Does Board Size Matter?

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Abstract

This paper uses minimum board size requirements to assess whether large boards reduce firm performance. Since 1976, the legally required minimum size of German supervisory boards increases from 12 to 16 directors as firms pass 10,000 domestic employees. Board sizes increase sharply at this threshold, indicating that the mandate is binding for many firms. Using a regression discontinuity design around the threshold and a difference-in-differences analysis around the law's introduction, we find robust evidence that forcing firms to have large boards lowers performance and value. At the threshold, operating return on assets drops by 2-3 percentage points and Tobin's Q by 0.20-0.25, with similar declines for treated firms after the law's introduction. Firms just above the threshold also generate lower acquisition announcement returns than firms just below, suggesting that large boards undertake worse acquisitions.

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Almost all large firms have a board of directors that plays a central role in their governance. Boards select, monitor, evaluate, compensate, and replace the firm's top executives (American Bar Association, 2009), but also advice and guide them (Adams and Ferreira, 2007). Due to governance failures and scandals, policy makers and regulators around the world have been concerned about the effectiveness of corporate boards, and governance codes in many countries include prescriptions on board size and independence (Adams, 2017). There is, however, a dearth of evidence that large boards harm firms. Because board size is endogenous, drawing conclusions from observed empirical correlations between firm performance and board size is difficult.

This paper uses regulatory minimum board size requirements to assess whether large boards reduce firm performance. German corporations have a two-tier board, with a management board that runs the firm and a supervisory board that represents shareholders and – in larger firms – employees. The supervisory board hires, advises, and monitors the management board. Since 1976, the legally required minimum size of the supervisory board is 12 directors for firms with 2,001-10,000 domestic employees, 16 directors for firms with 10,001-20,000 domestic employees, and 20 directors for firms with more than 20,000 domestic employees.

Using two research designs on data from two distinct time periods, we find robust evidence that forcing firms to have large boards is detrimental to their performance. The first analysis uses a panel of German firms from 1987 to 2016 and a regression discontinuity design to compare firms just below the 10,000 domestic employees threshold to firms just above.[1] Performance declines at the threshold: the reduced form estimates show a drop in operating return on assets (ROA) of 2 - 3 percentage points. Taking into account the increase in the probability of having a large board (defined as ≥16 directors) at the threshold, the two-stage least squares (2SLS) estimates link large boards to a 7 - 8 percentage point drop in ROA. Tobin's Q also declines at the threshold, with a drop of 0.20 - 0.25 in the reduced form and of 0.5 - 0.8 in 2SLS. In addition, firms just above the threshold have lower acquisition announcement returns than firms just below, consistent with large boards approving worse acquisitions.

The second research design is a difference-in-differences analysis around the introduction of the board size requirement in 1976. The analysis compares changes in firm performance from before to after the law's introduction of treated firms (>10,000 employees) to control firms (≤10,000 employees). Depending on the measurement window and the control firms chosen, treated firms' ROA declines by 1.2 - 2.9 percentage points relative to control firms. Treated firms' Tobin's Q declines by 0.12 - 0.15 compared to control firms. Hence, despite the different time periods and research designs, the estimates from the difference-in-differences analysis in the 1970s are in line

[1] We do not use the 2,000 employee threshold because employee codetermination changes at that level (see Section 1.1). We do not use the 20,000 employee threshold because there are too few observations around it.

with the reduced-form estimates from the regression discontinuity analysis for 1987-2016. This evidence supports the hypothesis that forcing firms to have large boards reduces firm performance and value.

Theory suggests that increasing the number of directors has both costs and benefits (Raheja, 2005; Harris and Raviv, 2008). On the one hand, boards' capacity for monitoring and advising increases with board size, simply because there are more people to draw on. A larger group also pools more information and allows for greater diversity of backgrounds and viewpoints. On the other hand, large boards may underperform because of frictions in group decision making (Lipton and Lorsch, 1992; Jensen, 1993). At some point, the benefits of more directors are outweighed by free-riding, slower decision making, and coordination and process problems. Lipton and Lorsch (1992) recommend limiting board size to ten people, with a preferred size of eight or nine, while Jensen (1993) conjectures that boards beyond seven or eight are unlikely to function effectively and are easier for the CEO to control.

The prior literature has mostly found a negative correlation between board size and firm performance. Yermack (1996) documents that board size is negatively related to profitability and firm value in a sample of US firms, and interprets this result as "consistent with theories that small boards are more effective." Similar negative correlations have subsequently been found for many other countries and time periods (Conyon and Peck (1998) for Denmark, France, Italy, the Netherlands, and the UK; Eisenberg, Sundgren, and Wells (1998) for Finland; Mak and Kusnadi (2005) for Malaysia and Singapore; Loderer and Peyer (2002) for Switzerland; De Andres, Azofra, and Lopez (2005) for a pooled sample of 10 OECD countries; Bennedsen, Kongsted, and Meisner Nielsen (2008) for Denmark; and Guest (2009) for the UK). The evidence is not completely unequivocal, with some studies finding insignificant correlations (de Jong et al. (2005) for the Netherlands; Black, Jang, and Kim (2006) for Korea) and some positive ones (Kiel and Nicholson (2003) for Australia; Adams and Mehran (2005) for US banks). Overall, however, the evidence suggests that board size is negatively correlated with profitability and firm value (Hermalin and Weisbach, 2003).

Interpreting this evidence is more of a challenge. Shareholders and executives endogenously choose the size of the board, which implies that unexplained cross-sectional differences in board size are due to unobserved differences in firm, owner, or executive characteristics (Hermalin and Weisbach, 1998, 2003; Raheja, 2005; Boone et al., 2007; Coles, Daniel, and Naveen, 2008; Harris and Raviv, 2008). If, as seems likely, these unobserved characteristics also affect firm performance, negative correlation between board size and performance is not causal.

The list of omitted variables likely to affect both board size and performance is long. For example, diversified firms tend to have large boards, because boards often grow when firms make

acquisitions, or because diversified firms need boards with more varied expertise. Diversified firms also tend to have lower valuations (Lang and Stulz, 1994; Berger and Ofek, 1995). Causality might even run from performance to board size, with troubled firms adding directors to their boards. For example, after loan covenant violations, boards often expand by adding directors linked to lenders (Ferreira, Ferreira, and Mariano, 2017).

The minimum board size requirements in Germany offer a relatively clean test of whether large boards reduce firm performance. The requirements are likely to force at least some firms to have larger boards than they would otherwise choose. The data suggest that the board size mandates are binding for many firms. More than 50% of firms between 7,500 and 10,000 domestic employees have a supervisory board with exactly 12 directors, the minimum number required. For firms between 10,000 and 12,500 domestic employees, again more than 50% have exactly 16 directors, also the minimum number required. This suggests that many firms just above the 10,000 employee threshold would prefer a smaller supervisory board, which allows us to test whether forcing them to adopt a larger one harms their performance.

Even though this paper's setting is useful and, to the best of our knowledge, unique, it does not create an ideal experiment. The number of domestic employees is not randomly assigned but at least in part under the control of management. Hence, firms might choose to remain below the 10,000 domestic employee threshold in order to avoid a larger board. Empirically, we find no evidence that there are unusually many firms just below the threshold, suggesting that few if any firms choose to do so. It is possible that firms view the cost of not growing as worse than the cost of a large board, or that executives simply do not mind making the supervisory board less effective. If firms were to bunch below the threshold, it would likely work against finding a decline in performance, as firms for which large boards are most harmful would decide to stay below. Nevertheless, given that we cannot rule out that employee numbers respond to the board size mandate for some firms, we cannot interpret the performance decline at the threshold as a clean estimate of the causal effect of large boards.

Another concern with the empirical setting is that the sample sizes are small. In the panel from 1987 to 2016, there are 71 sample firms (468 firm-year observations) with 7,500 to 12,500 domestic employees, the range on which we focus most of our analysis. The small sample size results in noisy estimates, especially in the 2SLS analysis. As a robustness test, we repeat the analysis using firms between 5,000 and 15,000 domestic employees, which yields similar but more precisely estimated coefficients. In the difference-in-differences analysis around the law's introduction in 1976, the number of firms is even smaller, with 38 sample firms with more than 10,000 employees and an equal number of matched control firms. Moreover, because the number of domestic employees is not available in the 1970s, we are forced to use total employees as a noisy and upwardly biased

proxy. Given these issues with both samples, it is reassuring that the estimated effects are not just qualitatively but also quantitatively similar.

Our study has implications for the optimal design and regulation of corporate boards. Its results support the prediction, made intuitively by Lipton and Lorsch (1992) and Jensen (1993) and more rigorously by the literature on optimal committee size (Sah and Stiglitz, 1988; Persico, 2004), that board effectiveness declines as board size becomes excessively large. Consequently, shareholders should pay attention to board size, especially if it is influenced by executives whose self-interest might not be in maximizing board effectiveness. Our results are also a warning to regulators that ill-designed board regulations can have large negative effects on firm performance.

Our paper connects to several literatures, most directly to the many studies of the empirical association between board size and firm performance. Our results support an important premise of the idea, proposed by Yermack (1996), that the negative cross-sectional correlation between board size and performance is due to some firms choosing excessively large boards. Implicit in this idea is the hypothesis that increasing the number of directors too much reduces board effectiveness, which our evidence supports.

More broadly, our results add to a growing body of evidence that board structure and composition have first-order effects on firm behavior and performance. Several recent studies use changes to board composition caused by new US exchange listing rules in 2004 as a quasi-experiment to study a variety of corporate outcomes (e.g., Chhaochharia and Grinstein, 2009; Duchin, Matsusaka, and Ozbas, 2010; Guthrie, Sokolowsky, and Wan, 2012; Banerjee, Humphery-Jenner, and Nanda, 2015; Guo and Masulis, 2015; Balsmeier, Fleming, and Manso, 2017). Because these rule changes focused on board composition and committees, these studies do not examine board size effects. Finally, our results are consistent with recent studies that use quasi-natural experiments to demonstrate that individual directors can have important effects on firm performance and value (e.g., Nguyen and Meisner Nielsen, 2010; Giannetti, Liao, and Yu, 2015; Hauser, 2017).

This paper proceeds as follows. Section 1 describes the institutional setting and the two empirical strategies. Section 2 describes the sample selection and variable definitions. Sections 3 to 5 present the empirical results, and Section 6 summarizes and concludes.

1 Institutional Setting and Empirical Strategy

1.1 Corporate boards in Germany

German stock corporations ("AG") and German limited liability companies ("GmbH") with more than 500 domestic employees are required to have a dual board structure with a management

board ("Vorstand") and a supervisory board ("Aufsichtsrat").[2] The management board is made up of the company's top executives and is responsible for running the firm. The supervisory board appoints the members of the management board for at most five years, with the possibility of reappointment. The supervisory board supervises the members of the management board, has the right to examine all corporate documents and assets, and can mandate that certain transactions, such as mergers or acquisitions, require its consent.[3]

In firms with more than 500 domestic employees, the supervisory board has both shareholder and employee representatives as directors. Shareholder representatives, who correspond to non-executive directors on US boards, are elected at the annual shareholder's meeting. Domestic employees (i.e., those employed in Germany) elect the employee representatives, who can be employees of the firm or union representatives. The proportions of shareholder and employee representatives are a function of firm size. Employee representatives make up one-third of the supervisory board in firms with 500 to 2,000 domestic employees, but one-half in firms with more than 2,000 domestic employees. The chairman of the supervisory board is normally a shareholder representative and receives a second, tie-breaking vote in case a board decision is deadlocked.

Because this paper's analysis focuses on firms with around 10,000 domestic employees, all our sample firms have an equal number of shareholder and employee representatives on their supervisory board. Important for interpreting our results, there is no difference in the level of employee representation on the supervisory board between firms just above and just below the 10,000 domestic employee threshold. Any difference in the outcome variables between our "treated" and our "control" firms should therefore be due to differences in board size, not due to differences in co-determination.

1.2 Legal requirements for supervisory board size

Until 1976, German law mandated a minimum size of the supervisory board of three, and a maximum size of 21.[4] In 1976, the law on codetermination ("Mitbestimmungsgesetz") introduced new minimum board size requirements for firms with more than 2,000 domestic employees. The law mandates that the supervisory board has to consist of 12, 16, or 20 members, depending on a firm's number of domestic employees:

[2] Our sample includes a small number of firms that are a hybrid of partnership and stock corporation (KGaA). Their board structure is that of a stock corporation. Since 2004, firms can choose the legal form of a Societas Europaea (SE). Firms with this legal form can choose between a dual and a unitary board structure.

[3] Besides Germany, dual board structures are mandatory in Austria, the Czech Republic, Denmark, Estonia, Hungary, Latvia, Poland, and the Slovak Republic. They are permitted (but not mandated) in Bulgaria, Croatia, Finland, France, Italy, Lithuania, the Netherlands, and Slovenia (Adams, 2017).

[4] The maximum size is an increasing function of the firm's paid-in shareholders' equity. All our sample firms have more than 20 million Deutsche Mark (relevant until 1998) or 10 million Euro in paid-in shareholders' equity, which gives them a maximum board size of 21.

- 12 for firms with more than 2,000, but not more than 10,000 domestic employees
- 16 for firms with more than 10,000, but not more than 20,000 domestic employees
- 20 for firms with more than 20,000 domestic employees

These are minimum size requirements, as the law allows firms to voluntarily choose a larger board size in their corporate charters. Firms with a board size requirement of 12 can voluntarily increase their board size to 16 or 20, and firms with a board size requirement of 16 can voluntarily increase their board size to 20. Four of the six employee representatives in firms with a supervisory board size of 12 are employees of the firm, and the other two are union representatives. For supervisory boards with 16 members, the corresponding numbers are six and two, and for the largest boards seven and three.[5]

To determine the number of domestic employees, the law requires firms to use a broad definition of employees that includes, for instance, trainees and part-time workers (Raiser, Veil, and Jacobs, 2015). Temporary and agency workers, on the other hand, are not counted. For business groups, the employee number is aggregated at the group level and determines the size of the supervisory board for the parent company. Only employees working in Germany are counted, with employees of foreign subsidiaries ignored.

The law exempts companies whose main purpose is political, religious, charitable, educational, or scientific, as well as companies engaged in news reporting and commentary. We exclude such firms from our sample.[6] For historical reasons, different board size requirements apply to firms in the coal, iron, and steel industries. We therefore also exclude firms from those industries.

1.3 Empirical strategy

We use two research designs based on data from two distinct time periods to examine the effect of forcing firms to have large boards on firm performance. Both designs exploit that the minimum required board size jumps discretely at 10,000 domestic employees. Our first empirical strategy compares firms below and above this threshold in a regression discontinuity analysis. Our second strategy uses a difference-in-differences analysis around the introduction of the board size requirement in 1976.

1.3.1 Regression discontinuity analysis

The first analysis uses a panel of firms from 1987 to 2016 and a regression discontinuity design that compares firms just below the 10,000 domestic employees threshold to firms just above. A

[5] Union representatives are also elected by the employees of the firm. Thus, unions have the right to propose employee representatives, but they cannot nominate them directly.
[6] The law also does not apply to firms with the legal form of a Societas Europaea (SE), which became available in 2004. None of our sample firms escaped the board size requirement by changing their legal form.

detailed discussion of the regression discontinuity methodology, including its assumptions, is provided by Lee and Lemieux (2010). For our main tests, we use a parametric regression discontinuity approach with a window of 7,500 to 12,500 domestic employees. The choice of this range is a tradeoff between accuracy and the number of observations. Within this range, there are 468 firm-year observations from 71 unique firms (see Section 2.1). As a robustness test, we also use a broader window of 5,000 to 15,000 domestic employees, which yields 892 firm-years from 120 unique firms.

We do not use the changes in the minimum board size at 2,000 or 20,000 domestic employees in our analysis. Firms crossing the threshold of 2,000 domestic employees have to also establish parity employee representation (i.e., an equal number of employee and owner representatives) on the supervisory board. This makes it difficult to disentangle the effects of employee representation and board size on firm performance. All firms around 10,000 domestic employees have parity employee representation, which allows us to isolate the effect of board size. We do not use the threshold of 20,000 domestic employees because there are too few firms around it.[7]

At the threshold of 10,000 domestic employees, the legally mandated size of the supervisory board increases from 12 to 16. Firms can voluntarily increase their board size in discrete steps to 16 or 20, but they cannot decrease it below the legally mandated size. A sharp regression discontinuity design would require board size to be exactly 12 to the left of the threshold and 16 to the right. In our data, a non-trivial number of firms have larger boards than required by law.[8]

We apply two complementary estimation methods. First, we estimate a reduced form model that estimates the effect of the threshold at 10,000 domestic employees on firm performance. This "intent-to-treat" approach exploits that the probability of being treated (i.e., of having a large board) increases discretely at the threshold. Second, we estimate a two-stage fuzzy regression discontinuity design in which we use the threshold as instrument for having a large board.

