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Does Board Size Matter?

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Abstract

This paper uses legal board size requirements to test whether board size affects firm performance and value. Since 1976, the minimum size of German firms' supervisory boards increases from 12 to 16 directors at 10,000 domestic employees, resulting in a sharp increase in board sizes. Regression discontinuity analyses show that ROA and Tobin's Q decline by 2-3 percentage points and 0.20, respectively, at the threshold. A difference-in-differences analysis around the law's introduction shows similar effects. Large boards' underperformance is persistent, not just a transitory effect of adding directors, and large boards are associated with lower profit margins and M&A announcement returns.

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Boards of directors play a central role in corporate governance. They select, monitor, evaluate, compensate, and replace top executives, but also advise and support them (Adams and Ferreira 2007, American Bar Association 2009). Policy makers and regulators in many countries have tried to improve board effectiveness by discouraging large boards (Adams 2017). The academic literature, however, provides little causal evidence on the effects of board size. Empirical studies, going back to at least Yermack (1996), have mostly found negative correlations between board size and firm performance. Because large boards are an endogenous choice, which is likely to be correlated with other drivers of performance, these correlations are difficult to interpret.

This paper exploits a minimum board size requirement to assess whether forcing firms to have large boards reduces firm performance. German corporations have a two-tier board, with a management board that runs the firm and a supervisory board that hires, advises, and monitors the management board. Since 1976, the supervisory board's legally mandated minimum size is 12 directors for firms with 2,000 to 10,000 domestic employees (DE), 16 directors for 10,000 to 20,000 DE, and 20 directors above 20,000 DE. These requirements appear to be binding: most firms with 5,000-10,000 DE have exactly 12 directors, and most firms with 10,000-15,000 DE have exactly 16. This suggests that many firms just above 10,000 DE would prefer a smaller board, which allows us to test whether requiring a larger one is harmful.

Using a regression discontinuity (RD) design and a difference-in-differences analysis, we find robust evidence that forcing firms to have large supervisory boards is detrimental to their performance and value. The RD analysis uses a panel of German firms from 1987 to 2016 and compares firms just below 10,000 DE to firms just above.[1] Performance declines at the threshold, with reduced form estimates showing a drop in return on assets (ROA) of 2-3 percentage points and a decline in Tobin's Q of around 0.20. Accounting for the higher probability of firms above 10,000 DE having a large board (with ≥16 directors), two-stage least squares (2SLS) estimates associate large boards with a noisily estimated 5-6 percentage point drop in ROA.

Even though this setting is useful and unique, it does not create an ideal experiment. The number of DE is at least in part under the control of management and, to avoid a larger board, some firms might strategically choose to remain below 10,000 DE. Even though we find no evidence of such behavior – firms do not bunch below the threshold, and they are no less likely to cross 10,000 DE than other thresholds – we cannot rule it out. We therefore analyze a second setting in which strategic behavior is less likely.

[1] We focus on this threshold because employee codetermination also changes at 2,000 DE (see Section 1.1), and because there are too few observations around 20,000 DE.

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The second setting is the introduction of the board size requirement in 1976, to which we apply a difference-in-differences (DiD) analysis. This analysis compares changes in firm performance and value from before to after the law's introduction of treated (>10,000 employees) to control firms (≤10,000).[2] We minimize concerns about firms strategically choosing to remain below 10,000 employees by classifying firms shortly after the threshold was announced. Depending on the measurement window, the law's introduction reduces treated firms' ROA by 1.3-2.0 percentage points and their Tobin's Q by 0.04-0.10. Thus, despite different time periods and research designs, the DiD and RD analyses show similar reductions in operating performance. The weaker effect on Tobin's Q in the DiD might be explained by stock prices anticipating the new law's effect.

Theoretically, increasing the number of directors has both costs and benefits (Raheja 2005, Harris and Raviv 2008, Kakhbod et al. 2022). 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 suffer from frictions in group decision making, such as free-riding and coordination problems (Lipton and Lorsch 1992, Jensen 1993), and the need to find more directors may lower their quality.

We empirically explore several mechanisms that might explain why large boards underperform. Our results show worse performance to be a steady-state feature of large boards, not just a transition effect, and large boards to be associated with lower profit margins (consistent with worse cost control) and lower acquisition announcement returns (consistent with worse M&A deals). We also find suggestive but insignificant evidence that directors added after crossing 10,000 DE are busier, less experienced, and less likely to have a doctorate. Notably, there is no evidence that large boards pay more for executives or employees, choose lower pay-for-performance sensitivities, or reduce CEO turnover. However, many of these results are noisily estimated, so more work is needed to understand why exactly large boards are less effective.

An issue with both of our settings is that the sample sizes are small. In the 1987-2016 panel, there are 104 sample firms (843 firm-year observations) with 5,000 to 15,000 DE, the range on which we focus most of our analyses. In robustness tests, we use a narrower bandwidth of 8,000 to 12,000 DE, with 61 firms and 360 firm-year observations. These small samples result in noisy estimates, especially in the 2SLS analysis. In the DiD analysis around the law's introduction, the number of firms is even smaller, with 38 "treated" firms with more than 10,000 employees and an equal number of matched control firms. Given these limitations, it is reassuring that we obtain similar results from the different bandwidths, research designs, and sample periods.

[2] Because the number of domestic employees is not available in the 1970s, we use total employees as proxy.

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Our analysis speaks to a literature, going back to at least Yermack (1996), that has documented mostly negative correlations between board size and firm performance.[3] Interpreting these correlations is challenging. Shareholders and executives endogenously choose the size of the board, so differences in board size are likely to be due to differences in firm, shareholder, or executive characteristics, many of which are unobservable (Hermalin and Weisbach 1998, 2003, Raheja 2005, Boone et al. 2007, Coles, Daniel, and Naveen 2008, Harris and Raviv 2008, Linck, Netter, and Yang 2008, Ferreira, Ferreira, and Mariano 2018). If, as seems likely, these characteristics also affect firm performance, the widely documented negative correlation between board size and performance does not measure the underlying causal effect.

We document detrimental effects of large boards in a setting that, despite its shortcomings, is much less prone to endogeneity concerns. Our results confirm 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, Kakhbod et al. 2022), that effectiveness declines as boards grow too large. This might explain why, over a period of generally improving corporate governance, US boards have been shrinking. From the 1950s to the 2000s, the size of the average US public firm board has declined from 11 to 9 directors, despite firms becoming much larger (Graham, Kim, and Leary 2020). It might also explain why, after the introduction of board gender quotas in many countries, firms reacted by replacing male directors, rather than by adding female ones.[4]

Because our treated firms are forced to have large boards, our results do not prove that the negative correlation between endogenously chosen large boards and performance found by Yermack (1996) and others is causal. Instead, what our results show is that this causal mechanism exists and that its effects are large – if exogenously imposed large boards did not reduce performance, it would be difficult to argue that endogenously chosen ones do.

More broadly, our results add to a growing body of evidence that boards are important for firm behavior and performance. Several studies use quasi-natural experiments to show that individual directors can have important effects on firms (Nguyen and Nielsen 2010, Giannetti,

[3] See, among others, Yermack (1996) for the US, 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 sample of 10 OECD countries, Bennedsen, Kongsted, and Meisner Nielsen (2008) for Denmark, and Guest (2009) for the UK. Some studies have found an insignificant correlation (de Jong et al. (2005) for the Netherlands; Black, Jang, and Kim (2006) for Korea) and some even a positive one (Kiel and Nicholson (2003) for Australia; Adams and Mehran (2005) for US banks).

[4] See Ahern and Dittmar (2012), Matsa and Miller (2013), Bøhren and Staubo (2016), Bertrand et al. (2019), and Eckbo, Nygaard, and Thorburn (2022) for Norway, Fedorets, Gibert, and Burow (2019) for Germany, Rebérioux and Roudaut (2019) and Ferreira et al. (2021) for France, Greene, Intintoli, and Kahle (2020) and Hwang, Shivdasani, and Simintzi (2021) for California, and Kuzmina and Melentyeva (2021) for a sample of seven European countries.

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Liao, and Yu 2015, Hauser 2018, Masulis and Zhang 2019). Another strand of the literature examines the effects of changes to boards caused by new US stock exchange listing rules in 2004 (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, they are not informative about board size effects.

This paper proceeds as follows. Section 1 describes the institutional background and Section 2 the two empirical strategies. Section 3 explains the sample selection and defines variables. Sections 4 to 6 present our empirical results, and Section 7 summarizes and concludes.

1 Institutional Setting

1.1 Corporate boards in Germany

German stock corporations ("AG") and German limited liability companies ("GmbH") with more than 500 DE have a dual board structure with a management board ("Vorstand") and a supervisory board ("Aufsichtsrat").[5] The management board consists of the company's top executives and is responsible for running the firm. The supervisory board appoints and oversees the management board. Appointments are for up to five years, with the possibility of reappointment. The supervisory board has the right to examine all corporate documents and assets, and it can mandate that certain transactions, such as mergers or acquisitions, require its consent.[6]

In firms with more than 500 DE, the supervisory board is made up of both shareholder and employee representatives. The annual shareholders' meeting elects the shareholder representatives, who resemble non-executive directors on US boards. Domestic employees (i.e., those employed in Germany) elect the employee representatives. The proportions of shareholder and employee representatives are a function of firm size. Employee representatives take one-third of the seats on the supervisory board of firms with 500 to 2,000 DE, but one-half in firms with more than 2,000 DE. In those firms, the chairman of the board is typically a shareholder representative and receives a second, tie-breaking vote in case a decision is deadlocked. Because our analysis focuses on firms close to 10,000 DE, all our firms have an equal number of shareholder and employee representatives on their supervisory board.

[5] Our sample includes some 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), which permits a choice between a dual and a unitary board structure. There are no SEs in our sample.

[6] 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).

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1.2 The size of the supervisory board

Until 1976, German law mandated a minimum size of the supervisory board of three members and a maximum of 21.[7] In 1976, the law on codetermination ("Mitbestimmungsgesetz") introduced new minimum board size requirements for firms that typically have more than 2,000 DE. Supervisory boards must have at least 12, 16, or 20 members, depending on the number of DE:

- 12 for firms with typically more than 2,000 but not more than 10,000 DE
- 16 for firms with typically more than 10,000 but not more than 20,000 DE
- 20 for firms with typically more than 20,000 DE

Subsequent legal commentary and jurisprudence interpreted the term "typically" (German "in der Regel") to reflect expected near-term changes in employment. In all cases, half of the supervisory board members are owner representatives and the other half employee representatives. For boards with 12 directors, four of the six employee representatives are employees and two are union representatives. With 16 directors, there are six employees and two union representatives, and for the largest boards seven and three. Unions nominate at least two candidates for each union seat, which employees vote on. There are no other differences in regulations between firms just above and just below 10,000 DE.

The law allows firms to voluntarily choose larger boards. Firms with a required board size of 12 can choose 16 or 20, and firms with a required board size of 16 can choose 20. To determine the number of DE, 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 to determine the size of the holding company's supervisory board. 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. For historical reasons, different board size requirements apply to firms in the coal, iron, and steel industries, which we therefore also exclude. 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 chose this form.

[7] The maximum is an increasing function of the firm's paid-in shareholders' equity. It is 21 for firms with paid-in equity above 20 million Deutsche Mark (until 1998) or 10 million Euro, which is the case for all our firms.

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2 Empirical strategy

To examine the effect of forcing firms to have large boards, we apply two research designs to data from two distinct time periods. Both designs exploit that the minimum board size increases discretely at 10,000 DE. Our first strategy is an RD analysis that compares firms just below and just above this threshold. Our second strategy is a DiD analysis around the introduction of the board size requirement in 1976.

2.1 Regression discontinuity analysis

We use a panel of firms from 1987 to 2016 and an RD design to compare firms just below the 10,000 DE threshold to firms just above. A detailed discussion of the RD approach and its assumptions is in Lee and Lemieux (2010). For our main tests, we focus on firms with 5,000 to 15,000 DE. This choice reflects a tradeoff between the desire to compare similar firms and the number of observations (see Section 3.1). As a robustness test, we use a narrower range of 8,000-12,000 DE, with similar but less precisely estimated results.

We do not use the minimum board size changes at 2,000 and 20,000 DE. Firms crossing 2,000 DE must also establish parity employee representation (i.e., an equal number of employee and shareholder representatives) on the supervisory board. This makes it impossible to disentangle the effects of employee representation and board size.[8] Firms close to 10,000 DE all have parity employee representation, which allows us to focus on the effect of changing board sizes. We do not use the threshold at 20,000 DE because too few firms are close to it (we found only 20 firms subject to the law and with all necessary data between 15,000 and 25,000 DE).

We estimate two complementary empirical models. Our focus is on reduced form regressions that analyze changes in firm performance at 10,000 DE. This "intent-to-treat" approach exploits that the probability of being treated (i.e., of having a large board) increases discretely at the threshold.[9] Specifically, we use a local-linear parametric RD model to regress firm performance, measured as either ROA or Tobin's Q, on an indicator variable (>10,000) for firms with more than 10,000 DE.

We control for any direct impact of the number of DE, the assignment variable, by including its centered value interacted with the threshold indicator. This allows for different effects of DE on each side of the threshold. Because it might take time for firms to change their board once they cross the threshold, and because it might take time for a board change to have an effect, performance is measured two years after we observe DE. As the law refers to the "typical"

[8] The effects of parity employee representation have been analyzed by Gorton and Schmid (2004), Fauver and Fuerst (2006), Kim, Maug, and Schneider (2018), and Lin, Schmid, and Xuan (2018). Jäger, Schoefer, and Heining (2021) focus on the effects of one-third employee representation in stock corporations below 500 DE.

[9] A sharp RD design would require board size to be exactly 12 to the left and 16 to the right of the threshold for all firms. This is not the case, for reasons explained later in this section.

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number of DE, we use the average of the domestic employee numbers reported for years t and t-1.[10] The idea is that the average DE number for year t determines board size in year t+1, which in turn affects firm performance in year t+2:

$$Performance_{i,t+2} = \alpha + \beta * >10{,}000_{i,t} + A_{i,t} + A_{i,t} * >10{,}000_{i,t} + \bar{\gamma} * \overline{C_{\iota,t+1}} + \epsilon_{i,t}$$

The coefficient of interest is β, which measures the discontinuous change in performance at the threshold of 10,000 DE. α is a constant, A the assignment variable (DE minus 10,000), and $\overline{C_{\iota,t+1}}$ is a vector of control variables that includes year and industry fixed effects based on the Fama/French 12 industries classification. Because firm characteristics, such as size and leverage, might be affected by the size of the board, including them can bias the coefficient on the threshold indicator. We therefore prefer models without such controls and present those with them, measured one year before performance, as robustness tests. Standard errors are clustered at the firm level.

