (2010), Bebchuk and Cohen (2005), and Bebchuk, Cohen, and Ferrell (2009) use anti-takeover provisions from several years before the year of analysis in an attempt to address simultaneity concerns. Cremers and Ferrell (2014) focus on differences in the relation between firm value and antitakeover provisions before and after the 1985 Moran v. Household case to achieve identification. Kadyrzhanova and Rhodes-Kropf (2011) use age-at-IPO as an instrument in a two-step estimation approach aimed at estimating the relation between governance provisions and takeover premiums. Our paper, in contrast, examines all 24 of the G-index provisions and their relations to takeover likelihood, as opposed to the indices' relations with other outcome variables.

This paper makes four contributions to the literature. First, we argue that the absence of an empirical correlation between takeover likelihood and the G-index or E-index reflects the

endogenous adoption of takeover defenses. We propose two instruments that allow for a direct empirical investigation of the relation between each of the 24 provisions used in the G-index (and those in the E-index) and takeover likelihood. The validity of each instrument, and our overall findings, are corroborated by the fact that the instruments are created using two fundamentally different peer effects yet our main qualitative results are similar and robust to using either instrument. Second, we show that both the G-index and E-index are negatively and significantly related to takeover likelihood. These results support the widespread assumption that these indices measure takeover deterrence, as well as the large body of empirical inferences that are based on this assumption. To our knowledge, our paper is the first to document a causal effect where higher numbers of takeover defenses are shown to cause lower takeover likelihoods. Third, our provision-level results show that the G-index and E-index are particularly noisy measures of takeover deterrence, as their predictive power comes from a subset of provisions, many of which are outside the E-index. And fourth, we construct a more efficient index, the D-index, based on the empirical relations between each individual provision and takeover likelihood. This new index contains the 14 provisions that most significantly relate to takeover likelihood, and adjusts for the finding that four of the provisions increase takeover likelihood. We demonstrate that the G-index and E-index are negatively related to takeover likelihood only because some of their provisions overlap with the provisions in the D-index.

The paper proceeds as follows. In section 2 we describe the data, discuss endogeneity issues in our empirical approach, and motivate our specific instruments. In section 3 we report the relation between takeover likelihood and both the G-index and E-index. We report these results first without correcting for endogeneity and then after correcting for endogeneity. In section 4 we investigate how each individual takeover defense relates to takeover likelihood. In

section 5 we use the section 4 results to create the D-index and demonstrate how it compares to the G-index, E-index, and other subsets of provisions within these indices in explaining takeover incidence. Section 6 concludes.

2. Descriptive information, endogeneity concerns, and instruments

2.1 Data and sample descriptive information

To address the question of whether the antitakeover provisions from the G-index and E-index do, in fact, relate to takeover deterrence we require information on firm acquisitions, firm- and industry-level control variables known from prior research to relate to takeover likelihood, and information on which provisions existed at each firm each year. Our acquisition data come from the Thomson's Securities Data Company (SDC) database, the firm- and industry-level information is from Compustat and CRSP, and the provision-level data are from the Investor Responsibility Research Center (IRRC) database.[2]

Institutional Shareholder Services (ISS) acquired IRRC in 2005. Riskmetrics then acquired ISS and starting in 2007 made significant changes to the format and scope of the governance data collected each year such that roughly only half of the original 24 components of the G-index are available in some form via Riskmetrics after 2006. Riskmetrics not only changed the exact information collected but also the manner of collecting and reporting the information such that even for the subset of variables collected by both IRRC and Riskmetrics there is a large structural change in 2006, despite the focus that both data sets had on S&P1500 firms. For example, both the IRRC and Riskmetrics data sets collect a binary variable named "labylw" signaling limits on shareholders' ability to amend bylaws. In 2006, the IRRC file

[2] The following SDC Filters were used in identifying IRRC targets: US Targets with deal form AR, M, AM, or AA and a completed status. The IRRC data have been acquired and alternatively controlled by ISS, Riskmetrics, and MSCI, and have been listed on the WRDS platform alternatively under the Riskmetrics and ISS names. To avoid confusion, in this paper we refer to the 1990-2006 data collected by IRRC as IRRC.

reports that 22.4% of firms have such limits whereas Riskmetrics reports that 85.0% of firms have such limits in 2007. Given the lack of many of the necessary variables after 2006 in Riskmetrics, and the extensive changes made to the way the data were collected even for the subset of variables that are common to the two data sets, we focus only on the IRRC data through 2006 and assume that the provisions constituting the G-index in 2006 carry forward for those firms for four more years. This approach also ensures that our analysis directly relates to the large body of existing research, which relies extensively on the IRRC data.

Projecting the data forward in time is consistent with the standard approach used in the literature for previous years in which IRRC did not report firm-level data. From 1990-2006, IRRC published governance data for 1990, 1993, 1995, 1998, 2000, 2002, 2004, and 2006, with each volume including corporate governance information for between 1,400 and 2,000 firms. Like previous studies, we fill in data from missing years by projecting forward from the most recent IRRC data. For example, the IRRC governance data from 1993 are used in 1994 and the 1995 data are used for 1996 and 1997.

Following the procedures of Gompers et al. (2003), we distill the 45 IRRC data elements into 24 corporate governance provisions, and report the G-index as a simple sum of the constituent provisions. The E-index described in Bebchuk et al. (2009) is calculated in the same manner as the G-index, by adding one for each provision in effect. The E-index is comprised of six governance provisions: poison pills, golden parachutes, classified boards, limits to shareholder amendments of the bylaws, supermajority requirements for mergers, and supermajority requirements for charter amendments.[3] Appendix A, Table A1 reports on the annual frequencies of each provision in our sample.

[3] Gompers, Ishii, and Metrick (2003) contains a detailed discussion of the 24 provisions in the G-index.

Firm-specific financial and operating control variables are from Compustat and CRSP and are motivated by prior work on takeover likelihood.[4] These variables include firm size (AT), leverage (DLTT/AT), the market-to-book ratio ((CSHO*PRC + DLTT)/AT), industry-adjusted operating return on assets (ROA = OIADP/AT), the property ratio (PPEGT/AT), the liquidity ratio ((ACT-LCT)/AT), average sales growth over 3 years (average(($SALE_{t0}$ - $SALE_{t-1}$)/ $SALE_{t-1}$)), the prior one-year market-adjusted return, and industry concentration as measured by the Herfindahl-Hirschman index using sales.[5] Industry adjustments are made using the Fama-French 49 industries.

Our initial sample consists of 32,229 firm-years from the intersection of firms in the IRRC and Compustat databases from 1990-2010. Missing control variables cause 6,319 firm-years to be eliminated from the sample. One of the required variables includes the requirement that each firm have at least 1 non-industry geographic peer firm within its state and at least 1 non-industry IPO-year peer for the calculation of the instrumental variables described in more detail in section 2.3. These data requirements result in the 25,910 firm-year observations that serve as our basic sample for all tests.

[Insert Table 1]

Using this basic sample, Table 1 reports the number of firms and takeovers and the mean G-index and E-index values by year. The mean G-index ranges from 8.7 to 9.3 during our sample period of 1990-2010, and is relatively stable across time.[6] For comparison, Gompers et

[4] For examples, see Palepu (1986), Ambrose and Megginson (1992), Song and Walkling (1993), Comment and Schwert (1995), and Field and Karpoff (2002).
[5] If PPEGT is missing but PPENT is not, we use PPENT to calculate the property ratio. ACT and LCT are not reported in Compustat for banks, so requiring these variables eliminates banks from our sample.
[6] The variation in the mean G-index and E-index values across proximate years is due to firms dropping from the sample. For example, consider the 1990 and 1991 values. The 1990 G-index values are used to populate 1990

al. (2003) report an annual average G-index of 8.9 to 9.3 during the 1990-1998 period. The E-index ranges from 2.4 to 2.8 during our sample period, again largely comparable to the figures reported for the 1990-2002 sample in Bebchuk et al. (2009). The trends in takeover frequency shown in Table 1, with peaks in the late 1990s and mid-2000s, are similar to those documented by Masulis, Wang and Xie (2007). Table 2 provides additional descriptive information for the firms in the final sample of 25,910 firm-year observations. Most of the sample characteristics are standard for research in this area, and the summary statistics for them are similar to those of other samples based on IRRC data (e.g., see Core, Guay, and Rusticus, 2006; Sokolyk, 2011).

[Insert Table 2]

2.2 Endogeneity concerns

Our research question is whether the takeover provisions as constituted within the G-index or E-index affect takeover likelihood. A naïve approach to this question would involve estimating a simple regression of a binary variable for being acquired (y_1) on the takeover index variable (y_2) as well as whatever control variables (x_1-x_k) appear in the model as shown in equation (1) below.

$$y_1 = \partial y_2 + \beta_1 x_1 + \cdots \beta_k x_k + u \qquad (1)$$

Given the endogenous nature of y_2, this approach would result in biased and inconsistent estimates of ∂ because $E(u \mid y_2, x_1 \ldots x_k) \neq 0$. Intuitively, endogeneity arises if managers' use of takeover defenses is affected by their assessment of the likelihood the firm will receive a takeover bid or if the adoption of the defenses is correlated with managers' underlying openness to being acquired. In this paper, we achieve identification by directly modeling the endogenous

through 1992, but the table above reports a slightly different annual mean in 1990 and 1991. The difference arises because not all of the firms that were included in 1990 still exist in 1991.

variable as a function of two instrumental variables (z) as shown in equation (2) and then using information from both equations to estimate ∂.

$$y_2 = \gamma_1 z + \gamma_2 x_1 + \cdots + \gamma_k x_k + e \qquad (2)$$

A valid instrument must meet both relevance and exclusion conditions (see Roberts and Whited, 2012). For the relevance condition, we report the first-stage F-statistic and the R-squared value for each of our tests. Staiger and Stock (1997) suggest a rule-of-thumb that the F-statistic be at least 10 for a strong instrument. Stock and Yogo (2005) tabulate various guidelines for identifying weak instruments depending on (1) the estimation bias and test statistic size distortion that the researcher is willing to accept relative to OLS estimation, (2) the number of endogenous variables involved, and (3) the number of instruments. Since we have one endogenous variable and up to two instruments, only the size distortion guidelines apply (the tabulated bias guidelines require three or more instruments). The Stock and Yogo (2005) size distortion guidelines for our application, assuming less than 10% size distortion (10% is the smallest category they consider) thus imply that the 2SLS first-stage F-statistics should be at least 19.9 for a strong instrument. When we use a limited-information maximum likelihood (LIML) approach, the first-stage F-statistics should be at least 8.7 for a strong instrument.

The exclusion condition requires that cov(z, u) = 0 and can be thought of as the requirement that the instrument only affect whether a firm is acquired (y_1) via its relation with the endogenous index (y_2) and not via some other pathway captured in the error term. Because the exclusion condition is not directly testable we discuss the creation of our instruments in detail in section 2.3 and argue that the exclusion condition is met.