The reduced form model regresses firm performance on an indicator variable (>10,000) for firms with at least 10,000 domestic employees. We control for any direct impact of the assignment variable, i.e., the number of domestic employees, on firm performance by including the centered number of employees as control variable. In some models, we include the squared assignment variable to allow for non-linear effects, and in others the assignment variable interacted with the

[7] We found only 21 firms between 17,500 and 22,500 domestic employees.
[8] For firms with 7,500-10,000 domestic employees, 111 out of 261 observations have boards larger than 12, the legal minimum. For firms with 10,000-12,500 domestic employees, 12 out 127 observations have boards larger than 16, the legal minimum.

threshold indicator to allow for different effects of the assignment variable on each side of the threshold.[9]

Because it takes time for a firm to enlarge its board once it crosses the threshold, and because an enlarged board might take time before it affects performance, we measure performance two years after we observe the number of domestic employees. The idea is that employee numbers in year t determine board sizes in year t+1, which in turn affect firm performance in year t+2. In some models, we control for firm characteristics, such as size and leverage. These characteristics are measured one year before firm performance, and hence one year after we observe the number of domestic employees.[10] All specifications include year and industry fixed effects based on the Fama-French 12 industries classification. The final reduced-form regression discontinuity model is

$$Performance_{i,t+2} = \alpha + \beta * >10{,}000_{i,t} + \sum_{p=1}^{2} A_{i,t}^{p} + A_{i,t} * >10{,}000_{i,t} + \vec{\gamma} * \overrightarrow{C_{i,t+1}} + \epsilon_{i,t},$$

where the dependent variable is either ROA or Tobin's Q. The main coefficient of interest is β, which measures the discontinuous change in the outcome variable at the threshold of 10,000 domestic employees. α is a constant, the assignment variable A is the number of domestic employees minus 10,000, and $\overrightarrow{C_{i,t-1}}$ is a vector of control variables (including industry and time fixed effects).

To quantify the effect of forcing firms to have large boards on performance, we next estimate a two-stage fuzzy regression discontinuity model. This model explicitly accounts for the fact that not all firms below the threshold are "untreated", as some voluntarily choose to have larger supervisory boards than legally required. Formally, we use the indicator for more than 10,000 domestic employees as instrument for having a large board. This instrument should be highly relevant because the legally binding minimum board size increases at this threshold. At the same time, it is unlikely that being slightly above or below the threshold has any direct impact on firm performance. We define a large board indicator that equals one if board size is at least 16 and zero otherwise. Because some firms drop temporarily below their minimum required board size due to director retirements or deaths, this indicator remains one if board size drops to 15 for one year, but is at least 16 in the year before and after.[11] We measure board size in the year after we observe the number of domestic employees. The first stage regresses the large board indicator on the indicator

[9] To avoid multicollinearity problems, we do not include polynomials of order two and their interactions with a dummy variable for the threshold in the same model.

[10] Because these firm characteristics are potentially affected by the size of the board, their inclusion might bias the estimated effect of the threshold indicator. We therefore present both models with and without firm characteristics.

[11] In robustness tests, we (i) define the large board indicator as at least 15 directors throughout, or (ii) use the number of directors as a continuous dependent variable in the first-stage regressions. The results are qualitatively and quantitatively similar.

for more than 10,000 domestic employees, using the same specification and controls as in the reduced-form:

$$Large\ Board_{i,t+1} = \alpha + \beta * >10{,}000_{i,t} + \sum_{p=1}^{2} A_{i,t}^{p} + A_{i,t} * >10{,}000_{i,t} + \vec{\gamma} * \overrightarrow{C_{\iota,t+1}} + \epsilon_{i,t}.$$

This first-stage regression estimates the effect of the threshold on the probability of having a large board. The second stage regresses firm performance on the predicted value $\widehat{LB}$ of the large board indicator from the first-stage, using the same specification and controls as before:

$$Performance_{i,t+2} = \alpha + \beta * \widehat{LB}_{i,t+1} + \sum_{p=1}^{2} A_{i,t}^{p} + A_{i,t} * >10{,}000_{i,t} + \vec{\gamma} * \overrightarrow{C_{\iota,t+1}} + \epsilon_{i,t}.$$

The coefficient of interest is β, which measures the effect of large boards (predicted using the first stage) on performance. Intuitively, the second-stage regression rescales the reduced-form effect of the threshold on performance by the threshold's effect on board size. The result is an estimate of how large boards that are due to the board size requirement affect firm performance.

A causal interpretation of this second-stage estimate requires that the allocation of firms around the threshold is independent of any other determinants of firm performance. In our setting, this may not be the case. Firms might strategically decide to stay or shrink below the threshold of 10,000 domestic employees to avoid the higher board size requirement. Upward manipulation is unlikely because firms are permitted to increase their board size beyond the legal minimum. In Section 3.5, we investigate whether firms strategically bunch below the threshold and find no evidence for it. Finally, all models use robust standard errors adjusted for clustering within firms.

1.3.2 Difference-in-differences analysis

The introduction of the board size requirement in 1976 allows us to conduct a difference-in-differences analysis. The analysis compares changes in firm performance from before to after the law's introduction for treated firms (>10,000 employees) with control firms (≤10,000 employees). In particular, we exploit that treated firms had to increase their board size to 16 or 20, whereas control firms only had to increase it to 12.

Even though the board size requirement is based on the number of domestic employees, not total employees, data limitations force us to define treated and control firms using total employees in this sample. We exclude firms that did not have to comply with the new law at all, i.e., those with less than 2,000 employees. This also ensures that both treated and control firms were subject to the newly introduced parity employee representation. This way, we can isolate the effect of board size on firm performance, as the effect of parity employee representation cancels out.

The law on codetermination was passed by the German parliament on March 18, 1976, and became effective on July 1st, 1976. Because of a transition period, 1978 is the year in which boards had to be in line with the new law for the first time. However, there was considerable uncertainty whether the law was constitutional. Several parties, including the main employer associations, filed a constitutional complaint shortly after the law's introduction. On March 1, 1979, the German Constitutional Court ruled that the law did not violate the German constitution and had to be followed by firms.

In most specifications, we use two-year pre- and post-periods around the law's introduction. We consider the two years before the law's introduction (i.e., 1974 to 1975) as the pre-period. Due to the legal uncertainty and the fact that firms were given time to adjust their boards, we exclude the introduction period from 1976 to 1978 from our analysis. 1979 is the first year for which it was clear that firms had to follow the new board size requirements (because we observe board size at year-end, and the ruling of the constitutional court took place in March 1979 and was effective immediately). The post period is defined as 1980 to 1981. Alternatively, we also analyze three-year windows around the introduction period, with 1973 to 1975 as the pre-period and 1979 to 1981 as the post-period.

We assign firms to the treatment or control group based on their number of total employees in 1975, i.e., the last year before the law was passed and became effective. Treated are firms with more than 10,000 total employees. We keep firms with more than 20,000 total employees in our main difference-in-differences specification. In a robustness test we exclude firms with more than 20,000 total employees to ensure that they do not drive our findings. Control firms are those that had more than 2,000, but at most 10,000 total employees. If data on employees is not available for 1975, we use the 1974 number. To reduce the difference in firm size between treated and control firms, we drop small control firms (based on their total assets in 1975) until the number of control firms is equal to the number of treated firms. This leads to a sample of 38 treated and an equal number of control firms. Nevertheless, treated firms are considerably larger than control firms (average total assets of about five billion versus 1.5 billion Euro).

We estimate a standard difference-in-differences model with firm fixed effects and a vector of controls, including time fixed effects:

$$Profitability_{i,t} = \alpha_i + \beta * Treated_i * Post_t + \vec{\gamma} * \overrightarrow{C_{i,t-1}} + \epsilon_{i,t}$$

The treatment dummy is absorbed by the firm fixed effect α_i and the post dummy is absorbed by year fixed effects. The coefficient of interest is β, which measures the change in profitability for treated firms after the law's introduction relative to control firms. We use robust standard errors that are adjusted for clustering at the firm-level.

Firms strategically staying or shrinking below the threshold is arguably less of a concern in this setting. To the best of our knowledge, the threshold of 10,000 domestic employees was first mentioned in a draft version of the law published in early 1974. Because we assign firms to the treatment or control group based on their number of employees in 1975 (measured at the end of the year), firms would have had to manipulate their employee number within less than two years. There was no incentive for firms to manipulate the number of employees upwards because they could voluntarily choose a larger board size before and after the law's introduction. Downward manipulation is also unlikely due to the short time window and the fact that it takes considerable time to dismiss employees in Germany.[12]

In an ideal setting, treated and control firms would only differ regarding their assignment to the treatment. In our setting, assignment to treatment is far from random because it depends on the number of domestic employees, which is positively correlated with firm size. Hence, our treatment firms are on average larger than the control firms, raising the concern that treatment and control firms might be affected by different shocks. Besides verifying that treatment and control firms appear to be on parallel trends before the law's introduction, we control for firm size in the difference-in-differences regressions. We also perform a robustness test in which we match treatment and control firms closely by size, which reduces the sample size but confirms that the estimated treatment effect is not due to size differences.

2 Data

2.1 The 1987-2016 panel

For the regression discontinuity (RD) analysis, we use an unbalanced panel of public and private German firms from 1987 to 2016. The data are from the Hoppenstedt database (www.bilanzen.de), which contains all publicly listed German firms as well as the largest private ones. Detailed information on the sample selection procedure is in Table 1.

We select all non-financial firms that have more than 7,500 total employees in at least one fiscal year between 1987 and 2016. For business groups, we only retain the parent company, and we require that the parent publishes consolidated financial statements for the entire group. This leaves 331 firms. We exclude firms that are exempt from the board size requirement or to whom a different requirement applies because of their industry or the nature of their business (see Section 1.2). This reduces the sample to 262 firms.

We use several sources to collect the number of domestic employees. For about one-third of the sample, this number is available in the Hoppenstedt database. For the remaining firms, we

[12] Germany has strong labor protection laws that make firing employees a lengthy and costly process. This dates back at least to the Employment Protection Act of 1951, long before the introduction of the board size requirement.

manually collect it from annual reports obtained from Hoppenstedt, Thomson Reuters' Thomson ONE, and corporate websites. When available, to be consistent with the board size requirement, we use the average number of domestic employees in a year instead of the year-end number. We are able to obtain the number of domestic employees for 185 firms and 2,079 firm-years.

Next, we restrict the sample to firms around the threshold of 10,000 domestic employees. Most of our analyses use a narrow range of 7,500-12,500 domestic employees, which contains 74 firms with 526 firm-year observations. Using a wider range of 5,000-15,000 domestic employees, we have 125 firms with 1,033 firm-year observations.

Finally, we try to expand the sample using the Worldscope database. Worldscope contains about 1,650 German firms between 1987 and 2016. We retain all firms not in the Hoppenstedt sample, download all available annual reports from Thomson One and corporate websites, hand-collect their number of domestic employees, and retain all firm-years in which this number is in the 5,000-15,000 range. This increases the sample size by 13 firms and 55 firm-years in the 5,000-15,000 range, and by 7 firms and 28 firm-years in the 7,500-12,500 range.

Financial and accounting data for our sample come from the Hoppenstedt database.[13] For most of the analysis, we require that performance data are available two years after we observe the number of domestic employees. This reduces the sample size to 468 observations, with most observations lost at the end of the sample period.

For the 2SLS analysis, we also require the actual size of the supervisory board in the year after we observe domestic employees. We hand-collect the number of directors from annual reports. Missing reports reduce the sample size in the 2SLS analysis to 60 firms and 388 observations with 7,500-12,500 domestic employees, and to 94 firms and 612 observations with 5,000-15,000 domestic employees.

2.2 The law introduction sample

We assemble a second dataset for the difference-in-differences (DiD) analysis around the introduction of the board size requirement in 1976. We collect accounting and financial data as well as the size of the supervisory board from Saling's and Hoppenstedt's Stock Guides ("Aktienführer") from 1972 to 1981.[14] These annual volumes report simplified financial statements and other information for all publicly-traded German firms. We hand-collect the number of employees from the annual Handbook of German Joint-Stock Companies ("Handbuch der deutschen Aktiengesell-

[13] In this sample period, German firms use three different reporting standards. We adjust all financial variables to make them comparable. For the 13 firms from Worldscope, we collect financial data from annual reports.
[14] Starting from 1979, these data are available electronically (http://digi.bib.uni-mannheim.de/aktienfuehrer/). Before 1979, we manually collect all necessary information.

schaften"). We drop financial firms and restrict the sample to firms that are subject to the board size requirement (see Section 1.2).

We define treated firms as firms that had more than 10,000 employees in 1975 (the year before the law passed), and control firms as firms with fewer than 10,000 employees. If information on the number of employees in 1975 is unavailable, we use the number in 1974. Given the law's long implementation period, to reduce noise in the assignment to treatment and control, we also require treatment firms to have at least 5,000 employees in 1980. This excludes firms that collapse in size during the implementation period and are therefore unaffected by the board size requirement. There are 38 treated firms in the sample. To minimize size differences between treated and control firms, we select the 38 control firms with the highest book assets in 1975.

The board size requirement is based on the number of domestic employees, not total employees. However, domestic employees are not reported in the Handbook of German Joint-Stock Companies, which forces us to define treated and control firms using total employees in this sample. Total employees are a noise and upwardly biased proxy for domestic employees, which should make finding statistically significant effects less likely. The relatively low level of globalization in the 1970s gives hope that the number of foreign employees, and hence the bias in our employee numbers, should be small for most firms.[15]

2.3 Variable definitions

Our main outcome variable is return on assets (ROA). In the 1987-2016 panel, we define ROA as earnings before interest and taxes divided by total assets. Due to limited data availability in the earlier law introduction sample, we define ROA as net income divided by total assets. For publicly listed firms in either sample, we use Tobin's Q as alternative performance measure. Appendix A provides detailed definitions of the dependent and control variables as well as their sources. Table 2 presents summary statistics. There are more control variables in the 1987-2016 panel than in the law introduction sample because of increasing data availability. We winsorize all financial variables at the 1% level. The exception is Tobin's Q, which we winsorize at the 5% level. Industry fixed effects are based on the Fama-French 12 industries classification.

3 Board size effects in the 1987-2016 panel

To assess whether forcing firms to have large boards is detrimental to firm performance, this section uses the 1987-2016 panel to compare firms just above the 10,000 domestic employees threshold to firms just below. In Section 3.1, we show that the threshold is associated with a sharp

[15] According to World Bank data, German foreign direct investment outflows were 0.5% of GDP in 1970, compared to 5% of GDP in 2000 (source: The World Bank, World Development Indicators).

increase in board sizes. In Section 3.2, we show univariate comparisons between firms just above and below the threshold, and in Sections 3.3 and 3.4, we use regression discontinuity analyses to estimate the change in performance at the threshold.

3.1 Board size around the threshold

Table 3 Panel A compares the supervisory boards of firms around the threshold of 10,000 domestic employees. The sample is restricted to firms between 7,500 and 12,500 domestic employees. As expected, the size of the supervisory board, measured the year after the number of employees is observed, increases sharply at the threshold. Median board size jumps from 12 for firms below 10,000 domestic employees to 16 for firms above. The increase in average board size is smaller (from 13.9 to 16.0), which suggests that some firms below the threshold voluntarily choose large boards. When we define a large board as at least 16 directors, 89% of firms above the threshold have a large board, compared to 41% of firms below. Even for firms above the threshold, the percentage of large boards is not 100%, likely because of firms that just passed the threshold or because of unexpected director resignations or deaths and the subsequent lengthy replacement process (the appointment of both owner and employee representatives requires an election).

Figure 1 graphically illustrates the relationship between domestic employees and board size. The figure shows mean and median board sizes for firms between 7,500 and 12,500 domestic employees in bins of 500. The increase in board size at the 10,000 domestic employees threshold is clearly visible in both means (Panel A) and medians (Panel B). The figures also show that many firms just below the threshold already have large boards – e.g., the median board size in the 9,500-10,000 bin is already 16. To examine whether this is due to firms that just crossed the threshold and have not yet adjusted their boards, Panels C and D exclude firms that crossed the threshold in either direction in the current year. This increases the jump in board size at the threshold considerably. Once we allow for a one-year transition period for firms that just crossed the threshold, we observe the expected sharp increase in board size.

The figures also show that most firms to the right of the threshold do not increase their board size beyond the required minimum of 16. The fact that most firms just below the threshold choose a board size of 12, and most firms just above the threshold one of 16, suggests that the board size requirements are binding for many firms. Hence, the firms just above the threshold are likely to include many with boards larger than they would voluntarily choose.

3.2 Univariate comparisons

The rest of Table 3 Panel A compares the characteristics of firms just above and just below the threshold of 10,000 domestic employees. The characteristics are measured in the year after domestic employees are observed. In terms of leverage, tangibility, and sales growth, the differences between

firms above and below the threshold are economically small and statistically insignificant. Mechanically, firms above the threshold are slightly larger than firms below. This is reflected not just in more domestic employees but also in more book assets, a higher fraction of foreign employees, and a greater likelihood of being publicly listed and of using international accounting standards. We control for these characteristics in our regression analyses.

