Gender diversity in corporate boards: Evidence from quota-implied discontinuities *

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Abstract

We use data across European corporate boards to investigate the effects of quota-induced female representation, under minimal possible identification assumptions. We find that having more women in board causally increases Tobin's Q, despite some negative effects on operating performance and more likely employment downsizings. We interpret this evidence as firms scaling down inefficient operations. Our results highlight that gender quotas are not necessarily a costly way of promoting equality.

Keywords: Gender diversity, women in boards, gender quota, performance

JEL codes: D22, G32, J16

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1 Introduction

Gender equality, and its main business-world facet – promoting female representation in boards of directors, – has become the agenda of policy makers across the world. At the same time, the first seminal papers by Ahern and Dittmar (2012) and Matsa and Miller (2013), which explore the setting of Norway that was the first to introduce a quota in 2002, convincingly demonstrate that the effects of this gender-related quota are negative. These results have outlined a major policy dilemma of whether gender equality is actually to be imposed at the expense of shareholders. In this paper, we explore the universe of European countries that introduced quotas, using a novel discontinuity-based identification strategy, to show that gender quotas for corporate boards are on average value-enhancing for shareholders, suggesting that such a policy dilemma might actually not be there.

Our results show that gender quotas for corporate boards are not necessarily a costly way of promoting gender equality. Specifically, we find a positive and large effect of the share of women in boards on Tobins' Q: a 10pp increase in the share of women increases Tobin's Q by 2.3, which is about 1.3 within-firm standard deviations of this variable. We decompose this effect into the market-value and book-value components, and observe that while market-value component increases, the book-value component goes down. As our further analysis shows, this is not an artefact of a change in capital structure, or an increase in dividend payout, but rather a result of reductions in labor, scaling down operations, and therefore lower operating profits (as a share of assets). Given that the long-run market reaction is not negative, the evidence suggests that these are the inefficient operations that are likely being scaled down, consistent with women being less prone to empire building. These changes cannot be attributed to general board quality, as boards with more women appear similar on observables, such as average age, number of qualifications, network size, and independence.

In order to identify these effects of female representation, we note that any percentage quota applied to a relatively small-sized group of individuals produces natural discontinuities in the actual minimum share of women that is to be achieved. This happens beause women come in whole numbers. For example, with a *de jure* quota of 25% a board of size 4 has to have at least 1 woman, making it exactly a 25% as the minimum. However, a board with 5 members has to have at least

two women, which *de facto* means having at least 40% of women, and this is a sizeable difference from what the quota prescribes. Since we consider board sizes measured before the exact percentage is announced, it is not known whether the close boards would eventually be 4 vs 5 (as with 25%) or, say,5 vs 6 (as with 40%), or 6 vs 7 (as with 33%), etc. This ensures that the ex ante sorting of firms into boards of the specific board sizes relevant for the specific percentage is likely to be random. In the 25% example, we therefore use the differential response of firms with boards of 4 vs 5 members to assess the effects of having to have a higher share of women, purely due to rounding. We further generalize this setting to multiple discontinuities within a country (e.g. also comparing 8- vs 9-member boards in case of a 25% quota), to multiple percentage quotas (e.g. comparing 5- to 6-member boards, and 7- to 8-member boards in case of a 40% quota), to multiple countries that introduced them in different years. In the most saturated specifications, we can even identify the effects out of relative intensities, such as compare the difference in performance between firms with 5 and 4 members (which are prescribed to have a 15% difference in minimum female share) to the difference in performance between firms with 9 and 8 members (which are prescribed to have only a 8.3% difference in minimum female share), and all the results go through.

The main benefit of our approach is that we bring the counterfactual firms as close as it is at all possible in the setting of a universally-imposed quota. Specifically, we do not have to rely on the assumption of private firms being good comparables to public firms (such as in Matsa and Miller, 2013); instead we are able to compare within public firms within the same country and, most importantly, within very narrowly-defined pre-existing board sizes (such as 4 vs 5). Neither we have to rely on any pre-existing heterogeneity in actual female presence across boards as part of the identifying variation (such as in Ahern and Dittmar, 2012, Bertrand et al, 2018, and Eckbo et al, 2019), since whether companies have more or less women to start with is likely relevant to how important women are for value in these companies, and some authors (e.g. Ferreira, 2014) suggest this may be problematic in terms of counterfactuals. Finally, unlike these other studies we examine the whole universe of European countries that introduced percentage quotas, both mandatory and voluntary, thereby attempting to speak towards generalizability.