Most of our empirical tests focus on systems of equations like those described in (1) and (2) above. In Tables 4 and 6 the endogenous variable is an index of provisions (i.e., G-index, E-index) that is treated as a pseudo-continuous variable. In Table 5, the endogenous variable is a single binary provision. When the dependent variable in (1) is binary we have the option either to impose a cumulative distribution function on the outcome or to estimate a linear probability model (LPM). Given that 2SLS in a LPM context allows for either binary or continuous endogenous regressors (both of which we use) we choose to use 2SLS with a LPM. This approach is similar to that discussed in econometrics texts such as Angrist and Pischke (2009, page 198) and Cameron and Trivedi (2010, page 485). Cameron and Trivedi specifically note that using a 2SLS approach with a LPM results in consistent estimates but that heteroskedasticity-robust standard errors must be used for inference. As alternatives to the 2SLS approach, for robustness we also employ a recursive bivariate probit model and a limited-information maximum likelihood (LIML) approach to estimate ∂ and obtain qualitatively similar results. As noted by Stock and Yogo (2005) and Hayashi (2000, page 542), 2SLS and LIML estimators have the same asymptotic distributions but LIML is more robust to small sample bias and to weak instruments.

2.3 Instrumental variables

Given the relevance and exclusion requirements described above, our instruments at the index level should (1) strongly correlate with index values at the firm, and (2) not relate to the likelihood of takeover at that firm in other ways. We use two instruments in this paper. The first instrument is based on the incidence of provisions at geographically-proximate firms that are not in the same industry as the subject firm. The second instrument is based on the incidence of provisions at firms that went public within one year of the firm in question.

To create the first instrument we first use zip codes to identify all firms within a 100-mile radius of the subject firm's headquarters. We then eliminate firms within this group if they (1) have the same Fama-French 49 industry classification as the subject firm or (2) are located in a different state. If no peer firms are found using this approach then a statewide net is used instead of a 100-mile radius. To illustrate the construction of the geography-based instrument assume that the antitakeover index has two provisions (provisions A and B). Assume the firm in question has four geographically-proximate peer firms; the presence of provision A using binary variables at these four firms is (0,0,1,1) and the presence of provision B at these four firms is (1,1,0,1). Using these numbers, 50% of the geographically-proximate firms have provision A and 75% have provision B. Thus the instrument at the index level for this firm would be 0.50 + 0.75 = 1.25. At the provision level, the instrument for provision A would be 0.50 and the instrument for provision B would be 0.75.

In creating this instrument we purposely purge the peer group of within-industry peers to isolate geographic-peer effects in takeover provisions that are not related to industry. We argue that this process picks up commonalities in takeover provisions that are driven by geographical proximity and that these (non-industry) trends arguably are not related to the specific takeover likelihood of the firm in question. Geographic proximity could explain takeover defenses if there is a spillover of management ideas at the local level (e.g., university-sponsored CEO forums) or shared legal or consulting services. The geographic proximity instrument is based on headquarters location and not state of incorporation, so the instrument does not pick up the tendency for firms to select Delaware or other specific states due to their laws.[7] Also, the instrument is based on location decisions by both the sample firm and its non-industry peers that typically were made many years before the year in which we measure takeover likelihood,

[7] For examples, see Bebchuk and Cohen (2003) or Dyreng, Lindsey, and Thornock (2014).

further implying that this instrument satisfies the exclusion condition. Figure 1 plots the headquarters in our sample and shows that these headquarters are distributed widely across the US.[8]

[Insert Figure 1]

To create the second instrument we follow a similar approach but identify peer firms from all firms in the sample that went public within one year of the subject firm but that are not in the same industry. This instrument is based on evidence that a firm's use of takeover defenses is strongly influenced by the year it went public. Daines and Klausner (2001) and Field and Karpoff (2002) show that IPO firms' use of takeover defenses varies systematically over time, and Hannes (2006) reports that a firm's use of takeover defenses does not change much after the IPO. Similarly, Johnson, Karpoff, and Yi (2015) find that 83% of firms that went public between 1997 and 2011 never changed their takeover defenses through the end of 2013.

Given the size of firms covered in IRRC, many of the firms in our sample went public years before our sample period (1990-2010). To capture variation in takeover defenses over time we define IPO-year cohorts starting in 1950 and move forward year-by-year through 2010. All firms that went public before 1950 are included as part of the 1950 cohort. Using this approach results in most years having 10 or more peer firms, with some years in the 1980s and 1990s having more than 100 peer firms per year. Following the logic introduced with the geography-based instrument, the provision-level instrument for a given firm is the percent of non-industry IPO-year cohort firms that have the same provision. The index-level instrument is the sum of the provision-level instruments. Appendix A Table A2 provides the number of IPOs in each year for our sample.

[8] Although not depicted, firms from both Hawaii and Alaska are also in our sample.

Similar to the geography-based instrument, we argue that whatever sets of provisions a firm's non-industry IPO-year cohort of firms chose to have years in the past should have no direct relation with the specific takeover likelihood of the firm in question in year t+1 and hence the exclusion requirement is met. The two instruments are calculated using two different peer effects – one geographic in nature, and the other year-based in nature. The differences in approaches are reflected in the relatively low correlation the instruments have with each other (correlation of .11 and .04, respectively, for the G-index and E-index instruments). The two instruments are based on fundamentally different peer effect arguments, yet nearly all of our results are not sensitive to whether we use only the geography-based, only the IPO-year-based, or both instruments together. These results suggest that each instrument does, in fact, identify exogenous and independent variation in the endogenous variables of interest.

3. Governance indices, individual provisions, and takeover deterrence

3.1 Takeover deterrence and the G-index and E-index

We begin our investigation of the relation between the indices and takeover deterrence in a traditional setting without regard to endogeneity. Columns 1-4 of Table 3 report coefficients from probit models, and columns 5-8 report results from linear probability models (for comparison purposes with subsequent tables). In all cases, the G-index and E-index are not significantly related to takeover likelihood within one year or within five years. The G-index results are consistent with earlier findings (Core, Guay, and Rusticus, 2006; Bates, Becher, and Lemmon, 2008; Kadyrzhanova and Rhodes-Kropf, 2011; Sokolyk, 2011), and the E-index result consistent with a result reported but not tabulated in Bates, Becher, and Lemmon (2008). Again,

these results are difficult to interpret because these tests do not attempt to control for endogeneity.

[Insert Table 3]

If firms with greater ex-ante exposure to unsolicited takeover bids deploy and maintain defenses, or if takeover defenses are related to managers' underlying willingness to accept takeover overtures, the models in Table 3 yield biased estimates. To address the bias that arises from firms' endogenous use of takeover defenses and takeover likelihood, we employ the estimation techniques and instrumental variables discussed in sections 2.2 and 2.3. Table 4 reports the results from takeover likelihood tests after correcting for endogeneity using both the geography-based and IPO-year-based instruments.[9] In addition to the G-index and E-index, we examine what Straska and Waller (2014) call the "O-index," which is the set of provisions outside the E-index but in the G-index. In Table 4, columns 1-3 (4-6) the dependent variable is set to 1 if the subject firm was acquired in year t+1 (years t+1 through t+5). The last two columns report the standardized coefficients for the G-index, E-index, and O-index from columns 1–6. The standardized results imply that a one standard deviation increase in the instrumented value of the G-index results in a 9.7% reduction in the likelihood of being acquired within one year and a 21.1% reduction within five years. A one standard deviation increase in the instrumented value of the E-index results in an 11.0% reduction in the likelihood of being acquired within one year and a 19.8% reduction within five years. The instrumented O-index also is negatively and significantly related to takeover likelihood.

[Insert Table 4]

[9] The results in Table 4 are from overidentified models. The just-identified results are qualitatively similar for the G-index using either instrument in isolation, but are significant for the E-index only with the geography-based instrument. The just-identified results are tabulated in Appendix A, Tables A3 and A4.

The bottom of Table 4 reports F-statistics from the first-stage regressions estimated with the second-stage results reported in the first six columns. In all cases, the F-statistics are large and easily exceed the guidelines outlined in Staiger and Stock (1997) and Stock and Yogo (2005) to identify "strong" instruments, as discussed in section 2.1.[10,11] Based on our economic argument that these instruments are not directly related to takeover likelihood, we interpret the results in Table 4 as providing evidence that the G-index and E-index are indeed negatively related to takeover likelihood after controlling for endogeneity. This evidence supports the literature's widespread use of the G-index and E-index as proxies for a firm's takeover vulnerability. Furthermore, the O-index results indicate that some provisions in the G-index but excluded from the E-index also work to deter takeovers.

4. Individual anti-takeover provisions as measures of takeover deterrence

In this section we move our attention from the index level to the individual provisions from which the indices are constituted. Our empirical strategy is the same as before: we rely on two equations in which one equation (the structural or takeover equation) models takeover likelihood as a function of the provision and other firm- and industry-level control variables

[10] Roberts and Whited (2012) discuss common problems with tests regarding overidentification and the exclusion criterion. Following this discussion, we rely more on our arguments in section 2 for instrument validity than on specification tests. Nonetheless, we take advantage of having two instruments by using the robust version of the Hausman overidentification test to test for instrument validity. The null hypothesis in this test is a joint null of both (1) correct model specification, and (2) instrument validity. The robust version of the Hausman test is appropriate because our models correct for heteroskedastic errors and cluster by firm (see Wooldridge 2002, page 123). Using this test, we reject the joint null for columns 1 and 2 at the 5% level but fail to reject the joint null for columns 3-6 (all have p-values > 0.10, with the largest p-value = 0.588). Given that the only difference between columns 1 and 4 and columns 2 and 5 is the use of different time horizons for the dependent variable and not a change in instruments, and that the qualitative conclusions are the same, we interpret the test results as providing corroborating evidence that our instruments are valid.

[11] The Stock and Yogo (2005) test statistics were derived in a setting with homoskedastic errors. Consistent with the discussion in Cameron and Trivedi (2010, page 199) and the lack of published guidelines on how to relate the test statistics to F-statistics in the context of heteroskedastic-robust errors, we follow Cameron and Trivedi and note that our F-statistics using robust standard errors greatly exceed the published guidelines and hence likely satisfy the test and reject the null of weak instruments.

while the other equation (the first stage in a 2SLS context) models the potentially endogenous presence of the provision as a function of the instruments and other exogenous variables.

Columns 1, 2, 7, 8 and 9 of Table 5 report the marginal effect that each provision has on takeover likelihood. A challenge that arises in these tests is how best to control for the other 23 provisions when examining the specific effect any one provision might have on takeover likelihood. Columns 1 and 2 of Table 5 present two approaches to this challenge. In column 1, the results come from a single takeover equation that includes 24 separate binary variables for each of the 24 provisions included together at the same time. In column 2, the results come from 24 separate takeover equations, estimated one at a time, in which a single provision is included as the binary variable of interest. In the column 2 models, we include as a control variable an index that sums up the remaining 23 provisions (i.e., an index that could range in value from 0 to 23) in each of the 24 regressions. All specifications in Table 5 also include the 75 firm-level and industry-level control variables from Table 4.