Table 3 also shows the outcome variables – ROA and Tobin's Q – measured two years after domestic employees are observed. There is some evidence that firms just above the threshold have lower ROA than firms below. This is surprising as larger firms usually have better operating performance and is a first hint at a negative effect of large boards on performance. Tobin's Q is also slightly lower for firms above the threshold, even though the differences are insignificant. Declines in Q around the threshold are in any case more difficult to interpret as Q tends to decline with firm size. To control for effects of firm size and of other firm characteristics on the outcome variables, we turn to regression analyses next.

3.3 Regression discontinuity analysis: Return on assets

In this section, we use a regression discontinuity design to estimate the change in operating performance at the threshold of 10,000 domestic employees. This approach allows to flexibly control for linear and non-linear effects of the number of domestic employees (the assignment variable) and of other firm characteristics and to isolate any discrete change in the outcome variables at the threshold.

We start with a visual exploration. Figure 2 shows the average ROA for firms between 7,500 and 12,500 domestic employees using bins of 500 (Panels A and C) and 250 (Panels B and D) employees. ROA is measured two years after the employee number is observed. The regressions displayed regress ROA on the number domestic employees, allowing for different slopes to the left and right of the threshold and for a discrete jump at the threshold. The graphs show a sharp decline in ROA of 2-3 percentage points at the threshold, consistent with a negative effect of imposing large boards on firm performance. The decline is larger and more precisely estimated if we exclude firm-years in which the firm crosses the threshold (Panels C and D). This is consistent with firms taking some time to adjust their board sizes and with large boards lowering firm performance after a few years.

Table 4 presents regressions of ROA on an indicator for firms with more than 10,000 domestic employees. ROA is measured two years after domestic employees, and the sample is restricted to firms with 7,500-12,500 domestic employees. Each column indicates how we control for the centered number of domestic employees. Model 1 has no controls, Models 2 and 3 include a linear control for the number of employees, Models 3 and 4 include both a linear and a quadratic term,

and Models 5 and 6 include separate linear terms to the left and right of the threshold (similar to Figure 2). Models 3 to 6 include controls for firm characteristics, such as leverage, tangibility, and whether the firm is listed, which reduces the sample size slightly. These characteristics are measured one year after the employee numbers, i.e., one year before ROA. All models include industry and year fixed effects.

Across specifications, we find strong and consistent evidence that ROA drops by 1-2 percentage points at the threshold of 10,000 domestic employees. This supports the view that forcing firms to have large boards is detrimental to performance. The performance decline is smallest in Model 1 with no controls for firm size, likely because larger firms tend to have higher ROA, which this specification incorrectly attributes to the >10,000 indicator. In Model 6, we exclude firm-years during which firms cross the threshold. Even though the number of observations drops by about 20%, the decline in ROA at the threshold increases to 3.3%. This is again consistent with time lags between crossing the threshold, adjustments to board size, and effects on firm performance.

In Table 5, we repeat the reduced-form analysis on firms with 5,000 to 15,000 domestic employees, which increases the sample size by more than 50%. The results are remarkably similar to those in Table 4, with large drops in ROA at the threshold of 10,000 domestic employees. For most specifications, the larger sample means that the performance declines are more precisely estimated, with T-statistics above 2.5. The performance decline is, however, small and insignificant in Model 1, with no controls for firm size. The likely reason is once again that this model misattributes the positive overall size-performance relationship to the threshold.

To better quantify the effect of forcing firms to have large boards, Table 6 presents two-stage instrumental variable regressions. The sample is again restricted to firms between 7,500 and 12,500 domestic employees. In the first stage, we estimate the effect of the threshold on the probability of having a large board, defined as at least 16 directors. The need to observe the actual board size reduces the sample size to 400 observations. In the second stage, we estimate the effect of large boards (predicted using the first stage) on ROA. Intuitively, the second-stage regressions rescale the reduced-form effect of the threshold on performance (estimated in Tables 4 and 5) by the threshold's effect on board size. The result is an estimate of how large boards that are due to the board size requirement affect firm performance.[16]

The first-stage regressions in Table 6 show a large and highly significant increase in board size at the threshold. Depending on the model specification, the probability of having a large board, measured one year after employee numbers are observed, increases by between 30 and 54

[16] A causal interpretation requires the assumption that the allocation of firms around the threshold is independent of any other determinants of firm performance, which may not be the case. See Section 3.5 for further discussion.

percentage points. The Kleibergen-Paap Wald F-statistic for the strength of the first stage varies considerably across specifications. In Model 1, the F-statistic is 35.5, suggesting a very strong effect of the threshold on board size. However, this model lacks any controls for firm size. Once controls for the number of domestic employees are introduced in Models 2 to 6, the F-statistics drop considerably. Consistent with Figure 2, the predictive power of the first stage is strongest in Model 6, which excludes firms that cross the threshold in the current year and allows for separate linear controls for the number of domestic employees on each side of the threshold. The first-stage F-statistic for this model is 11.0, which suggests that any weak instrument bias is likely to be small.

The second-stage regressions in Table 6 show large negative effects of regulation-imposed large boards on firm performance. In specifications with controls for the number of domestic employees and firm characteristics (Models 3-6), the instrumented-for large board indicator reduces ROA by 7.0 to 8.6 percentage points, with a 7.0 percentage point effect in our preferred specification (Model 6). This suggests that forcing firms to have a large board is detrimental to operating performance.

In Table 7, we repeat the instrumental-variables analysis on firms with 5,000 to 15,000 domestic employees. Because of the larger sample size, the predictive power of the threshold for board size is strengthened, with first stage F-statistics that are consistently above 12. The second-stage effect of instrumented-for large boards on operating performance is smaller but still economically large. In specifications with controls for domestic employees and other firm characteristics (Models 3-6), forcing firms to have large boards reduces ROA by 4.8 to 5.6 percentage points. Hence, independently of the exact bandwidth around the threshold, the instrumental-variables estimation suggests large negative effects of regulation-induced large boards on operating performance.

3.4 Regression discontinuity analysis: Tobin's Q

Next, we examine the effect of the 10,000 domestic employees threshold on Tobin's Q, defined as a firm's market value divided by book assets. The main advantage of Tobin's Q is that its numerator is a forward-looking measure of value. The disadvantage of Tobin's Q is that it is only available for publicly-traded firms, which reduces our sample size to only 232 observations in the 7,500-12,500 range and 416 observations in the 5,000-15,000 range.

Table 8 presents reduced-form regressions of Tobin's Q on an indicator for firms with more than 10,000 domestic employees. Q is measured two years after domestic employees, and the sample is again restricted to firms with 7,500-12,500 domestic employees. The model specifications are the same as in Tables 4 and 5.

Across all specifications with controls for the number of domestic employees (Models 2-6), Tobin's Q drops by about 0.25 at the threshold. This drop is statistically significant at the 10% level when controls for firm characteristics are included (Models 3 to 6) and at the 11% level without controls (Model 2). Model 1, with no controls for the number of domestic employees, shows a smaller and statistically insignificant drop in Q. This specification conflates the overall effect of firm size on Q with the local effect of the threshold.

Table 9 repeats these reduced-form regressions with firms from 5,000 to 15,000 domestic employees. In all specifications that control for the number of domestic employees (Models 2-6), the drop in Tobin's Q at the threshold is still around 0.25. Because of the larger sample size, the statistical significance of the performance decline is higher than in Table 8, with Model 2 significant at the 10% level and all other models at the 5% level. Hence, the reduced-form estimates suggest a sizeable negative effect of forcing firms to have large boards on Tobin's Q.

To further quantify the effect of forcing firms to have large boards, Tables 10 and 11 present two-stage instrumental variable regressions for the 7,500-12,500 and 5,000-15,000 samples, respectively. The first-stage regressions estimate the effect of the threshold on the probability of firms having a large (≥16 directors) board, and the second-stage regressions estimate the effect of (instrumented-for) large boards on Tobin's Q. Because of the small sample sizes, in models that control for the number of domestic employees (Models 2-6), the first-stage F-statistics are between 2.83 and 10.4. Hence, weak-instrument bias is a concern and the second-stage estimates need to be interpreted cautiously.

In our preferred specification (Model 6), which excludes firm-years in which firms cross the threshold and allows for separate linear controls for domestic employees on each side of the threshold, the threshold is associated with a 53 (Table 10) and 51 (Table 11) percentage point increase in the probability of a large board. The second-stage regressions estimate a decline in Tobin's Q due to a regulation-imposed large board of 0.54 and 0.46, respectively. The first-stage F-statistics for this specification are 5.66 and 10.4, respectively, which suggests that any weak-instrument biases should be moderate.

To summarize, the results from Sections 3.3 and 3.4 show sharp declines in both ROA and Tobin's Q at the threshold of 10,000 domestic employees. Forcing firms to adopt large boards appears to be detrimental to both operating performance and valuations, consistent with the hypothesis that excessively large boards are ineffective.

3.5 Bunching, covariate balance, and placebos

3.5.1 Strategic behavior around the threshold

Interpreting the estimates from the two-stage instrumental variable regressions as causal effects requires that the allocation of firms around the threshold is as-good-as-random, or at least independent of any other determinants of ROA and Tobin's Q. However, the number of domestic employees is at least in part under the control of management, which calls this assumption into question. If increases in board size are costly, firms might deliberately decide to stay below the threshold.

In Figures 3 and 4, we examine whether there is any evidence that firms bunch below the threshold of 10,000 domestic employees. Figure 3 plots the distribution of firms around the threshold, which appears to be smooth. Figure 4 shows that the formal continuity test proposed by McCrary (2008) rejects the discontinuity of the distribution at the threshold.

As an alternative test of whether firms deliberately stay below (or above) 10,000 domestic employees, Appendix B examines the frequency with which firms cross thresholds from 7,000 to 13,000 domestic employees. There is no evidence that firms treat the 10,000 domestic employee threshold differently. For example, the frequency with which firms cross 10,000 domestic employees from below is slightly higher than for 9,000 or 11,000 employees, but slightly lower than for 8,000 or 12,000 employees. None of these differences are statistically significant.

Hence, the data do not show any evidence of strategic behavior around the threshold of 10,000 domestic employees. It is possible that firms view the long-run cost of not growing as worse than the cost of a large board. Alternatively, self-interested executives might prefer a less effective supervisory board, even if a side effect is worse firm performance.

3.5.2 Covariate balance

If there is no self-selection of firms to be above or below the threshold of 10,000 domestic employees, then firms on either side of the threshold should be comparable to each other, at least when looking at characteristics that are not themselves affected by having large boards. In Table 12 and Appendix C, we examine whether there are any systematic differences in firm characteristics between firms just above and just below the threshold.

Table 12 presents reduced-form regressions of firm characteristics on the threshold indicator for more than 10,000 domestic employees. The sample is restricted to firms with 7,500-12,500 domestic employees, and the regression includes separate linear controls for the centered number of domestic employees on each side of the threshold. With the exception of the listing status, which is marginally significant, the coefficient on the treshold indicator is insignificant in all regressions, indicating that the characteristics vary smoothly across the threshold. Appendix C presents

regression discontinuity plots around the threshold for the different firm characteristics and shows no evidence of any discrete changes at the threshold.

The results in this and in the previous subsection suggest no bunching of firms below the threshold and no observable differences between firms right above and right below the threshold. This indicates that firms do not behave strategically around the threshold, and makes it more likely that the declines in ROA and Tobin's Q at the threshold are causal effects of forcing firms to have large boards.

3.5.3 Placebo tests

For further evidence that the performance decline at the 10,000 domestic employees threshold is due to the board size requirement and not simply an effect of more domestic employees, we repeat the analysis using alternative thresholds. First, we split the sample of firms between 5,000 and 10,000 (10,000 and 15,000) domestic employees at the median number of domestic employees. This results in thresholds of 7,422 and 12,052 domestic employees, respectively. Second, we repeat the analysis using a threshold of 10,000 *total* employees. Given that the board size requirement is based on domestic, rather than total, employees, and given that German firms are rapidly internationalizing during the 1987-2016 sample period, the 10,000 total employee threshold should have no effect on board size (and thus performance) for most firms.

Table 13 presents reduced-form regressions of ROA on these alternative threshold indicators, and Appendix D presents the corresponding regression discontinuity plots. The samples are restricted to 5,000 to 10,000 domestic employees (Model 1), 10,000 to 15,000 domestic employees (Model 2), and ± 2,500 or ± 5,000 total employees around the 10,000 total employee threshold (Models 3 and 4). The regressions include separate linear controls for the centered number of domestic or total employees on each side of the threshold. Both the regressions and the plots show no evidence of any systematic changes in performance around the alternative thresholds. These placebo tests suggest that the performance change at the threshold of 10,000 domestic employees is caused by the minimum board size requirement.

3.6 Robustness tests

Table 14 presents additional robustness tests of the reduced-form change in ROA at the threshold of 10,000 domestic employees. In Model 1, we control for the share of domestic employees in total employees. Firms below 10,000 domestic employees might decide to increase their foreign instead of their domestic employees in order to retain a smaller board. The observation that there is no bunching of firms just below 10,000 domestic employees speaks against this idea, as does the observations that the share of domestic employees does not change significantly at the threshold (see Section 3.5.2). Nevertheless, Model 1 separately includes the share of domestic

employees as a control variable. We continue to find significantly lower ROA for firms above the threshold.

Model 2 restricts the sample to firms in high-growth industries. Avoiding the larger board size by strategically staying below the 10,000 domestic employees threshold should be more costly in high-growth industries. We define an industry as high growth if it has above median industry sales growth over the last two years, with the industry definitions given by the Fama-French 12 industries classification.[17] The decline in ROA at the threshold is statistically significant and economically large.

Model 3 excludes all firm-year observations with board size above 17. The goal is to exclude firms for which the board size requirement is not a binding constraint. The decline in ROA at the threshold remains large and highly significant.

Models 4 to 7 restrict the sample to firms with 8,000-12,000 and 8,500-11,500 domestic employees, respectively. In Models 5 and 7, we additionally exclude firm-years in which firms cross the threshold of 10,000 domestic employees. The smaller sample sizes reduce statistical power and increase the importance of firms that just crossed the threshold, causing the decline in ROA at the threshold to become insignificant in Models 4 and 6. However, after excluding years in which firms cross the threshold in Models 5 and 7, the decline in ROA is once again large and significant.

Finally, the dependent variable in Models 8 and 9 is return on equity (ROE), defined as net income divided by shareholders' equity. In Model 9, we again exclude firm-years in which firms cross the threshold of 10,000 domestic employees. The estimate in Model 9 shows a 5 percentage point decline in ROE, a statistically significant and economically large effect.

4 The introduction of the board size requirement

The introduction of the board size requirement in 1976 allows us to conduct a difference-in-differences analysis. This analysis compares changes in performance from before to after the law's introduction between "treated" (>10,000 employees) and "control" firms (<10,000 employees).

4.1 Difference-in-differences analysis

A first draft of the law that included the board size requirement was presented in 1974, the law passed in 1976, and elections of supervisory boards had to comply with the law starting in 1978. However, the law's constitutionality was challenged in court, and it was not until March 1, 1979, that the German Constitutional Court affirmed the law's validity. We treat the period before 1976

[17] The results are robust to other industry definitions and to measuring growth using the number of total or domestic employees.

as the pre-treatment period, the period from 1979 as the post-treatment period, and we exclude the law's introduction phase from 1976 to 1978 from the analysis.

We label firms with more than 10,000 employees in 1975 as treated and firms with fewer than 10,000 employees as control firms, even though both sets of firms face new minimum board size requirements, with minimum board sizes of 16 or 20 for treated and of 12 for control firms.[18] If 1975 employee numbers are unavailable, we use 1974 numbers. Even though the board size requirement is based on the number of domestic employees, this number is not available in the 1970s, forcing use to use total employees as a noisy and upwardly biased proxy. Because German firms are much less internationalized in the 1970s than today, the difference between domestic and total employees should be small for most firms in this sample.

Figure 5 confirms that board sizes increase more for treated than for control firms around the law's introduction, suggesting that the law forced treated firms to enlarge their boards more. Until 1978, average board sizes are close to 14 for treated and 11 for control firms. In 1978, treated firms increase their boards by 4.3 to 18.3 directors, while control firms increase their boards by 3.0 to 14.0. This differential change in board sizes between treated and control firms is larger in medians. The relatively sizeable increase in average board size for control firms is due to a small number of firms that have fewer than 10,000 employees in 1975 but more than 10,000 employees by the time the law becomes effective in 1979, making them effectively treated.[19] In a robustness test, we drop control firms with more than 20,000 domestic employees in the post-period and find stronger results.