To further quantify the effect of imposing large boards on firm performance, we also estimate fuzzy two-stage RD models. These explicitly account for the fact that not all firms to the left of the threshold have exactly 12 directors and not all firms to the right 16. The reasons include firms that voluntarily choose large boards, time lags between crossing the threshold and adjusting boards, unexpected director departures, and noisy DE numbers. The law uses the "typical" number of DE, including trainees and part-time employees, but excluding agency and temporary workers. The numbers we observe are often year-end numbers (which we average to mimic the law more closely) and might include or exclude different groups. Thus, our DE numbers are observed with error, which makes finding significant changes at the threshold less likely.

Formally, the two-stage least squares (2SLS) approach uses the indicator for more than 10,000 DE as an instrument for having a large board. In the first stage, the dependent variable is an indicator for boards with at least 16 directors, which we regress on the indicator for more than 10,000 DE, using the same specification and controls as in the reduced form:

$$Large\ Board_{i,t+1} = \alpha + \beta' * >10{,}000_{i,t} + A_{i,t} + A_{i,t} * >10{,}000_{i,t} + \bar{\gamma} * \overline{C_{\iota,t+1}} + \epsilon_{i,t}$$

The coefficient β' estimates the effect of the threshold on the probability of having a large board. Board size is measured one year after DE. To minimize the effect of short-term fluctuations, we keep the large board indicator switched on if board size drops to 15 for one year but is at least 16 in the year before and after. Results are similar if we define *Large Board* as at least 15 directors throughout, or if we use the number of directors as a continuous dependent variable in the first stage.

[10] If DE are unavailable in year t-1 we use year t only.

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In the second stage, we regress firm performance on $\widehat{LB}$, the large board indicator's predicted value from the first stage, using the same specification and controls as before:

$$Performance_{i,t+2} = \alpha + \beta'' * \widehat{LB}_{i,t+1} + A_{i,t} + A_{i,t} * >10{,}000_{i,t} + \bar{\gamma} * \overline{C_{\iota,t+1}} + \epsilon_{i,t}$$

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 caused by the board size requirement affect firm performance.

There are two concerns with this model. First, a causal interpretation of the second stage requires that the allocation of firms around the threshold is independent of any other determinants of firm performance. This may not be the case, as firms with certain characteristics might choose to remain (or move) below 10,000 DE to avoid a larger board. Even though there is no evidence that firms bunch below the threshold, we cannot rule it out. Second, the small number of observations in some of our models creates concerns about weak-instrument bias and, thus, the reliability of the second-stage estimates.

2.2 Difference-in-differences analysis

The introduction of the board size requirements in 1976 creates an opportunity for a difference-in-differences (DiD) analysis. The codetermination law, which includes the board size rules, was passed by the German parliament on March 18, 1976, and became effective on July 1, 1976. The law included a transition period, making 1978 the first year in which boards had to comply with the new rules. However, there was considerable uncertainty whether the law was constitutional. Shortly after the law's passing, several parties, including the main employer associations, filed a constitutional complaint (Wiedemann 1980). The legal process concluded on March 1, 1979, with the Constitutional Court affirming the law.

We define pre- and post-treatment periods based on this chronology, focusing on two- and three-year windows around the law's introduction. The pre-periods are 1974-75 or 1973-75, before the law passed. To allow for the transition period and the legal uncertainty before the Constitutional Court's 1979 ruling, we exclude 1976-78 or 1976-79. The post-periods are 1980-81 or 1979-81.

The DiD analysis compares changes in firm performance from before to after the law's introduction between treated (>10,000 employees) and control (2,000-10,000 employees) firms. Even though the board size requirement is based on domestic, not total, employees, data limitations in this sample force us to use total employees. We define treated and control firms based on their employees in the year before the law passed.

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Treated firms had to increase their board size to 16 or 20, whereas control firms had to increase it to only 12. We drop firms with fewer than 2,000 employees, to which the new law did not apply. All remaining firms in the sample also became subject to parity employee representation. Its effect should therefore cancel out, allowing the analysis to identify the incremental effect of a larger increase in board size.

We estimate a standard DiD model with firm fixed effects, year fixed effects, and a vector of controls:

$$Performance_{i,t} = \alpha_i + \beta''' * Treated_i * Post_t + \gamma * \overline{C_{i,t-1}} + \epsilon_{i,t}$$

The coefficient of interest is β''', which measures the differential change in performance after the law's introduction for treated compared to control firms. The treatment and the post dummy are absorbed by the firm and the year fixed effects, respectively. Control variables are lagged by one period and standard errors clustered at the firm level.

Ideally, treated and control firms should differ only in their assignment to the treatment. In our setting, the assignment depends on the number of DE. This makes our treated firms larger than the control firms, creating the concern that they might be affected by different shocks. Besides verifying that treated and control firms are on parallel trends before the law's introduction, we control for firm size in the DID regressions. We also perform a robustness test in which we match treated and control firms by size, which further reduces the sample size but confirms that the treatment effect is unlikely to be caused by size differences.

3 Data

3.1 The 1987-2016 panel

For the regression discontinuity analysis, we use an unbalanced panel of public and private German firms from 1987 to 2016. Most of the data come from the Hoppenstedt database (www.bilanzen.de), which contains all publicly listed and larger private German firms. Data availability in Hoppenstedt is poor before 1987, and 2016 was the last year with available data when conducting the analyses.

Most of our analyses focus on firms with 5,000-15,000 DE, with a narrower range of 8,000-12,000 DE used for robustness. We begin the sample selection with all 535 non-financial firms that have more than 5,000 total employees in at least one fiscal year between 1987 and 2016. For business groups, we retain only the parent company, requiring that it publishes consolidated financial statements for the entire group. This leaves 492 firms. We exclude firms that are exempt from the board size rules because of the nature of their business (see Section 1.2), firms to which

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different rules apply because of their industry, state-owned firms, and not-for-profit firms. This reduces the sample to 387 firms.

We use several sources to collect the number of DE. For about one-third of the sample, it is available in the Hoppenstedt database. For the remaining firms, we collect it from annual reports obtained from Hoppenstedt, Thomson Reuters' Thomson ONE, or corporate websites. Following the wording of the board size requirement, whenever available we collect the average number of DE for the year, instead of the year-end number. We are able to obtain DE for 260 firms and 2,988 firm-years.

Next, we restrict the sample to firm-years that fall into the 5,000-15,000 DE range, which yields 112 firms with 906 firm-year observations. We then expand the sample using the Worldscope database, which has close to 1,650 German firms between 1987 and 2016. For firms not already in the Hoppenstedt sample, we extract annual reports from Thomson One and corporate websites, hand collect their number of DE, and retain all firm-years in which it is in the relevant range. This increases the sample to 125 firms with 966 firm-year observations.

Financial and accounting data are from Hoppenstedt, Worldscope, and annual reports.[11] For most of the analyses, we require performance data two years after DE. This reduces the final sample to 104 firms with 843 firm-years.

For the first stage of the two-stage least squares analysis, we also need the actual size of the supervisory board for the year after we observe DE. We extract the number of board members from annual reports. Missing reports reduce the sample size in the 2SLS analysis to 81 firms with 630 firm-years. Appendix Table A1 summarizes the sample selection procedure.

3.2 The law introduction sample

For the DiD analysis around the introduction of the board size requirement in 1976, we use the Saling and Hoppenstedt Stock Guides ("Aktienführer") for 1972 to 1981 to identify firms and to collect their financial and accounting numbers and the size of their supervisory boards.[12] These annual volumes report simplified financial statements and other information for all publicly traded German firms. We obtain the number of employees from the annual Handbook of German Joint-Stock Companies ("Handbuch der deutschen Aktiengesellschaften"). We drop financial firms and restrict the sample to firms that are subject to the board size requirement (see Section 1.2).

[11] During the sample period, German firms use three different reporting standards. We adjust financial variables to make them comparable. The difference between German and US accounting rules was largest early in the sample period, but Harris, Lang, and Möller (1994) show that the correlation between annual earnings and stock returns was similar in both countries.

[12] We obtain both scans of the books and already extracted electronic data from the Aktienführer Data Archive of Mannheim University Library (http://digi.bib.uni-mannheim.de/aktienfuehrer/).

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We define treated firms as those with more than 10,000 total employees in 1975 (the year before the law passed), and control firms as those with 2,000-10,000 employees. The board size requirement is based on domestic, not total employees. The number of DE, however, is not reported in the Handbook or any other available source, forcing us to define treated and control firms using total employees. These are a noisy and upwardly biased proxy for DE, which should make finding significant effects less likely. The still 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.[13]

If information on the number of employees in 1975 is unavailable, we use the number from 1974. To exclude treated firms unaffected by the law because they collapsed in size before it became binding, we also require treated firms to have at least 5,000 employees in 1978. To reduce the size difference between treated and control firms, we select the largest control firms (based on total assets in 1975) until their number equals the number of treated firms. This process yields 38 treated and 38 control firms.

3.3 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. In the earlier law introduction sample, due to limited data, we define ROA as net income divided by total assets. For publicly listed firms, we also use Tobin's Q as performance measure in both samples. These two variables are the focus of most of the literature on board size effects, starting with Yermack (1996).

Appendix Table A2 provides definitions of all variables and their sources, and Table 1 presents summary statistics. More firm characteristics are observable in the 1987-2016 panel than in the earlier law introduction sample. We winsorize all financial variables at the 1% level, except for Tobin's Q, which we winsorize at the 5% level to reduce its skewness.

4 Regression discontinuity analysis around the threshold

To test whether forcing firms to have large boards harms their performance, we first use the 1987-2016 panel and compare firms just above the 10,000 DE threshold to firms just below. Section 4.1 confirms that board sizes increase sharply at the threshold. Section 4.2 shows univariate comparisons between firms above and below the threshold, and Sections 4.3 and 4.4 use RD analyses to estimate changes in performance at the threshold.

[13] German foreign direct investment outflows were only 0.5% of GDP in 1970, compared to 5% of GDP in 2000 (The World Bank World Development Indicators).

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4.1 Board size around the threshold

Table 2, Panel A, compares firms above and below the threshold of 10,000 DE. The sample is restricted to firms with 5,000-15,000 DE. As expected, the size of the supervisory board, measured one year after DE are observed, increases sharply at 10,000 DE. Median board size jumps from 12 for firms below the threshold to 16 for firms above. The increase in average board size is smaller, from 13.5 to 16.0, as many firms below the threshold voluntarily choose larger boards.[14] If we define a "large board" as at least 16 directors, 89% of firms above the threshold have a large board, compared to 31% of firms below.[15]

The finding that most firms below the threshold choose a board size of 12 and most firms above one of 16 suggests that the size requirement is binding for many of them. This makes it likely that many firms just above the threshold have boards that are significantly larger than they would be without the rule.

Figure 1 illustrates the relationship between DE and board size. In Panel A, the increase in average board size at 10,000 DE is significant but moderate. While most firms above the threshold have close to the required minimum of 16 directors, many firms below the threshold, especially those close to it, have more than the required 12. One contributor are firms that just fell below 10,000 DE and have not yet reduced their board size. Panel B therefore excludes firms that crossed the threshold in either direction in the current year, which amplifies the jump in board size at the threshold.

4.2 Univariate comparisons

Table 2, Panel A, continues by comparing the performance of firms above and below the 10,000 DE threshold. The outcome variables – ROA and Tobin's Q – are observed two years after DE. There is little evidence that firms above the threshold have lower ROA or Tobin's Q than firms below. These univariate comparisons contrast smaller firms below the threshold with larger firms above, which does not identify the discontinuous effect of the board size requirement. The comparisons would be biased, if, for instance, firm size is correlated with performance, which is why we turn to RD regressions in the next section.

The remainder of Panel A compares other characteristics of firms above and below 10,000 DE, with all characteristics observed one year after DE. Firms on both sides of the threshold have similar profit margins, asset intensity, asset turnover, and growth rates of assets, sales, and employees. Unsurprisingly, firms above the threshold are larger. This is reflected in more

[14] Among firm years with 5,000-10,000 DE, 149 (out of 440) have more than 12 directors. Among firm years with 10,000-15,000 DE, only 15 (out of 190) have more than 16 directors.

[15] The main reasons for firms above the threshold not to have a large board are firms reacting slowly after passing 10,000 DE and noisy DE numbers. See Section 2.1 for further discussion.

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employees and more book assets, but also in a greater share of foreign employees and a greater likelihood of being publicly listed or using international accounting standards. Firms above the threshold also have slightly lower leverage. We control for these differences in the regressions. Unexpectedly, firms above the threshold pay significantly lower wages. In Section 6.2, we test whether this difference might be explained by the board size requirement.

4.3 RD results: Operating performance

We next use RD regressions to estimate the discontinuous change in operating performance at the threshold of 10,000 DE. This approach allows to control for direct effects of DE (the assignment variable) and of other firm and industry characteristics.

We start with a visual exploration. Figure 2 shows average ROA, measured two years after DE, for firms with 5,000-15,000 DE (in 1,000 DE bins). The figure also shows linear regressions of ROA on DE on each side of the threshold. The regressions suggest that ROA declines by slightly more than 2 percentage points (p.p.) at the threshold, consistent with a negative effect of imposing large boards on performance.

Table 3, Panel A, presents reduced-form RD regressions of ROA on an indicator for firms with more than 10,000 DE. ROA is again measured two years after DE, and the sample is restricted to firms with 5,000-15,000 DE. All regressions include separate linear controls for DE on each side of the threshold. Models 2 to 4 include industry and year fixed effects, and Models 3 and 4 include controls for firm characteristics (book assets, leverage, accounting standard, listed), which slightly reduces the sample size. These characteristics are measured one year after the employee numbers, and thus one year before ROA.

ROA drops by 2.2-2.7 p.p. at the threshold, indicating that forcing firms to have large boards reduces their performance. The estimated effect is smaller when controlling for the full set of firm characteristics. These might, however, be “bad controls”, i.e., they might be affected by the treatment and therefore bias the coefficient on the threshold indicator. For example, large boards might choose different leverage or be more or less likely to seek a listing. Consequently, we prefer specifications without firm characteristics.

As a first robustness test, Panel B repeats the RD analysis in a narrower bandwidth of firms with 8,000-12,000 DE. Even though the sample size is reduced to only 360 observations, the estimated effects are similar, with ROA dropping by 2.3-2.6 p.p. at the threshold. Three of the four estimates are statistically significant at the 10% level, and the fourth estimate, when all firm characteristics are included, has a p-value of 11.0%.