Neither of the approaches in columns 1 or 2 deal with endogeneity, but the results are presented in this way to show that the signs, sizes, and significance of the coefficients in columns 1 and 2 are generally similar using either approach. This result suggests that we can control for the net effect of the remaining 23 provisions collectively while parsimoniously looking at the specific effect that each provision has on takeover likelihood, considered in isolation.[12] The marginal effects reported in columns 7, 8, and 9 start with the general approach in column 2 by including an index of the 23 provisions, and use 2SLS, recursive bivariate probit model (RBPM),

[12] In additional robustness tests we re-estimate all specifications in Table 5 using the same two equations that appear in the Table 5 heading but in each case without the index of 23 provisions (i.e., the $Index_{23}$ variable) to ensure that this modeling assumption is not driving our results. We find that the same coefficients that are significant in Table 5 are significant and they have the same signs. One difference using this alternative approach is that the negative marginal effects of poison pills on takeover likelihood becomes significant in some of the 2SLS and LIML results in addition to the RBPM results suggesting that poison pills are significant in explaining takeover likelihood. The F-statistic for poison pills in the robustness table also exceeds 10. See Appendix A Table A6. In Table 6 we report on a supplemental test in which the D-index includes poison pills.

and LIML methodologies, respectively, to account for endogeneity. In each case the results are estimated using both the takeover and provision equations together with exogenous variation in each provision's incidence being identified using the provision-level instruments.

[Insert Table 5]

Column 7 of Table 5 reports the marginal effects of each of the 24 provisions as estimated using 2SLS with a linear probability model (LPM) with 24 separate regressions in which each provision is treated, in turn, as the endogenous binary variable of interest. Columns 3-6 report diagnostic information related to these same 24 2SLS regressions. Column 3 reports the first-stage R-squared value. Column 4 reports the F-statistic from the first-stage of each specification to provide information about the strength of the provision-level instrument. Column 5 summarizes this information by highlighting which provisions have strong instruments using the rule-of-thumb from Staiger and Stock (1997) that requires an F-statistic greater than 10. Column 6 reports a "Yes" if the *p*-value from a regression-based test of exogeneity is smaller than 10% and hence provides supporting evidence that the variable in question is actually endogeneous.[13] To be conservative, we purposely use a 10% cutoff for this test rather than a 5% cutoff.

For robustness, columns 8 and 9 report the marginal effects of the 24 provisions on takeover likelihood using two alternative estimation approaches that are based on the same two underlying equations but that use different modeling assumptions and hence are not subject to the same weaknesses as 2SLS. The column 8 results are estimated using a recursive bivariate

[13] The errors for a LPM are known to be heteroskedastic. In our specifications the errors are also clustered by firm. Hence, the test for endogeneity is not done using the traditional Hausman or Durbin-Wu-Hausman approaches but instead uses a variation of the Durbin-Wu-Hausman test that is robust to heteroskedastic and clustered errors. See Wooldridge (2002, pages 118-121) for a discussion of the traditional approach. Cameron and Trivedi (2010) discuss the robust test (page 190) as the "robustified" Durbin-Wu-Hausman test. The test was implemented in Stata and is referred to in the Stata documentation for the ivregress/estat endogeneous command as the "regression-based test".

probit model (RBPM). Under this approach, the two equations are estimated as simultaneous equations using maximum likelihood techniques that allow for correlation between the errors in the two equations. As discussed in Greene (2003, pages 715-716), this type of approach can be used to consistently estimate the marginal effects of an endogeneous binary regressor in a system of equations like the system we are using in which both equations in the system have binary outcomes. Given that the correlation in errors is allowed and modeled, this approach is not as sensitive to some of the assumptions needed to motivate the 2SLS approach. Following Greene (2003, page 716) we estimate the marginal effects in column 8 as the average difference in each firm-year's predicted probability of observing a takeover conditional on having or not having the provision in place while holding all other characteristics at the firm constant. A comparison of the results in columns 7 and 8 reveals that the signs and significance of the RBPM marginal effects are for the most part similar to the 2SLS results.

As an additional robustness test, in column 9 we report the marginal effects from a limited-information maximum likelihood (LIML) estimation of the two underlying equations. As noted in Stock and Yogo (2005) and in Hayashi (2000, page 542), 2SLS and LIML estimators have the same asymptotic distributions but LIML is more robust to small sample bias and to weak instruments. A comparison of the marginal effects using the 2SLS, RBPM, and LIML approaches show a few differences, but all of the significant results from the 2SLS approach are confirmed significant by one of the alternative robustness approaches, with only two results lacking unanimous support.[14]

[14] The Table 5 2SLS LPM results are based on an overidentified model using both the geography-based and IPO-year-based instruments together. The just-identified version of the 2SLS LPM results for Table 5 are tabulated in Appendix A in Table A5. In all cases if a variable is found to be significant using the 2SLS LPM approach with an overidentified model (Table 5) then it also appears significant in at least one of the just-identified models shown in Table A5. The F-statistics in Table A5 show how for certain provisions the IPO-based instrument is better while for others the geography-based instrument is better. Using the instruments together in Table 5 generally leads to results

Column 10 summarizes how we use the results in Table 5 to identify the provisions that are most significantly related to acquisition likelihood, and which constitute the basis for our empirically-driven deterrence index, or D-index. We first focus on the signs and significance of the 2SLS results for provisions that have a strong instrument. This is because 2SLS coefficients with strong instruments are consistent. By this criterion, the following provisions are negatively related to acquisition likelihood: anti-greenmail provisions, director indemnification, director contracts, limitations on director liability, directors' duties provisions, fair price restrictions, cashout laws, and supermajority requirements. By this criterion, straight (not cumulative) voting and restrictions on action by written consent are positively related to acquisition likelihood. For each of these provisions, the RBPM or LIML results, or both, provide corroborating evidence.

For several other provisions, the F-statistics in column 4 indicate the absence of strong instruments, and the regression-based-test for exogeneity (see footnote 13) fails to indicate evidence of endogeneity. For these provisions, we rely on the signs and significance of the LPM results in columns 1 and 2. This is because, in the absence of endogeneity, OLS estimation (columns 1 and 2) is more efficient than 2SLS estimation (column 7). By this criterion, classified boards and unequal voting rights are negatively related to acquisition likelihood, while compensation plans and golden parachutes are positively related to acquisition likelihood.

Using this logic, a total of 14 of the 24 provisions in the G-index are individually and significantly related to takeover likelihood. Column 10 indicates the direction of effect for each of these 14 provisions.

Three additional provisions have mixed or weaker evidence. First, limitations on making amendments to the charter appear weakly significant in column 2 and hence are a candidate for

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for each provision that mirror the just-identified results for whichever instrument has the higher F-statistic for that provision.

inclusion in column 10. We do not include it because the signs of the 2SLS, RBPM, and LIML marginal effects are opposite the sign in column 2 and appear in some cases to be significant. Second, the coefficient for executive severance is significant in column 2, but we do not include it in column 10 because of severe limitations with the IRRC severance data.[15]

The third provision with mixed evidence is poison pills. Pills are not included in column 10 based on the absence of a strong instrument and the insignificance of the poison pill coefficient in columns 1 and 2. In Appendix A Table A6 we explore the robustness of our results using a slightly different model. The results in Table A6 are similar to those in Table 5 except for poison pills. In Table A6, the F-statistic for poison pills is larger than 10 and the marginal effects appear negatively and significantly related to takeover likelihood in some specifications. Our mixed evidence regarding poison pills mirrors an ongoing theoretical debate about the importance of a firm's explicit adoption of a poison pill. Pills are widely regarded as having a strong deterrence effect on unsolicited takeovers, an argument that Bebchuk et al. (2009) use to include poison pills in the E-index. Coates (2000) and others, however, point out that nearly all firms have the legal right to adopt poison pills at any time, even after receiving an unsolicited takeover bid, a right affirmed in a 1995 Delaware Supreme Court decision. By this argument, the nearly universal availability of such latent poison pills eliminates the incremental deterrence of observed poison pills. In our main tests, we rely on the Table 5 results and exclude poison pills from the D-index, a decision that is consistent with the argument that all firms have

[15] Before 2006 firms were not required to report their severance agreements; hence, IRRC was only able to detect severance arrangements for the subset of firms that chose to disclose their severance arrangements. Starting in 2006 firms were required to disclose more information about existing severance arrangements and Execucomp started reporting the dollar amount of severance in the event of involuntary termination. Comparing the percent of CEOs in the IRRC dataset reported as having a severance package in 2006 with those in Execucomp reveals the problem with the IRRC severance data: both datasets focus on S&P1500 firms and while IRRC reports that only 3.8% of CEOs had severance in 2006, Execucomp reports that 50.5% of CEOs had severance arrangements.

latent pills. In a sensitivity test reported in Table 6, however, we develop an augmented D-index that includes poison pills.

Four provisions have the opposite effect on takeover likelihood than assumed in the construction of the G-index: compensation plans with change-in-control provisions, golden parachutes, limitations on written consent, and the lack of cumulative voting. The positive effects of the two compensation-related variables have a simple interpretation: if offered a generous payout conditional on their firm being acquired, managers will be more likely to seek acquirers or to agree to be acquired if an unsolicited bid arises.

The positive effects of the other two variables do not have easy interpretations. The positive marginal effect of limitations on shareholders' ability to act by written consent corresponds with a finding in Sokolyk (2011), albeit using a substantially different methodology. It is conceivable that such limitations decrease outside activists' ability to force specific changes in corporate policy, increasing the marginal value of a takeover attempt. Similarly, most prior researchers argue that straight voting discourages takeover attempts because dissidents are unable to cumulate their votes to elect one or two dissident-backed directors to the corporate board. It is possible, however, that precluding such dissident activity encourages outside activists to substitute away from activist efforts and toward takeover of the whole firm. Such interpretations are consistent with our findings that limitations on action by written consent and straight voting are positively related to acquisition likelihood, but these interpretations are highly speculative.

5. An empirically based deterrence index

The results in Tables 4 and 5 and the related results in Appendix A imply the following four conclusions:

(1) After controlling for endogeneity using either the geography-based or IPO-year-based instruments, or both instruments together, higher levels of the G-index are associated with significantly lower takeover likelihood. These results corroborate the assumption used in many studies, that the G-index is a measure of takeover deterrence.

(2) After controlling for endogeneity using the geography-based instrument, or both instruments together – but not the IPO-year-based instrument on its own – higher levels of the E-index are associated with a significantly lower takeover likelihood. The insignificant results for the E-index using the IPO-year-based instrument could reflect the E-index's relatively strong reliance on golden parachutes, as in Table 5 we find that golden parachutes, by themselves, are positively related to takeover likelihood.

(3) After controlling for endogeneity using either the geography-based or IPO-year-based instruments, or both instruments together, an index based on only the provisions that are included in the G-index but excluded from the E-index (the "O-index") is negatively and significantly related to takeover likelihood.

(4) After controlling for endogeneity, there is strong evidence that ten of the individual provisions in the G-index have negative marginal effects on takeover likelihood and four individual provisions have positive marginal effects on takeover likelihood. These 14 provisions are identified in Table 5.

In this section we take a purely empirical and atheoretic approach to construct a new index that, empirically, best reflects a firm's overall takeover defenses. We call this the Deterrence Index, or D-index. In creating the D-index we draw from column 10 of Table 5 and add 1 for each of the 10 provisions that have significant negative marginal effects on takeover likelihood, and add 1 for the absence of each of the four provisions that have significant positive effects. The index therefore ranges in value from 0 to 14.