Panel B of Table 3 compares the characteristics of treated and control firms in 1973-75, before the law's introduction. Unsurprisingly, treated firms are significantly larger than control firms, both in terms of total assets and in terms of total employees. For example, the average treatment firm has 52,175 employees, while the average control firm has only 6,467 employees. To mitigate concerns related to differences in firm size between treated and control firms, we later perform propensity score matching on book assets.

Table 15 presents the results of the difference-in-differences estimation. We analyze windows of two and three years around the introduction period, leaving the introduction period itself out. All specifications include firm and year fixed effects, and the dependent variables are ROA and Tobin's Q. Control variables are lagged by one period, and standard errors are clustered at the firm-level.

[18] Treatment firms include firms with more than 20,000 domestic employees, for which the minimum required board size is 20.

[19] For example, Deutsche Babcock AG increased its employees from about 6,000 in 1975 to 26,000 in 1977 due to a large acquisition. As a result, its board increased from 6 to 20 members.

Across all specifications, the coefficients on Post x Treated are economically large and statistically significant. ROA declines by between 1.2 and 2.0 percentage points from before to after the law's introduction for treated compared to control firms. Tobin's Q declines by between 0.12 and 0.15 for treated compared to control firms. These results support the hypothesis that the more stringent board size requirements for treated firms are detrimental to firm value and performance.

Figure 6 plots average ROA for treated and control firms from 1972 to 1982. Before the passage of the law (1973-1975), as well as during the law's implementation phase (1976-1978), the performance of treated and control firms evolves in parallel. Thus, even though treated firms are larger than control firms, there is no obvious violation of the parallel trends assumption before the treatment period. After the law becomes effective, Figure 6 shows a sharp downward shift in the performance of treated firms relative to control firms.

4.2 Robustness

Table 16 presents several robustness tests of the difference-in-differences analysis of ROA around the introduction of the board size requirement. To address concerns about size differences between treated and control firms, Model 1 selects treated and control firms using propensity score matching on book assets with a caliper of 0.033, which corresponds to 10% of the standard deviation of the propensity score. After matching, there is no significant difference in average size between treated and control firms. Even though the number of observations drops considerably, ROA declines by a highly significant 2.9 percentage points from before to after the law's introduction for treated compared to control firms.

Model 2 excludes control firms that have more than 20,000 total employees in the post-period. These control firms grew from below 10,000 employees in 1975 to more than 20,000 employees by 1979, requiring them to have boards of size 20 in the post-period. Removing these highly treated "control" firms strengthens the treatment effect.

Models 3a, 3b, and 3c are placebo tests. As before, firms are sorted into treated and control based on the number of employees in 1974/75. In Model 3a, the hypothetical pre-period is from 1970 to 1972 and the post-period from 1973 to 1975. In Model 3b, the pre-period is from 1970 to 1972 and the post-period from 1973 to 1974. In Model 3c, the sample is restricted to firms with 2,000 to 10,000 total employees in 1974/75. Treatment is defined using a median sample split based on the number of total employees in 1974/75. As in the main analysis, the pre-period is from 1974 to 1975 and the post-period from 1980 to 1981. None of the placebo tests show significant differential changes in performance for treated compared to control firms.

In another attempt to reduce size differences between treated and control firms, Model 4 excludes very large treated firms with at least 50,000 employees in 1975. Despite the reduced

sample size, and despite removing some of the most severely treated firms with a required board size of 20, the treatment effect remains economically large and statistically significant.

Model 5 excludes firms for which the Saling or Hoppenstedt Stock Guides report the ownership of foreign plants. As the board size requirement is based on the number of domestic employees, while data limitations force us to use total employees as proxy, the presence of foreign plants makes it more likely that our classification into treated and control firms is incorrect. Excluding firms with foreign plants reduces the sample size only slightly, which confirms that few German firms had foreign operations in the 1970s. Removing such firms strengthens the treatment effect.

Model 6 excludes firms with 10,000-20,000 employees and more than 15 directors as well as firms with >20,000 employees and more than 19 directors in 1975 already. These firms are already in compliance with the new board size requirement before its introduction and should therefore be unaffected by it. Excluding these firms leaves the estimated treatment effect almost unchanged.

Finally, Model 7 controls for changes in director busyness around the introduction of the board size requirement. Busyness is defined as the share of directors with at least three simultaneous positions. We collect information on director busyness in 1975 and 1979 from the Saling and Hoppenstedt Stock Guides, respectively.[20] Busyness stayed relatively constant in treated firms at around 18%, while it decreased from 12% to 9% in control firms. Controlling for busyness in Model 7 of Table 16 does not materially alter the results.

5 M&A announcement returns

In this section, we examine one potential channel for the negative effects of large boards on firm performance and value. In particular, we examine stock price reactions to announcements of M&A deals. If larger boards result in poorer monitoring and/or advising, we expect that firms above the 10,000 domestic employees threshold are more likely to engage in value-decreasing deals.

We match M&A deals from the SDC Platinum database to the 1987-2016 panel of firms. The matching is done by name, with close attention to name changes and group structures. This allows us to include deals done by subsidiaries of our sample firms. If the information is available, we require that the sample firms either acquire more than 50% of the target shares, or that the difference between the fraction of shares sought and the fraction of shares held prior to the transaction exceeds 50%. We drop repurchase transactions, squeeze-outs, acquisitions with deal sizes below one million Euros, and deals for which the synopsis indicates that they are not an acquisition. We also drop

[20] For 1975, we extract directors from the Saling Stock Guide and search by name for their other board affiliations. For 1979, we use director names extracted from the Hoppenstedt Stock guide and made available by the University of Mannheim in electronic form (https://digi.bib.uni-mannheim.de/aktienfuehrer/). This approach takes only board positions at firms listed in the Stock Guides into account, which biases our busyness measure downward.

deals for which there is another M&A announcement in the 30 days before the announcement. The final M&A sample is from 1991 to 2016.[21]

We examine cumulative market-adjusted excess returns (CARs) in three- and five-day windows around the announcements of M&A deals. Excess returns are defined as stock returns minus the return on the CDAX market index.[22] The return data is from Datastream. We follow the steps in Ince and Porter (2006) to deal with known problems in the Datastream database.

Table 17 presents reduced-form regressions of acquisition announcement returns on an indicator for firms with more than 10,000 domestic employees. The regressions include separate linear controls for the number of domestic employees to the left and right of the threshold as well as firm characteristics. Acquisition announcement returns are observed one year after (and other control variables in the same year as) the employee numbers. Models 1, 3a, and 4a include acquirers with 7,500 to 12,500 domestic employees, while Models 2, 3a and 4a use the broader sample between 5,000 and 15,000 domestic employees. In Models 3 and 4, we exclude firm-years in which firms cross the threshold of 10,000 domestic employees. Model 4 includes additional deal characteristics as controls. As these characteristics are at least in part endogenous choices made by directors, their inclusion might bias the coefficient on the threshold indicator.

Across all models, the stock price reactions to deal announcements are lower for acquirers just above the threshold of 10,000 domestic employees compared to those just below. Announcement returns drop by 1.6% to 2.2% at the threshold in Models 1 and 2, and by 1.4% to 2.1% in Models 3 and 4. These results suggest that forcing firms to have large boards results in worse M&A deals, offering one potential explanation for the drop in performance and value at the threshold of 10,000 domestic employees.

6 Summary and conclusion

This paper uses minimum board size requirements in Germany to assess whether forcing firms to have large boards reduces firm performance. Since 1976, the legally required minimum size of the supervisory board increases from 12 to 16 directors as German firms reach 10,000 domestic employees. There is a sharp increase in board size at this threshold, indicating that the mandate is binding for many firms.

Using a regression discontinuity design around the threshold and a difference-in-differences analysis around the law's introduction, we find robust evidence that forcing firms to have large boards lowers performance and value. At the threshold of 10,000 domestic employees, operating

[21] See Netter, Stegemoller, and Wintoki (2011) for a discussion of data screens in the M&A literature.
[22] The CDAX is a value-weighted index of all stocks traded on the Frankfurt Stock Exchange that are listed in the General Standard or Prime Standard market segments.

return on assets drops by 2-3 percentage points and Tobin's Q by 0.2-0.25. Around the law's introduction in 1976, treated firms' ROA declines by 1.2-2.9 percentage points relative to control firms. Treated firms' Tobin's Q declines by 0.12-0.15 compared to control firms. In addition, firms above the threshold engage in worse M&A deals than firms below.

The evidence suggests that forcing firms to have large boards reduces firm performance and value. This supports the prediction that board effectiveness declines as board size becomes excessively large, made intuitively by Lipton and Lorsch (1992) and Jensen (1993) and more rigorously by the literature on optimal committee size (Sah and Stiglitz, 1988; Persico, 2004). This in turn supports an important premise of the idea, advanced by Yermack (1996), that the negative cross-sectional correlation between board size and firm performance is due to some firms choosing excessively large and therefore ineffective boards.

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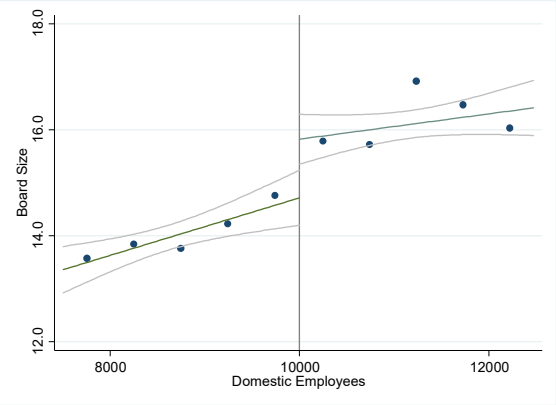
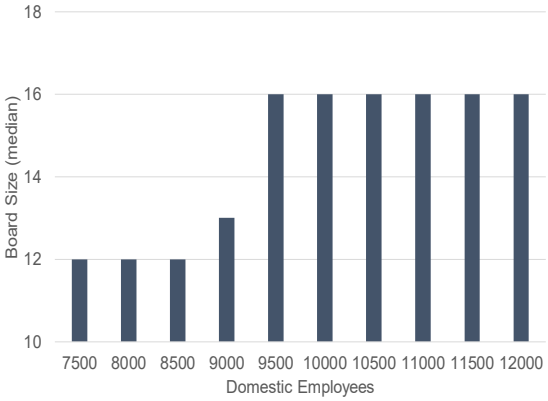
Figure 1: Figures (a) and (c) show regression discontinuity plots with linear fit and the corresponding 90% confidence interval. The x-axis displays the number of domestic employees, measured in bins of 500 employees around 10,000 domestic employees. The sample is limited to firms whose number of domestic employees is between 7,500 and 12,500. The number of domestic employees is lagged by one period. For Figures (a) and (c) (Figures (b) and (d)), the y-axis shows the mean (median) board size in the respective bin. The bin width is 500. In Figures (c) and (d), we additionally require that the treatment indicator around the threshold of 10,000 domestic employees stays constant in the two years before we observe Board Size.

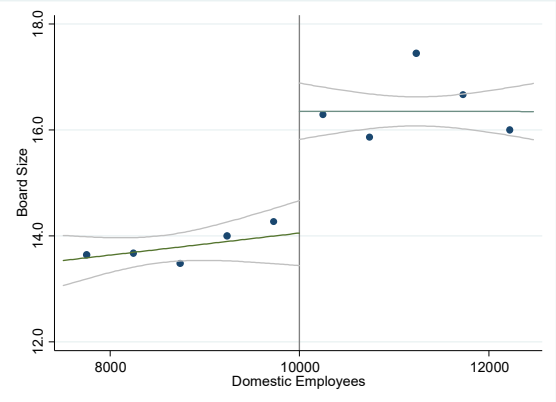
(a) mean values



(b) median values



(c) mean values



(d) median values

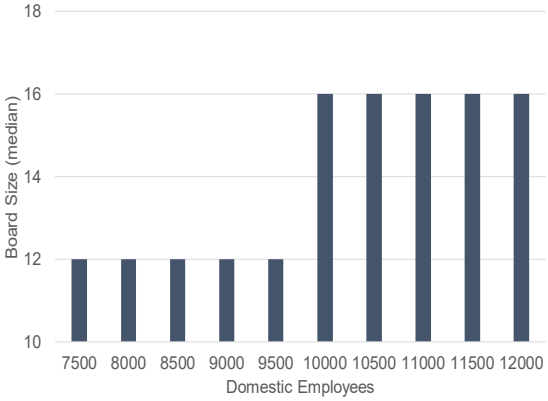
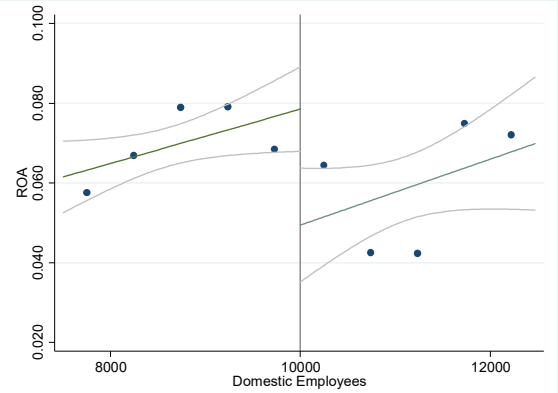
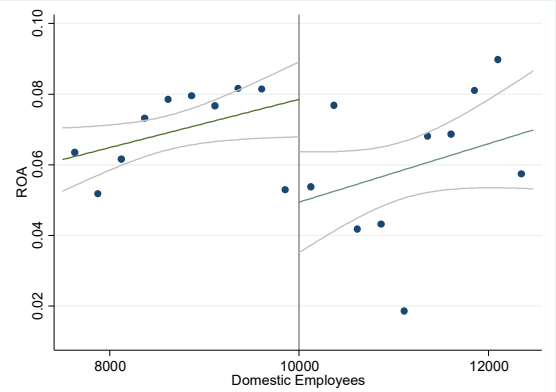


Figure 2: This figure shows regression discontinuity plots with linear fit and the corresponding 90% confidence intervals. The x-axis displays the number of domestic employees, measured in bins of 500 (250) employees around 10,000 domestic employees. The sample is limited to firms whose number of domestic employees is between 7,500 and 12,500. The number of domestic employees is lagged by two periods. The y-axis shows the mean ROA in the respective bin. In Figures (c) and (d), we additionally require that the treatment indicator around the threshold of 10,000 domestic employees stays constant in years t-2 and t-3 (i.e., one year before we observe Board Size).

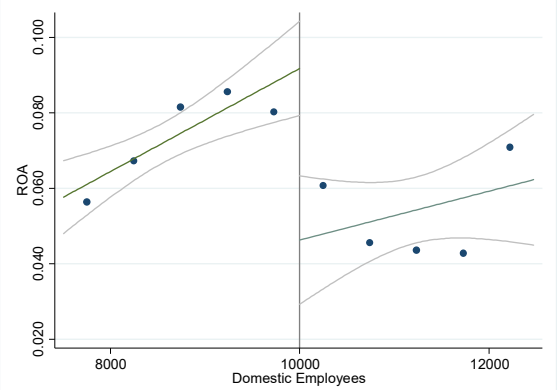
(a) bins of 500



(b) bins of 250



(c) bins of 500



(d) bins of 250

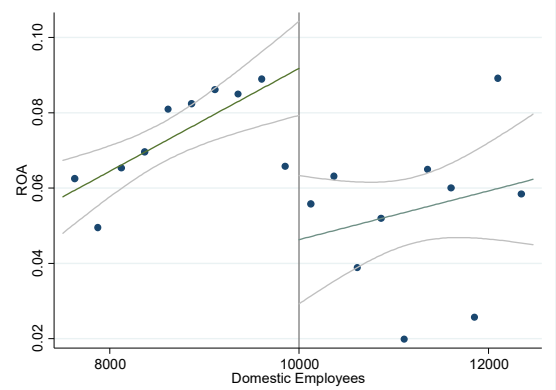


Figure 3: Distribution of firms around the threshold of 10,000 domestic employees

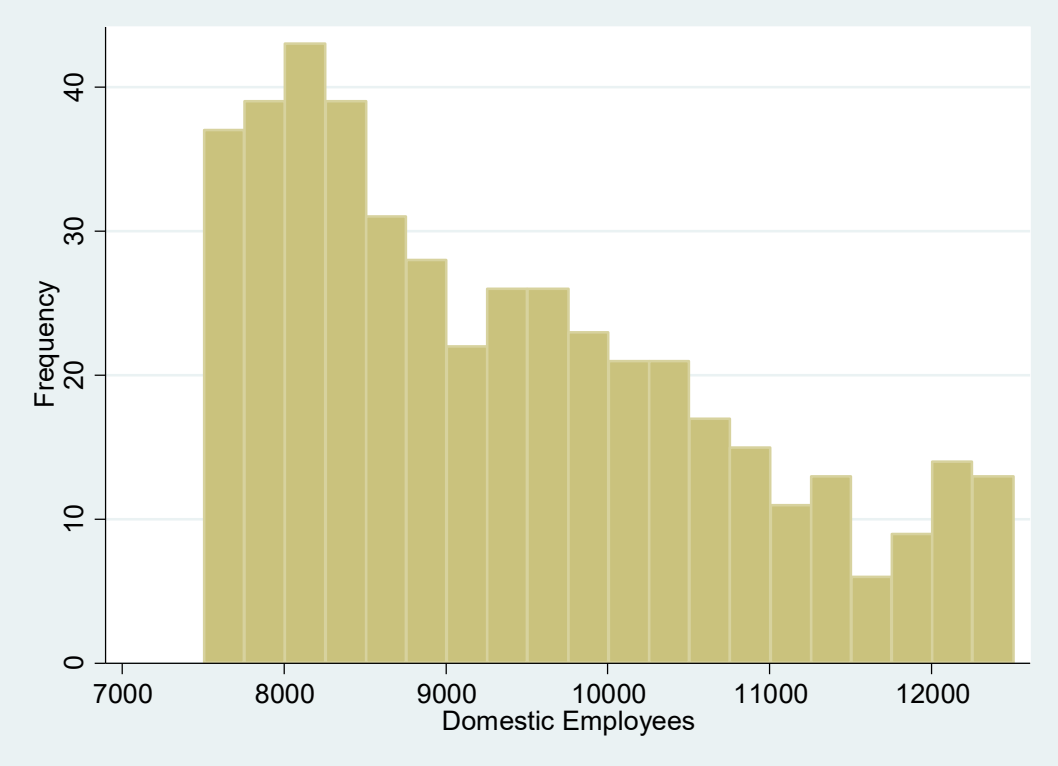


Figure 4: McCrary (2008) continuity test around the threshold of 10,000 domestic employees. We use the "DCdensity" command in Stata and default values for bin size and bandwidth.