To further quantify the effect of forcing firms to have large boards, Table 4 presents two-stage instrumental variable regressions. The sample is again restricted to firms with 5,000-15,000

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DE. The first stage estimates the effect of the threshold on the probability of having a large board, defined as at least 16 directors, one year after DE are observed. The need to observe each firm's actual board size reduces the sample to 630 observations.

The second stage estimates the effect of large boards (predicted using the first stage) on ROA. Intuitively, the second stage 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 caused by the board size requirement affect firm performance. Both stages include separate linear controls for DE on each side of the threshold, and Models 2 to 4 include year and industry fixed effects.

The first stage results show a large increase in board size at the threshold. Depending on the specification, the probability of having a large board increases by 35 to 42 percentage points. However, because of the small sample size and because of noise in the relationship between DE and board size, the Kleibergen-Paap Wald F-statistic measuring the strength of the first stage varies from 11.3-14.3, close to the critical values of Stock and Yogo (2005). Weak-instrument bias is, thus, a concern.

The second stage results show large negative effects of forcing firms to have large boards. Instrumented-for large boards reduce ROA by 4.9 to 6.5 percentage points, which suggests that imposing large boards severely undermines operating performance. However, because of the low-powered first stage, these point estimates should be interpreted cautiously.

4.4 RD results: Tobin's Q

Next, we examine the effect of the board size requirement on Tobin's Q. Its numerator includes the firm's equity market capitalization, making it a forward-looking measure of value. Its main disadvantage is that it is only available for publicly traded firms, which reduces the sample with 5,000-15,000 DE to only 419 observations.

Table 5, Panel A, presents reduced-form discontinuity regressions of Tobin's Q on the indicator for more than 10,000 DE. Q is measured two years after DE, and the specifications follow the ROA analysis. All models include separate linear controls for DE on each side of the threshold, Models 2 to 4 include industry and year fixed effects, and Models 3 and 4 include controls for firm characteristics.

Across specifications, Tobin's Q falls by 0.14 to 0.23 at the threshold. The estimates become statistically significant at the 10% level or better in Models 2 to 4, when industry and year fixed effects are included. Compared to an average Q of 1.35, these reduced-form estimates suggest a sizeable negative effect of forcing firms to have large boards. In Panel B, we again repeat the analysis for firms with 8,000-12,000 DE. Even though the sample has only 174 observations, Q

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falls by 0.22 to 0.29 at the threshold, slightly more than in the wider bandwidth and significant at the 5% level in all but one model.

To further quantify the effect of imposing large boards on firm value, in untabulated analyses we ran 2SLS regressions in the 5,000-15,000 DE bandwidth. The first stage estimates the effect of the threshold on the probability of firms having large boards, and the second stage estimates the effect of (instrumented-for) large boards on Tobin's Q. Using the same specifications as in Table 4, large boards reduce Tobin's Q by 0.49 to 0.78 in the second stage, with p-values between 3.3% and 16.6%. However, because of the small sample, all first-stage F-statistics are below 5. Hence, weak-instrument bias is a serious concern, which makes these estimates unreliable.

In sum, the results in this and the previous section indicate sharp declines in both ROA and Tobin's Q at 10,000 DE. Forcing firms to adopt large boards appears to be detrimental to both their operating performance and value, which is consistent with the hypothesis that excessively large boards are ineffective.

4.5 Robustness

We next conduct several robustness tests of the RD results. Because of the noisiness of the 2SLS and Tobin's Q analyses, we focus on reduced-form RD regressions of ROA around the threshold of 10,000 DE. The sample is restricted to firms with 5,000-15,000 DE throughout, and all models include industry and year fixed effects. Appendix Table A3 presents the results.

In Model 1, we drop the interaction between the assignment variable and the threshold indicator, thereby restricting the effect of DE to be the same on both sides of the threshold. If the slope is in fact the same, this should increase the efficiency of the estimation. The estimated decline in ROA at the threshold is close to the baseline estimates in Table 3. The same is true in Model 2, which measures ROA, the outcome variable, one year after DE instead of after two (and once again allow for different slopes of DE on either side of the threshold). This change in timing slightly increases the sample size, with little effect on the estimated effect.

Model 3 omits firms with 17 or more directors on their board. These firms have chosen to have larger boards than required, so the board size rule does not seem to be a binding constraint. If voluntarily choosing a large board is uncorrelated with ROA, omitting these firms should increase the ROA decline at the threshold, as firms unharmed by the requirement are dropped. The estimated decline in ROA is indeed slightly larger (-3.0 versus -2.6 p.p.).

Finally, Model 4 uses a triangular kernel to weight observations around the threshold. The fall in ROA at the threshold is 2.7 p.p., close to the estimate in the baseline analysis and highly statistically significant. Thus, the abrupt decline in operating performance at 10,000 DE appears to be a robust feature of the data.

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4.6 Placebo tests

To further assess whether the performance decline at 10,000 DE is due to the board size requirement and not, for instance, a firm size effect, we repeat the analysis using alternative thresholds at which board size requirements do not change. We again focus on reduced-form discontinuity regressions of ROA on domestic employees, and the specifications follow the baseline analysis in Table 3.

The results from the placebo tests are in Appendix Table A4. Models 1 to 4 are estimated on firms with 5,000-10,000 DE and use thresholds of 6,000, 7,000, 8,000, and 9,000 DE, respectively. Models 5 to 8 focus on firms with 10,000-15,000 DE and use thresholds of 11,000, 12,000, 13,000, and 14,000 DE, respectively. There are no significant ROA declines at any of these thresholds. Five out of eight estimates are positive, with one estimate almost significant (p=12.5%), indicating that ROA is more likely to increase than decrease at arbitrary thresholds. The largest ROA decline at any of the alternative thresholds is -0.91 p.p., much smaller than the decline estimated at 10,000 DE.

4.7 Strategic behavior and covariate balance

Interpreting the RD results as causal requires that the allocation of firms around the threshold is as-good-as-random, or at least independent of any other determinants of firm performance. Because employment levels are at least partly under the control of management, this is a strong assumption. For example, if increases in board size are costly, some types of managers might choose to stay below the threshold.[16]

We first visually examine whether firms bunch below the threshold of 10,000 DE. Figure 3 plots the frequency distribution of firms around the threshold. There is no unusual concentration of firms just below 10,000 DE, and no sign of "missing firms" above it. Figure 4 shows results from the test proposed by McCrary (2008), which fails to reject the null hypothesis that the distribution of firms at the threshold is continuous.

For an alternative test of whether firms deliberately stay above or below 10,000 DE, Appendix Table A5 reports the frequency with which firms cross a series of thresholds from 7,000 to 13,000 DE. There is no evidence that firms treat 10,000 DE as unusual. For example, the probability that firms cross 10,000 DE from below is higher than for 9,000 or 11,000 DE but lower than for 7,000 or 12,000 DE. None of these differences are statistically significant.

Firms might use a variety of strategies to stay below 10,000 DE while still growing their operations. One approach is to hire more foreign employees. To test whether firms do this,

[16] If firms were to bunch below the threshold, it would likely work against finding a decline in performance at the threshold, as firms for which large boards are most harmful would decide to stay below.

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Model 1 of Appendix Table A6 is a reduced-form discontinuity regression of the share of foreign employees on the 10,000 DE indicator. The specification follows the baseline analysis in Table 3, and the sample is restricted to firms with 5,000-15,000 DE. The results show a statistically insignificant decrease in foreign employees at 10,000 DE, providing suggestive evidence that firms just below the treshold might have more employees abroad. To test whether a change in foreign employees at the treshold can explain the observed decline in performance, Model 2 of Table A6 includes the share of foreign employees as a control variable in a reduced-form discontinuity regression of ROA on the 10,000 DE indicator. The estimated drop in ROA at the treshold remains close to the one in the baseline analysis.

Another strategy to stay below 10,000 DE is to add capital instead of labor. To test whether firms do this, Model 3 of Table A6 is a reduced-form discontinuity regression of asset intensity, defined as assets per employee, on the 10,000 DE indicator. Sample and regression specification are the same as before. The results show a small and statistically insignificant decrease in asset intensity at 10,000 DE, suggesting that firms just below the threshold are using slightly more capital per employee. To test whether changing asset intensity might explain the decline in performance at the treshold, Model 4 includes asset intensity as a control in a reduced-form discontinuity regression of ROA on the 10,000 DE indicator. The drop in ROA at the treshold is again close to the one in the baseline analysis.

Finally, we examine whether there are systematic differences in firm characteristics between firms just above and below 10,000 DE. If firms do not self-select, firms on both sides of the threshold should be similar, at least in terms of characteristics not affected by board size. Appendix Table A7 presents reduced-form discontinuity regressions of the firm characteristics we have used as control variables on the indicator for more than 10,000 DE. The specifications follow the baseline analysis in Table 3, and the sample is again restricted to firms with 5,000-15,000 DE. The dependent variables are observed one year after the employee numbers.

The threshold indicator is insignificant for all firm characteristics, indicating that they vary smoothly across the threshold. Some of the point estimates, such as the ones for book assets or the probability of being listed, are, however, sizeable, likely owing to the noisiness of the small sample. It is therefore reassuring that our results are robust to controlling for these characteristics.

In sum, the data show little evidence of strategic behavior around the threshold. 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 it entails worse firm performance. In either case, the evidence is consistent with the performance decline at 10,000 DE being caused by forcing firms to have large boards.

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5 The introduction of the board size requirement

The introduction of the board size requirement in 1976 creates an opportunity for a difference-in-differences analysis. The idea is to compare changes in performance from before to after the law's introduction between "treated" (>10,000 employees) and "control" firms. If the board size requirement is costly, we expect the relative performance of treated firms to decline.

Firms strategically moving or remaining below 10,000 DE is less of a concern in this setting. The threshold was first mentioned in a draft version of the law in early 1974. We classify firms as treated or control based on their employees in 1975, leaving little time for workforce reductions. Doing so would have also been difficult because of Germany's stringent labor protection laws.[17]

5.1 DiD results

Figure 5 confirms that the law's introduction was followed by larger board size increases for treated than for control firms. Comparing 1978 to 1975, median board size rose from 13 to 20 for treated and from 9 to 12 for control firms. Average board size increased from 14.0 to 18.3 and from 11.2 to 14.1, respectively. The board size increase in control firms is in part due to firms that grew from below to above 10,000 employees by the time the law became effective, making them effectively treated.[18]

Table 2, Panel B, reports characteristics of treated and control firms for 1973-75, before the law passed. Unsurprisingly, treated firms are significantly larger than control firms, both in terms of employees and assets. Because firms of different sizes might be subject to different systematic shocks, in a robustness test we use propensity score matching to reduce the size difference between treated and control firms.

Figure 6 plots the average ROA for treated and for control firms from 1972 to 1982. Before the passage of the law in 1976 and during the transition period (until the Constitutional Court's decision in 1979), the performance of treated and control firms evolves in parallel. Thus, even though treated firms are larger, there is no obvious violation of the parallel trends assumption. In 1980-1981, after the law became effective, there is a sharp downward shift in the performance of treated relative to control firms. The performance of treated firms appears to recover in 1982, three years after the law became effective, which might suggest that its effect is transitory. We examine this possibility in Section 6.

[17] These laws, summarized in Ebbinghaus and Eichhorst (2009), go back to at least the Employment Protection Act of 1951.

[18] For example, because of an acquisition, Deutsche Babcock AG grew from about 6,000 employees in 1975 to 26,000 in 1977, and its board increased from 6 to 20 members.

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Table 6 presents the results of the difference-in-differences estimation. We focus on two- and three-year windows before and after the transition period. The dependent variables are ROA and Tobin's Q, and all specifications include firm and year fixed effects.

The differential performance change (given by the Treated x Post coefficient) is economically large and statistically significant in six out of eight regressions. ROA declines by 1.3-2.0 percentage points from before to after the law's introduction for treated compared to control firms, and all estimates are statistically significant. Tobin's Q declines by 0.04-0.10, statistically significant in the two- but not the three-year window. The relatively small effect on Q might be due to stock prices already anticipating the law's effect before it passed. Overall, however, the evidence suggests that stricter board size requirements are detrimental to both firm value and performance.

5.2 Robustness

Appendix Table A8 assesses the robustness of the DiD result, focusing on ROA as the measure of firm performance. To reduce the size difference between treated and control firms, Models 1 and 2 select treated and control firms using propensity score matching on book assets. After matching with a restrictive caliper (10 percent of the standard deviation of the propensity score logit), there is no significant difference in average size between treated and control firms. Even though the number of observations becomes small, ROA declines by 2.6-2.7 p.p. from before to after the law's introduction for treated compared to control firms, statistically significant in the three- but marginally insignificant in the two-year window.

For an alternative approach to reducing the size difference between treated and control firms, Models 3 and 4 exclude firms with more than 50,000 employees in 1975. Despite dropping the most severely treated firms (with a newly required board size of 20), the treatment effect remains economically and statistically significant.

Models 5 and 6 exclude firms for which the 1975 Saling or Hoppenstedt Stock Guides report the presence of foreign plants. Data limitations force us to use total employees in the DiD analysis, even though the board size requirement is based on DE, so foreign operations make it more likely that our classification of firms into treated or control is incorrect. Excluding firms with foreign plants has almost no effect on the treatment effect. The reduction in sample size is small, consistent with few German firms having foreign operations in the 1970s.

Models 7 and 8 exclude control firms that had more than 20,000 employees in 1978 (1979 if 1978 data are not available). These firms grew from below 10,000 employees in 1975 to more than 20,000 in the post-period, requiring them to have boards of at least 20 directors. Dropping these firms barely changes the treatment effect.

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Finally, Models 9 and 10 exclude treated firms that are already in compliance with the board size requirement before its introduction – i.e., firms that in 1975 have 10,000-20,000 employees and at least 16 directors, or more than 20,000 employees and at least 20 directors. These firms are likely to be unaffected by the new board size requirement.[19] Excluding them slightly reduces the treatment effect in the two-year window and slight increases it in the three-year window.

5.3 Placebo tests

Appendix Table A9 reports placebo regressions. We again sort firms into a treatment and a control group based on their employees in 1975. Treated and control firms in Models 1 and 2 are as in the baseline analysis, but the pre-period is 1970-72 and the post-period 1973-75, both before the law's introduction. In Models 3 to 6, the pre- and post-periods are as in the baseline analysis, but the sample is restricted to firms with 2,000-10,000 employees in 1975, all below the actual threshold. "Treated" firms are defined as those with employees above the sample median.