Figure 2 illustrates the relationships between the D-index, G-index, and E-index. The figure also includes two lesser-used indices, the FK-index used by Field and Karpoff (2002), Chemmanur et al. (2011), and Johnson et al. (2014), and the Alternative Takeover Index (ATI) described by Cremers and Nair (2005). The D-index consists of a subset of the provisions in the G-index that partially overlaps with the provisions in each of the E-index, FK-index, and ATI.

[Insert Figure 2]

Table 6 reports on tests that compare each index's empirical relation to takeover likelihood. Column 1 reports the marginal effect of each set of provisions on takeover likelihood using a linear probability model without correcting for endogeneity. As noted previously, neither the G-index nor the E-index correlates with takeover likelihoods in tests that do not account for endogeneity. The ATI also is not significantly related to takeover likelihood, although the FK-index is negatively related to takeover likelihood at the 10% level.

[Insert Table 6]

Column 2 reports the marginal effect of each set of provisions as estimated from the takeover equation after accounting for endogeneity using a 2SLS approach. For each index, we calculate index-specific geography-based and IPO-year-based instruments by summing the provision-level instruments for the set of provisions included in the index. In these tests, after correcting for endogeneity, the G-index, E-index, O-index, and FK-index all are negatively related to takeover likelihood.[16] Column 3 reports standardized coefficients, and columns 4 and

[16] In the original ATI some of the provisions were considered jointly. For example, a value of 1 was added to the index if the firm had either limitations on calling special meetings or limitations on acting by written consent. Similarly a value of 1 was added to the index if the firm had either a blank check provision or a poison pill. Given that various indices treated the provisions jointly whereas others treated them separately and to ensure we could compare the various indices and subsets of provisions in Table 6, we coded the indices in Table 6 as though each of the provisions were considered separately. Hence a value of 2 would be added to the ATI index in Table 6 if the firm in question has both a blank check and a poison pill rather than 1.

5 report results from the first-stage regressions indicating the presence of strong instruments for each index.

Rows 6-8 report results for the new Deterrence Index, or D-index. Rows 6 and 7 enter the D-index provisions with the corrected signs for the four provisions that empirically are positively related to takeover likelihood, and row 8 enters the D-index provisions with the original signs as used by previous researchers. The results in row 6 show that the D-index is significantly and negatively related to takeover likelihood with or without correcting for endogeneity. This provides evidence that, collectively, the provisions in the D-index are strongly negatively related to takeover likelihood, and given the strength and validity of our instruments the estimated relation is causal. Row 7 displays similar results for an augmented D-index that includes poison pills. As shown by row 8, D-index provisions entered without corrected signs remain negatively related to takeover likelihood only after accounting for the endogeneity, similar to the results for G-index and E-index in rows 1 and 2, respectively. Collectively, these results imply that effective measures of takeover deterrence should both correct for individual provisions' directional effects on takeover likelihood, and account for endogeneity.

The results in rows 9-12 illustrate which subsets of the various provisions actually reflect takeover deterrence, and which constitute noise. Each row reports the effect on takeover likelihood of the subset of provisions in a given index that are not in the D-index. In each case, the non-D-index provisions are not significantly related to takeover likelihood with or without correcting for endogeneity. We note that the F-statistics from the first-stage regressions associated with rows 9-12 all easily exceed the guidelines from the literature for the identification of strong instruments. Hence the lack of significance in these rows is not due to weak instruments.

These results are corroborated by the results in rows 13-20. Each row reports the relation to takeover likelihood for the subset of an index's provisions that are also in the D-index. We report two sets of results for each index. The first enters the D-index provisions with the corrected signs for the four provisions, and the second enters the D-index provisions with the original signs as used by previous researchers.

In row 13, the E-index provisions that also are in the D-index are negatively related to takeover likelihood with or without treatments for endogeneity if we count the absence of a golden parachute instead of its presence consistent with the sign of the marginal effect as reported in Table 5. Without correcting the sign on golden parachutes, the E-index provisions that also are in the D-index are negatively related to takeover likelihood only after correcting for endogeneity. Similarly, the subsets of each of the other indices that are in the D-index are negatively related to takeover likelihood, but the relation becomes smaller or insignificant in tests that do not control for endogeneity if the provisions are not entered taking into account the positive marginal effects of four of the provisions. We conclude from these results that, although the G-index, E-index, O-index, and FK-index are negatively related to takeover likelihood after controlling for endogeneity, these relations are wholly attributable to the set of provisions that constitute the D-index.[17]

Six provisions in the D-index are not in any of the other indices (other than the G-index): cashouts, compensation plans, director indemnification, straight voting, director liability, and director contracts. The inclusion of these six provisions could surprise some researchers simply because they generally are treated as not materially affecting takeover deterrence. By selecting

[17] In additional untabulated tests, we estimate takeover likelihood models that include both the D-index and indices constructed from G-index (or E-index) provisions that are not in the D-index as explanatory variables. The D-index coefficient is negative and significant, while the coefficients for the non-D-index provisions are not statistically significant.

other provisions as the most important, the authors of the E-index, FK-index, and ATI implicitly assert these six D-index provisions are not important. We do not take a stand on whether we should or should not expect these six provisions to be important. But as demonstrated in rows 21 and 22 of Table 6, these six provisions, as a group, are empirically important.

6. Conclusion

The G-index and E-index are used extensively in the literature as proxies for takeover vulnerability. Yet, because of endogeneity, almost no empirical evidence exists that quantifies whether, or how much, various takeover defenses, or combination of defenses, actually affect a firm's likelihood of being acquired. Indeed, we find that, in simple tests that do not account for endogeneity, there is no empirical relation between a firm's G-index or E-index and its takeover likelihood.

In this paper we use two new instruments to achieve identification in tests of the relation between takeover defenses and takeover likelihood. The first instrument is based on the use of takeover defenses by geographically proximate firms that are not in the same industry as the subject firm, and the second instrument is based on the use of takeover defenses by firms in the same IPO cohort as the subject firm but not in the same industry. Previous findings indicate that a firm's geography and IPO year have strong effects on its use of takeover defenses that are related to networking and law firm influence rather than a direct concern about takeover vulnerability. These instruments thus help to simulate arbitrary variation in a firm's use of takeover defenses to test for the relation between the use of such defenses and takeover likelihood.

Using these instruments to account for endogeneity, we find that a one-standard deviation increase in the instrumented value of a firm's G-index (E-index) results in a 9.7% (11.0%)

reduction in the probability that the firm will be acquired within one year. At the provision level we find strong evidence that 10 provisions negatively affect takeover likelihood: anti-greenmail provisions, classified boards, director indemnification, limitations on director liability, director contracts, directors' duties provisions, fair price provisions, cashout laws, supermajority vote requirements, and unequal voting rights. We also find mixed evidence that poison pills are negatively related to takeover likelihood. Four provisions counted as takeover deterrents in the G-index are positively and significantly related to takeover likelihood: change-in-control compensation plans, golden parachutes, the absence of cumulative voting, and limits on shareholders acting by written consent.

Overall, our results provide the first direct empirical support for the widespread use of the G-index and E-index as measures of takeover deterrence because – after taking endogeneity into account – higher values of both indices are shown to have a negative causal effect on takeover likelihood. However, we also show that the relation between takeover likelihood and the G-index is driven by a subset of provisions that, collectively, we call the Deterrence Index or D-index. The D-index is a purely empirically-based collection of 14 provisions that, we propose, best reflects a firm's takeover defense posture. Many of these provisions are excluded from the E-index, and four of them are counted with the opposite sign from how they are included in the G-index. While the D-index provisions individually and jointly are significantly related to takeover likelihood, the G-index and E-index provisions that are not in the D-index are not significantly related to takeover deterrence.

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Figure 1: Firm headquarters in our sample

The figure below shows the headquarters of firms in our sample, used to create geography-based instruments for the use of individual takeover defenses and indices of takeover defenses. Our sample was created as the intersection of firms in both the IRRC and Compustat databases from 1990-2010.

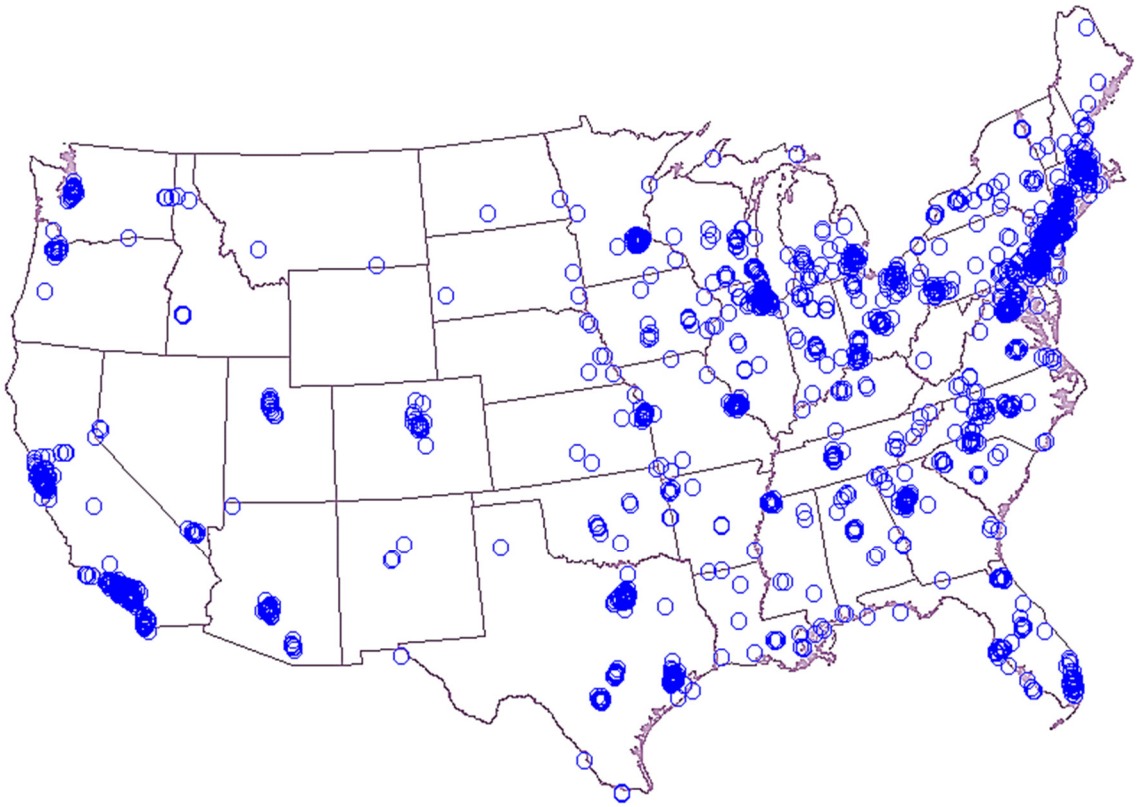

Figure 2: Visual portrayal of the relations between different takeover indices

In the figure below the 24 provisions covered in the G-index are represented visually by the largest circle. Each of the shapes within the circle represents other takeover indices used in the literature to proxy for takeover vulnerability. The shaded regions identify which provisions are shared between indices. The figure visually highlights the differences in opinions that exist in the finance literature about which provisions relate to takeover likelihood, and helps motivate the empirical measures used in Table 6. The G-index, E-index, FK-index, and ATI are described in Gompers, Ishii, and Metrick (2003), Bebchuk, Cohen, and Ferrell (2009), Field and Karpoff (2002), and Cremers, Nair, and John (2009), respectively. The O-index includes the G-index provisions minus the E-index provisions and is shown in the figure using the circular hatch marks. The four provisions shown with negative signs indicate that based on evidence from Table 5 the presence of these provisions is empirically linked to higher, not lower, takeover likelihood.