The limitation of our study is that this ability to provide causal estimates under minimally possible identification assumptions comes at a cost of sample size requirements. As such, we might

not be able to estimate every single effect for every single country separately (as in the end there are only a few dozens of affected listed firms headquartered in each of the countries such as Belgium, the Netherlands, Spain, and Norway). However, we do show that the main effects are similar for all countries together, as well as for some larger individual countries, and subsamples of largest firms across groups of countries.

While our paper relates to a broad literature on gender and team performance in general (Hoogendoorn et al, 2013), board diversity (Adams and Ferreira, 2009), board representation (Jäger et al, forthcoming), gender differences across directors (Adams and Funk, 2012), gender spillovers (Matsa and Miller, 2011), it is most closely related to papes studying quota-imposed effects of gender diversity and firm performance. The recent evidence on Norway is more mixed (Eckbo et al, 2019, find no effects, and Nygaard, 2011, finds heterogeneous effects depending on information asymmetry), and for Italy Ferrari et al, 2016, find no differences in performance, but some positive effects on stock price. At the same time, Hwang et al (2019) find negative market reaction to the introduction of gender quota in a sample of Californian firms.

Given that we show the way to investigate the effects of the effects of any universally-imposed percentage quota under minimally possible identification assumptions, we view our first contribution as methodological and hence policy-relevant. Our discontinuity-based approach is inspired by Angrist and Lavy (1999) Maimonides rule. Our empirical strategy has most power when a percentage quota applies to a small-sized group of people, which is the case with corporate boards. It would also the case with members of the Cabinet, members of the European parliament, but not e.g. members of Congress, which are too numerous to provide any meaningful discontinuities in shares. As such, our identification strategy can also be applied to many political economy and other small-team settings outside corporate finance, and not only in the context of gender. It is also easily adaptable to other empirical setups, whenever close counterfactuals are of interest (such as in event studies).

The second contribution is that we consider all European countries that introduced percentage-based regulation for public companies together, and as such attempt to generalize and unify all quota-based evidence. Finally, and relatedly, our resuts apply to both mandatory quotas and voluntary regulation, speaking again towards generalizability.

The paper is organized as follows: Section 2 describes the empirical strategy; Section 3 discusses the data and provides summary statistics; Section 4 shows the first-stage results and validates the instrument; Section 5 presents the main results on the effects of female representation on value, performance, and other variables; Section 6 concludes.

2 Empirical Strategy

To illustrate the idea behing our instrument, let's suppose that a firm faces a quota of 25% of women on board (the specific number is used for illustration purposes). Does it mean that every firm that is *compliant* to this quota will have to have at least 25% of women? Well, it turns out that most firms will actually have to have a percentage much higher than 25%, even if they want to only marginally comply with the 25%-quota. And the simple reason for that is that women (and men too) come in round numbers. So a board of 2 directors will have to have at least 1 woman, making it a 50% share of women overall), while a board of 5 members will have to have at least 2 women, making it a 40% share of women. Only a board that is an exact multiple of 4 (e.g. 4 members) will have to have exactly 25% as the minimum to comply with the quota. Given how reluctant firms may have been in becoming compliant, even the differences in these minimum requirements induced by the same quota will likely produce enough powerful variation for us to identify the effects of interest. Overall, a firm with board size b, facing a quota q would need to have a minimum of

$$\frac{int((b-1) \cdot q) + 1}{b},$$

where $int(a)$ is the integer part of a real number a, making this minimum a sawtooth-like pattern of a board size, such as the one in Figure 1 (drawn for the 25% case for concreteness).[1]

This pattern produces some natural discontinuities in the minimum required share of women, which is what we will use in conjunction with our instrument. It is essential that we will never use the contemporaneous board size when constructing the instrument (since it is likely to be endogenous), but rather the original board size that existed before the quota was announced or implemented.

[1] This can be equally spelled as $\frac{roundup(bq)}{b}$, where *roundup* is the upward-rounding function.