None of the placebo tests show any significant changes in performance for treated compared to control firms. The largest ROA decline is 0.07 percentage points, much smaller than the 1.3-2.0 p.p. observed for actually treated firms in the main DiD analysis.

6 Potential mechanisms

We have found robust evidence that forcing firms to have large boards is detrimental. What remains unknown is the mechanism. Large boards might, for example, perform worse because of frictions in group decision making. Alternatively, the incremental directors might be of lower ability, busier, or worse matches. These issues might hamper all board activities or only specific ones, such as advising or monitoring managers. Moreover, worse performance might be a steady-state feature of large boards or a transitory effect of being forced to add new directors.

Our small samples and the lack of data on most board activities prevent us from fully uncovering the underlying mechanism. However, we are able to show that worse performance is a steady-state feature of large boards, and that large boards are associated with significantly lower profit margins (consistent with worse cost control) and lower acquisition announcement returns (consistent with worse M&A deals). Because of limited data availability in the 1970s, most analyses in this section focus on the 1987-2016 panel of firms.

6.1 Transition versus steady-state effects

The worse performance of firms forced to have large boards might be a steady-state feature, pointing to frictions in group decision making or worse directors, or it might be a transitory effect of having to add directors who need time to integrate and learn. To examine this question, we use

[19] They might still be affected if they would have shrunk their boards without the requirement.

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the 1987-2016 panel of firms with 5,000-15,000 DE and conduct two analyses, one excluding firms that recently crossed the threshold and one focusing on them.

In Table 7, Panel A, we repeat our baseline reduced-form RD regressions of ROA on the 10,000 DE indicator after excluding all firms that crossed 10,000 DE within the last three years. The remaining firms had at least three years to adapt their board after crossing the threshold, or may simply not have crossed it. In this sample, ROA drops by 3.7-4.5 p.p. at the threshold, which is more than in the full sample. Excluding only firms that crossed the threshold from below (and therefore likely needed to add directors) yields similar results (untabulated).

Panel B again shows reduced-form RD regressions of ROA on the 10,000 DE indicator but focuses on firms that cross the threshold. The sample is limited to a ±3-year window around crossings, and we include firm fixed effects in Models 2 to 4, so the threshold coefficient is identified from comparing the same firm above and below the threshold. ROA declines by 1.4-1.9 p.p. at the threshold, which is smaller than in the baseline analysis and statistically significant in only one of the four models. Thus, the worse performance of firms above 10,000 DE appears to be a steady-state feature, not just a transitory effect of changing boards after crossing the threshold.

6.2 Profit margins, asset turnover, wages, and growth

Using the 1987-2016 panel, we next decompose the negative impact of the board size requirement on ROA into its effects on asset turnover (Sales/Assets) and the profit margin (EBIT/Sales).[20] Models 1 and 2 in Table 8, Panel A, show reduced-form RD regressions of these two ROA components on the 10,000 DE indicator. The regression specifications and the sample are the same as in the baseline analysis in Table 3.

There is a small and statistically insignificant increase in asset turnover at the 10,000 DE threshold (Model 1) and, thus, no evidence of less efficient asset use by large boards. Profit margins, however, drop by 3.2 p.p. at the threshold (Model 2). This suggests that large boards are associated with lower operating margins, possibly caused by worse cost control.

A potential explanation for higher costs could be higher employee pay. Model 3, however, shows a small and statistically insignificant decline in the log of average employee wages at the 10,000 DE threshold. Thus, there is no evidence that larger boards allow employees to extract more pay. Similarly, in untabulated analyses we found no significant change in the ratio of employees to assets ("labor intensity") at the threshold. Thus, mandating large boards does not cause firms to substitute labor for assets or vice versa.

Panel B estimates the effects of the 10,000 DE threshold on sales growth, asset growth, and employee growth. There is little evidence of systematic changes in growth rates at the threshold.

[20] ROA is the product of profit margin and asset turnover: ROA = EBIT/Assets = EBIT/Sales * Sales/Assets.

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Two of the three threshold coefficients are positive, one is negative, and all are statistically insignificant. Thus, forcing firms to have large boards seems to neither impede nor enhance growth.

6.3 Mergers & acquisitions

Important corporate transactions, such as mergers or acquisitions, typically require the consent of the supervisory board. We therefore examine the effect of the 10,000 DE threshold on M&A announcement returns. If larger boards provide worse monitoring or advice, firms above the threshold might do worse deals. Using the SDC Platinum database, we identify 253 acquisition deals with all necessary data by firms in the 5,000-15,000 DE range from 1991 to 2016.[21]

Table 9 reports reduced-form RD regressions of acquirer announcement returns on the 10,000 DE indicator. DE are observed at the year-end before the deal announcement; the regression specifications otherwise follow the baseline analysis in Table 3. Announcement returns are cumulative excess returns over five trading days around the announcement, with excess returns defined as daily stock returns net of the return on the CDAX market index.[22]

All four models show worse stock price reactions to M&A announcements for acquirers just above the 10,000 DE threshold compared to those just below. Announcement returns drop by 1.5-1.9 p.p. at the threshold, statistically significant in three out of four models. The one marginally insignificant estimate (p=10.3%) is from a model with controls for deal characteristics, which might themselves be affected by the size of the board. Combined with a small and statistically insignificant increase in the number of deals at the threshold (untabulated), the evidence suggests that forcing firms to have large boards results in worse M&A deals.

6.4 CEO turnover and executive pay

Large boards might be laxer in their monitoring of CEOs and other top executives. We therefore examine the effect of the 10,000 DE threshold on CEO turnover and executive pay. Data are collected from annual reports that are available for only a subset of firms, which further reduces the sample size.

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[21] The first deal announcement with all necessary data in SDC Platinum is in 1991. The matching is done by firm name and includes deals by subsidiaries. If the information is available, we require that acquirers purchase more than 50% of target shares, or that the difference between the percentage of shares held before and the percentage sought exceeds 50%. We drop deals below one million Euros, repurchases, squeeze-outs, and others for which the synopsis indicates that they are not acquisitions. We also drop deals with another M&A announcement in the preceding 30 days.

[22] The CDAX is a value-weighted index of all stocks in the General Standard and Prime Standard market segments of the Frankfurt Stock Exchange. The data are from Datastream. Following Ince and Porter (2006), we remove inactive stocks reporting a sequence of zero returns at the end of their listing period. We also drop observations where a one-day return is above +50% and the previous return is below -50%, and vice versa, as well as observations with lagged stock prices below one.

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Appendix Table A10 reports reduced-form RD regressions of CEO turnover and executive pay on the 10,000 DE indicator. The specifications follow the baseline analysis in Table 3. Models 1 and 2 show a small and statistically insignificant increase in the CEO turnover probability at the threshold. Using ROA or the year-on-year change in ROA to measure performance, there are also no significant changes in the CEO turnover-performance sensitivity at the threshold. Thus, there is no evidence that large boards are less likely to dismiss CEOs.

Models 3 and 4 focus on top executive pay, measured as the log of the average annual compensation of executive board members.[23] Firms above the threshold are associated with marginally and insignificantly lower executive pay, and the pay-for-performance slope does not change significantly at the threshold. In sum, Table A10 provides little evidence that mandating large boards reduces CEO turnover, increases executive pay, or weakens pay-for-performance.

6.5 Blockholders

Large shareholders might reduce coordination problems between directors, which are likely to be worse in large boards. Large shareholders might choose compatible directors, coordinate their actions, or simply reduce the number of views represented on the board. We therefore test whether large shareholders reduce the negative effect of mandating large boards on performance. Because corporate ownership is endogenous and might respond to the board size requirement, any results should be interpreted with caution. The data on blockholders are either from Hoppenstedt or hand collected from annual reports, which again reduces the sample size.

Appendix Table A11 presents reduced-form RD regressions of ROA on the indicator for more than 10,000 DE, interacted with indicators (Models 1 and 3) or count variables (Models 2 and 4) for blockholders with at least 5% ownership, 5-25% ownership, and greater than 25% ownership. The interaction coefficients are all positive and economically large, indicating that blockholders reduce the negative effect of large boards on performance. However, the coefficients are noisily estimated and almost all statistically insignificant, providing at most suggestive evidence that blockholders alleviate the effects of large boards.

6.6 Director quality

The sub-par performance of firms forced to have large boards might be due to a limited supply of qualified directors, causing the incremental directors to be of lower ability or worse matches, or simply to be busy.[24] It is, however, impossible to determine which directors on a

[23] Data on the pay of individual executives are rarely available before 2006.
[24] Adams, Akyol, and Verwijmeren (2018) show that directors' skills, and how these skills are combined on boards, matter for firm performance. Hauser (2018) shows that reductions in director busyness lead to improvements in firm performance.

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board are "incremental," in the sense that they would not be present without the board size requirement.

We nevertheless conduct two analyses. First, using the 1987-2016 panel, we examine directors added by firms that cross the 10,000 DE threshold from below. There are 31 firms that do so in our sample, with a total of 36 crossings. To comply with the board size requirement, most firms must add directors after crossing the threshold. We identify all directors added in the year of the crossing and the next two years and compare them to the firm's incumbent directors. To assess whether directors added after a crossing are different, we perform the same comparison for directors added at other times.

Table 10 shows that directors added after crossing the 10,000 DE threshold are more likely to be female or busy (defined as having at least three directorships), and less likely to have a doctorate or executive experience than incumbents. However, none of these differences are statistically significant. There is also some evidence that the differences between new directors and incumbents (in terms of busyness, executive experience, and doctorates) are worse after a crossing than at other times, possibly because mandatory expansions do not allow firms to wait for directors to become available. Statistical significance is, however, again elusive.

Because we do not have annual reports from the 1970s, busyness is the only director characteristic we can observe around the introduction of the board size requirement. We collect information on director busyness in 1975 and 1979 from the Saling and Hoppenstedt Stock Guides, respectively, and again define a busy director as having at least three simultaneous supervisory board positions.[25]

In untabulated results, we find that the share of busy directors stayed almost constant at around 18% between 1975 and 1979 in treated firms (>10,000 total employees in 1975), while it decreased from 12% to 9% in control firms (2,000-10,000 total employees). The lack of an overall increase in director busyness, despite the mandated expansion of boards, is interesting. It implies that the pool of directors expanded, consistent with recent evidence on board gender quotas (Ferreira et al. 2021).

Appendix Table A12, Model 1, regresses the change in the share of busy directors on an indicator for treated firms, while controlling for firm size and leverage. There is a 2.8 p.p. increase in the share of busy directors between 1975 and 1979 for treated compared to control firms. To examine whether this can explain the underperformance of treated firms after the introduction of the board size requirement, Model 2 is a DiD regression with ROA as dependent variable (similar

[25] For 1975, we hand collect directors from the Saling Stock Guide. For 1979, we obtain directors from the Hoppenstedt Stock Guide made available in electronic form by the University of Mannheim (https://digi.bib.uni-mannheim.de/aktienfuehrer/).

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to Table 6) that controls for the 1975-79 change in board busyness. The relative decline in the performance of treated firms remains large and significant. The decline is worse for treated firms that had a larger increase in board busyness, but this interaction is insignificant.

6.7 Summary

We have explored several mechanisms that might explain the negative effect of mandated large boards on firm performance. Worse performance is a steady-state feature of large boards, not just a transition effect, and large boards are associated with lower profit margins (consistent with worse cost control) and lower acquisition announcement returns (consistent with worse M&A deals). There is also suggestive but insignificant evidence that directors added after crossing the threshold are busier, less experienced, and less likely to have a doctorate. We have found no evidence that large boards cause higher pay for employees or executives or reduce CEO turnover.

7 Conclusion

This paper has used minimum board size requirements to assess whether forcing firms to have large boards reduces their performance or value. Since 1976, the minimum size of German firms' supervisory boards increases discretely at 10,000 DE. Our results strongly suggest that forcing firms to have large boards is costly. At the 10,000 DE threshold, operating return on assets drops by 2-3 percentage points and Tobin's Q by around 0.20. After the law's introduction in 1976, treated firms' ROA and Tobin's Q decline by, respectively, 1.3-2.0 percentage points and 0.04-0.10 compared to control firms.

Limited data on board activities make it difficult to identify precisely why large boards underperform. Our evidence shows that worse performance is a steady-state feature of large boards, not a transitory effect of adding directors, and that large boards are associated with lower profit margins and lower acquisition announcement returns. Independently of the exact mechanism, our findings show that choosing the right board size is important for firm performance, and they are a warning that ill-designed board regulations can have large costs.

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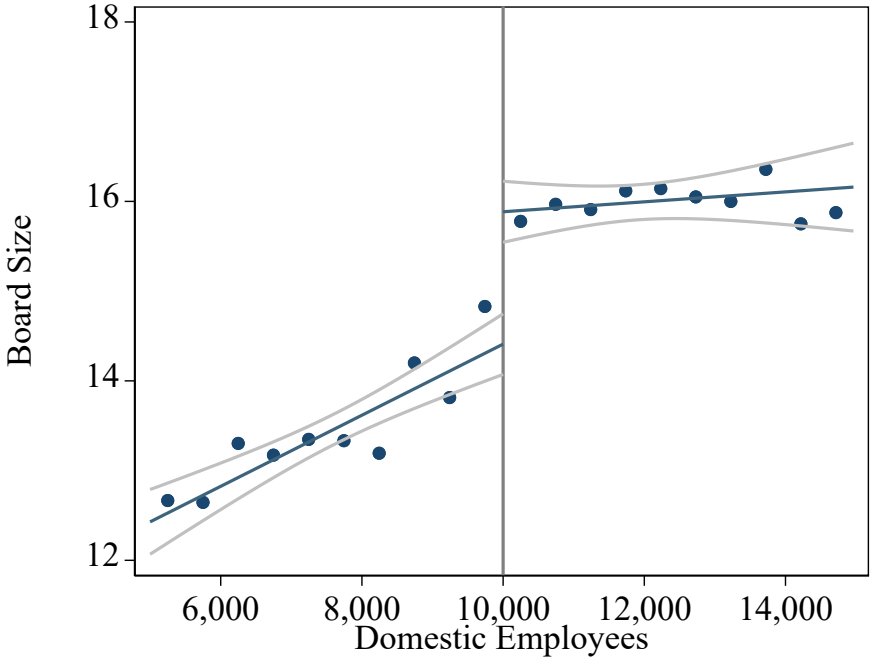
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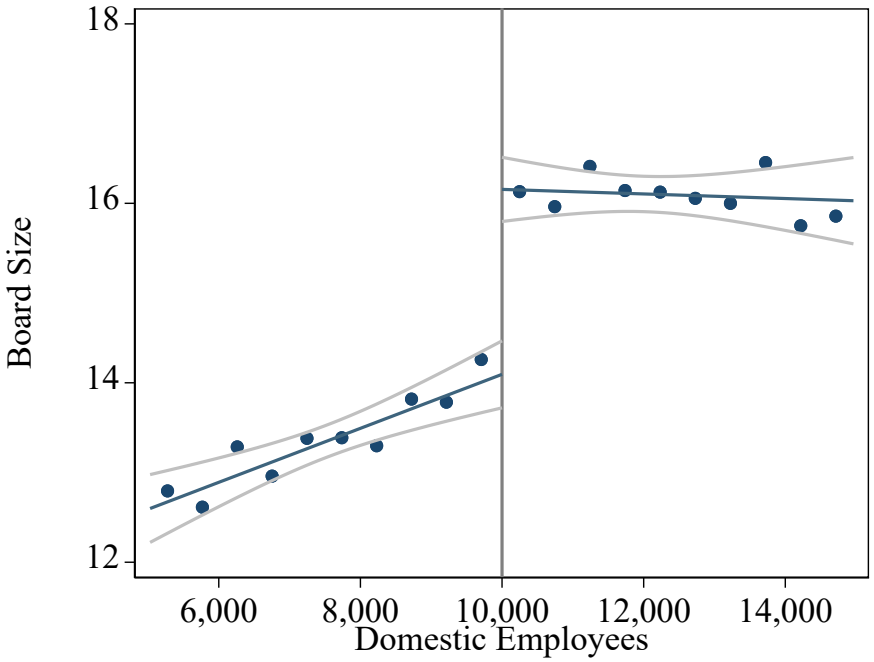
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Figure 1: The figures show average board sizes as a function of the number of DE in the 1987-2016 panel. The sample is restricted to firms with 5,000-15,000 DE. DE are lagged by one year and firms are grouped into bins of 500 DE. The figures include linear RD plots with 90% confidence intervals. Figure (b) excludes firms that crossed the 10,000 DE threshold in either direction in year t-1, when DE are observed.