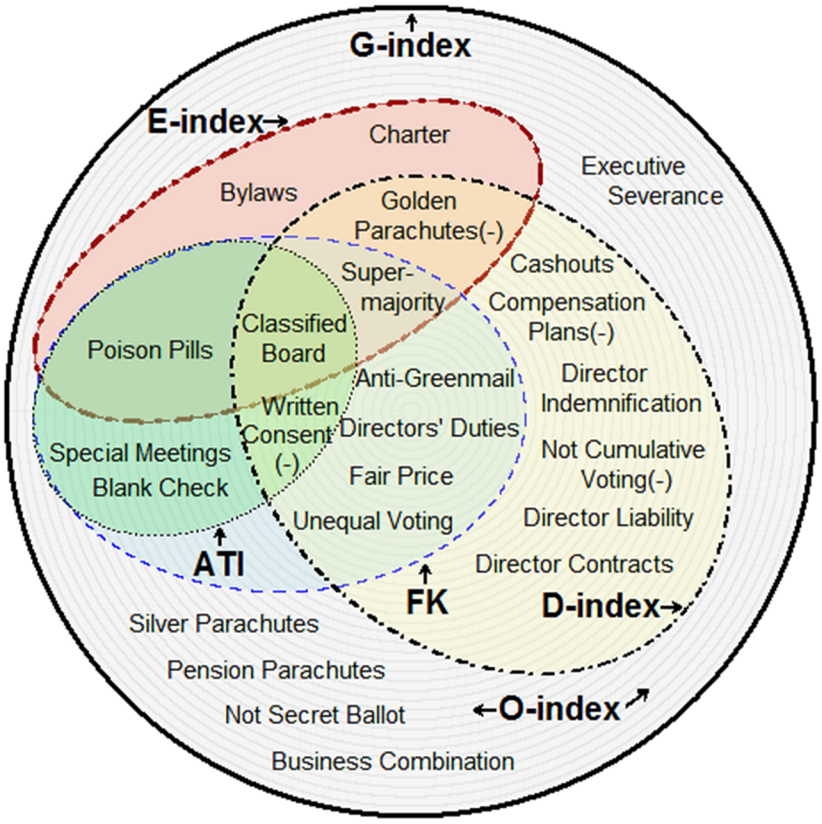

Table 1: Sample information across years

The table reports the number of firms (year t) and the number of takeovers (year t+1) in each year of our sample. The last two columns report the mean G-index and E-index values for the firms in the sample. The sample is based on the intersection of the IRRC and Compustat databases each year from 1990 through 2010.

Year	Number of Firms	Number of Takeovers	G-Index	E-index
1990	1,043	24	8.96	2.38
1991	1,024	22	8.98	2.39
1992	1,004	18	9.00	2.41
1993	1,105	25	9.19	2.47
1994	1,081	40	9.21	2.48
1995	1,148	39	9.28	2.53
1996	1,115	60	9.28	2.54
1997	1,044	59	9.30	2.54
1998	1,434	131	8.75	2.53
1999	1,320	110	8.78	2.53
2000	1,306	64	9.02	2.65
2001	1,215	30	9.04	2.65
2002	1,535	51	9.06	2.72
2003	1,481	42	9.08	2.73
2004	1,498	73	9.13	2.78
2005	1,426	75	9.16	2.79
2006	1,387	104	9.10	2.79
2007	1,280	58	9.10	2.79
2008	1,199	31	9.12	2.79
2009	1,156	44	9.12	2.79
2010	1,109	64	9.15	2.80

Table 2: Descriptive statistics

The mean and median values of the variables described below are shown for all firms in the sample from 1990–2010. The sample is based on the intersection of IRRC and Compustat firms. Firm size is measured as the book value of assets. Leverage is measured as long-term debt divided by book value of assets. Market to book is the sum of the book value of debt and the market value of equity all divided by the book value of assets. ROA is calculated as operating income after depreciation divided by the book value of assets. It is adjusted by subtracting the median industry ROA each year using Fama-French 49 industries. The property ratio is calculated as the gross property, plant, and equipment divided by the book value of assets. The liquidity ratio is the difference between current assets and liabilities divided by the book value of assets. Sales growth is the average annual sales growth calculated over years t, t-1, and t-2. Market-adjusted returns are the buy-and-hold returns at the firm over the prior calendar year minus the buy-and-hold return on the CRSP value-weighted index over the same time period. Industry concentration is measured as the Herfindahl-Hirshman index using Compustat sales information.

Variable	Mean	Median	Observations
G-index	9.08	9	25,910
E-index	2.63	3	25,910
Target	0.04	0	25,910
Firm size ($ millions)	4,903.59	1,270.88	25,910
Market value of equity ($ millions)	5,769.42	1,227.51	25,910
Leverage	0.21	0.19	25,910
Market to book	1.52	1.13	25,910
Industry-adjusted ROA	0.05	0.03	25,910
Property ratio	0.61	0.54	25,910
Liquidity ratio	0.20	0.17	25,910
Sales growth	0.09	0.07	25,910
3-year sales growth	0.03	0.02	25,910
Market-adjusted return	0.02	-0.03	25,910
Industry concentration	6.41	5.11	25,910

Table 3: Takeover likelihood and takeover indices without accounting for endogeneity

Coefficients from probit and linear probability models are shown in columns 1–4 and 5–8, respectively. In columns 1–2 and 5–6 (3–4 and 7–8) the dependent variable is set to one if the firm was acquired over the next year (five years). The control variables are described in Table 2. The sample is constructed from the intersection of the IRRC and Compustat databases from 1990–2010. The number of observations drops slightly in models 1 and 2 because some industry-year cells do not contain observations with variation in the dependent variable (i.e., both 1 and 0). *p*-values are shown in parentheses below the coefficients with significance at the 10%, 5%, and 1% levels noted using *, **, ***, respectively. The errors are robust to heteroskedasticy and clustered at the firm level.

	Probit Models				Linear Probability Models			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	(t+1)	(t+1)	(t+1, t+5)	(t+1, t+5)	(t+1)	(t+1)	(t+1, t+5)	(t+1, t+5)
G-index	-0.004		0.001		-0.001		0.000	
	(0.451)		(0.947)		(0.331)		(0.951)	
E-index		0.005		0.021		0.000		0.006
		(0.732)		(0.222)		(0.822)		(0.195)
Firm size	-0.114***	-0.116***	-0.139***	-0.139***	-0.011***	-0.011***	-0.037***	-0.037***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Leverage	0.191**	0.190**	0.396***	0.393***	0.016	0.016	0.110***	0.109***
	(0.020)	(0.020)	(<0.001)	(<0.001)	(0.104)	(0.104)	(<0.001)	(<0.001)
Market to book	-0.088***	-0.088***	-0.120***	-0.119***	-0.002	-0.002	-0.010*	-0.010*
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(0.102)	(0.103)	(0.080)	(0.080)
Property ratio	-0.147***	-0.151***	-0.093	-0.096	-0.015***	-0.016***	-0.031	-0.031
	(0.007)	(0.005)	(0.171)	(0.157)	(0.005)	(0.004)	(0.125)	(0.115)
Liquidity ratio	-0.423***	-0.421***	-0.329***	-0.323***	-0.053***	-0.052***	-0.117***	-0.115***
	(<0.001)	(<0.001)	(0.001)	(0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Sales growth	-0.161**	-0.159**	-0.062	-0.061	-0.020***	-0.020***	-0.029**	-0.029**
	(0.011)	(0.011)	(0.159)	(0.165)	(0.001)	(0.002)	(0.029)	(0.031)
Industry-adjusted ROA	-0.233	-0.236	-0.279	-0.285	-0.044**	-0.045**	-0.173***	-0.173***
	(0.131)	(0.126)	(0.130)	(0.123)	(0.011)	(0.011)	(0.003)	(0.003)
Market-adjusted return	0.013	0.012	-0.016	-0.017	0.000	0.000	-0.010*	-0.010*
	(0.685)	(0.707)	(0.387)	(0.352)	(0.884)	(0.899)	(0.075)	(0.067)
Industry concentration	-0.005	-0.005	-0.014*	-0.014*	-0.000	-0.000	-0.003*	-0.003*
	(0.463)	(0.476)	(0.055)	(0.061)	(0.319)	(0.341)	(0.063)	(0.074)
Constant	-0.777***	-0.818***	0.201	0.155	0.138***	0.134***	0.474***	0.459***
	(0.002)	(0.001)	(0.502)	(0.605)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Year controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	25,806	25,806	25,910	25,910	25,910	25,910	25,910	25,910
Pseudo R-square	0.066	0.066	0.061	0.061				
Chi-square	636.412	636.080	551.567	551.425				
R-square					0.025	0.025	0.059	0.059

Table 4: Takeover likelihood and takeover indices accounting for endogeneity

The table below shows the second stage coefficients from a linear probability model after instrumenting the G-index, E-index, and O-index variables using both the geography-based and IPO-year-based instruments described in section 2.3. In columns 1–3 (4–6) the dependent variable is set to one if the firm was acquired in the next year (five years). The control variables are described in Table 2. The last two columns report the second stage coefficients from six regressions that mirror those in columns 1–3, and 4–6, respectively, but using standardized versions of the G-index, E-index, and O-index variables where a one-unit increase in the standardized variable represents a standard deviation increase in the underlying index. To save space only the main variables of interest are reported (and stacked) in the last two columns from six separate regressions that in each case include the same control variables as shown in columns 1–6. *p*-values are shown in parenthesis below the coefficients with significance at the 10%, 5%, and 1% levels noted using *, **, ***, respectively. Errors are robust to heteroskedasticity and clustered at the firm level.