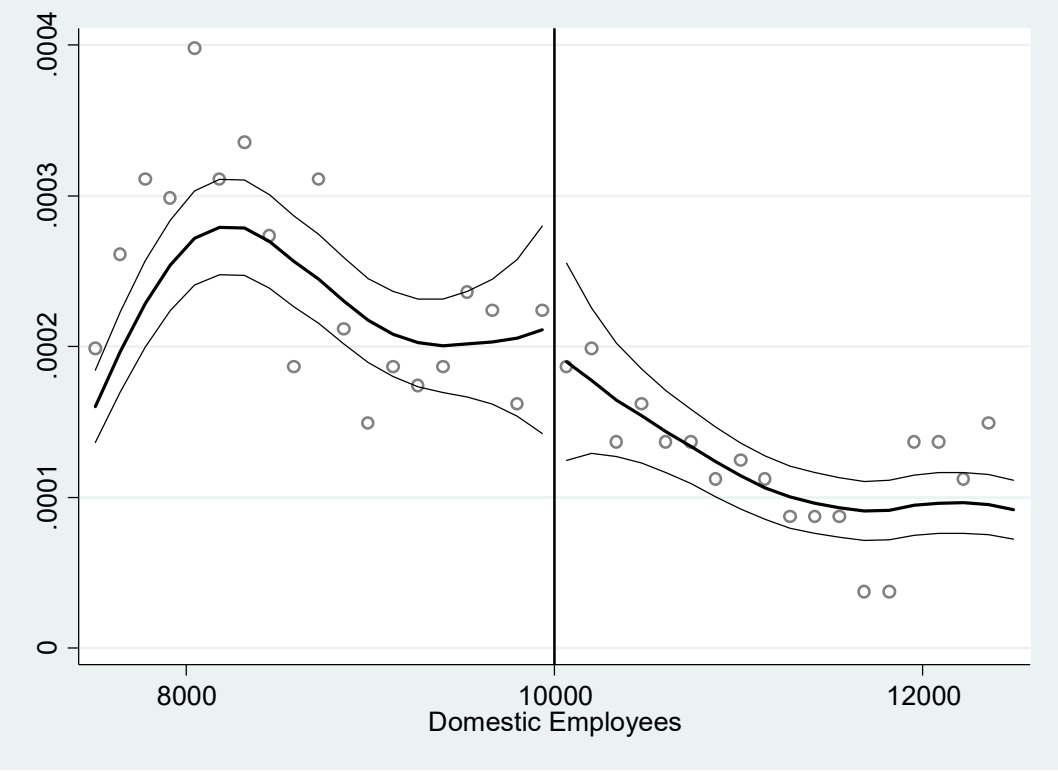
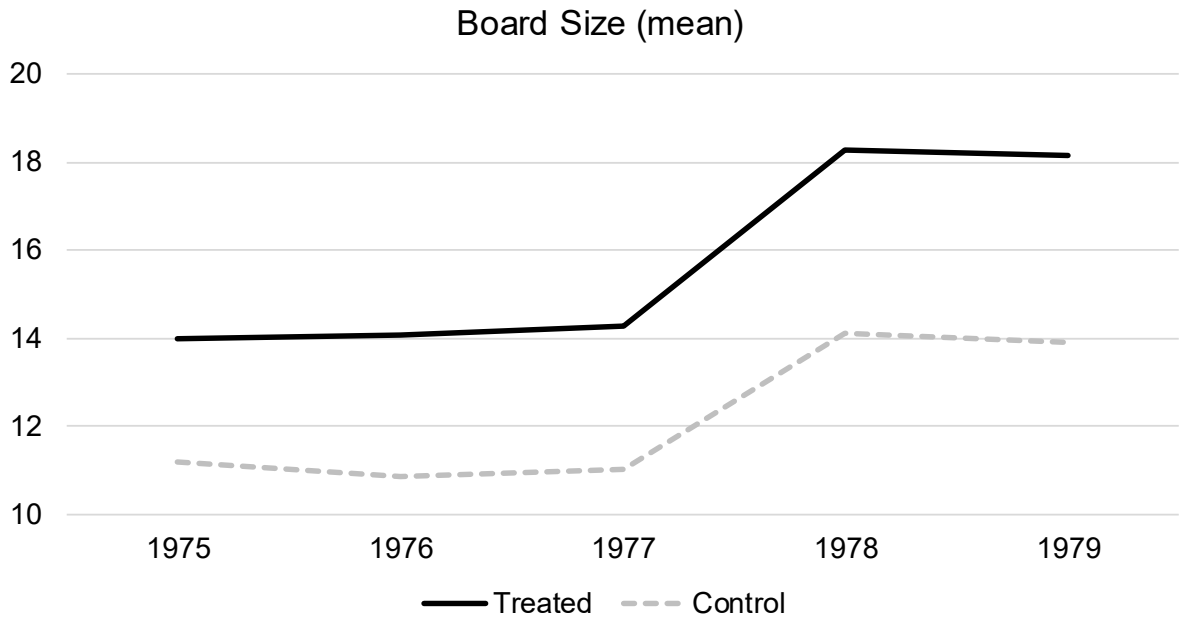


Figure 5: The figure shows mean and median board size over time. Treatment firms are firms with more than 10,000 total employees in 1974/75.



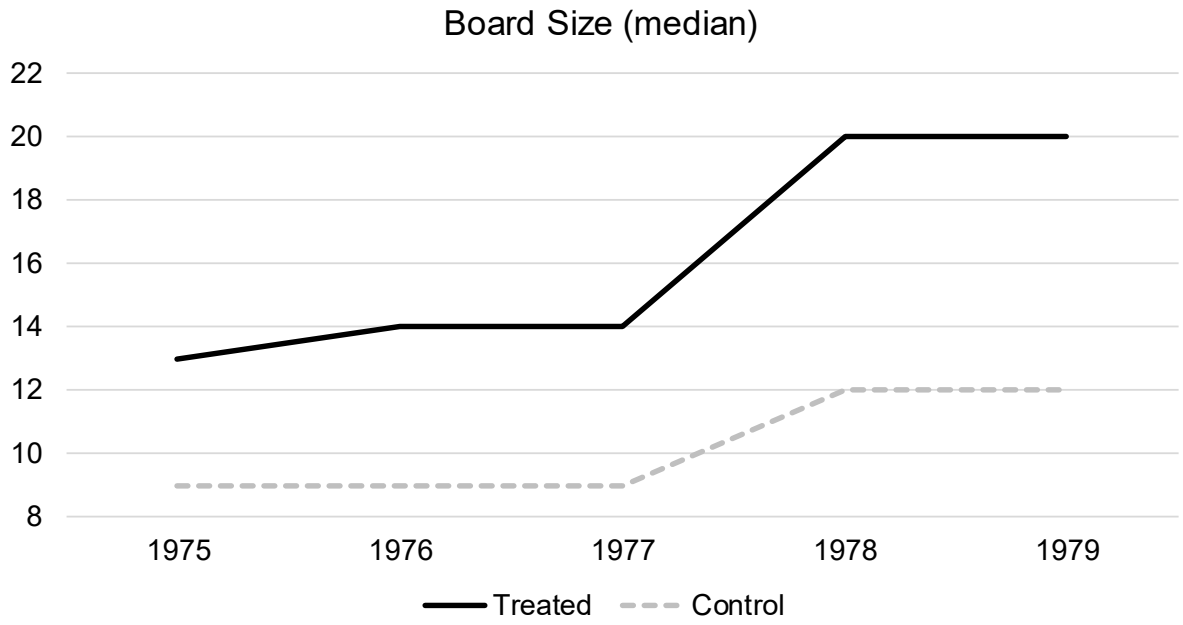


Figure 6: The figure shows mean ROA over time. Treatment firms are firms with more than 10,000 total employees in 1974/75.

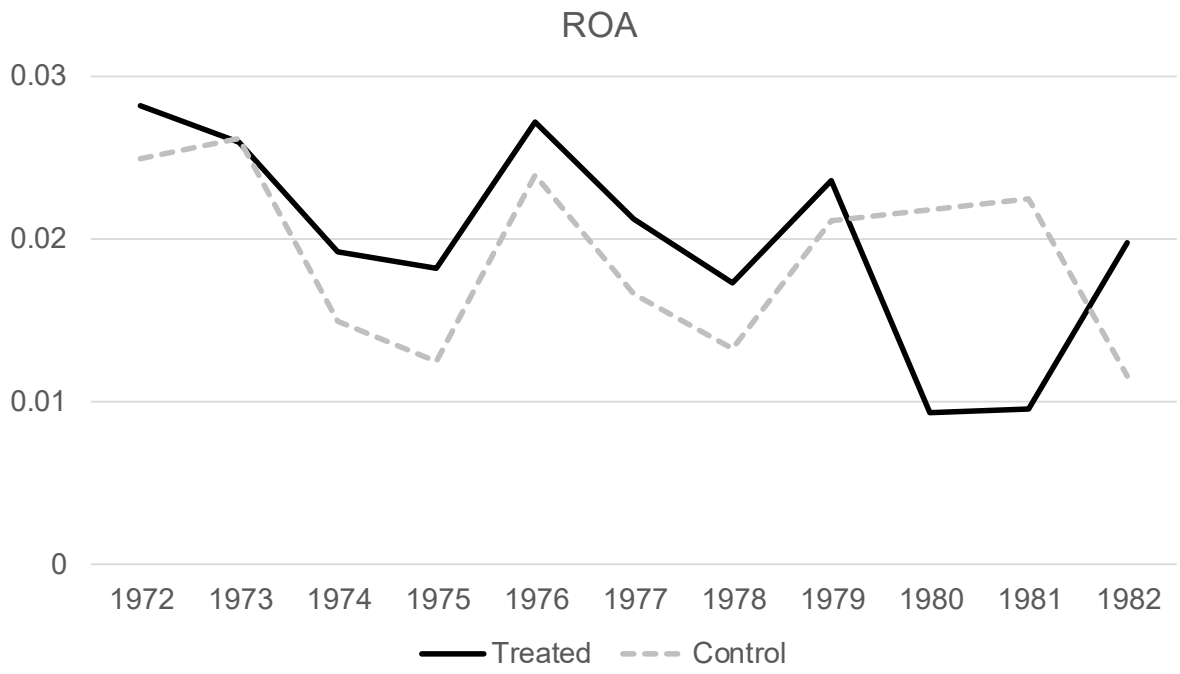


Table 1: Sample selection
This table shows the sample selection process for the regression discontinuity analysis in Section 3.1. The process below is for firms with 7,500-12,500 domestic employees.

Step	Description	Firms	Observations
1	Selection of all non-financial firms with consolidated financial statements in Hoppenstedt (www.bilanzen.de) that have at least 7,500 total employees during at least one fiscal year between 1987 and 2016	362	-
2	Exclusion of firms that are not the highest entity in case of business groups	331	-
3	Exclusion of firms that are exempt from the law (e.g., news reporting firms, steel producing firms, cooperatives) and firms that do not seek to maximize profits (hospitals and universities)	262	-
4	Exclusion of firms with no information on the number of domestic employees	185	2,079
5	Exclusion of firms whose number of domestic employees is not in the range between 7,500 and 12,500	74	526
6	Addition of firms from Worldscope with the number of domestic employees available in annual reports and between 7,500 and 12,500	81	554
7	Missing accounting data in t+2	71	468
8	Missing financial controls in t+1	69	454
9	Missing board size data in t+1	60	388

Table 2: Descriptive statistics

This table shows descriptive statistics for the 1987-2016 panel (Panel A) and the law introduction sample (Panel B). In the 1987-2016 panel, firms have between 7,500 and 12,500 domestic employees. The outcome variables (ROA and Tobin's Q) are observed two years after the employee numbers. All other variables are observed one year after the employee numbers. A description of all variables is in Appendix A.

Variable	N	Mean	1st quartile	Median	3rd quartile	SD
Panel A: 1987-2016 panel						
ROA	454	0.07	0.04	0.06	0.09	0.06
Tobin's Q	221	1.37	1.05	1.25	1.59	0.43
Large Board	388	0.56	0.00	1.00	1.00	0.50
Board Size	388	14.60	12	16	16	2.47
>10,000	454	0.31	0.00	0.00	1.00	0.46
Domestic Employees	454	9,375	8,183	9,085	10,340	1,356
Share Dom. Empl.	454	0.63	0.38	0.62	0.91	0.28
Size	454	5,373	1,092	2,453	5,904	12,217
Leverage	454	0.66	0.58	0.68	0.75	0.15
Tangibility	454	0.30	0.17	0.26	0.39	0.17
Sales Growth	454	0.05	-0.01	0.06	0.11	0.15
Accounting Standard	454	0.52	0.00	1.00	1.00	0.50
Listing	454	0.49	0.00	0.00	1.00	0.50
Panel B: Law introduction sample (1973 to 1981)						
Treated	397	0.49	0.00	0.00	1.00	0.50
ROA	397	0.02	0.01	0.02	0.03	0.03
Tobin's Q	391	1.37	1.13	1.26	1.50	0.33
Size	397	3,355	755	1,719	3,646	4,906
Leverage	397	0.71	0.64	0.70	0.79	0.11
Sales Growth	397	0.12	0.04	0.10	0.17	0.20

Table 3: Univariate comparisons

The table shows mean and median values for treated and control firms in the 1987-2016 panel (Panel A) and the law introduction sample (Panel B). In the 1987-2016 panel, firms have between 7,500 and 12,500 domestic employees. The outcome variables (ROA and Tobin's Q) are observed two years after the employee numbers. All other variables are observed one year after the employee numbers. Panel B shows values for 1972-1975, the period before the law's passage. P-values are based on two-sided t-tests and Wilcoxon signed-rank tests. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. A description of all variables is in Appendix A.

	Mean values			**Median values**		
Variable	**>10,000**	**<10,000**	**p-value**	**>10,000**	**<10,000**	**p-value**
Panel A: 1987-2016 panel						
Board Size	0.89	0.41	0.00	1.00	0.00	0.00
Large Board	16.03	13.91	0.00	16.00	12.00	0.00
Domestic Employees	11,089	8,610	0.00	10,946	8,503	0.00
Share Dom. Empl.	0.58	0.65	0.01	0.53	0.63	0.08
Size	6,009	5,090	0.46	4,255	1,924	0.00
Leverage	0.65	0.67	0.31	0.67	0.68	0.47
Tangibility	0.31	0.29	0.36	0.28	0.26	0.34
Sales Growth	0.03	0.05	0.27	0.05	0.06	0.39
Accounting Standard	0.61	0.47	0.00	1.00	0.00	0.00
Listing	0.60	0.44	0.00	1.00	0.00	0.00
ROA	0.06	0.07	0.09	0.06	0.07	0.16
Tobin's Q	1.32	1.40	0.22	1.21	1.29	0.19
Firms	38	63				
Observations	140	314				
Panel B: Law introduction sample (1973-1975)						
ROA	0.02	0.02	0.45	0.02	0.02	0.23
Tobin's Q	1.43	1.37	0.20	1.36	1.24	0.03
Size	5,333	1,504	0.00	2,888	805	0.00
Leverage	0.70	0.71	0.37	0.69	0.73	0.03
Sales Growth	0.09	0.10	0.78	0.10	0.11	0.95
Total Employees	52,175	6,467	0.00	27,007	6,222	0.00
Firms	38	38				
Observations	107	109				

Table 4: Regression discontinuity analysis – ROA in reduced form
This table shows reduced-form OLS regressions. The dependent variable is ROA. The main explanatory variable is >10,000, an indicator for firms with more than 10,000 domestic employees. Only firm-years with 7,500 to 12,500 domestic employees are included. In Model 6, we exclude firm-years in which firms cross the threshold of 10,000 domestic employees. ROA is observed two years after and all other variables one year after the employee numbers. Polynomial indicates how we control for the centered number of domestic employees. Both sides indicates that the polynomials are interacted with the >10,000 dummy. All models include industry and year fixed effects. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. A description of all variables is in Appendix A.