(a) Average board size

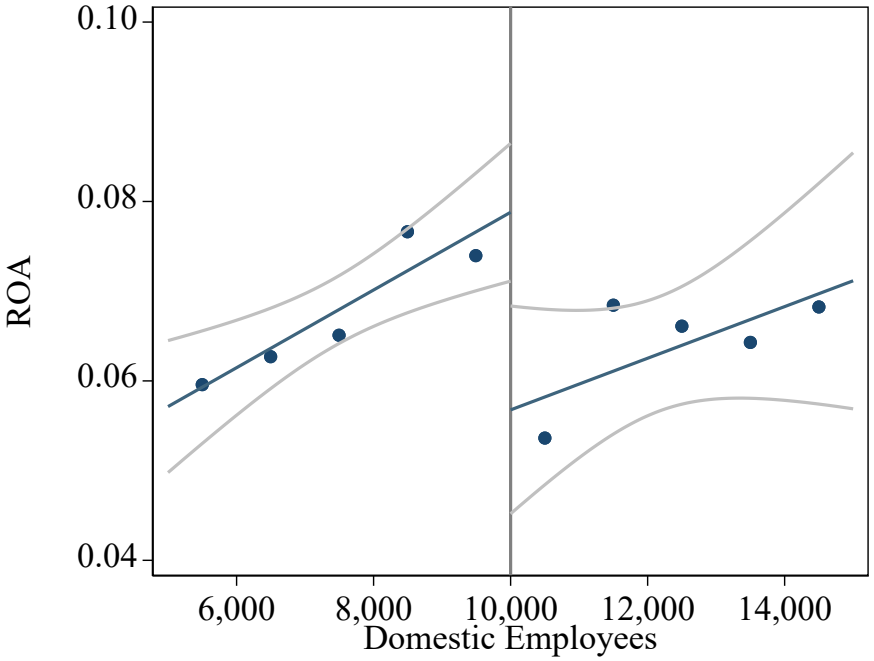


(b) Average board size without crossers



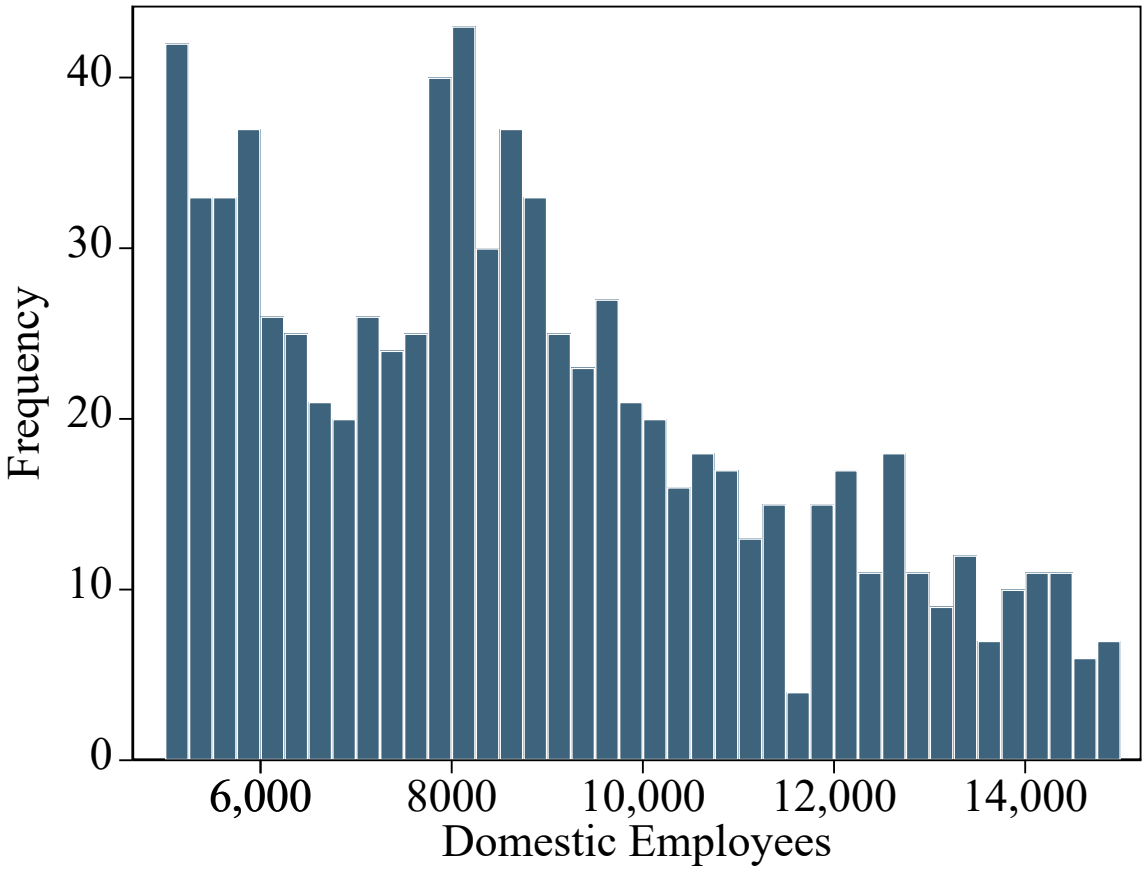
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Figure 2: The figures show return on assets (ROA) as a function of the number of DE in the 1987-2016 panel. The sample is restricted to firms with 5,000-15,000 DE. The x-axis shows the number of DE, lagged by two years, with firms grouped into bins of 1,000 DE. The y-axis shows the mean ROA in each bin. The figures also include linear RD plots with 90% confidence intervals.



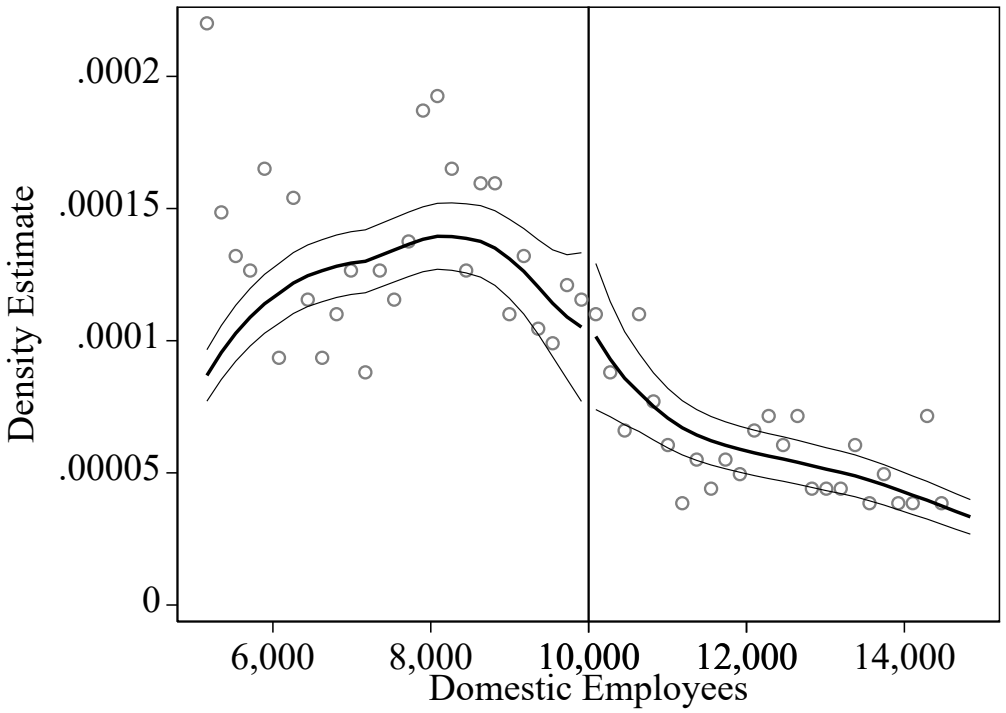
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Figure 3: The figure shows the distribution of firms around the threshold of 10,000 DE in the 1987-2016 panel. The sample is restricted to firms with 5,000-15,000 DE. The x-axis shows the number of DE, with observations grouped into bins of 250 DE. The y-axis shows the number of firm-year observations in each bin.



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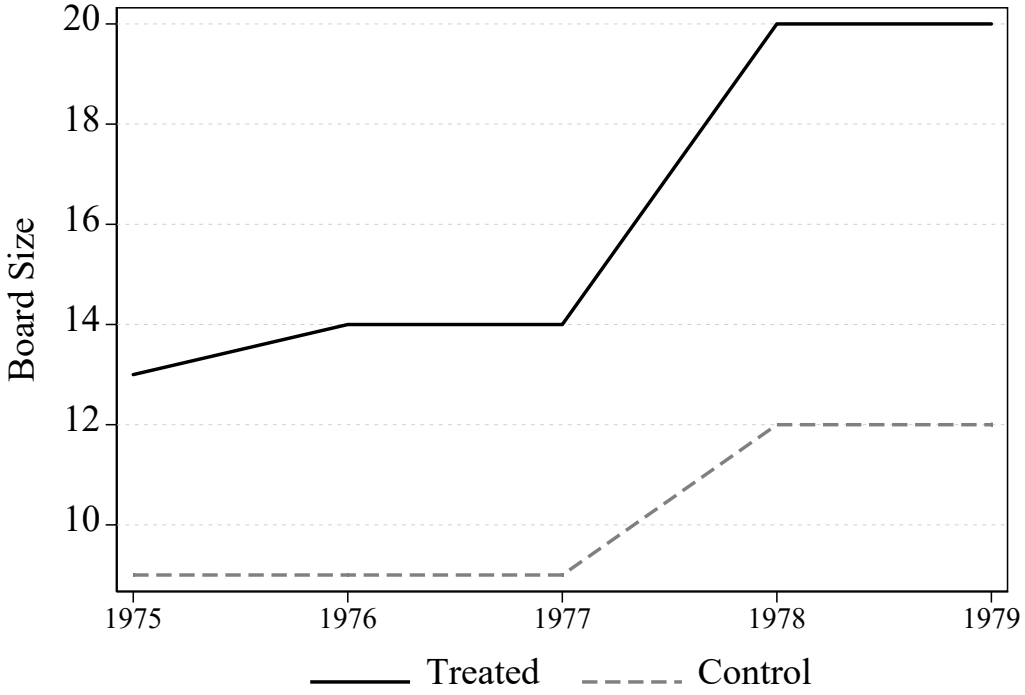
Figure 4: The figure illustrates the results from a McCrary (2008) continuity test around the threshold of 10,000 DE in the 1987-2016 panel. The sample is restricted to firms with 5,000-15,000 DE. We use the "DCdensity" command in Stata with default values for bin size (182.5) and bandwidth (2006.3). The x-axis shows the number of DE and the y-axis shows the density estimate.



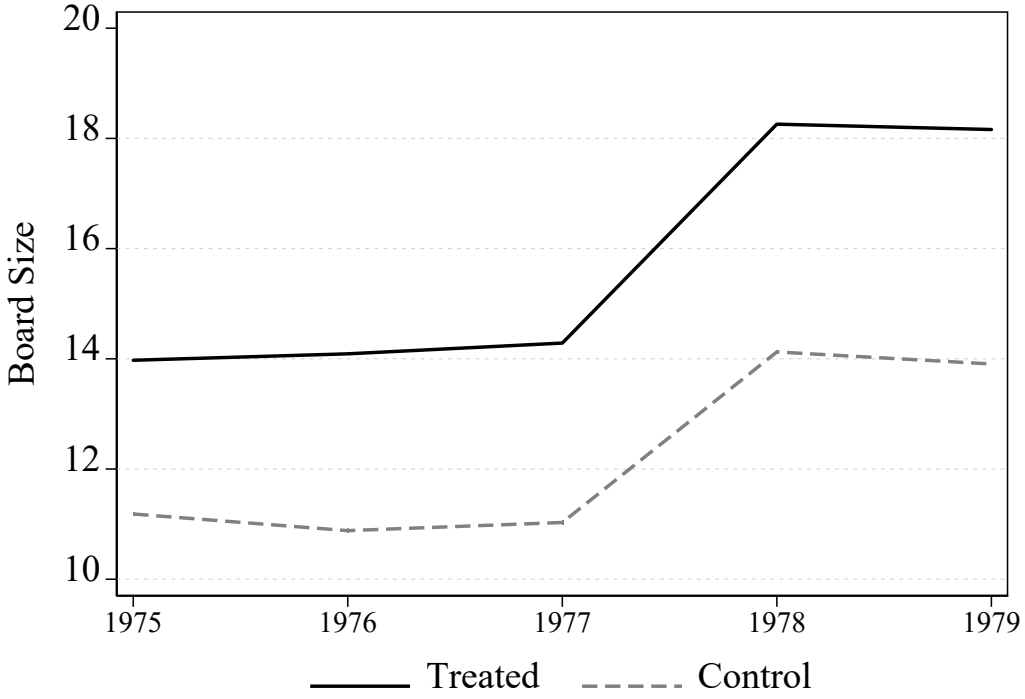
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Figure 5: Figure (a) shows median board sizes around the introduction of the board size requirement in 1976. Figure (b) shows the corresponding mean values. Firms are classified as "treated" if they have more than 10,000 total employees in 1975, and as "control" if they have 2,000 to 10,000 employees in that year.