Column:	(1)	(2)	(3)	(4)	(5)	(6)	Columns 1–3, standardized coefficients	Columns 4–6, standardized coefficients
	Acquired within one year			Acquired within five years				
	(t+1)	(t+1)	(t+1)	(t+1,t+5)	(t+1,t+5)	(t+1,t+5)		
G-index	-0.008***			-0.032***			-0.097***	-0.211***
	(<0.001)			(<0.001)			(<0.001)	(<0.001)
E-index		-0.019**			-0.069**		-0.110**	-0.198**
		(0.023)			(0.041)		(0.023)	(0.041)
O-index			-0.008***			-0.036***	-0.079***	-0.175***
			(<0.001)			(<0.001)	(<0.001)	(<0.001)
Firm size	-0.009***	-0.011***	-0.008***	-0.027***	-0.037***	-0.027***		
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)		
Leverage	0.016	0.019*	0.015	0.110***	0.121***	0.104***		
	(0.113)	(0.062)	(0.142)	(<0.001)	(<0.001)	(<0.001)		
Market to book	-0.003*	-0.003	-0.003*	-0.012*	-0.012*	-0.011*		
	(0.096)	(0.106)	(0.093)	(0.078)	(0.088)	(0.073)		
Property ratio	-0.011*	-0.013**	-0.012**	-0.010	-0.020	-0.013		
	(0.052)	(0.024)	(0.035)	(0.636)	(0.333)	(0.529)		
Liquidity ratio	-0.059***	-0.061***	-0.056***	-0.144***	-0.148***	-0.131***		
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)		
Sales growth	-0.023***	-0.021***	-0.022***	-0.043***	-0.035**	-0.041***		
	(<0.001)	(0.001)	(<0.001)	(0.002)	(0.012)	(0.002)		
Industry-adjusted ROA	-0.043**	-0.044**	-0.043**	-0.166***	-0.171***	-0.166***		
	(0.017)	(0.016)	(0.015)	(0.007)	(0.006)	(0.006)		
Market-adjusted return	0.001	0.001	0.001	-0.007	-0.007	-0.008		
	(0.720)	(0.697)	(0.789)	(0.259)	(0.267)	(0.167)		
Industry concentration	-0.001	-0.001*	-0.000	-0.004**	-0.004**	-0.003*		
	(0.173)	(0.093)	(0.294)	(0.029)	(0.016)	(0.061)		
Constant	0.188***	0.184***	0.171***	0.704***	0.652***	0.637***		
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)		
Year controls	Yes	Yes	Yes	Yes	Yes	Yes		
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes		
Observations	25,910	25,910	25,910	25,910	25,910	25,910		
Chi-square (2nd stage)	516.2	509.8	520.4	579.5	561.6	588.2		
Prob < Chi-square (2nd stage)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
F-statistic (1st stage)	80.0	28.6	124.2	80.0	28.6	124.2		
R-square (1st stage)	0.166	0.110	0.190	0.166	0.110	0.190		

Table 5: Takeover likelihood as a function of individual provisions after correcting for endogeneity

Columns 1, 2, 7, 8, and 9 report the marginal effects related to the ∂_i's shown in the takeover equation below where p_i is an indicator variable for each of the 24 takeover provisions considered in the paper. In all specifications the dependent variable (y_1) is set to 1 in year t if the firm in question is acquired in t+1. In all specifications the same 75 control variables used in Table 4 are also included (but not tabulated) controlling for various firm, industry and year effects.

$$y_1 = \propto_0 + p_i\partial_i + Index_{23}\vartheta_{23} + \sum_{j=1}^{75} x_j\beta_j + e \qquad \text{(takeover equation, columns 2-9)}$$

$$p_i = \alpha_0 + z\_p_{geo,i}\pi_i + z\_p_{ipo,i}\theta_i + Index_{23}\alpha_{23} + \sum_{j=1}^{75} x_j\gamma_j + u \qquad \text{(first stage equation, columns 3-9)}$$

The results in columns 1 and 2 are estimated using only the takeover equation whereas the results in the other columns are estimated using both equations. In column 1 the marginal effects are all from a single linear probability regression model (LPM) that includes all 24 provisions together each as separate indicator variables in addition to the control variables. Hence for column 1, unlike the other columns, the takeover equation does not include an *Index23* variable and instead includes 24 p_i's. In contrast, the marginal effects in column 2 (and in each of the other columns) are from 24 separate regressions where for each regression one provision at a time is included as an indicator variable (p_i) while simultaneously controlling collectively for the other 23 provisions using an index (index23). The results in columns 3-7 all come from 2SLS LPMs that include both the geography- and IPO-year-based instruments (z_p_{geo} and z_p_{ipo}) in the first stage. The instruments are described in section 2.3. Columns 3 and 4 report the R-square and F-statistic from the first-stage equations and provide a sense as to the strength of the instruments. Column 5 indicates whether there is evidence of a strong instrument using the F-statistic rule-of-thumb cutoff of 10 as advocated in Staiger and Stock (1997). Column 6 indicates whether the p-value from the test for exogeneity is less than 10%. For this test the null hypothesis is that the variables are exogenous, so a p-value < 10% provides evidence that the provision in question needs to be treated as endogenous. Column 7 reports the marginal effect of each provision on being acquired as estimated in the second stage (takeover) equation. For robustness, columns 8 and 9 are based on alternative modeling approaches and report the marginal effects from a recursive bivariate probit model (RBPM) and a limited-information maximum likelihood (LIML) model, respectively. The underlying equations (shown above) are similar for the 2SLS LPM, RBPM, and LIML models but different key assumptions are made in each approach. For the RBPM, the two left-hand side variables in the equations above are considered latent variables (y_1^*, p_i^*). By assumption, y_1 and p_i are observed to equal 1 when their underlying respective latent variables are above a certain threshold. In the RBPM the errors are assumed to have a bivariate normal distribution with a modeled correlation of ρ: $\binom{u}{e} \sim N\left\{\binom{0}{0}, \binom{1\ \rho}{\rho\ 1}\right\}$. RBPM marginal effects are estimated as the difference in the predicted probability of observing a takeover conditional on having or not having the provision while holding all other characteristics at the firm constant following Greene (5 ed., page 716). For both the RBPM and LIML approaches, maximum likelihood estimation techniques are used to estimate both equations. Column 10 summarizes the sign of each provision's marginal effect on the likelihood of being acquired using a 10% p-value cutoff. Column 10 uses the signs and significance of the 2SLS LPM results if there is evidence of a strong instrument. If the instrument is weak and there is no evidence of endogeneity then the LPM results from columns 1 and 2 are used. Significance of the 2SLS, RBPM, and LIML marginal effects is shown using asterisks with significance at the 10%, 5% and 1% shown using *, **, and ***, respectively. Errors are corrected for heteroskedasticiy and clustered by firm. As in previous tests, there are 25,910 firm-year observations used in these tests.

Table 5, continued

Provision	(1) LPM marginal effects (all together)	(2) LPM marginal effects (one at a time)	(3) LPM 2SLS first-stage R-Square	(4) LPM 2SLS first-stage F-Statistic	(5) Evidence of a strong instrument	(6) Evidence of endog-eneity?	(7) LPM 2SLS marginal effects	(8) Recursive Bivariate Probit marginal effects	(9) LIML marginal effects	(10) Include in D-index?
Anti-greenmail	-0.004	-0.007**	0.250	156.603	yes	yes	-0.027***	-0.006***	-0.027***	-
Blank check	-0.007*	-0.004	0.108	38.368	yes	yes	0.038	0.011	0.038	
Classified board	-0.006**	-0.003	0.155	4.129			-0.017	0.000	-0.018	-
Compensation plans	0.006*	0.007**	0.132	0.766			-0.203	0.014	-0.225	+
Not cumulative voting	0.000	0.003	0.131	36.933	yes	yes	0.035**	0.015	0.035**	+
Director indemnification	0.001	-0.005*	0.212	122.747	yes	yes	-0.033***	-0.008***	-0.033***	-
Director contracts	-0.008**	-0.009**	0.072	18.987	yes		-0.058*	-0.004	-0.058*	-
Director liability	-0.008**	-0.008***	0.439	430.945	yes	yes	-0.018***	-0.009***	-0.018***	-
Directors duties	-0.003	-0.007	0.149	41.304	yes	yes	-0.039***	-0.005***	-0.039***	-
Fair price	-0.002	-0.007**	0.258	112.707	yes	yes	-0.047***	-0.022***	-0.047***	-
Golden parachutes	0.016***	0.017***	0.137	0.065			-0.209	0.027	-1.148	+
Bylaws	0.000	0.003	0.088	33.906	yes		0.030	0.004	0.030	
Charter	0.017	0.018*	0.055	2.859			-0.149	-0.010***	-0.150	
Cashouts	-0.001	-0.008	0.299	32.579	yes	yes	-0.030**	-0.001**	-0.030**	-
Special meeting	-0.004	0.002	0.176	74.202	yes		0.019	0.006	0.019	
Written consent	0.010***	0.010***	0.179	100.519	yes	yes	0.032**	0.009**	0.032**	+
Pension parachutes	-0.002	0.003	0.060	4.312			-0.135	-0.004***	-0.135	
Business combination	0.000	0.001	0.170	82.135	yes		-0.007	-0.003	-0.007	
Poison pill	0.000	0.004	0.140	2.675			-0.090	-0.036**	-0.090	
Not secret ballot	-0.005	-0.004	0.164	12.830	yes	yes	-0.043	0.006	-0.043	
Executive severance	-0.001	-0.009*	0.043	0.812			0.321	-0.001	0.322	
Silver parachutes	0.002	0.002	0.059	0.563			-0.502	-0.003**	-0.760	
Supermajority	-0.008***	-0.010***	0.203	156.398	yes	yes	-0.042***	-0.018***	-0.043***	-
Unequal voting	-0.018**	-0.022**	0.029	1.349			0.712	-0.001	0.719	-

Table 6: Which sets of provisions explain takeover likelihood?

The table below reports the regression coefficients in columns 1 and 2 from limited probability models (LPM) where in each row a different set of provisions is included as the key variable of interest. In all cases the same 75 control variables shown in Table 4 for various firm, industry and year effects are included in these regressions but not tabulated. The dependent variable (y_1) is set to 1 in year t if the firm was acquired in year t+1. The ∂'s in column 1 were estimated without correcting for endogeneity using just the takeover model shown below.

$$y_1 = \propto_0 + set_i\partial_i + \sum_{j=1}^{75} x_j\beta_j + e \qquad \text{(takeover equation)}$$

$$set_i = \delta_0 + set_i geo\_IV_i\pi_i + set_i ipo\_IV_i\vartheta_i + \sum_{j=1}^{75} x_j\omega_j + \mu \text{ (first stage equation)}$$

In the equations, set_i refers to each of the 22 sets of provisions listed in Table 6. These particular sets of provisions correspond with either (1) the anti-takeover indices used in the literature, or (2) subsets of these indices that either do or do not overlap with the provisions found to be significant in explaining takeover likelihood in Table 5. For example, row 1 corresponds with the G-index as discussed in Gompers, Ishii, and Metrick (2003) and row 9 corresponds with the subset of provisions in the G-index that are not also in D-index. The D-index refers to the sets of provisions identified in column 10 of Table 5. The ∂'s in column 2 were estimated after correcting for endogeneity using a 2SLS approach with the geography- and IPO-year-based instruments ($set_i geo\_IV_i, set_i ipo\_IV_i$) described in section 2.3. The ∂'s in column 3 are standardized versions of those in column 2. The last 2 columns report the F-statistic and R-square values form the 1st stage equations used when estimating the ∂'s in columns 2 and 3. The significance of the ∂'s is shown at the 10%, 5%, and 1% levels using *, **, ***, respectively. The errors are robust to heteroskedasticity and clustered at the firm-level. The sets of provisions noted as having corrected signs indicate that those sets of provisions were aggregated using the signs from Table 5 meaning that the absence of golden parachutes and compensation plans and the presence of cumulative voting and limitations on written consent were added to these sets. As in previous tests, observations number 25,910.