Model	1	2	3	4	5	6
Dep. variable	ROA	ROA	ROA	ROA	ROA	ROA
>10,000	**-0.016****	**-0.031*****	**-0.022****	**-0.020***	**-0.021***	**-0.033****
	(-2.16)	**(-2.76)**	**(-2.08)**	**(-1.77)**	**(-1.84)**	**(-2.21)**
Ln(Size)			-0.010	-0.010*	-0.010	-0.012*
			(-1.62)	(-1.68)	(-1.66)	(-1.86)
Leverage			-0.13***	-0.13***	-0.13***	-0.13***
			(-3.53)	(-3.51)	(-3.51)	(-3.55)
Tangibility			-0.0014	0.00064	-0.00013	-0.011
			(-0.058)	(0.028)	(-0.0056)	(-0.50)
Sales Growth			0.038*	0.038*	0.038*	0.041*
			(1.71)	(1.71)	(1.70)	(1.73)
Acc. Std.			0.0025	0.0027	0.0028	0.0030
			(0.26)	(0.28)	(0.28)	(0.29)
Listing			-0.0085	-0.0081	-0.0084	-0.0020
			(-0.96)	(-0.92)	(-0.94)	(-0.21)
Observations	468	468	454	454	454	366
Treated	147	147	140	140	140	104
R^2	0.178	0.184	0.330	0.331	0.330	0.342
Industry FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
Polynomial	no	one	one	two	one	one
Both sides	no	no	no	no	yes	yes

Table 5: **Regression discontinuity analysis – ROA in reduced form (extended sample)**
This table shows reduced-form OLS regressions. The dependent variable is ROA. The main explanatory variable is >10,000, an indicator for firms with more than 10,000 domestic employees. Only firm-years with 5,000 to 15,000 domestic employees are included. In Model 6, we exclude firm-years in which firms cross the threshold of 10,000 domestic employees. ROA is observed two years after and all other variables one year after the employee numbers. Polynomial indicates how we control for the centered number of domestic employees. Both sides indicates that the polynomials are interacted with the >10,000 dummy. All models include industry and year fixed effects. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. A description of all variables is in Appendix A.

Model	1	2	3	4	5	6
Dep. variable	ROA	ROA	ROA	ROA	ROA	ROA
>10,000	**-0.0079**	**-0.026*****	**-0.027*****	**-0.021****	**-0.022****	**-0.035*****
	(-1.06)	**(-2.72)**	**(-2.97)**	**(-2.58)**	**(-2.57)**	**(-3.37)**
Ln(Size)			-0.011**	-0.012**	-0.012**	-0.013**
			(-2.02)	(-2.14)	(-2.17)	(-2.14)
Leverage			-0.094**	-0.094**	-0.093**	-0.086**
			(-2.59)	(-2.62)	(-2.62)	(-2.40)
Tangibility			-0.014	-0.014	-0.014	-0.021
			(-0.70)	(-0.71)	(-0.68)	(-1.06)
Sales Growth			0.034**	0.033*	0.033*	0.039**
			(2.01)	(1.97)	(1.97)	(2.16)
Acc. Std.			0.012	0.012	0.012	0.011
			(1.28)	(1.25)	(1.28)	(1.11)
Listing			-0.0042	-0.0047	-0.0047	-0.0013
			(-0.52)	(-0.60)	(-0.60)	(-0.16)
Observations	892	892	791	791	791	647
Treated	237	237	217	217	217	168
R^2	0.086	0.095	0.208	0.213	0.214	0.222
Industry FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
Polynomial	no	one	one	two	one	one
Both sides	no	no	no	no	yes	yes

Table 6: Regression discontinuity analysis – ROA in 2SLS

This table shows 2-stage least squares regressions. The dependent variable in the second stage is ROA. The dependent variable in the first stage is Large Board, an indicator for supervisory boards with at least 16 members. The instrument is >10,000, an indicator for firms with more than 10,000 domestic employees. Only firm-years with 7,500 to 12,500 domestic employees are included. In Model 6, we drop firm-years in which firms cross the threshold of 10,000 domestic employees. ROA is observed two years after and board size and all other variables one year after the employee numbers. Polynomial indicates how we control for the centered number of domestic employees. Both sides indicates that the polynomials are interacted with the >10,000 dummy. All models include industry and year fixed effects. F-statistic is the Kleibergen-Paap Wald F-statistic. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. A description of all variables is in Appendix A.

Model	1a	1b	2a	2b	3a	3b	4a	4b	5a	5b	6a	6b
Dep. variable	Large Board	ROA	Large Board	ROA	Large Board	ROA	Large Board	ROA	Large Board	ROA	Large Board	ROA
Large Board		**-0.037****		**-0.12****		**-0.086*****		**-0.078*****		**-0.079*****		**-0.070*****
		(-2.12)		**(-2.40)**		**(-2.89)**		**(-2.75)**		**(-2.82)**		**(-3.03)**
>10,000	**0.46*****		**0.30****		**0.32****		**0.33****		**0.33****		**0.54*****	
	(5.96)		**(2.37)**		**(2.50)**		**(2.58)**		**(2.58)**		**(3.32)**	
Ln(Size)					0.070	-0.0024	0.069	-0.0036	0.068	-0.0037	0.043	-0.0051
					(1.17)	(-0.32)	(1.15)	(-0.50)	(1.13)	(-0.50)	(0.69)	(-0.73)
Leverage					-0.33	-0.16***	-0.33	-0.16***	-0.34	-0.16***	-0.47	-0.16***
					(-0.97)	(-3.31)	(-0.97)	(-3.28)	(-0.97)	(-3.31)	(-1.24)	(-3.35)
Tangibility					-0.17	-0.00023	-0.16	0.0063	-0.15	0.0061	-0.080	0.0100
					(-0.57)	(-0.0075)	(-0.53)	(0.22)	(-0.51)	(0.21)	(-0.27)	(0.36)
Sales Growth					-0.12	0.031	-0.12	0.033	-0.12	0.032	-0.074	0.034
					(-0.84)	(1.27)	(-0.83)	(1.35)	(-0.83)	(1.32)	(-0.48)	(1.23)
Acc. Std.					0.22**	0.028*	0.22**	0.026*	0.22**	0.027*	0.24**	0.024*
					(2.01)	(1.93)	(2.01)	(1.88)	(2.01)	(1.92)	(2.34)	(1.85)
Listing					-0.077	-0.017	-0.076	-0.016	-0.077	-0.016	-0.13	-0.013
					(-0.69)	(-1.53)	(-0.68)	(-1.52)	(-0.68)	(-1.54)	(-1.08)	(-1.19)
Observations	400	400	400	400	388	388	388	388	388	388	317	317
Treated	133	133	133	133	127	127	127	127	127	127	98	98
Industry & year FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Polynomial	no	no	one	one	one	one	two	two	one	one	one	one
Both sides	no	no	no	no	no	no	no	no	yes	yes	yes	yes
F-statistic	35.5		5.62		6.25		6.68		6.67		11.0	
Stage	first	second	first	second	first	second	first	second	first	second	first	second

Table 7: **Regression discontinuity analysis – ROA in 2SLS (extended sample)**

This table shows 2-stage least squares regressions. The dependent variable in the second stage is ROA. The dependent variable in the first stage is Large Board, an indicator for supervisory boards with at least 16 members. The instrument is >10,000, an indicator for firms with more than 10,000 domestic employees. Only firm-years with 5,000 to 15,000 domestic employees are included. In Model 6, we drop firm-years in which firms cross the threshold of 10,000 domestic employees. ROA is observed two years after and board size and all other variables one year after the employee numbers. Polynomial indicates how we control for the centered number of domestic employees. Both sides indicates that the polynomials are interacted with the >10,000 dummy. All models include industry and year fixed effects. F-statistic is the Kleibergen-Paap Wald F-statistic. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. A description of all variables is in Appendix A.

Model	1a	1b	2a	2b	3a	3b	4a	4b	5a	5b	6a	6b
Dep. variable	Large Board	ROA	Large Board	ROA	Large Board	ROA	Large Board	ROA	Large Board	ROA	Large Board	ROA
Large Board		**-0.029****		**-0.067****		**-0.056*****		**-0.049*****		**-0.048*****		**-0.053*****
		(-1.97)		**(-2.23)**		**(-2.93)**		**(-3.03)**		**(-2.92)**		**(-3.12)**
>10,000	**0.49*****		**0.37*****		**0.43*****		**0.44*****		**0.45*****		**0.61*****	
	(7.46)		**(3.47)**		**(4.15)**		**(4.50)**		**(4.55)**		**(5.47)**	
Ln(Size)					0.11**	-0.0030	0.11**	-0.0044	0.10**	-0.0049	0.072	-0.0047
					(2.53)	(-0.43)	(2.34)	(-0.63)	(2.26)	(-0.71)	(1.44)	(-0.68)
Leverage					-0.20	-0.096**	-0.20	-0.096**	-0.20	-0.096**	-0.23	-0.092**
					(-0.75)	(-2.47)	(-0.75)	(-2.52)	(-0.78)	(-2.54)	(-0.86)	(-2.40)
Tangibility					0.34	0.015	0.34	0.014	0.35	0.015	0.37	0.012
					(1.47)	(0.68)	(1.51)	(0.64)	(1.55)	(0.67)	(1.58)	(0.54)
Sales Growth					-0.057	0.027	-0.058	0.027	-0.059	0.027	-0.063	0.026
					(-0.48)	(1.41)	(-0.48)	(1.41)	(-0.49)	(1.42)	(-0.46)	(1.20)
Acc. Std.					-0.036	0.021**	-0.037	0.021**	-0.037	0.021**	-0.029	0.018*
					(-0.34)	(2.20)	(-0.35)	(2.15)	(-0.36)	(2.16)	(-0.27)	(1.70)
Listing					-0.0088	-0.013	-0.0094	-0.013	-0.010	-0.013	-0.055	-0.011
					(-0.084)	(-1.49)	(-0.089)	(-1.61)	(-0.099)	(-1.63)	(-0.51)	(-1.23)
Observations	685	685	685	685	612	612	612	612	612	612	512	512
Treated	187	187	187	187	176	176	176	176	176	176	139	139
Industry & year FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Polynomial	no	no	one	one	one	one	two	two	one	one	one	one
Both sides	no	no	no	no	no	no	no	no	yes	yes	yes	yes
F statistic	55.6		12.0		17.2		20.2		20.7		29.9	
Stage	first	second	first	second	first	second	first	second	first	second	first	second

Table 8: Regression discontinuity analysis – Tobin's Q in reduced form
This table shows reduced-form OLS regressions. The dependent variable is Tobin's Q. The main explanatory variable is >10,000, an indicator for firms with more than 10,000 domestic employees. Only firm-years with 7,500 to 12,500 domestic employees are included. In Model 6, we exclude firm-years in which firms cross the threshold of 10,000 domestic employees. ROA is observed two years after and all other variables one year after the employee numbers. Polynomial indicates how we control for the centered number of domestic employees. Both sides indicates that the polynomials are interacted with the >10,000 dummy. All models include industry and year fixed effects. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. A description of all variables is in Appendix A.

Model	1	2	3	4	5	6
Dep. variable	Tobin's Q	Tobin's Q	Tobin's Q	Tobin's Q	Tobin's Q	Tobin's Q
>10,000	**-0.077**	**-0.27**	**-0.23***	**-0.23***	**-0.23***	**-0.24***
	(-1.12)	**(-1.64)**	**(-1.86)**	**(-1.88)**	**(-1.86)**	**(-1.92)**
Ln(Size)			-0.041	-0.040	-0.038	-0.045
			(-0.52)	(-0.51)	(-0.49)	(-0.62)
Leverage			-1.50***	-1.50***	-1.51***	-1.66***
			(-2.93)	(-2.92)	(-2.95)	(-3.17)
Tangibility			-0.021	-0.032	-0.068	-0.068
			(-0.071)	(-0.11)	(-0.23)	(-0.23)
Sales Growth			-0.029	-0.027	-0.018	-0.075
			(-0.22)	(-0.19)	(-0.13)	(-0.53)
Acc. Std.			-0.054	-0.052	-0.045	-0.071
			(-0.32)	(-0.31)	(-0.26)	(-0.41)
Observations	232	232	221	221	221	176
Treated	92	92	86	86	86	68
R^2	0.434	0.451	0.611	0.611	0.612	0.661
Industry FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
Polynomial	no	one	one	two	one	one
Both sides	no	no	no	no	yes	yes

Table 9: Regression discontinuity analysis – Tobin's Q in reduced form (extended sample)
This table shows reduced-form OLS regressions. The dependent variable is Tobin's Q. The main explanatory variable is >10,000, an indicator for firms with more than 10,000 domestic employees. Only firm-years with 5,000 to 15,000 domestic employees are included. In Model 6, we exclude firm-years in which firms cross the threshold of 10,000 domestic employees. ROA is observed two years after and all other variables one year after the employee numbers. Polynomial indicates how we control for the centered number of domestic employees. Both sides indicates that the polynomials are interacted with the >10,000 dummy. All models include industry and year fixed effects. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. A description of all variables is in Appendix A.

Model	1	2	3	4	5	6
Dep. variable	Tobin's Q	Tobin's Q	Tobin's Q	Tobin's Q	Tobin's Q	Tobin's Q
>10,000	**-0.12**	**-0.19***	**-0.21****	**-0.19****	**-0.20****	**-0.28*****
	(-1.25)	**(-1.73)**	**(-2.16)**	**(-2.07)**	**(-2.13)**	**(-2.75)**
Ln(Size)			-0.018	-0.036	-0.036	-0.049
			(-0.28)	(-0.53)	(-0.52)	(-0.74)
Leverage			-1.41***	-1.39***	-1.39***	-1.54***
			(-2.88)	(-2.94)	(-2.92)	(-3.33)
Tangibility			-0.15	-0.17	-0.15	-0.26
			(-0.48)	(-0.54)	(-0.50)	(-0.85)
Sales Growth			0.24	0.25	0.25	0.22
			(1.43)	(1.49)	(1.49)	(1.30)
Acc. Std.			0.060	0.050	0.049	0.083
			(0.45)	(0.37)	(0.36)	(0.64)
Observations	416	416	397	397	397	333
Treated	130	130	121	121	121	99
R^2	0.218	0.220	0.424	0.428	0.428	0.487
Industry FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
Polynomial	no	one	one	two	one	one
Both sides	no	no	no	no	yes	yes

Table 10: Regression discontinuity analysis –Tobin's Q in 2SLS

This table shows 2-stage least squares regressions. The dependent variable in the second stage is Tobin's Q. The dependent variable in the first stage is Large Board, an indicator for supervisory boards with at least 16 members. The instrument is >10,000, an indicator for firms with more than 10,000 domestic employees. Only firm-years with 7,500 to 12,500 domestic employees are included. In Model 6, we drop firm-years in which firms cross the threshold of 10,000 domestic employees. ROA is observed two years after and board size and all other variables one year after the employee numbers. Polynomial indicates how we control for the centered number of domestic employees. Both sides indicates that the polynomials are interacted with the >10,000 dummy. All models include industry and year fixed effects. F-statistic is the Kleibergen-Paap Wald F-statistic. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. A description of all variables is in Appendix A.