(a) Median board size

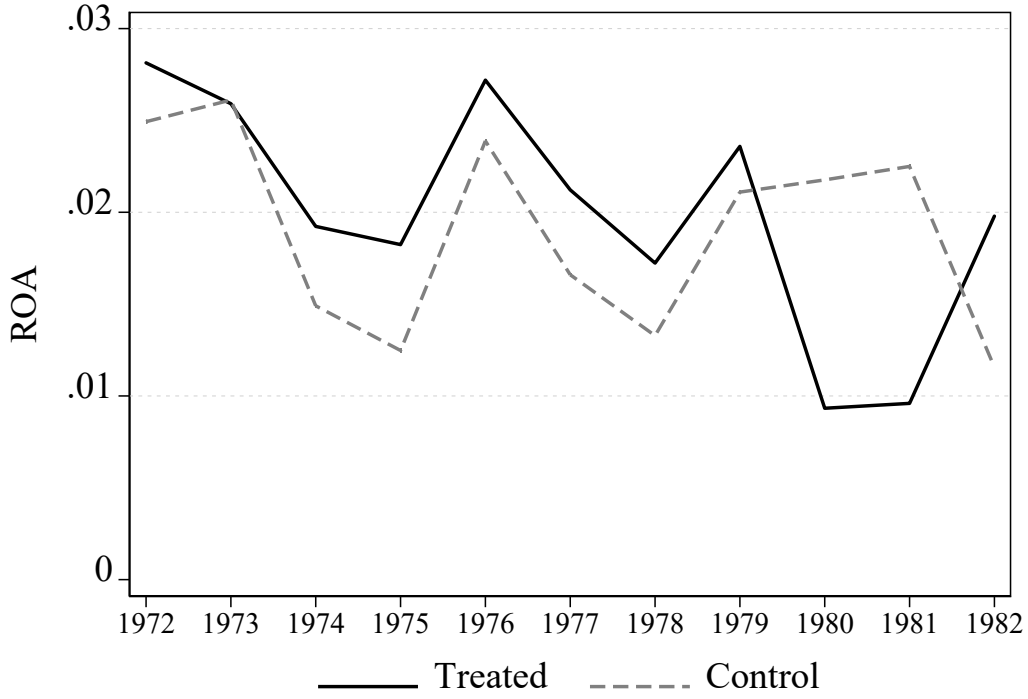


(b) Mean board size



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Figure 6: The figure shows the evolution of average ROA around the introduction of the board size requirement in 1976. ROA is defined as net income over total assets. Firms are classified as "treated" if they have more than 10,000 total employees in 1975, and as "control" if they have 2,000 to 10,000 employees in that year.



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Table 1: Descriptive statistics
This table shows descriptive statistics for the 1987-2016 panel in Panel A and for the law introduction sample in Panel B. The 1987-2016 panel is restricted to firms with 5,000-15,000 DE. Variable descriptions are in Appendix Table A2.

Variable	N	Mean	10th percentile	Median	90th percentile	SD
Panel A: 1987-2016 panel						
Board Size	630	14.23	12.00	15.00	16.00	2.39
Large Board	630	0.48	0.00	0.00	1.00	0.50
Domestic Employees	843	8,817	5,573	8,453	12,740	2,595
>10,000	843	0.30	0.00	0.00	1.00	0.46
Share Foreign Empl.	833	0.38	0.00	0.39	0.74	0.27
ROA	843	0.07	0.01	0.06	0.12	0.06
Tobin's Q	419	1.35	0.94	1.21	1.92	0.46
Assets	841	4,382	462	1,805	11,997	9,829
Leverage	841	0.67	0.46	0.69	0.85	0.15
Accounting Standard	841	0.50	0.00	1.00	1.00	0.50
Listing	841	0.53	0.00	1.00	1.00	0.50
Asset Intensity	833	0.19	0.05	0.12	0.39	0.19
Profit Margin	841	0.06	0.00	0.05	0.12	0.05
Asset Turnover	843	1.47	0.72	1.25	2.35	0.93
Employee Wages	760	45,396	25,145	41,954	64,583	19,530
Sales Growth	841	0.05	-0.09	0.05	0.19	0.15
Asset Growth	843	0.05	-0.09	0.05	0.19	0.15
Employee Growth	830	0.02	-0.09	0.02	0.13	0.12
Acq. Ann. Returns	253	0.00	-0.04	0.00	0.05	0.04
Listed Target	253	0.07	0.00	0.00	0.00	0.26
Diversifying Deal	253	0.32	0.00	0.00	1.00	0.47
International Deal	253	0.57	0.00	1.00	1.00	0.50
CEO Turnover	498	0.11	0.00	0.00	1.00	0.31
Executive Pay	575	1,304	399	825	2,625	1,277
CEO Age	498	56.46	48.00	57.00	64.00	6.39
Retirement Age	498	0.11	0.00	0.00	1.00	0.31
Blockholder > 5%	322	0.88	0.00	1.00	1.00	0.33
Blockholder 5-25%	322	0.26	0.00	0.00	1.00	0.44
Blockholder > 25%	322	0.62	0.00	1.00	1.00	0.49
#Blockholder > 5%	322	1.73	0.00	1.00	3.00	1.33
#Blockholder 5-25%	322	0.99	0.00	0.00	3.00	1.48
#Blockholder > 25%	322	0.75	0.00	1.00	2.00	0.70
Panel B: Law introduction sample (1973 to 1981)						
Board Size	339	13.72	6.00	12.00	21.00	5.06
Employees	281	34,378	3,744	13,646	90,290	58,506
Treated	397	0.49	0.00	0.00	1.00	0.50
ROA	397	0.02	0.00	0.02	0.05	0.03
Tobin's Q	391	1.15	0.93	1.09	1.50	0.22
Assets	397	3,355	521	1,719	8,598	4,906
Leverage	397	0.71	0.56	0.70	0.86	0.11
Busyness	263	0.14	0.00	0.13	0.30	0.11

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Table 2: Univariate comparisons

This table compares mean and median firm characteristics of treated and control firms in the 1987-2016 panel (Panel A) and in the law introduction sample for 1973-1975, before the law's passage (Panel B). The 1987-2016 panel is restricted to firms with 5,000-15,000 DE. ROA and Tobin's Q (the outcome variables) are observed two years and all other variables one year after the employee numbers. P-values are based on two-sided t-tests for means and Wilcoxon signed-rank tests for medians. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Variable descriptions are in Appendix Table A2.

	Medians			**Means**		
Variable	**>10,000**	**<10,000**	**p-value**	**>10,000**	**<10,000**	**p-value**
Panel A: 1987-2016 panel						
Board Size	16.00	12.00	0.00	16.04	13.45	0.00
Large Board	1.00	0.00	0.00	0.89	0.31	0.00
Domestic Employees	12,083	7,578	0.00	11,137	8,654	0.00
Share Foreign Empl.	0.47	0.34	0.00	0.44	0.39	0.13
ROA	0.06	0.06	0.75	0.06	0.07	0.14
Tobin's Q	1.22	1.20	0.72	1.31	1.38	0.22
Assets	3,981	1,402	0.00	6,220	3,559	0.00
Leverage	0.67	0.69	0.07	0.65	0.67	0.02
Accounting Standard	1.00	0.00	0.00	0.60	0.46	0.00
Listing	1.00	0.00	0.01	0.60	0.50	0.01
Asset Intensity	0.13	0.12	0.20	0.18	0.19	0.33
Profit Margin	0.05	0.05	0.51	0.06	0.05	0.73
Asset Turnover	1.27	1.26	0.80	1.55	1.46	0.22
Employee Wages	35,262	44,024	0.00	39,459	47,244	0.00
Sales Growth	0.06	0.05	0.50	0.06	0.05	0.26
Asset Growth	0.05	0.05	0.91	0.06	0.05	0.61
Employee Growth	0.02	0.02	0.97	0.03	0.02	0.33
Firms	46	94				
Observations	249	594				
Panel B: Law introduction sample (1973-1975)						
Board Size	12.00	9.00	0.00	13.67	10.95	0.00
Employees	27,007	6,222	0.00	52,175	6,467	0.00
ROA	0.02	0.02	0.23	0.02	0.02	0.45
Tobin's Q	1.12	1.11	0.93	1.18	1.18	0.89
Assets	2,888	805	0.00	5,333	1,504	0.00
Leverage	0.69	0.73	0.03	0.70	0.71	0.37
Firms	38	38				
Observations	107	109				

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Table 3: Regression discontinuity analysis – ROA in reduced form

This table shows reduced-form RD regressions with ROA as dependent variable. The main explanatory variable is >10,000, an indicator for firms with more than 10,000 DE. All models include separate linear controls for DE to the left and right of the threshold. Except for Model 1, the models also include industry and year fixed effects. Only firm-years with 5,000-15,000 DE (8,000-12,000 DE) are included in Panel A (Panel B). ROA is observed two years and all other variables one year after the employee numbers. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Variable descriptions are in Appendix Table A2.

Panel A: Firms with 5,000-15,000 DE				
Model	1	2	3	4
Dep. variable	ROA	ROA	ROA	ROA
>10,000	**-0.022****	**-0.026****	**-0.027*****	**-0.023****
	(-2.42)	**(-2.57)**	**(-2.69)**	**(-2.39)**
Ln(Assets)			-0.012*	-0.0088
			(-1.94)	(-1.53)
Leverage				-0.17***
				(-4.78)
Acc. Std.				0.0069
				(0.54)
Listing				-0.012*
				(-1.80)
Observations	843	843	841	841
"Treated"	249	249	249	249
Adjusted R^2	0.01	0.09	0.13	0.26
Industry FE	no	yes	yes	yes
Year FE	no	yes	yes	yes
Panel B: Firms with 8,000-12,000 DE				
Model	1	2	3	4
Dep. variable	ROA	ROA	ROA	ROA
>10,000	**-0.026***	**-0.026***	**-0.023***	**-0.023**
	(-1.80)	**(-1.83)**	**(-1.78)**	**(-1.62)**
Ln(Assets)			-0.012**	-0.0068
			(-2.20)	(-1.24)
Leverage				-0.14***
				(-3.96)
Acc. Std.				-0.0098
				(-0.72)
Listing				-0.011
				(-1.11)
Observations	360	360	358	358
"Treated"	119	119	119	119
Adjusted R^2	0.02	0.17	0.21	0.30
Industry FE	no	yes	yes	yes
Year FE	no	yes	yes	yes

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Table 4: Regression discontinuity analysis – ROA in 2SLS

This table shows 2-stage least squares regressions with ROA as outcome variable. 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 DE. All models include separate linear controls for DE to the left and right of the threshold. Except for Model 1, the models also include industry and year fixed effects. Only firm-years with 5,000-15,000 DE are included. ROA is observed two years after and all other variables (including board size) one year after the employee numbers. 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. Variable descriptions are in Appendix Table A2.

Model	1.a	1.b	2.a	2.b	3.a	3.b	4.a	4.b
Dep. variable	Large Board	ROA	Large Board	ROA	Large Board	ROA	Large Board	ROA
Large Board		**-0.062***		**-0.062****		**-0.065****		**-0.049****
		(-1.89)		**(-2.29)**		**(-2.44)**		**(-2.32)**
>10,000	**0.35*****		**0.41*****		**0.42*****		**0.42*****	
	(3.36)		**(3.59)**		**(3.78)**		**(3.63)**	
Ln(Assets)					0.086**	-0.0074	0.058	-0.0092
					(2.07)	(-0.90)	(1.38)	(-1.45)
Leverage							0.00011	-0.16***
							(0.00043)	(-4.46)
Acc. Std.							0.17*	0.029***
							(1.73)	(2.90)
Listing							0.019	-0.019**
							(0.22)	(-2.43)
Observations	382	382	382	382	630	630	630	630
"Treated"	128	128	128	128	190	190	190	190
Industry & year FE	no	no	yes	yes	yes	yes	yes	yes
F-statistic	11.3		12.9		14.3		13.2	
Stage	first	second	first	second	first	second	first	second

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Table 5: Regression discontinuity analysis – Tobin's Q in reduced form
This table shows reduced-form RD regressions with Tobin's Q as dependent variable. The main explanatory variable is >10,000, an indicator for firms with more than 10,000 DE. All models include separate linear controls for DE to the left and right of the threshold. Except for Model 1, the models also include industry and year fixed effects. Only firm-years with 5,000-15,000 DE (8,000-12,000 DE) are included in Panel A (Panel B). Tobin's Q is observed two years and all other variables one year after the employee numbers. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Variable descriptions are in Appendix Table A2.

Panel A: Firms with 5,000-15,000 DE				
Model	1	2	3	4
Dep. variable	Tobin's Q	Tobin's Q	Tobin's Q	Tobin's Q
>10,000	**-0.14**	**-0.19***	**-0.23****	**-0.17***
	(-1.49)	**(-1.71)**	**(-2.11)**	**(-1.89)**
Ln(Assets)			-0.13	-0.077
			(-1.14)	(-1.05)
Leverage				-1.55***
				(-3.75)
Acc. Std.				0.17
				(1.00)
Observations	419	419	419	419
"Treated"	133	133	133	133
Adjusted R^2	0.00	0.13	0.18	0.36
Industry FE	no	yes	yes	yes
Year FE	no	yes	yes	yes
Panel B: Firms with 8,000-12,000 DE				
Model	1	2	3	4
Dep. variable	Tobin's Q	Tobin's Q	Tobin's Q	Tobin's Q
>10,000	**-0.22**	**-0.29****	**-0.27****	**-0.26****
	(-1.58)	**(-2.29)**	**(-2.54)**	**(-2.21)**
Ln(Assets)			-0.059	-0.034
			(-0.66)	(-0.45)
Leverage				-1.26***
				(-3.16)
Acc. Std.				0.025
				(0.18)
Observations	174	174	174	174
"Treated"	68	68	68	68
Adjusted R^2	0.02	0.47	0.47	0.58
Industry FE	no	yes	yes	yes
Year FE	no	yes	yes	yes

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Table 6: Difference-in-differences analysis around the introduction of the board size requirement
This table shows firm fixed effects regressions with ROA or Tobin's Q as dependent variables. In Models 1, 2, 5, and 6, the pre-period is 1974-75 and the post-period is 1980-81. In Models 3, 4, 7, and 8, the pre-period is 1973-75 and the post-period is 1979-81. Treated firms are all firms with at least 10,000 employees in 1975 (1974 if 1975 data are unavailable), which are matched by an equal number of control firms using the largest firms (based on 1975 total assets) with <10,000 employees. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Variable descriptions are in Appendix Table A2.