Additionally, since firms in a cross-section would likely not choose their board sizes completely randomly, and we want to isolate the closest possible comparisons, we explore only the upward parts of this sawtooth-like pattern (this is analogous to Angrist and Lavy, 1999, "discontinuity sample", highlighted in red in Figure 1). While many of the neighboring board sizes would be close enough comparables in terms of minimizing omitted variable bias concerns, the treatment is highest precisely at these jumps. Focusing on these very close comparisons will additionally allow us to flexibly control for the original board size effects using fixed effects without the need to rely on additional functional form assumptions and extrapolation on how female presence or our variables of interest would depend on the board size itself had there been no quota. Our findings are nevertheless robust to using the whole schedule.

Our simplest possible instrument in this framework, $Right_i$, is then the dummy that takes the value 1 for firms that were located just to the right of the kink of the discontinuity sample (i.e. 5, 9, 13, etc in the case of 25% quota), in the year before the quota was announced, and the value of 0 for firms located to just to the left of this kink (i.e. 4, 8, 12, etc in the case of 25% quota), and missing for all other values:

$$Right_i = \left\{ \begin{matrix} 0 \text{ if } \frac{int((b_{i0}-1)\cdot q_c)+1}{b_{i0}} < \frac{int((b_{i0})\cdot q_c)+1}{b_{i0}+1} \\ 1 \text{ if } \frac{int((b_{i0}-2)\cdot q_c)+1}{b_{i0}-1} < \frac{int((b_{i0}-1)\cdot q_c)+1}{b_{i0}} \end{matrix} \right\},$$

where b_{i0} is the board size of firm i in the year before the quota was announced (this year is country-specific), and q_c is the country-specific quota.

To give example of the identifying variation, let's consider for simplicity just one country, e.g. the United Kingdom (which is where most of our observations will come anyway), which in 2011 published a recommendation by Lord Davies (2011) to incentivise the larger firms to have at least 25% of women on boards by 2015. Our discontinuity sample in the UK will thus consist of firms that in 2010 (a year before the announcement) had 4 or 5, 8 or 9, 12 or 13, etc board members (highlighted in red in Figure 1). We will be making all of our comparisons within each of these red pairs, and to do that, we use the kink-specific fixed effects, λ_{kc}, that capture separate intercepts for firms that have 4 and 5 board members, vs firms that have 8 or 9 board members, vs firms that

have 12 or 13 board members, etc. Due to these fixed effects none of our results can be explained by firms having very different board sizes and hence different values and other variables (see e.g. Yermack, 1996). This means that we will only be comparing e.g. firms with 8 to firms with 9 board members, out of which the former happened to have a multiple of 4 a year before the specific percentage quota was announced, and the latter happened to have one more board member. As we are employing multiple kinks, the kink-specific fixed effects also help us to very flexibly control for average cross-sectional differences between firms of different board sizes (e.g. 4 and 5 vs 8 and 9), so our results cannot be explained by firms with much larger boards having on average different proportions of women than firms with smaller boards. It is important, that firms have naturally sorted into these original board sizes before the actual percentage of the quota gets revealed, which even further reduces any concerns for selection of firms into specific board sizes (e.g. multiples of 4 vs one more member). Our main argument will thus be that this pre-existing sorting of firms within a kink, e.g. into whether to have 8 or 9 board members (and conditional on other things that we control for later), is likely to be close to random. This will be further weakened in the more saturated specifications.

While we will show below that the dynamics of the relationship between the share of women and *Right* is such that the instrument does not predict it in the period before the quota annoucement, and as such there is no direct effect of the original board size on the share of female directors, a similar exclusion restriction will have to be satisfied for all of our dependent variables, as well. Since one might argue that firms to the right of the kink mechanically have one more board member within each bin (as 5>4 and 9>8), and this might have its own effect on the dependent variables even in the absense of any quota (hence violating the exclusion restriction), we weaken the identification requirements further and move to a difference-in-differences setup, estimating the first stage specification as follows:

$$Share_{it} = \gamma Post_{ct} Right_i + \lambda_{kct} + \lambda_i + \omega_{it}, \tag{1}$$

where $Share_{it}$ is the proportion of women in the board of firm i in year t, $Post_{ct}$ is the country-

specific dummy variable that takes the value of 1 for the years after compliance, and 0 for the years before announcement, $Right_i$ is the instrument as defined above, λ_{kct} are the kink-specific fixed effects (described above and kept country- and also year-specific, so as to absorb any country-year variation as well), λ_i are firm fixed effects, and ω_{it} is the error term.