	Sets of Provisions	(1) LPM ∂'s	(2) 2SLS LPM ∂'s	(3) 2SLS LPM std ∂'s	(4) 1st Stage F-statistic	(5) 1st Stage R-Square
Anti-takeover indices used in literature						
1	All provisions in G-index	-0.001	-0.008***	-0.097***	80.011	0.166
2	All provisions in E-index	0.000	-0.019**	-0.110**	25.593	0.110
3	All provisions in O-index	-0.001	-0.008***	-0.079***	124.182	0.190
4	All provisions in FK-index	-0.001*	-0.014***	-0.126***	44.780	0.127
5	All provisions in ATI	0.001	0.007	0.045	43.527	0.113
New takeover deterrence –index based on Table 5 results column 10						
6	All provisions in D-index (corrected signs)	-0.005***	-0.008***	-0.077***	295.846	0.385
7	D-index provisions plus poison pills (corrected signs)	-0.005***	-0.007***	-0.074***	302.620	0.383
8	All provisions in D-index (original signs)	-0.001	-0.008***	-0.083***	153.813	0.247
Subsets of provisions from takeover indices that are NOT also in the D-index						
9	G-index provisions not in D-index	0.000	0.001	0.005	20.643	0.075
10	E-index provisions not in D-index	0.001	0.025	0.071	35.597	0.075
11	O-index provisions not in D-index	-0.002	0.004	0.015	28.662	0.071
12	ATI and FK-index provisions not in D-index	0.001	0.012	0.049	20.543	0.113
Subsets of provisions from takeover indices that ARE also in the D-index						
13	E-index provisions also in D-index (corrected signs)	-0.010***	-0.036***	-0.145***	42.172	0.106
14	E-index provisions also in D-index	0.000	-0.034***	-0.150***	54.234	0.138
15	O-index provisions also in D-index (corrected signs)	-0.005***	-0.008***	-0.064***	351.472	0.404
16	O-index provisions also in D-index	-0.002*	-0.009***	-0.069***	181.68	0.262
17	FK-index provisions also in D-index (corrected signs)	-0.005***	-0.014***	-0.092***	220.771	0.286
18	FK-index provisions also in D-index	-0.003***	-0.018***	-0.120***	80.341	0.173
19	ATI provisions also in D-index (corrected signs)	-0.008***	-0.079***	-0.231***	23.93	0.094
20	ATI provisions also in D-index	0.002	0.013	0.048	46.957	0.081
Subset of provisions in D-index not also in E-index, KF, or ATI indices						
21	Six provisions unique to D-index (corrected signs)	-0.005***	-0.009***	-0.051***	275.027	0.348
22	Six provisions unique to D-index (original signs)	-0.002	-0.010***	-0.055***	233.103	0.263

Appendix A

Table A1: Percent of firms with each provision during the sample period. Each year's data is used in the subsequent year(s) until the next IRRC volume becomes available. In the G-index, 1 was added to the index if the firm did not allow cumulative voting or did not allow secret ballots. In this table Cumulative vote is set equal to 1 if the firm had a cumulative vote, and secret ballot is set equal to 1 if the firm allowed secret ballots.

Provision	1990	1993	1995	1998	2000	2002	2004	2006
Blank check	77.0	79.7	84.7	87.0	88.7	90.2	90.3	91.3
Classified board	57.2	58.4	59.8	57.9	58.3	59.3	58.7	55.4
Special meeting	24.6	28.3	30.4	31.5	36.4	47.9	50.7	52.0
Written consent	24.6	28.4	31.1	30.9	35.1	44.6	46.5	48.3
Compensation plans	42.2	63.4	70.9	61.2	71.2	73.7	75.9	75.7
Director contracts	17.9	15.9	13.3	11.3	9.7	8.5	7.7	7.7
Golden parachutes	49.8	52.5	53.3	54.6	62.3	67.2	73.4	77.9
Director indemnification	40.9	38.6	37.3	23.2	23.6	18.6	17.4	18.1
Director liability	73.6	68.8	65.2	46.4	43.9	33.1	31.4	30.6
Executive severance	13.6	5.2	10.3	12.2	10.6	7.0	6.5	3.7
Bylaws	13.6	15.4	15.2	16.5	18.9	21.4	22.2	21.2
Charter	2.5	2.6	2.5	2.6	2.5	2.0	1.9	2.1
Cumulative vote	18.7	16.9	15.7	12.4	11.2	9.1	8.9	8.7
Secret ballot	2.5	9.1	11.5	9.1	10.3	10.0	11.6	13.0
Supermajority	38.0	38.6	37.9	34.3	33.9	31.7	31.6	31.4
Unequal voting	2.2	2.1	2.0	1.8	1.2	1.1	0.8	0.6
Anti-greenmail	6.9	6.8	6.5	5.0	4.7	3.4	3.3	3.5
Directors' duties	5.5	6.7	6.6	6.3	6.7	6.7	7.2	6.9
Fair price	33.7	35.1	33.4	26.8	26.3	20.8	20.0	19.8
Pension parachutes	4.2	5.1	3.9	2.3	1.4	1.0	0.9	0.7
Poison pill	52.7	55.0	54.4	52.7	56.3	57.1	58.0	54.1
Silver parachutes	4.1	4.9	3.5	2.6	1.8	1.5	1.1	1.2
Anti-greenmail law	17.9	17.4	16.9	14.2	14.9	13.7	13.6	13.8
Business combination law	86.2	89.5	89.8	90.8	92.0	92.7	92.0	92.6
Cash out law	4.5	4.3	4.2	3.2	3.1	2.9	2.9	3.1
Directors' duties law	5.5	5.3	5.3	4.3	4.0	3.9	4.1	4.3
Fair price law	34.3	35.2	34.2	31.2	31.5	28.7	28.9	29.7
Control-share acquisition law	28.1	28.4	28.0	26.7	26.3	24.8	24.9	25.4

Table A2: Number of firms in the sample going public each year. All IPO years before 1950 are assigned a 1950 IPO date for compiling the firm's IPO year cohort.

IPO year	Firms	IPO year	Firms	IPO year	Firms	IPO year	Firms
1950	244	1965	22	1980	20	1995	114
1951	6	1966	15	1981	50	1996	136
1952	6	1967	27	1982	28	1997	83
1953	6	1968	36	1983	89	1998	78
1954	7	1969	48	1984	47	1999	116
1955	6	1970	30	1985	41	2000	68
1956	5	1971	28	1986	95	2001	39
1957	8	1972	251	1987	109	2002	33
1958	6	1973	17	1988	59	2003	9
1959	7	1974	6	1989	43	2004	5
1960	11	1975	12	1990	54	2005	1
1961	10	1976	12	1991	107	2007	1
1962	76	1977	11	1992	119		
1963	14	1978	13	1993	142		
1964	24	1979	18	1994	91		

Table A3: Takeover likelihood as a function of index values after correcting for endogeneity – using only the geography-based instrument.

This table corresponds to Table 4 in the main body of the paper. Table 4 in the main body of the paper presents the overidentified results using both instruments. This table shows the second stage coefficients from a linear probability model after instrumenting the G-index, E-index, and O-index variables using only the geography-based instrument described in section 2.3 of the paper. In columns 1–3 (4–6) the dependent variable is set to 1 if the firm was acquired in the next year (five years). The control variables are described in Table 2 in the paper. *p*-values are shown in parentheses below the coefficients with significance at the 10%, 5%, and 1% levels noted using *, **, ***, respectively. Errors are robust to heteroskedasticity and are clustered at the firm level.

	Using only the geography-based instrument					
	(1)	(2)	(3)	(4)	(5)	(6)
	(t+1)	(t+1)	(t+1)	(t+1, t+5)	(t+1, t+5)	(t+1, t+5)
G-index	-0.017***			-0.051***		
	(0.001)			(0.005)		
E-index		-0.053***			-0.142**	
		(0.003)			(0.020)	
O-index			-0.014***			-0.044**
			(0.002)			(0.015)
Firm size	-0.006***	-0.011***	-0.007***	-0.022***	-0.037***	-0.024***
	(0.004)	(<0.001)	(<0.001)	(0.002)	(<0.001)	(<0.001)
Leverage	0.016	0.024**	0.014	0.110***	0.132***	0.103***
	(0.142)	(0.040)	(0.183)	(<0.001)	(<0.001)	(<0.001)
Market to book	-0.003*	-0.004	-0.003*	-0.013*	-0.014*	-0.012*
	(0.093)	(0.117)	(0.089)	(0.080)	(0.099)	(0.073)
Property ratio	-0.005	-0.008	-0.009	0.002	-0.010	-0.009
	(0.489)	(0.254)	(0.147)	(0.935)	(0.679)	(0.688)
Liquidity ratio	-0.067***	-0.076***	-0.058***	-0.159***	-0.180***	-0.134***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Sales growth	-0.027***	-0.024***	-0.024***	-0.050***	-0.041***	-0.044***
	(<0.001)	(<0.001)	(<0.001)	(0.001)	(0.008)	(0.003)
Industry-adjusted ROA	-0.041**	-0.043**	-0.042**	-0.161**	-0.168**	-0.164***
	(0.037)	(0.043)	(0.021)	(0.012)	(0.013)	(0.007)
Market-adjusted return	0.002	0.003	0.001	-0.005	-0.004	-0.007
	(0.520)	(0.428)	(0.712)	(0.459)	(0.615)	(0.205)
Industry concentration	-0.001*	-0.001**	-0.000	-0.004**	-0.006***	-0.003*
	(0.087)	(0.023)	(0.276)	(0.023)	(0.008)	(0.062)
Constant	0.258***	0.269***	0.199***	0.837***	0.836***	0.675***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Year controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	25910	25910	25910	25910	25910	25910
Chi-square(2nd stage)	448.3	435.3	491.5	546.1	504.4	573.3
Prob< Chi-square(2ndstage)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
F-statistic(1st stage)	33.5	18.0	54.5	33.5	18.0	54.5
R-square(1st stage)	0.117	0.097	0.123	0.117	0.097	0.123

Table A4: Takeover likelihood as a function of index values after correcting for endogeneity – using only the IPO-year-based instrument.

This table corresponds to Table 4 in the main body of the paper. Table 4 in the main body of the paper presents the overidentified results using both instruments. This table shows the second stage coefficients from a linear probability model after instrumenting the G-index, E-index, and O-index variables using only the IPO-year-based instrument described in section 2.3 of the paper. In columns 1–3 (4–6) the dependent variable is set to 1 if the firm was acquired in the next year (five years). The control variables are described in Table 2 in the paper. *p*-values are shown in parentheses below the coefficients with significance at the 10%, 5%, and 1% levels noted using *, **, ***, respectively. Errors are robust to heteroskedasticity and are clustered at the firm level.