Model	1a	1b	2a	2b	3a	3b	4a	4b	5a	5b	6a	6b
Dep. variable	Large Board	Tobin's Q	Large Board	Tobin's Q	Large Board	Tobin's Q	Large Board	Tobin's Q	Large Board	Tobin's Q	Large Board	Tobin's Q
Large Board		**-0.18**		**-0.98**		**-0.77****		**-0.77****		**-0.77****		**-0.54****
		(-1.32)		**(-1.62)**		**(-2.48)**		**(-2.51)**		**(-2.50)**		**(-2.40)**
>10,000	**0.47*****		**0.31***		**0.37****		**0.37****		**0.37****		**0.53****	
	(4.45)		**(1.86)**		**(2.21)**		**(2.21)**		**(2.19)**		**(2.38)**	
Ln(Size)					0.0019	-0.051	-0.0021	-0.055	-0.0016	-0.053	-0.0022	-0.054
					(0.024)	(-0.68)	(-0.026)	(-0.74)	(-0.020)	(-0.72)	(-0.029)	(-0.87)
Leverage					-0.074	-1.63***	-0.060	-1.62***	-0.064	-1.62***	-0.045	-1.73***
					(-0.18)	(-3.27)	(-0.15)	(-3.23)	(-0.16)	(-3.24)	(-0.11)	(-3.64)
Tangibility					-0.20	-0.29	-0.13	-0.22	-0.14	-0.26	-0.0012	-0.10
					(-0.52)	(-0.78)	(-0.33)	(-0.61)	(-0.36)	(-0.67)	(-0.0032)	(-0.32)
Sales Growth					0.051	0.0080	0.032	-0.0096	0.036	-0.0020	0.045	-0.057
					(0.27)	(0.062)	(0.17)	(-0.074)	(0.18)	(-0.015)	(0.26)	(-0.54)
Acc. Std.					0.011	-0.022	-0.0032	-0.035	0.00011	-0.029	0.11	-0.0096
					(0.058)	(-0.20)	(-0.017)	(-0.32)	(0.00060)	(-0.27)	(0.76)	(-0.074)
Observations	229	229	229	229	218	218	218	218	218	218	174	174
Treated	92	92	92	92	86	86	86	86	86	86	68	68
Industry & year FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Polynomial	no	no	one	one	one	one	two	two	one	one	one	one
Both sides	no	no	no	no	no	no	no	no	yes	yes	yes	yes
F statistic	19.8		3.45		4.87		4.90		4.80		5.66	
Stage	first	second	first	second	first	second	first	second	first	second	first	second

Table 11: Regression discontinuity analysis –Tobin's Q in 2SLS (extended sample)

This table shows 2-stage least squares regressions. The dependent variable in the second stage is Tobin's Q. The dependent variable in the first stage is Large Board, an indicator for supervisory boards with at least 16 members. The instrument is >10,000, an indicator for firms with more than 10,000 domestic employees. Only firm-years with 5,000 to 15,000 domestic employees are included. In Model 6, we drop firm-years in which firms cross the threshold of 10,000 domestic employees. ROA is observed two years after and board size and all other variables one year after the employee numbers. Polynomial indicates how we control for the centered number of domestic employees. Both sides indicates that the polynomials are interacted with the >10,000 dummy. All models include industry and year fixed effects. F-statistic is the Kleibergen-Paap Wald F-statistic. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. A description of all variables is in Appendix A.

Model	1a	1b	2a	2b	3a	3b	4a	4b	5a	5b	6a	6b
Dep. variable	Large Board	Tobin's Q	Large Board	Tobin's Q	Large Board	Tobin's Q	Large Board	Tobin's Q	Large Board	Tobin's Q	Large Board	Tobin's Q
Large Board		**-0.27***		**-0.73**		**-0.56****		**-0.44****		**-0.49****		**-0.46****
		(-1.82)		**(-1.56)**		**(-2.35)**		**(-2.08)**		**(-2.23)**		**(-2.50)**
>10,000	**0.62*****		**0.24***		**0.35****		**0.36****		**0.35****		**0.51*****	
	(7.44)		**(1.68)**		**(2.36)**		**(2.49)**		**(2.44)**		**(3.22)**	
Ln(Size)					0.061	0.021	0.050	-0.020	0.048	-0.020	0.045	-0.033
					(1.22)	(0.36)	(0.84)	(-0.31)	(0.81)	(-0.30)	(0.74)	(-0.54)
Leverage					0.011	-1.65***	0.030	-1.60***	0.035	-1.59***	0.0040	-1.70***
					(0.041)	(-3.32)	(0.11)	(-3.46)	(0.13)	(-3.39)	(0.014)	(-4.04)
Tangibility					0.13	-0.19	0.13	-0.21	0.14	-0.18	0.24	-0.20
					(0.36)	(-0.50)	(0.35)	(-0.59)	(0.38)	(-0.50)	(0.63)	(-0.57)
Sales Growth					-0.0011	0.15	0.0017	0.15	0.00087	0.15	0.010	0.19
					(-0.0081)	(1.09)	(0.012)	(1.23)	(0.0064)	(1.19)	(0.068)	(1.36)
Acc. Std.					-0.047	0.098	-0.053	0.085	-0.056	0.076	-0.011	0.13
					(-0.35)	(0.96)	(-0.40)	(0.78)	(-0.43)	(0.71)	(-0.11)	(1.21)
Observations	372	372	372	372	355	355	355	355	355	355	299	299
Treated	117	117	117	117	110	110	110	110	110	110	88	88
Industry / year FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Polynomial	no	no	one	one	one	one	two	two	one	one	one	one
Both sides	no	no	no	no	no	no	no	no	yes	yes	yes	yes
F statistic	55.3		2.83		5.59		6.19		5.96		10.4	
Stage	first	second	first	second	first	second	first	second	first	second	first	second

Table 12: Regression discontinuity analysis – covariates around the threshold
This table shows reduced-form OLS regressions. The dependent variables are in the column titles. The main explanatory variable is >10,000, an indicator for firms with more than 10,000 domestic employees. Only firm-years with 7,500 to 12,500 domestic employees are included. The dependent variables are observed two years after and all other variables one year after the employee numbers. Polynomial indicates how we control for the centered number of domestic employees. Both sides indicates that the polynomials are interacted with the >10,000 dummy. All models include industry and year fixed effects. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. A description of all variables is in Appendix A.

Model	1	2	3	4	5	6	7
Dep. variable	Ln(Size)	Leverage	Tangibility	Sales Growth	Acc. Std.	Listing	Share Domestic Employees
>10,000	**0.16**	**0.046**	**0.00065**	**-0.0022**	**0.0082**	**0.18***	**0.0028**
	(0.79)	**(1.53)**	**(0.017)**	**(-0.083)**	**(0.098)**	**(1.78)**	**(0.057)**
Ln(Size)		0.025	-0.012	0.015	0.13***	0.077	-0.16***
		(1.14)	(-0.39)	(1.47)	(3.44)	(1.01)	(-4.75)
Leverage	0.76		-0.27*	-0.13***	0.060	-0.71**	-0.14
	(0.94)		(-1.89)	(-3.19)	(0.23)	(-2.51)	(-0.97)
Tangibility	-0.33	-0.21**		0.060	-0.15	-0.41	0.21
	(-0.40)	(-2.50)		(1.28)	(-0.56)	(-1.38)	(1.00)
Sales Growth	0.69**	-0.031	0.13**		0.073	-0.075	-0.019
	(2.46)	(-0.55)	(2.34)		(0.63)	(-0.46)	(-0.25)
Acc. Std.	0.75***	-0.00085	-0.022	0.021		0.50***	-0.13*
	(2.70)	(-0.020)	(-0.39)	(0.85)		(5.22)	(-1.74)
Listing	0.23	-0.059	-0.056	-0.037*	0.33***		0.0078
	(0.79)	(-1.62)	(-1.13)	(-1.95)	(5.41)		(0.16)
Observations	456	456	459	456	456	455	439
Treated	141	141	143	141	141	141	139
Industry FE	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes
Polynomial	one	one	one	one	one	one	one
Both sides	yes	yes	yes	yes	yes	yes	yes

Table 13: Regression discontinuity analysis – placebo tests

This table shows reduced-form OLS regressions. The dependent variable is ROA. The sample is limited to firms whose number of domestic employees is between 5,000 and 10,000 (10,000 and 15,000) in Model 1 (Model 2), or to firms whose number of total employees is between 7,500 and 12,500 (5,000 and 15,000) in Model 3 (Model 4). The main explanatory variable is Threshold Indicator. This indicator variable is set to one if the number of domestic employees is above the median in the sample used in Model 1 (Model 2), and zero otherwise. In Models 3 and 4, it is set to one if the number of total employees is greater than 10,000, and zero otherwise. ROA is observed two years after and all other variables one year after the employee numbers. Polynomial indicates how we control for the centered number of domestic employees. Both sides indicates that the polynomials are interacted with the >10,000 dummy. All models include industry and year fixed effects. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. A description of all variables is in Appendix A.

Model	1a	1b	2a	2b	3a	3b	4a	4b
Test	7,422 DE	7,422 DE	12,052 DE	12,052 DE	10,000 TE	10,000 TE	10,000 TE	10,000 TE
Dep. variable	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA
Threshold Indicator	**-0.0093 (-0.83)**	**-0.0052 (-0.57)**	**-0.0060 (-0.35)**	**-0.023 (-1.44)**	**-0.0020 (-0.22)**	**-0.0079 (-1.02)**	**-0.0032 (-0.39)**	**-0.0025 (-0.34)**
Ln(Size)		-0.012**		-0.018**		0.0021		-0.0060
		(-2.03)		(-2.14)		(0.36)		(-1.40)
Leverage		-0.10***		-0.13**		-0.12***		-0.093***
		(-2.92)		(-2.32)		(-3.90)		(-4.04)
Tangibility		-0.011		-0.063		-0.045		-0.049**
		(-0.53)		(-1.65)		(-1.36)		(-2.29)
Sales Growth		0.054***		0.050		0.086***		0.079***
		(2.64)		(1.31)		(5.04)		(6.81)
Acc. Std.		0.015		0.015		-0.0064		-0.0058
		(1.54)		(0.97)		(-0.72)		(-0.89)
Listing		0.0019		-0.0035		-0.0096		-0.0054
		(0.21)		(-0.25)		(-1.10)		(-0.85)
Observations	629	613	229	220	748	729	1,956	1,925
Treated	316	309	114	108	239	234	444	438
R^2	0.103	0.239	0.332	0.461	0.195	0.313	0.138	0.250
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Polynomial	one	one	one	one	one	one	one	one
Both sides	yes	yes	yes	yes	yes	yes	yes	yes

Table 14: Regression discontinuity analysis – robustness

This table shows reduced-form OLS regressions. The dependent variable is ROA in Models 1 to 6 and ROE in Models 7 and 8. The main explanatory variable is >10,000, an indicator for firms with more than 10,000 domestic employees. Only firm-years with 7,500 to 12,500 domestic employees are included unless otherwise stated. Model 2 includes only firms with above median industry sales growth over the last two years. The industry definition follows the Fama-French 12 industries classification. Model 3 excludes observations with board size above 17. Models 5, 7, and 9 exclude firm-years in which firms cross the threshold of 10,000 domestic employees. The dependent variables are observed two years after and all other variables one year after the employee numbers. Polynomial indicates how we control for the centered number of domestic employees. Both sides indicates that the polynomials are interacted with the >10,000 dummy. All models include industry and year fixed effects. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. A description of all variables is in Appendix A.

Model	1	2	3	4	5	6	7	8	9
Robustness test	Share Domestic Employees	High sales growth	Board Size ≤ 17	8,000 ≤ DE ≤ 12,000	8,000 ≤ DE ≤ 12,000	8,500 ≤ DE ≤ 11,500	8,500 ≤ DE ≤ 11,500		
Dependent variable	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROE	ROE
Large Board	**-0.021***	**-0.033****	**-0.033****	**-0.017**	**-0.028***	**-0.0083**	**-0.029***	**-0.023**	**-0.051***
	(-1.82)	**(-2.42)**	**(-2.44)**	**(-1.32)**	**(-1.78)**	**(-0.77)**	**(-1.79)**	**(-1.18)**	**(-1.93)**
Ln(Size)	-0.012	-0.011	-0.0085	-0.0076	-0.0070	-0.0095	-0.011**	-0.0085	-0.013
	(-1.53)	(-1.57)	(-0.98)	(-1.19)	(-1.13)	(-1.62)	(-2.26)	(-0.86)	(-1.19)
Leverage	-0.13***	-0.16***	-0.15***	-0.15***	-0.13***	-0.12***	-0.12***	0.0058	0.033
	(-3.58)	(-3.88)	(-3.31)	(-3.66)	(-3.70)	(-2.88)	(-3.54)	(0.089)	(0.52)
Tangibility	0.0026	0.00011	0.016	0.023	0.013	0.057**	0.053**	-0.023	-0.032
	(0.12)	(0.0029)	(0.63)	(0.89)	(0.60)	(2.11)	(2.29)	(-0.59)	(-0.80)
Sales Growth	0.040*	0.046	0.031	0.014	0.011	-0.0030	-0.015	0.12**	0.13**
	(1.75)	(1.51)	(1.26)	(0.59)	(0.43)	(-0.11)	(-0.46)	(2.49)	(2.59)
Acc. Std.	0.0011	-0.0053	0.00051	0.0052	0.0070	0.012	0.014	0.029	0.034
	(0.13)	(-0.45)	(0.038)	(0.49)	(0.68)	(1.17)	(1.54)	(1.42)	(1.59)
Listing	-0.0082	-0.0044	-0.0086	-0.015	-0.0093	-0.0050	0.0057	-0.036*	-0.025
	(-0.93)	(-0.42)	(-0.94)	(-1.63)	(-0.90)	(-0.45)	(0.48)	(-1.87)	(-1.28)
Share Domestic Employees	-0.014								
	(-0.70)								
Observations	454	327	348	351	275	257	195	456	367
Treated	140	96	112	113	79	98	69	141	105
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
Polynomial	one	one	one	one	one	one	one	one	one
Both sides	yes	yes	yes	yes	yes	yes	yes	yes	yes

Table 15: Difference-in-differences analysis around the introduction of the board size requirement
The dependent variables are ROA and Tobin's Q. All models are firm-fixed effects regressions. The sample period is from 1973 (or 1974) to 1975 (pre-period) and from 1979 (or 1980) to 1981 (post-period). Treated firms have at least 10,000 total employees in 1975 (1974 if employee data is not available in 1975). Control firms are dropped based on total assets in 1975 until the number of control and treated firms is equal. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. A description of all variables is in Appendix A.

Model	1	2	3	4	5	6
Dep. variable	ROA	ROA	ROA	ROA	Tobin's Q	Tobin's Q
Window [years]	[-2;+2]	[-3;+3]	[-2;+2]	[-3;+3]	[-2;+2]	[-2;+2]
Treated x Post	**-0.020****	**-0.013***	**-0.020****	**-0.012***	**-0.15*****	**-0.12****
	(-2.32)	**(-1.92)**	**(-2.48)**	**(-1.78)**	**(-2.77)**	**(-2.11)**
Leverage			-0.056	-0.038		-0.49*
			(-1.25)	(-1.03)		(-1.71)
Ln(Size)			0.0055	-0.0010		-0.050
			(0.53)	(-0.13)		(-0.90)
Sales Growth			0.00068	0.0081		0.042
			(0.048)	(1.01)		(0.67)
Observations	267	397	267	397	279	279
Treated	131	195	131	195	137	137
Adjusted R^2	0.035	0.036	0.034	0.036	0.24	0.24
Firm FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes

Table 16: Difference-in-differences analysis – robustness

The dependent variable is ROA. All models are firm fixed effects regressions. Unless otherwise stated, the sample period is from 1974 to 1975 (pre-period) and from 1980 to 1981 (post-period). Treated firms have at least 10,000 total employees in 1975 (1974 if employee data is not available in 1975). Unless otherwise stated, control firms are dropped based on total assets in 1975 until the number of control and treated firms is equal. Model 1 uses propensity-score matching on book assets with a restrictive caliper of .0327, corresponding to 10% of the standard deviation of the propensity score. Model 2 excludes control firms with more than 20,000 total employees in the post-period. Models 3a, 3b, and 3c are placebo tests. In Model 3a (3b), the sample period is from 1970 to 1975 (1974). Post is set to one from 1973. In Model 3c, the dataset is restricted to firms with 2,000 to 10,000 total employees in 1974/75. Treatment is defined using a median sample split based on the number of total employees in 1974/75. Model 4 excludes firms with at least 50,000 employees in the pre-period. Model 5 excludes firms that have foreign plants. Model 6 excludes firms with 10,000-20,000 employees and more than 15 directors and firms with >20,000 employees and more than 19 directors in 1975. Model 7 controls for director busyness. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. A description of all variables is in Appendix A.