Model	1	2	3	4	5	6	7	8
Dep. variable	ROA	ROA	ROA	ROA	Tobin's Q	Tobin's Q	Tobin's Q	Tobin's Q
Years	[-2;+2]	[-2;+2]	[-3;+3]	[-3;+3]	[-2;+2]	[-2;+2]	[-3;+3]	[-3;+3]
Treated x Post	**-0.020****	**-0.020****	**-0.013***	**-0.013***	**-0.10****	**-0.084****	**-0.061**	**-0.037**
	(-2.32)	**(-2.50)**	**(-1.92)**	**(-1.86)**	**(-2.54)**	**(-2.07)**	**(-1.63)**	**(-0.99)**
Ln(Assets)		0.0058		0.0015		-0.044		-0.048
		(0.72)		(0.22)		(-1.23)		(-1.44)
Leverage		-0.056		-0.034		-0.14		-0.33**
		(-1.20)		(-0.90)		(-0.82)		(-2.22)
Observations	267	267	397	397	279	279	413	413
"Treated"	131	131	195	195	137	137	202	202
Adjusted R^2	0.04	0.04	0.04	0.04	0.23	0.24	0.16	0.19
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes	yes

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Table 7: Regression discontinuity analysis – ROA without recent threshold crossers and around crossings
This table shows reduced-form RD regressions with ROA as dependent variable. The main explanatory variable is >10,000, an indicator for firms with more than 10,000 DE. All models include separate linear controls for DE to the left and right of the threshold. Only firm-years with 5,000-15,000 DE are included. In Panel A, the sample excludes all firms that crossed 10,000 DE within the last three years, and, except for Model 1, the models include industry and year fixed effects. In Panel B, the sample is restricted to a ±3-year window around firms crossing 10,000 DE, and, except for Model 1, the models include firm and year fixed effects. ROA is observed two years and all other variables one year after the employee numbers. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Variable descriptions are in Appendix Table A2.

Panel A: Without recent threshold crossers				
Model	1	2	3	4
Dep. variable	ROA	ROA	ROA	ROA
>10,000	**-0.038*** **	**-0.045*** **	**-0.045*** **	**-0.037*** **
	(-3.04)	**(-3.45)**	**(-3.39)**	**(-3.42)**
Ln(Assets)			-0.012*	-0.009
			(-1.71)	(-1.49)
Leverage				-0.17***
				(-4.65)
Acc. Std.				0.011
				(0.89)
Listing				-0.010
				(-1.46)
Observations	746	746	744	744
"Treated"	199	199	199	199
Adjusted R^2	0.02	0.10	0.13	0.27
Industry FE	no	yes	yes	yes
Year FE	no	yes	yes	yes
Panel B: Around threshold crossings				
Model	1	2	3	4
Dep. variable	ROA	ROA	ROA	ROA
>10,000	**-0.019***	**-0.015**	**-0.014**	**-0.014**
	(-1.78)	**(-1.48)**	**(-1.38)**	**(-1.34)**
Ln(Assets)			-0.0092	-0.023
			(-0.34)	(-1.02)
Leverage				-0.11
				(-1.68)
Acc. Std.				0.019
				(1.12)
Listing				-0.015
				(-0.44)
Observations	263	263	262	262
"Treated"	129	129	129	129
Adjusted R^2	0.02	0.13	0.13	0.15
Firm FE	no	yes	yes	yes
Year FE	no	yes	yes	yes

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Table 8: Regression discontinuity analysis – operating policies
This table shows reduced-form RD regressions. The dependent variables are in the column headers. The main explanatory variable is >10,000, an indicator for firms with more than 10,000 DE. All models include separate linear controls for DE to the left and right of the threshold as well as industry and year fixed effects. Only firm-years with 5,000-15,000 DE are included. ROA is observed two years and all other variables one year after the employee numbers. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Variable descriptions are in Appendix Table A2.

Panel A: Asset turnover, profit margin, and employee wages			
Model	1	2	3
Dep. variable	Asset Turnover	Profit Margin	Employee Wages
Definition	Sales/Total Assets	EBIT/Sales	ln(Avg. Empl. Wage)
>10,000	**0.11**	**-0.032*** **	**-0.060**
	(1.08)	**(-3.22)**	**(-0.81)**
Observations	843	841	760
"Treated"	249	248	235
Adjusted R^2	0.36	0.18	0.32
Industry FE	yes	yes	yes
Year FE	yes	yes	yes
Panel B: Sales, asset, and employee growth			
Model	1	2	3
Dep. variable	Sales Growth (%)	Asset Growth (%)	Employee Growth (%)
>10,000	**0.23**	**0.91**	**-0.77**
	(0.11)	**(0.49)**	**(-0.38)**
Observations	841	843	830
"Treated"	249	250	250
Adjusted R^2	0.08	0.05	0.04
Industry FE	yes	yes	yes
Year FE	yes	yes	yes

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Table 9: Regression discontinuity analysis – acquisition announcement returns
This table shows reduced-form RD regressions. The dependent variables are 5-day cumulative market-adjusted excess returns (CER) around the announcement of an M&A deal. The main explanatory variable is >10,000, an indicator for firms with more than 10,000 DE. All models include separate linear controls for DE to the left and right of the threshold. Except for Model 1, the models also include industry and year fixed effects. Only firm-years with 5,000-15,000 DE are included. Acquisition announcement returns and deal characteristics are observed in the year after and firm characteristics in the same year as the employee numbers. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Variable descriptions are in Appendix Table A2.

Model	1	2	3	4
Dep. variable	CER	CER	CER	CER
Trading days	[-2;+2]	[-2;+2]	[-2;+2]	[-2;+2]
>10,000	**-0.018***	**-0.019***	**-0.018***	**-0.015**
	(-1.81)	**(-1.93)**	**(-1.93)**	**(-1.68)**
Ln(Assets)			0.0018	0.0017
			(0.74)	(0.71)
Leverage			0.0098	0.0130
			(0.34)	(0.47)
Acc. Std.			0.0034	0.0039
			(0.34)	(0.39)
Listed Target				0.0130
				(1.37)
Diversifying Deal				-0.0086
				(-1.11)
International Deal				-0.0009
				(-0.16)
Observations	253	253	253	253
"Treated"	119	119	119	119
Adjusted R^2	0.01	0.03	0.02	0.03
Industry FE	no	yes	yes	yes
Year FE	no	yes	yes	yes

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Table 10: Directors added after crossing 10,000 DE from below

This table shows characteristics of newly appointed and incumbent directors measured as firm-year averages. Upward Movers are firms that moved above 10,000 DE in the last three years. Other Firms are firms that did not cross 10,000 DE within the last three years. The sample is restricted to firms with 5,000-15,000 DE. Busyness is the share of directors with at least three simultaneous board positions. Executive (CEO) Experience is the share of directors with past or current executive (CEO) positions. Female is the share of female directors. Doctorate is the share of directors with a PhD or comparable degree. Diff (column 5) is the difference between new and incumbent directors. DiD (column 7) is the difference-in-differences between new and incumbent directors in Upward Movers compared to the same difference in Other Firms. P-values are based on standard errors clustered by firm. Variable descriptions are in Appendix Table A2.

		1	2	3	4	5	6	7	8
Director characteristic		New directors	N	Incumbents	N	Diff	p-value	DiD	p-value
Busyness	Upward Movers	25.7%	144	21.5%	716	4.2%	0.38	5.31%	0.26
	Other Firms	18.9%	809	20.1%	5107	-1.1%	0.57		
Executive Experience	Upward Movers	22.4%	116	28.5%	498	-6.1%	0.33	-4.51%	0.50
	Other Firms	23.7%	843	25.3%	4685	-1.6%	0.51		
CEO Experience	Upward Movers	8.6%	116	8.1%	498	0.6%	0.88	1.03%	0.79
	Other Firms	7.4%	843	7.9%	4685	-0.4%	0.74		
Female	Upward Movers	15.3%	137	10.5%	639	4.8%	0.13	-0.55%	0.87
	Other Firms	18.3%	656	12.9%	4233	5.4%	0.00		
Doctorate	Upward Movers	23.4%	137	26.0%	646	-2.6%	0.40	-3.12%	0.41
	Other Firms	28.2%	659	27.8%	4262	0.5%	0.85		

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Appendix

Table A1: Sample selection
This table describes the sample selection process for the 1987-2016 panel. The baseline sample contains firms with 5,000-15,000 domestic employees (DE).

		Firms	Obs.
1	All non-financial firms in Hoppenstedt with consolidated financial statements and at least 5,000 total employees during at least one fiscal year between 1987 and 2016	535	-
2	Within business groups, drop subsidiaries	492	-
3	Drop firms exempt from the law (e.g., news reporting, mining, steel production, cooperatives), state-owned firms, and non-profits	387	-
4	Drop firm-years with missing information on the number of DE	260	2,988
5	Drop firm-years for which average DE is not within 5,000-15,000	112	906
6	Add Worldscope firms with average DE in annual reports and within 5,000-15,000	125	966
7	Drop firm-years with missing accounting data in t+2	104	843
8	Drop firm-years with missing control variables in t+1	103	841
9	Drop firm-years with missing board size data in t+1	81	630

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Table A2: 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), WC for Worldscope, and AM for Amadeus.

Variable	Description
Panel A: 1987-2016 panel	
>10,000	Dummy that equals one if the firm has more than 10,000 average DE. Source: HS / annual reports.
Accounting Standard	Dummy that equals one if the firm follows international accounting standards. Source: HS / annual reports.
CER	Cumulative market-adjusted excess returns around the announcement of an M&A deal, starting two trading days before the announcement and ending two trading days after. Excess returns are daily stock returns minus the return on the CDAX market index. Source: DS / SDC.
Asset Growth	Growth rate of book assets between year t and year t-1. Source: HS / WC.
Asset Intensity	Total assets divided by total employees. Source: HS / WC.
Asset Turnover	Sales divided by total assets. Source: HS / WC.
Assets	Book value of total assets in million Euro. Converted to 2016 values based on German inflation rates from the OECD. Source: HS / WC.
Blockholder >5%	Dummy that equals one if there is at least one shareholder with more than 5% of the firm's outstanding shares. Source: HS / annual reports.
Blockholder 5-25%	Dummy that equals one if there is at least one shareholder with 5% to 25% of the firm's outstanding shares. Source: HS / annual reports.
Blockholder >25%	Dummy that equals one if there is at least one shareholder with more than 25% of the firm's outstanding shares. Source: HS / annual reports.
#Blockholder >5%	Number of shareholders with more than 5% of the firm's outstanding shares. Source: HS / annual reports.
#Blockholder 5-25%	Number of shareholders with 5% to 25% of the firm's outstanding shares. Source: HS / annual reports.
#Blockholder >25%	Number of shareholders with more than 25% of the firm's outstanding shares. Source: HS / annual reports.
Board Size	Number of supervisory board members at fiscal year-end. Source: Annual reports.
Busyness	Share of directors with at least three simultaneous board positions. Source: HS / AM.
CEO Age	Calendar year minus year of CEO birth. Source: HS / annual reports / company websites.
CEO Experience	Share of directors with past or current CEO experience. Source: HS / AM.
CEO Turnover	Dummy that equals one if there is a change in CEO during the fiscal year. Source: HS / annual reports.
Diversifying deal	Dummy that equals one if the firm acquires a target from a different Fama-French 12 industry. Source: SDC.
Doctorate	Share of directors with a PhD or comparable degree. Source: HS / AM.
Domestic Employees	Average number of DE. Source: HS / annual reports.
Employee Growth	Growth rate of total employees between year t and year t-1. Source: HS / annual reports.
Employee Wages	Total wages and salaries in Euro divided by total employees. Converted to 2016 values based on German inflation rates from the OECD. Source: HS / WC / annual reports.
Executive Experience	Share of directors with past or current executive experience. Source: HS / AM.
Executive Pay	Average executive compensation of members of the management board in thousands of Euros. Converted to 2016 values based on German inflation rates from the OECD. Source: HS / annual reports.

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Female	Share of female directors. Source: HS / AM.
International deal	Dummy that equals one if the target is headquartered outside Germany. Source: SDC.
Large Board	Dummy that equals one if the firm's supervisory board has at least 16 members. Remains one in years in which board size temporarily drops to 15, with at least 16 members in both the year before and after. Source: Annual reports.
Leverage	Total book debt divided by total book debt plus book value of equity. Source: HS / WC.
Listed Target	Dummy that equals one if the target has a stock market security identifier. Source: SDC.
Listing	Dummy that equals one if the firm's shares are listed on a regulated market in Germany. Source: Annual reports / company websites.
Profit Margin	Earnings before interest and taxes divided by sales. Source: HS / WC.
Retirement Age	Dummy that equals one if CEO age is between 63 and 66 years. Source: HS / annual reports / company websites.
ROA	Earnings before interest and taxes divided by total assets. Source: HS / WC.
Sales Growth	Growth rate of sales between year t and year t-1. Source: HS / WC.
Share Foreign Employees	Total employees minus DE, divided by total employees. Source: HS / annual reports.
Tobin's Q	Sum of market value of equity and total liabilities divided by sum of common equity and total liabilities ((wc08001+wc03351)/(wc03501+wc03351)). Source: WC.
Panel B: Law introduction sample (1973 to 1981)	
Assets	Book value of total assets in million Euro. Converted to 2016 values based on German inflation rates from the OECD. Source: SG.
Board Size	Number of supervisory board members. Source: SG.
Busyness	Share of directors with at least three simultaneous board positions. Source: SG.
Employees	Total number of employees. Source: HB.
Leverage	Total book debt divided by total book debt plus book value of equity. Source: SG.
Post	Dummy that equals one starting from 1979 or 1980, i.e., after the law's implementation period.
ROA	Net income divided by total assets. Source: SG.
Treated	Dummy that equals one if the firm had at least 10,000 total employees in 1975 (or 1974 if 1975 unavailable). Source: HB.
Tobin's Q	Sum of equity market capitalization and total liabilities divided by sum of book equity and total liabilities. Book equity is the book value of common equity, obtained by multiplying total equity with the ratio of par value of common stock divided by total par value. Market equity is the product of number of shares outstanding and share price, summed across share classes. Source: SG.