This move to difference-in-differences helps to address potential pre-existing differences in the value of the company or other dependent variables for boards of different sizes. Additionally, it allows to absorb any non-linear relationship between $Share$ and board size that may exist even in the absense of quota, under the assumption that the form of this non-linear relationship is similar before and after the reform. It is worth noting, that our setup is different from the usual use of DID in the quota setup (e.g. that in Ahern and Dittmar, 2012, and Matsa and Miler, 2013), not only in the way which firms we consider to be relevant counterfactuals to each other (firms with very close ex ante board sizes, rather than firms with different ex ante shares of women or public and private companies), but also in the way the timing of the shock is defined. In our setup we can actually first exlore the dynamics of the first stage and observe when firms start responding to the instrument, and then consider the second stage only where the instrument provides enough of powerful variation. As we will see further, the cross-sectional differences in $Share$ start kicking in only after compliance years, so we set $Post$ to be 1 during the years post-compliance, and to 0 – during the years before announcement. The middle years are not used in the main part of the analysis, since empirically the firms do not respond to the instrument during these years.[2]

The implicit assumption in the first-stage equation (1) above is that the effect on $Share$ of being on the right of the kink is the same at different kinks. This is fine, as long as we believe that that the effect mostly comes from having one more woman (rather than the percentage share itself), and it is constant across kinks. But if not, then we also want to be able to identify from intensities themselves, and hence use the minimum-implied share as the instrument. We therefore proceed to defining our second instrument in the following way:[3]

[2] In reality this speed of compliance may be also specific to the country, but we don't have enough observations to estimate it for each country individually, so we choose to be as agnostic as possible. Our argument on "shopping" for the first stage mirrors optimal selection of instruments, as long as identification assumptions are maintained (see e.g. Paravisini et al, 2014).

[3] Our instrument is different from *Shortfall* instrument, introduced by Eckbo et al (2019) in that *Shortfall* uses the ex ante share of women on board as part of its construction.

$$MinShare_i = \frac{int((b_{i0} - 1) \cdot q_c) + 1}{b_{i0}},$$

This allows us to proceed to our fullest specifications, where we will estimate the first stage of our main equations of interest as follows:

$$Share_{it} = \gamma Post_{ct} MinShare_i + \lambda_{kct} + \lambda_i + \nu_{it}, \tag{2}$$

where $Right_i$ can now be additionally included as a control variable (i.e. it is a separate intercept for having firms with 5, 9, 13, etc board members vs those with 4, 8, 12, etc, with exact numbers specific to the country) and its effect is allowed to vary over time. This allows to fully capture any effects of having one more board member (incuding that of having more effective odd vs less effective even boards, as in. Deng et al, 2012, even in trends), and identify γ out of relative intensities only.

The coefficient of interest, γ, is still identified, because there are multiple kinks for each quota. In essence, we now measure the relative increase in the minimum share of women in boards of original size when moving from 4 to 5 (i.e. from 25% to 40%) compared to the increase in this share when moving from 8 to 9 (i.e. from 25% to 33%), accounting for the fact that both are expected to see an increase of one more additional board member and one more women, but the minimum share $MinShare_i$ will rise disproportionaly more in the former case relative to the latter and hence the final share $Share_{it}$ would also on average rise more. This presents a very tight identification, under the minimal assumptions that are ever possible in the setting of a universal percentage quota.

As we will be measuring the effects over time, we cluster errors at firm level to account for arbitrary autocorrelation within firms and heteroskedasticity. However, it is important to emphasize again that the identifying variation is mostly cross-sectional, which means that we do not have to explicitly rely on timings associated with the quota (speed of compliance, when to define pre vs post, etc), which some (e.g. Eckbo et al, 2019) have argued might present a problem in terms of coincidences with various macro events and the associated differential impact of these events across firms with different shares of women. This reinforces the importance of bringing the comparison

firms as close to each other as possible and then let the data tell us when the change happens, which is precisely what we do – in the quota setting, and estimate (1) and (2) on the data 3 years before the quota announcement ($Post_{ct} = 0$) and 3 years after the quota compliance year ($Post_{ct} = 1$), skipping the intermediary years altogether.