Model	1	2	3a	3b	3c	4	5	6	7
Dep. variable	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA
Test	Size matching	No large control firms	Placebo	Placebo	Placebo	No large treated firms	No foreign plants	No already treated firms	Busyness
Window [years]	[-2;+2]	[-2;+2]	[-3;+3]	[-3;+2]	[-2;+2]	[-2;+2]	[-2;+2]	[-2;+2]	[-2;+2]
Treated x Post	**-0.029****	**-0.022****	**-0.000043**	**-0.0018**	**0.011**	**-0.018***	**-0.022****	**-0.018***	**-0.016****
	(-2.51)	**(-2.64)**	**(-0.0075)**	**(-0.35)**	**(1.13)**	**(-1.94)**	**(-2.56)**	**(-1.98)**	**(-2.07)**
Leverage	-0.32***	-0.056	0.014	0.073	0.13**	-0.089*	-0.053	-0.091*	-0.060
	(-3.85)	(-1.26)	(0.30)	(1.63)	(2.17)	(-1.72)	(-1.18)	(-1.83)	(-1.46)
Ln(Size)	0.020	0.010	-0.0025	-0.0076	-0.030	0.0089	0.0064	0.0097	0.0034
	(1.54)	(1.07)	(-0.19)	(-0.61)	(-1.45)	(0.91)	(0.61)	(1.00)	(0.35)
Sales Growth	-0.0016	0.0015	0.027	0.040***	0.014	-0.0022	-0.00040	-0.0030	0.0012
	(-0.11)	(0.13)	(1.52)	(2.71)	(1.36)	(-0.14)	(-0.028)	(-0.19)	(0.086)
Busyness									-0.10**
									(-2.16)
Observations	84	269	284	206	251	199	259	206	267
Treated	42	131	139	100	128	99	127	102	131
Adjusted R^2	0.39	0.037	0.085	0.12	0.089	0.032	0.037	0.037	0.080
Firm and year FE	yes	yes	yes	yes	yes	yes	yes	yes	yes

Table 17: Acquisition announcement returns

This table shows reduced-form OLS regressions. The dependent variables are cumulative abnormal returns (CARs) around the announcements of M&A deals. The main explanatory variable is >10,000, an indicator for firms with more than 10,000 domestic employees. Only firm-years with 7,500 to 12,500 (5,000 to 15,000) domestic employees are included in Models 1, 3a, and 4a (Models 2, 3b, and 4b). In Models 3 and 4, we exclude firm-years in which firms cross the threshold of 10,000 domestic employees. Acquisition announcement returns are observed one year after and other control variables in the same year as the employee numbers. Polynomial indicates how we control for the centered number of domestic employees. Both sides indicates that the polynomials are interacted with the >10,000 dummy. All models include industry and year fixed effects. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. A description of all variables is in Appendix A.

Model	1a	1b	2a	2b	3a	3b	4a	4b
Dep. variable	CAR	CAR	CAR	CAR	CAR	CAR	CAR	CAR
Sample	7,500-12,500	7,500-12,500	5,000-15,000	5,000-15,000	7,500-12,500	5,000-15,000	7,500-12,500	5,000-15,000
Window [trading days]	[-2;+2]	[-1;+1]	[-2;+2]	[-1;+1]	[-2;+2]	[-2;+2]	[-2;+2]	[-2;+2]
>10,000	**-0.022*** **	**-0.018*** **	**-0.021*** **	**-0.016*** **	**-0.019***	**-0.021*** **	**-0.014**	**-0.019*** **
	(-3.55)	**(-2.97)**	**(-3.19)**	**(-3.11)**	**(-1.92)**	**(-2.41)**	**(-1.55)**	**(-2.29)**
Ln(Size)	0.0082	0.014**	0.0016	0.0031	0.0060	0.000042	0.0015	-0.0010
	(1.27)	(2.10)	(0.44)	(0.92)	(0.90)	(0.012)	(0.20)	(-0.29)
Leverage	-0.044	-0.069	-0.0017	-0.022	0.021	0.026	0.021	0.037
	(-0.92)	(-1.41)	(-0.058)	(-1.00)	(0.36)	(0.75)	(0.34)	(0.97)
Tangibility	0.0059	0.037	0.029	0.014	-0.014	0.0075	-0.027	-0.0075
	(0.13)	(0.82)	(1.40)	(0.75)	(-0.28)	(0.39)	(-0.50)	(-0.34)
Sales Growth	-0.064***	-0.032*	-0.037*	-0.011	-0.042	-0.012	-0.039	-0.011
	(-3.02)	(-1.81)	(-1.82)	(-0.69)	(-1.53)	(-0.44)	(-1.37)	(-0.44)
Acc. Std.	0.012	-0.00042	0.019*	0.011	-0.012	0.0042	-0.010	0.0051
	(0.99)	(-0.027)	(1.74)	(1.29)	(-0.69)	(0.49)	(-0.59)	(0.59)
Listed Target							0.028*	0.018**
							(1.80)	(2.23)
Diversifying deal							-0.010	-0.0048
							(-1.25)	(-0.79)
International deal							-0.0060	-0.011
							(-0.74)	(-1.35)
Observations	161	161	249	249	138	222	138	222
Treated	83	83	124	124	69	108	69	108
Adjusted R^2	0.283	0.175	0.187	0.112	0.247	0.170	0.293	0.203
Polynomial	one	one	one	one	one	one	one	one
Both sides	yes	yes	yes	yes	yes	yes	yes	yes

Appendix A: Variable definitions and data sources

The data sources are abbreviated as DS for Datastream, HB for Handbook of German Joint-Stock Companies, HS for Hoppenstedt, SDC for SDC Platinum, SG for Stock Guide (Saling or Hoppenstedt) and WC for Worldscope.

Variable	Description
Main variables	
ROA	1987-2016 Panel: earnings before interest and taxes divided by total assets. Law Introduction Sample: net income divided by total assets. Source: HS / SG / WC.
Tobin's Q	Sum of equity market capitalization and total liabilities divided by the sum of common equity and total liabilities. 1987-2016 Panel: all variables taken from Worldscope ((wc08001+wc03351)/(wc03501+wc03351)). Law Introduction Sample: book equity is the product of number of shares outstanding with the nominal share value, summed across share classes. Market equity is the product of number of shares outstanding with the share price, also summed across share classes. Source: WC / SG.
Large Board	Dummy that equals one if a firm's supervisory board has at least 16 members. The dummy remains one in years in which board size temporarily drops to 15, with at least 16 board members in both the year before and after. Source: Annual reports.
Board Size	Number of supervisory board members at fiscal year-end. Source: Annual reports.
>10,000	Dummy that equals one if a firm has more than 10,000 domestic employees. Source: HS and annual reports.
Domestic Employees	Number of domestic employees. Source: HS and annual reports.
Total Employees	Total number of employees. Source: HS and annual reports.
Share Domestic Employees	Domestic employees divided by total employees. Source: HS and annual reports.
Treated	Dummy that equals one for firms that had at least 10,000 total employees in 1975 (or 1974 if 1975 unavailable). Source: HB.
Post	Dummy that equals one after 1980, i.e., after the law's implementation period.
Other variables	
ROE	Net income divided by the book value of equity. Source: HS / WC.
Size	Book value of total assets in million Euro. Converted to 2016 values based on German inflation rates from the OECD. Source: HS / SG / WC.
Leverage	Total debt divided by total debt plus book value of equity. Source: HS / SG / WC.
Tangibility	Property, plant, and equipment scaled by total assets. Source: HS / SG / WC.
Sales Growth	Logarithmic sales growth between year t and year t-1. Source: HS / SG / WC.
Accounting Standard	Dummy that equals one if a firm follows international accounting standards. Source: HS and annual reports.
Listing	Dummy that equals one if a firm's shares are listed on a regulated market in Germany. Source: Annual reports / hand-collected.
Busyness	Share of directors with at least three simultaneous board positions. Source: SG.
M&A deals	
CAR	Cumulative market-adjusted excess returns around the announcement of an M&A deal. Excess returns are stock returns minus the return on the CDAX market index. Source: DS / SDC.
Listed Target	Dummy that equals one if the target firm has a stock market security identifier. Source: SDC.
Diversifying deal	Dummy which equals one if the firm acquires a target that does not share the same Fama-French 12 industry classification. Source: SDC.
International deal	Dummy which equals one if the target is located outside Germany. Source: SDC.

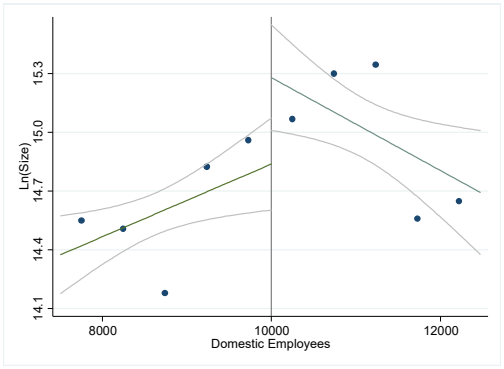
Appendix B: The probability of crossing alternative thresholds

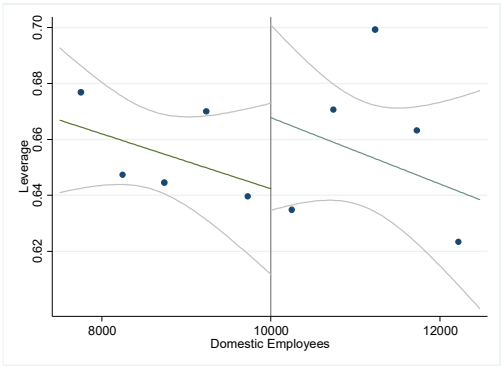
This table shows the probability of firms moving above or below alternative thresholds of domestic employees. For example, the first row shows that from the set of firms with between 6,000 and 7,000 domestic employees in year t, 21.5% have more than 7,000 domestic employees in year t+1.

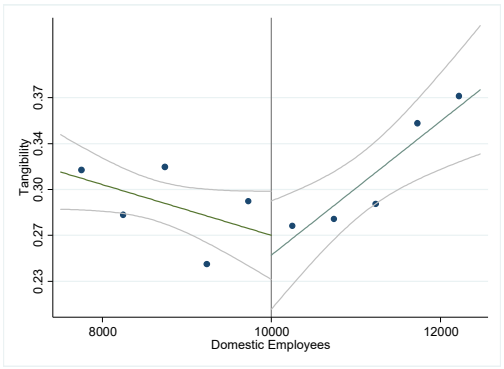
Panel A: Moving up	**Percentage of firms moving up**
Domestic employees between 6,000 – 7,000, moving above 7,000	21.50%
Domestic employees between 7,000 – 8,000, moving above 8,000	25.95%
Domestic employees between 8,000 – 9,000, moving above 9,000	22.92%
Domestic employees between 9,000 – 10,000, moving above 10,000	*24.00%*
Domestic employees between 10,000 – 11,000, moving above 11,000	17.11%
Domestic employees between 11,000 – 12,000, moving above 12,000	25.58%
Domestic employees between 12,000 – 13,000, moving above 13,000	26.92%
Panel B: Moving down	**Percentage of firms moving down**
Domestic employees between 13,000 – 14,000, moving below 13,000	31.25%
Domestic employees between 12,000 – 13,000, moving below 12,000	23.08%
Domestic employees between 11,000 – 12,000, moving below 11,000	37.21%
Domestic employees between 10,000 – 11,000, moving below 10,000	*27.63%*
Domestic employees between 9,000 – 10,000, moving below 9,000	23.00%
Domestic employees between 8,000 – 9,000, moving below 8,000	15.97%
Domestic employees between 7,000 – 8,000, moving below 7,000	15.27%

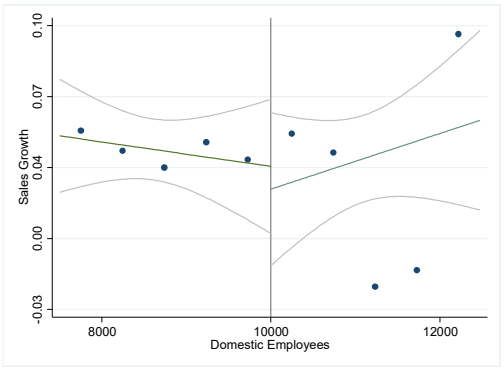
Appendix C: Balancing of covariates around the threshold

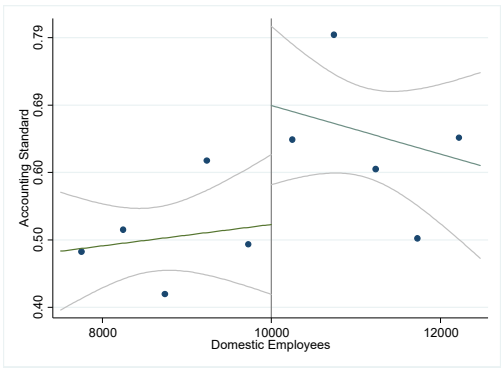
This figure shows regression discontinuity plots with linear fit and the corresponding 90% confidence intervals. The x-axis displays the number of domestic employees, measured in bins of 500 employees around the threshold of 10,000 domestic employees. The sample is limited to firms whose number of domestic employees is between 7,500 and 12,500. The firm characteristics are observed two years after the domestic employee numbers. The y-axis shows the mean dependent variable in the respective bin.

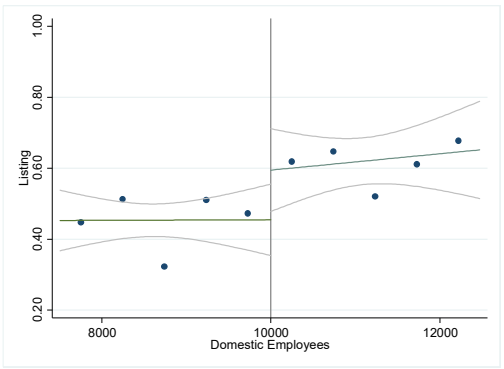


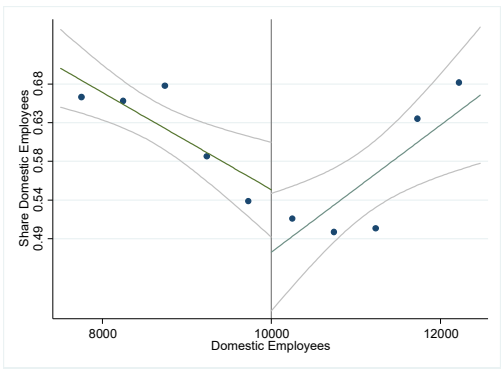








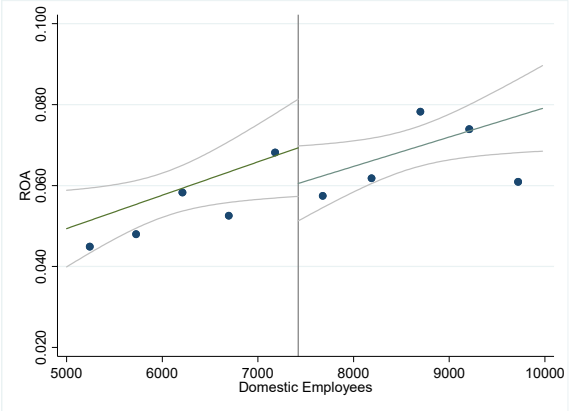




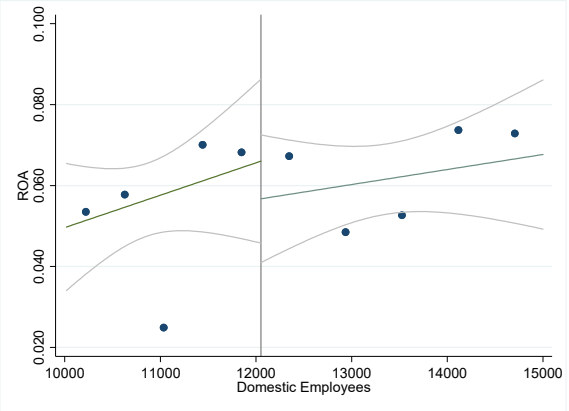
Appendix D: Placebo tests

This figure shows regression discontinuity plots with linear fit and the corresponding 90% confidence intervals. The x-axis displays the number of domestic or total employees, measured in bins of 500 employees around several thresholds. The sample is limited to firms with 5,000 to 10,000 domestic employees in Figure (a), to firms with 10,000 to 15,000 domestic employees in Figure (b), to firms with 7,500 to 12,500 total employees in Figure (c), and to firms with 5,000 to 15,000 total employees in Figure (d). The threshold is the median number of domestic employees in the given sample in Figures (a) and (b). In Figures (c) and (d), the threshold is 10,000 total employees. ROA is observed two years after the domestic or total employee numbers. The y-axis shows the average ROA in the respective bin.

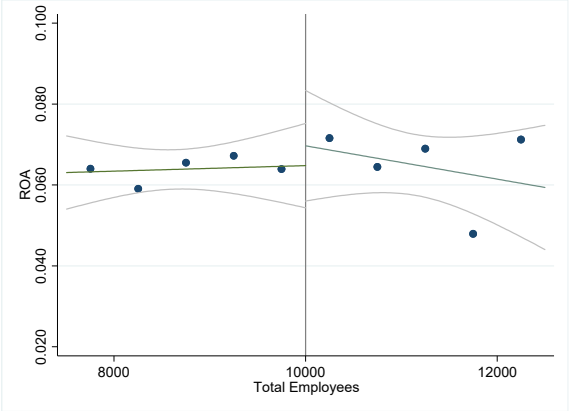
(a) Domestic employees, threshold: 7,422



(b) Domestic employees, threshold: 12,052



(c) Total employees, threshold: 10,000



(d) Total employees, threshold: 10,000