	Using only the IPO-year-based instrument					
	(1)	(2)	(3)	(4)	(5)	(6)
	(t+1)	(t+1)	(t+1)	(t+1, t+5)	(t+1, t+5)	(t+1, t+5)
G-index	-0.005***			-0.028***		
	(0.010)			(0.002)		
E-index		-0.004			-0.035	
		(0.713)			(0.390)	
O-index			-0.007***			-0.034***
			(0.005)			(0.001)
Firm size	-0.009***	-0.011***	-0.009***	-0.029***	-0.037***	-0.027***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Leverage	0.016	0.017*	0.015	0.110***	0.116***	0.105***
	(0.109)	(0.094)	(0.134)	(<0.001)	(<0.001)	(<0.001)
Market to book	-0.003*	-0.002	-0.003*	-0.012*	-0.011*	-0.011*
	(0.098)	(0.107)	(0.095)	(0.078)	(0.086)	(0.074)
Property ratio	-0.012**	-0.015***	-0.013**	-0.013	-0.025	-0.014
	(0.029)	(0.007)	(0.025)	(0.555)	(0.225)	(0.499)
Liquidity ratio	-0.057***	-0.054***	-0.055***	-0.141***	-0.133***	-0.130***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Sales growth	-0.022***	-0.020***	-0.022***	-0.041***	-0.032**	-0.040***
	(0.001)	(0.001)	(0.001)	(0.003)	(0.020)	(0.003)
Industry-adjusted ROA	-0.043**	-0.044**	-0.043**	-0.167***	-0.172***	-0.166***
	(0.015)	(0.011)	(0.014)	(0.006)	(0.004)	(0.005)
Market-adjusted return	0.001	0.001	0.001	-0.007	-0.008	-0.008
	(0.767)	(0.858)	(0.808)	(0.228)	(0.166)	(0.160)
Industry concentration	-0.001	-0.000	-0.000	-0.004**	-0.004**	-0.003*
	(0.208)	(0.299)	(0.299)	(0.032)	(0.042)	(0.061)
Constant	0.173***	0.144***	0.165***	0.676***	0.565***	0.627***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Year controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	25910	25910	25910	25910	25910	25910
Chi-square(2nd stage)	524.2	542.4	521.6	578.9	574.6	585.1
Prob < Chi-square(2nd stage)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
F-statistic(1st stage)	140.3	39.2	208.5	140.3	39.2	208.5
R-square(1st stage)	0.157	0.104	0.176	0.157	0.104	0.176

Table A5: Takeover likelihood as a function of individual provisions after correcting for endogeneity

This table corresponds to Table 5 in the main body of the paper. See the Table 5 heading for a detailed explanation of the two equations and variables used in the 2SLS equations. The 2SLS LPM results presented in Table 5 are for the over-identified models using both the geography-based and IPO-year-based instruments. In this table the just-identified results are presented for comparison. *, **, and *** indicate statistical significance at the 10%, 5% and 1% level, respectively. Errors are corrected for heteroskedasticiy and are clustered by firm.

	Just-identified model (Geography IV)		Just-identified model (IPO-year IV)		Over-identified model (both IVs)	
Provision	LPM 2SLS First-stage F-Statistic (Geography IV)	LPM 2SLS Marg. Eff. (Geography IV)	LPM 2SLS First-stage F-Statistic (IPO year IV)	LPM 2SLS Marg. Eff. (IPO-year IV)	LPM 2SLS First-stage F-Statistic (Geography and IPO-year IV)	LPM 2SLS Marg. Eff.
Anti-greenmail	278.863	-0.022***	36.918	-0.090***	156.603	-0.027***
Blank check	2.150	0.087	75.211	0.037	38.368	0.038
Classified board	0.158	-0.811	8.117	-0.010	4.129	-0.017
Compensation plans	0.769	-0.405	0.779	-0.076	0.766	-0.203
Not Cumulative voting	62.431	0.024	15.639	0.108*	36.933	0.035**
Director indemnification	64.681	-0.031*	182.736	-0.034***	122.747	-0.033***
Director contracts	7.424	0.027	35.031	-0.077**	18.987	-0.058*
Director liability	73.990	-0.020	704.996	-0.018***	430.945	-0.018***
Directors' duties	82.601	-0.039***	0.007	1.186	41.304	-0.039***
Fair price	134.078	-0.048***	81.792	-0.048***	112.707	-0.047***
Golden parachutes	0.022	-1.629	0.105	0.077	0.065	-0.209
Bylaws	3.800	-0.074	63.877	0.037	33.906	0.030
Charter	4.739	-0.236	2.781	0.048	2.859	-0.149
Cashouts	64.929	-0.029**	2.781	-0.385	32.579	-0.030**
Special meeting	30.921	0.005	117.451	0.023	74.202	0.019
Written consent	14.033	0.119**	183.649	0.025*	100.519	0.032**
Pension parachutes	3.473	-0.100	6.261	-0.148	4.312	-0.135
Business combination	157.112	-0.005	10.445	-0.082	82.135	-0.007
Poison pill	0.956	-0.083	4.323	-0.091	2.675	-0.090
Not secret ballot	0.529	-0.143	25.158	-0.042	12.83	-0.043
Executive severance	0.597	0.204	1.084	0.342	0.812	0.321
Silver parachutes	0.847	0.166	0.207	-1.673	0.563	-0.502
Supermajority	231.506	-0.039***	72.786	-0.054***	156.398	-0.042***
Unequal voting	2.185	0.601	0.346	0.994	1.349	0.712

Table A6: Table 5 specifications without the *Index*$_{23}$ variable

This table relates to Table 5 in the main paper. As described in the heading to Table 5, most of the results in Table 5 were estimated controlling for the remaining 23 provisions using the *Index*$_{23}$ variable. This table shows the key results from Table 5-like specifications that were estimated without including the other 23 provisions. The dependent variable in Columns 2–4 equals one if the firm is acquired within one year (t+1), and the dependent variable in columns 5–7 equals one if the firm is acquired within five years (t+1, t+5).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			(t+1)			(t+1, t+5)	
	1st-stage F-statistic	LPM 2SLS Marg. Eff.	Bivariate Probit Marg. Eff.	LIML Marg. Eff.	LPM 2SLS Marg. Eff.	Bivariate Probit Marg. Eff.	LIML Marg. Eff.
Anti-greenmail	163.186	-0.028***	-0.006***	-0.028***	-0.125***	-0.026***	-0.125***
Blank check	30.715	0.045	0.011	0.045	0.170	0.052	0.170
Classified board	6.900	-0.024	0.000	-0.024	-0.107	0.007	-0.111
Compensation plans	1.669	-0.088	0.013	-0.095	-0.615	-0.005	-0.770
Not Cumulative voting	35.965	0.037**	0.016	0.037**	0.146**	0.075	0.148**
Director indemnification	147.693	-0.031***	-0.008***	-0.031***	-0.133***	-0.036***	-0.133***
Director contracts	24.198	-0.055**	-0.004	-0.055**	-0.262**	-0.026**	-0.265**
Director liability	479.124	-0.017***	-0.008***	-0.017***	-0.076***	-0.038***	-0.076***
Directors' Duties	41.849	-0.039***	-0.005***	-0.039***	-0.143**	-0.015**	-0.143**
Fair price	145.632	-0.042***	-0.022***	-0.042***	-0.168***	-0.083***	-0.168***
Golden parachutes	0.528	-0.053	0.027	-0.073	-0.022	0.101	-0.034
Bylaws	27.557	0.033	0.004	0.033	0.080	0.019	0.080
Charter	2.661	-0.155	-0.010***	-0.157	-0.269	-0.015***	-0.273
Cashouts	31.355	-0.031**	-0.001**	-0.031**	-0.080	-0.003	-0.080
Special meeting	56.815	0.022	0.006	0.022	0.067	0.020	0.067
Written consent	63.431	0.037**	0.009**	0.037**	0.129**	0.041**	0.132**
Pension parachutes	5.381	-0.128	-0.004***	-0.128	-0.661	-0.011***	-0.663
Business combination	84.245	-0.007	-0.002	-0.007	-0.030	0.013	-0.030
Poison pill	10.309	-0.049	-0.040**	-0.049	-0.230*	-0.148**	-0.230*
Not secret ballot	12.919	-0.042	0.006	-0.042	-0.179	0.053	-0.179
Executive severance	1.153	0.274	-0.001	0.275	0.946	-0.004	0.946
Silver parachutes	0.962	-0.530	-0.003**	-0.606	-1.584	-0.005	-3.641
Supermajority	173.849	-0.041***	-0.017***	-0.041***	-0.140***	-0.054***	-0.141***
Unequal voting	1.229	0.719	-0.001	0.763	3.426	0.001	4.209

Table A7: Summary of the criteria for each provision's inclusion in, or exclusion from, the D-index
This table draws on the information from Table 5 in the paper as well as from Tables A5 and A6 in Appendix A and summarizes the statistical evidence used to decide which provisions to include in the D-index. LPM refers to linear probability models. 2SLS refers to two-stage-least squares. RBPM refers to recursive bivariate probit models. LIML refers to limited-information maximum likelihood models. Robustness tests refer to the tests reported in Tables A5 and A6.

	Marginal Effect	Decision for inclusion in D-index?	Evidence for inclusion (exclusion) in D-index based on Table 5 and appendix Tables A5 and A6
Anti-greenmail	-	Include	Strong IV and strong 2SLS, RBPM, and LIML results.
Blank check		Exclude	Strong IV but not found to be significant in the 2SLS, RBPM, and LIML results.
Classified board	-	Weak Include	Lacking strong IV but no evidence of endogeneity and significant in some of the LPM results.
Compensation plans	+	Include	Lacking strong IV but no evidence of endogeneity and significant in LPM results
Not cumulative voting	+	Include	Strong IV and strong 2SLS results and LIML results.
Director indemnification	-	Include	Strong IV and strong 2SLS, RBPM, and LIML results.
Director contracts	-	Include	Strong IV and weak but consistent 2SLS results and LIML results. Additional support in robustness tests.
Director liability	-	Include	Strong IV and strong 2SLS results and LIML results.
Directors' duties	-	Include	Strong IV and strong 2SLS results and LIML results.
Fair price	-	Include	Strong IV and strong 2SLS results and LIML results.
Golden parachutes	+	Include	Lacking strong IV but no evidence of endogeneity and significant in LPM results
Bylaws		Exclude	Not significant in tests
Charter		Weak Exclude	Lacking strong IV. Marginally significant in LPM results but sign on LPM results is opposite the 2SLS, RBPM, and LIML results. Given the difference in sign between the 2 significant results we left this out of the D-index.
Cashouts	-	Include	Strong IV and strong 2SLS, RBPM, and LIML results.
Special meeting		Exclude	Not significant in tests
Written consent		Include	Strong IV and strong 2SLS, RBPM, and LIML results.
Pension parachutes		Weak Exclude	Lacking strong IV and not significant in LPM results
Business combination		Exclude	Not significant in tests
Poison pill	-	Weak Exclude	Lacking strong IV but significant in RBPM results. Also significant in some of the robustness tests.
Not secret ballot		Exclude	Not significant in tests
Executive severance		Weak Exclude	Lacking strong IV but no evidence of endogeneity and significant in some of the LPM results. Problems with data.
Silver parachutes		Exclude	Lacking strong IV and not significant in LPM results
Supermajority	-	Include	Strong IV and strong 2SLS, RBPM, and LIML results.
Unequal voting	-	Weak Include	Lacking strong IV but no evidence of endogeneity and significant in LPM results