A natural question is why being on the right of the kink *before* the quota can at all predict share of females after the quota when firms have so many different ways of adjusting board composition to satisfy the quota? For example, those 9s that really don't want to have 33.3%, can just reduce the board size to 8 to attain the required minimum of 25%. If all firms to the right adjust like that, then γ will be close to zero. Furthermore, if firms instead adjust only adding new female members until quota is satisfied, then those on the right may even end up with *lower* share than those on the left (e.g. among firms with zero females that adjust by adding new members only, 4s will need 2 extra women for an average of 2/6=33.3% and 5's will also need 2 extra women for an average of 2/7=28.6%). Only if firms exchange males for females at least to some extent would γ be positive (e.g. in the extreme: 40% for 5-member boards and 25% for 4-board members). However, how firms really adjust is ultimately an empirical question, and ex ante our identification strategy does not assume anything about their behavior.

This means three important things for us. First, from purely econometric side, all other ways of adjusting, except exchanges, will bring γ closer to zero (or even negative), reducing the power of the first stage, and making it harder for us to track any changes in $Share_{it}$ at all (and later in the dependent variables of interest). Second, if we do find a positive and significant γ (which we do), this means that the predominant way of adjustment to the quota is actually exchanging males for females. This is an imporant statement about board size being so sticky that all other ways of adjustment are costlier, at least on the margin. And third, different countries may have different ways of adjustment due to a variety of institutional and cultural reasons, suggesting that if we were to bundle all countries together, we may want to additionally model γ as country-specific in the first stage. To sum up, our identification strategy does not assume that all firms adjust by exchanging males for females, but empirically explores whether this is on average true or not, and then uses this fact to track changes in the variables of interest.

3 Data and Summary Statistics

The results of our paper are based on two sets of data. We use an unbalanced panel of listed companies across European countries and the US (as a placebo country) from BoardEx to obtain the director-level information on gender, age, number of qualifications, network size, role (ED or SD), and other characterstics, to be averaged at the firm level, and then merge it with financial data on public companies from Thomson Reuters. The exact set of countries is comprised of the United Kingdom, France, Italy, Belgium, Spain, the Netherlands and Norway. It is defined by the countries that introduced formal (through quotas) or informal (through e.g. advisory recommendations) regulation on gender diversity that satisfies the following criteria: 1) this regulation contains a specific minimum percentage that has to be achieved (otherwise, we would not be able to exploit our instrument); 2) it applies to a vast majority or even all public firms (rather than some narrowly-defined group, such as only state companies, – otherwise the power of the first stage will be low in case we don't measure firms subjected to regulation very precisely); 3) it has compliance date no later than 2017 (otherwise we will not have enough observations to measure the outcomes); and 4) there are at least 20 firms in the discontinuity sample (otherwise, our multiple-fixed-effects specifications would not be estimated; however, effectively this is not a hard constraint, as it rules out only Iceland with its 3 firms in the discontinuity sample).[4] The period of study varies depending on the country and the respective year when regulation was introduced, and covers all years from 4 years before quota/regulation first announcement to 4 years after and including the compliance year (or to 2018, whichever is earlier). The complete coverage of countries with a short description of regulation and the relevant years is presented in Table 1.

As expected due to BoardEx coverage, most of our sample (slightly less than 60%), comes from the United Kingdom. We will therefore present all the analysis both for the UK alone, as well as for all countries together. The counts in Table 1 show the number of firms in the discontinuity sample as of the year before regulation announcement. For example, there were 458 public firms in the UK

[4] We do, hovewer, have to exclude Germany, because listed companies above 2,000 employees (precisely the ones subject to the 30% gender quota after 2016) have to have either 12, or 16, or 20 supervisory board seats, depending on the number of employees (Co-determination Act, 1976). As such, there are no comparable firms within any discontinuity bin.

in 2010 that had board sizes that are either exact multiples of 4, or had one more board member. The second largest country is France with 137 firms in 2009 in the relevant discontinuity sample (which for a quota of 40% covers many more board sizes). On the other hand, there were only 22 firms in the relevant discontinuity sample in Norway or and 31 in Spain. Since we also perform our analysis for the UK alone, and our results are very similar, they are not driven by any of these countries having very small sets of firms.