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Table A3: Regression discontinuity analysis – robustness

This table shows reduced-form RD regressions with ROA as dependent variable. The main explanatory variable is >10,000, an indicator for firms with more than 10,000 DE. Model 1 uses the same linear control for DE on both sides of the threshold. All other models use separate linear controls for DE to the left and right of the threshold (as in the baseline analysis). In Model 2, ROA is observed one year after the employee numbers, in all other models two years after the employee numbers (as in the baseline analysis). Model 3 excludes observations with board size above 17. Model 4 uses triangular kernels to weight observations on each side of the threshold. All models include industry and year fixed effects. Only firm-years with 5,000-15,000 DE are included. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Variable descriptions are in Appendix Table A2.

Model	1	2	3	4
Robustness test	One linear polynomial	Lagged once	Board Size ≤ 17	Triangular kernel
Dep. variable	ROA	ROA	ROA	ROA
>10,000	**-0.026****	**-0.025****	**-0.030****	**-0.027*****
	(-2.62)	**(-2.54)**	**(-2.44)**	**(-2.75)**
Observations	843	903	568	843
"Treated"	249	268	165	249
Adjusted R^2	0.09	0.08	0.09	n.a.
Industry FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes

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Table A4: Regression discontinuity analysis – placebo tests

This table shows reduced-form RD regressions with ROA as dependent variable. The main explanatory variable is Threshold Indicator, which is set to one if DE is above the threshold shown in the column header. All models include separate linear controls for DE to the left and right of the threshold as well as industry and year fixed effects. Only firm-years with either 5,000-10,000 DE (Models 1 to 4) or 10,000-15,000 DE (Models 5 to 8) are included. ROA is observed two years after the employee numbers. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Variable descriptions are in Appendix Table A2.

Model	1	2	3	4	5	6	7	8
Test	6,000 DE	7,000 DE	8,000 DE	9,000 DE	11,000 DE	12,000 DE	13,000 DE	14,000 DE
Dep. variable	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA
Threshold Indicator	**0.0070**	**-0.0046**	**0.014**	**0.0017**	**0.031**	**0.0028**	**-0.0091**	**-0.0054**
	(0.60)	**(-0.39)**	**(1.48)**	**(0.13)**	**(1.56)**	**(0.13)**	**(-0.56)**	**(-0.33)**
Sample	5,000-10,000	5,000-10,000	5,000-10,000	5,000-10,000	10,000-15,000	10,000-15,000	10,000-15,000	10,000-15,000
Observations	594	594	594	594	249	249	249	249
"Treated"	449	357	241	97	177	130	73	35
Adjusted R^2	0.08	0.08	0.09	0.09	0.13	0.11	0.11	0.11
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes	yes

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Table A5: The probability of crossing alternative thresholds
This table shows the percentage of firms crossing various DE thresholds. For example, the first row of Panel A shows that, from the set of firms with 6,000-7,000 DE in year t, 25% have more than 7,000 DE in year t+1.

Panel A: Moving up	**Percentage of firms**
DE of 6,000 – 7,000, moving above 7,000	25.0%
DE of 7,000 – 8,000, moving above 8,000	22.4%
DE of 8,000 – 9,000, moving above 9,000	20.8%
DE of 9,000 – 10,000, moving above 10,000	*23.7%*
DE of 10,000 – 11,000, moving above 11,000	15.3%
DE of 11,000 – 12,000, moving above 12,000	31.9%
DE of 12,000 – 13,000, moving above 13,000	26.3%
Panel B: Moving down	**Percentage of firms**
DE of 13,000 – 14,000, moving below 13,000	34.2%
DE of 12,000 – 13,000, moving below 12,000	21.1%
DE of 11,000 – 12,000, moving below 11,000	38.3%
DE of 10,000 – 11,000, moving below 10,000	*29.2%*
DE of 9,000 – 10,000, moving below 9,000	18.6%
DE of 8,000 – 9,000, moving below 8,000	16.7%
DE of 7,000 – 8,000, moving below 7,000	14.7%

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Table A6: Manipulation around the threshold

This table shows reduced-form RD regressions. The dependent variable is Share Foreign Employees in Model 1, ROA in Models 2 and 4, and Asset Intensity in Model 3. The main explanatory variable is >10,000, an indicator for firms with more than 10,000 DE. All models include separate linear controls for DE to the left and right of the threshold as well as industry and year fixed effects. Only firm-years with 5,000-15,000 DE are included. The dependent variables are observed two years and all other variables one year after the employee numbers. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Variable descriptions are in Appendix Table A2.

Model	1	2	3	4
Test	Share Foreign Employees	Share Foreign Employees	Asset Intensity	Asset Intensity
Dep. variable	Share Foreign Employees	ROA	Asset Intensity	ROA
>10,000	**-0.048**	**-0.027****	**-0.014**	**-0.027*****
	(-1.08)	**(-2.55)**	**(-0.32)**	**(-2.63)**
Share Foreign Employees		-0.031*		
		(-1.70)		
Asset Intensity				-0.025
				(-1.46)
Observations	779	833	833	828
"Treated"	234	249	250	249
Adjusted R^2	0.19	0.10	0.29	0.10
Industry FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes

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Table A7: Regression discontinuity analysis – covariates around the threshold

This table shows reduced-form RD 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 DE. All models include separate linear controls for DE to the left and right of the threshold as well as industry and year fixed effects. Only firm-years with 5,000-15,000 DE are included. The dependent variables are observed one year after the employee numbers. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Variable descriptions are in Appendix Table A2.

Model	1	2	3	4
Dep. variable	Ln(Assets)	Leverage	Acc. Std.	Listing
>10,000	**-0.089**	**0.037**	**0.019**	**0.089**
	(-0.55)	**(1.48)**	**(0.25)**	**(0.89)**
Observations	845	845	847	847
"Treated"	250	250	250	250
Adjusted R^2	0.44	0.18	0.46	0.18
Industry FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes

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Table A8: Difference-in-differences analysis – robustness

This table shows firm fixed effects regressions with ROA as dependent variable. In Models 1, 3, 5, 7, and 9, the pre-period is 1974-75 and the post-period is 1980-81. In Models 2, 4, 6, 8, and 10, the pre-period is 1973-75 and the post-period is 1980-81. Before further restrictions, treated firms are all firms with at least 10,000 employees in 1975 (1974 if 1975 data are unavailable), which are matched by an equal number of control firms using the largest firms (based on 1975 total assets) with <10,000 employees. Models 1 and 2 select treated and control firms using propensity-score matching on 1975 total assets with a caliper of 10% of the standard deviation of the propensity score logit. Models 3 and 4 exclude treated firms with >50,000 employees in 1975/74. Models 5 and 6 exclude firms with foreign plants in 1975/74. Models 7 and 8 exclude control firms with >20,000 employees in 1978 (1979 if 1978 data are unavailable). Models 9 and 10 exclude treated firms that are already in compliance in 1975/74 (i.e., firms with 10,000-20,000 (>20,000) employees and at least 16 (20) directors in 1975/74). T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Variable descriptions are in Appendix Table A2.

Model	1	2	3	4	5	6	7	8	9	10
Test	Size matching	Size matching	No large treated firms	No large treated firms	No foreign plants	No foreign plants	No large control firms	No large control firms	No already treated firms	No already treated firms
Dep. Variable	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA
Years	[-2;+2]	[-3;+3]	[-2;+2]	[-3;+3]	[-2;+2]	[-3;+3]	[-2;+2]	[-3;+3]	[-2;+2]	[-3;+3]
Treated x Post	**-0.026**	**-0.027***	**-0.017***	**-0.013***	**-0.019****	**-0.013***	**-0.019****	**-0.012***	**-0.017***	**-0.015***
	(-1.67)	**(-2.00)**	**(-1.81)**	**(-1.69)**	**(-2.22)**	**(-1.88)**	**(-2.27)**	**(-1.84)**	**(-1.83)**	**(-1.91)**
Observations	84	123	199	297	259	386	269	398	206	305
"Treated"	42	63	99	148	127	189	131	195	102	150
Adjusted R^2	0.07	0.11	0.02	0.03	0.05	0.04	0.03	0.03	0.02	0.04
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

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Table A9: Difference-in-differences analysis - placebo tests

This table shows firm fixed effects regressions with ROA as dependent variable. In Models 1 and 2, the pre-period is 1970-72 and the post-period 1973-75, both before the law's introduction. Treated firms are all firms with at least 10,000 employees in 1975 (1974 if 1975 data are unavailable), which are matched by an equal number of control firms using the largest firms (based on 1975 total assets) with <10,000 employees. In Models 3 to 6, the sample is restricted to firms with 2,000-10,000 employees in 1975/74, all below the 10,000 DE threshold. "Treated" firms are those with more employees than the 1975/74 sample median. In Models 3 and 4, the pre-period is 1974-75 and the post-period is 1980-81. In Models 5 and 6, the pre-period is 1973-75 and the post-period is 1979-81. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Variable descriptions are in Appendix Table A2.

Model	1	2	3	4	5	6
Test	Placebo - timing	Placebo - timing	Placebo - treatment	Placebo - treatment	Placebo - treatment	Placebo - treatment
Dep. variable	ROA	ROA	ROA	ROA	ROA	ROA
Years	[-3;+3]	[-3;+3]	[-2;+2]	[-2;+2]	[-3;+3]	[-3;+3]
Treated x Post	**-0.00067**	**-0.000036**	**0.0034**	**0.0083**	**0.00074**	**0.0026**
	(-0.11)	**(-0.0057)**	**(0.33)**	**(0.86)**	**(0.089)**	**(0.34)**
Ln(Assets)		0.0024		-0.026		-0.019
		(0.15)		(-1.25)		(-1.18)
Leverage		0.040		0.13**		0.066
		(1.01)		(2.14)		(1.62)
Observations	284	284	251	251	375	375
"Treated"	139	139	128	128	190	190
Adjusted R^2	0.06	0.06	-0.01	0.08	0.01	0.04
Firm FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes

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Table A10: Regression discontinuity analysis – CEO turnover and executive pay
This table shows reduced-form RD regressions with CEO Turnover or ln(Executive Pay) as dependent variables. The main explanatory variable is >10,000, an indicator for firms with more than 10,000 DE. All models include separate linear controls for DE to the left and right of the threshold as well as industry and year fixed effects. Only firm-years with 5,000-15,000 DE are included. CEO Turnover and ln(Executive Pay) are observed one year after and all other variables in the same year as the employee numbers. Delta ROA is the difference in ROA between the year in which employee numbers are observed and the prior year. ROA and Delta ROA are demeaned. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Variable descriptions are in Appendix Table A2.

Model	1	2	3	4
Dep. variable	CEO Turnover	CEO Turnover	Ln(Executive Pay)	Ln(Executive Pay)
>10,000	**0.014**	**0.017**	**-0.0031**	**-0.027**
	(0.27)	**(0.32)**	**(-0.017)**	**(-0.14)**
ROA	-0.62		2.08**	
	(-1.37)		(2.18)	
>10,000 * ROA	**0.87**		**-1.01**	
	(1.46)		**(-0.82)**	
Delta ROA		-0.27		0.25
		(-0.64)		(0.40)
>10,000 * Delta ROA		**-0.30**		**0.70**
		(-0.29)		**(0.69)**
Ln(CEO Age)	0.37***	0.36***		
	(2.93)	(2.69)		
Retirement Age	0.091*	0.091*		
	(1.93)	(1.87)		
Observations	498	491	575	563
Treated	147	145	164	161
Adjusted R^2	0.01	0.01	0.55	0.54
Industry FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes

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Table A11: Regression discontinuity analysis – blockholders

This table shows reduced-form RD regressions with ROA as dependent variable. The main explanatory variable is >10,000, an indicator for firms with more than 10,000 DE. Blockholders are observed as dummies in Models 1 and 3 and as count variables in Models 2 and 4. All models include separate linear controls for DE to the left and right of the threshold as well as industry and year fixed effects. Only firm-years with 5,000-15,000 DE are included. ROA is observed two years and blockholders one year after the employee numbers. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Variable descriptions are in Appendix Table A2.

Model	1	2	3	4
Dep. variable	ROA	ROA	ROA	ROA
Measurement of blockholders	Dummy	Count	Dummy	Count
>10,000	**-0.050****	**-0.027***	**-0.052****	**-0.025***
	(-2.02)	**(-1.91)**	**(-2.03)**	**(-1.83)**
Blockholder > 5%	0.013	-0.0051*		
	(0.96)	(-1.84)		
>10,000 * Blockholder > 5%	**0.024**	**0.0082**		
	(1.04)	**(1.51)**		
5% < Blockholder < 25%			0.0080	-0.0049*
			(0.58)	(-1.73)
>10,000 * Blockholder 5-25%			**0.019**	**0.0098***
			(0.72)	**(1.76)**
Blockholder > 25%			0.015	0.0033
			(1.02)	(0.56)
>10,000 * Blockholder > 25%			**0.030**	**0.017**
			(1.23)	**(1.09)**
Observations	322	322	322	322
"Treated"	112	112	112	112
Adjusted R^2	0.15	0.15	0.15	0.15
Industry FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes

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Table A12: Difference-in-differences analysis – director busyness

This table shows OLS regressions with ΔBusyness (Model 1) and ROA (Model 2) as dependent variables. ΔBusyness is the change in director busyness from 1975 to 1979. Model 1 includes year FE and Model 2 firm and year FE. The pre-period spans 1974-75 and the post-period 1980-81. Treated firms are all firms with at least 10,000 employees in 1975 (1974 if 1975 data are unavailable), which are matched by an equal number of control firms using the largest firms (based on 1975 total assets) with <10,000 employees. T-statistics based on standard errors clustered by firm are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Variable descriptions are in Appendix Table A2.

Model	1	2
Dep. variable	ΔBusyness	ROA
Years	[-2;+2]	[-2;+2]
Treated x Post		**-0.016****
		(-2.10)
Treated	**0.028***	
	(1.89)	
Ln(Assets)	0.0057	0.0032
	(0.81)	(0.47)
Leverage	-0.029	-0.061
	(-0.58)	(-1.50)
Post x ΔBusyness		-0.074
		(-1.15)
Post x Treated x ΔBusyness		**-0.096**
		(-1.10)
Observations	263	263
"Treated"	129	129
Adjusted R^2	0.01	0.10
Firm FE	no	yes
Year FE	yes	yes

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