In Figure 2 we further show the exact distribution of pre-announcement-year board sizes, by country, with red/dark bars representing the discontinuity sample, and the grey/light bars representing all other boards sizes not used in the analysis, across BoardEx-Thomson Reuters listed firms. We also do not consider (almost mechanically) very small boards of fewer that 4 members in the year before quota announcement. Since French quota is defined as of non-executive members, the relevant discontinuity samples are based on the ex ante number of non-executive directors, rather than total board size. Depending on the exact quota percentage, which defines the board sizes to be included in the discontinuity sample, and the distribution of firms across board sizes, our sample covers from 53% of these firms in the UK, to 72% in France, and above 75% in most other countries, for a total of about 60% of all BoardEx-Thomson Reuters public firms in these countries. In unreported results we also show that variable distributions in the pre-announcement year are similar in the discontinuity sample and out of it, in each country, which is something to be expected from the very way it is constructed. This also speaks to the generalizability of our results to boards of different sizes. In what follows we call the discontinuity sample as the sample.

Table 2 presents summary statistics on the main variables of interest, with all financial variables winsorized at 1% tails. For comparability reasons we present the statistics for the post-compliance sample only. Companies in our sample have on average 21 bln Euro total assets (0.5 bln in the log form) and an average market capitalization of 4 bln Euro (0.34 bln in the log form). The average board size is equal to 8, both before the announcement of regulation and also after, suggesting that on average firms do not decrease these in order to avoid hiring an extra women and board sizes are generally sticky. Firms have about 19% females post-compliance, compared to less than 6% before the announcement. The former is somewhat smaller than any of the quotas considered, since not

all regulation is mandatory, and not for all firms in the sample. The main instrument (predicted minimum share of women, $MinShare_i$) averages to 35% and summarizes the average quota-implied share of women in the discontinuity sample. As expected, about half of the firms are located to the right of the kink.

Following prior research on firm value and governance, we compute Tobin's Q as our main measure of firm value (Yermack, 1996; Ahern and Dittmar, 2012). It is defined as the sum of total assets and market equity less common book equity divided by total assets, and averages to 1.8 in the post-compliance period. This is comprised of 1.2 of the ratio of market equity to assets and about 0.5 of book equity to assets. About 18% of firms capital comes from debt (as normalized to assets). Average return on assets is slightly negative and amounts to -1.7%. There are slightly fewer observations available for other operating performance indicators. Among them, average asset turnover is 0.88 Euros of sales per 1 Euro of assets, and gross profit and operating expenses ratio to assets equal 0.39 and 0.49, respectively. Firms on average grow by 6.4pp per year in terms of employment, but there is a 23% chance of a large downsizing (above 3% of the labor force), and a 6.7% – of a very large downsizing (above 10% of the labor force). Given high and positive average employment growth, firms are much more likely to have similar-sized expansions. Specifically, there is a 47.5% chance of a large expansion (above 3% of the labor force), and a 24.3% chance of a very large one (above 10% of the labor force), on average.

Finally, the average age of a director in sample is 58 years, s/he has on average 1.7 qualifications, a network size of above 9 hundred people, has served in the company for about 8 years; and about half of directors are independent.

4 First-Stage Results

4.1 Effect of the instrument on actual share of women (First-Stage)

The first empirical test of interest is the one that shows that the instrument (being to the right of discontinuity, $Right_i$, or the predicted minimum share of women, $MinShare_i$) has a significant and direct impact on the actual share of women, $Share_{it}$. This is a necessary condition for further

exploration of the effects of women on corporate outcomes in the IV-2SLS framework. It may, for example, happen that firms to the right of the discontinuity might simply choose not to hire an extra women director as the instrument suggests, but instead decide to reduce their board size by one member, thus being able to satisfy the quota exactly. This would of course in no way invalidate the identification strategy itself, but instead make the difference between firms to the left and right of the discontinuity negligible. In other words, in this case the first-stage coefficient would be zero. This ultimately becomes an empirical question, which we now explore. To summarize, we find that the instrument does predict differences in female shares, implying that the firms do not choose to change their board sizes to comply with the quota exactly, suggesting that the costs of adjusting board sizes are large enough.

The results of estimating (1) and (2) are presented in Table 3 (columns 1 to 4 an 5 to 6, respectively). Panel A shows the results for the United Kingdom that constitutes the majority of our observations, and Panel B tracks all countries together.[5] Column 1 uses the simplest possible setup and estimates (1) using the data from the first kink only (i.e. boards of 4 and 5 in the UK), using post-compliance years only. There is a largest jump in the minimum share at this kink, so the effect on $Share_{it}$ is expected to be the largest. The coefficient of 0.05 implies that there is a 5pp difference in the share of women on average in the years post compliance, between firms that used to have 4 and 5 board members before announcement. If all firms complied exactly with this voluntary regulation in all years and did not change their board sizes, then this magnituded would be 0.15 (the difference between 40% and 25%). However, none of this is assumed in the identification, and it is only important that this instrument does provide a significant explanatory power. The economic magnitude of the coefficient, however, suggests that firms do comply to a large extent even with a voluntary quota in the UK. Column 2 repeats the same exercise, but now in the full DID setup of (1), including firm fixed effects. The results are virtually identical, suggesting that there are no pre-existing differences in $Share_{it}$ between firms with 4 and 5 board members before the quota is announced, even in terms of the averages. Furthermore, this is a very strong instrument, with the

[5]In all specifications throughout the paper we drop a few firms that already have a higher share of women than the quota, before the quota is announced. Dropping these few unaffected firms naturally increases the power of the first stage. The results are, however, similar if these few firms are kept, and available upon request.

first-stage F-statistic well above 10, despite not huge sample sizes. Columns 3 and 4 uses two largest kinks and all kinks, respectively, and the magnitude of the coefficient expectedly drops, since the jumps become smaller and smaller, while the instrument is still significant at the 1% level.

In column 5 to 6 we turn to using intensities, and estimate (2), again in the cross-section and in panel, where we can fully account for any potential effects of the extra board member of those firms to the right of the kink. The most interesting observation on the economic magnitude comes from the last column. One can think of it as a weighted average of how well firms comply with the instrument. If everybody would just satisfy just the minimum required share, as prescribed by the instrument, then the coefficient would have been exactly 1. However, arguably, some firms would prefer to change the board size in the opposite direction (driving the magnitude closer to zero, as discussed above), some would not comply because e.g. they are not required to (again, making the coefficient closer to zero), and some would react stronger and hire a higher percentage than minimum predicted by the instrument (increasing the magnitude). As such, the obtained coefficients represent a weighted average of these types of behavior in the same spirit as the probability of being a complier in the standard binary IV case. What we observe in column 6 is that after accounting for all time-invariant firm heterogeneity, this coefficient is indeed very close to 1, suggesting that on average firms in the UK comply with the quota precisely.

While unfortunately, due to BoardEx much lower coverage in other countries, we do not have enough observations to replicate the analysis for each country separately, in Panel B we consider all firms in our sample together (appropriately accounting for all fixed effects that are now country-specific as well, as explained in Section 2). As the dynamics of compliance (including the time between announcement and compliance) and the stickiness of boards are likely to be very different across countries, the economic magnitudes may naturally change, but they don't, and the coefficients remain very significant, all at least at 1% level. The first-stage F-statistics becomes a bit larger than in Panel A in most specifications. It is notable that after accounting for extra board members and firm heterogeneity, $MinShare_i$ can still predict the actual share of women quite precisely even across all countries. This is notable because higher quota percentages in other countries also imply that the kinks are located much closer to each other (e.g. 5 and 6 vs 7 and 8 in case of a 40% quota)

and as such there is less variation left when these are compared relative to each other.

From the ex ante perspective, the tightest in terms of identification and the most powerful in expectation should be specifications 2 and 6 (these exactly correspond to equations (1) and (2) above). And empirically, these turn out to have both the highest economic magnitudes, and some of the strongest F-statistics. We will therefore use these two most saturated specifications in all of our second-stage results.

4.2 Validating the instrument

4.2.1 Placebo regressions

To check that our instrument is not picking up some pre-existing differences across firms that may relate to future shares of women and future outcomes, we run several placebo regressions in Table 4. Panels A and B estimate specifications similar to (2), for the UK and all countries, respectively, but for the years prior to quota announcement (from 4 years to 1 year before announcement in the cross-sectional specifications, and from 7 years to 1 year before announcement in the panel specifications). As expected, we see no significant effects, suggesting that there are no pre-existing differences, neither in averages, nor in trends, across firms with neighbour-sized boards (such as firms with 4 and 5-member boards) before the announcement of the quota.

Perhaps a more striking test comes when we fully replicate the UK setup (using same years and same discontinuity samples based on 25% quota), but on the *US* firms. These are reported in Panel C. As expected, we see that in a country that did not introduce a 25% regulation, our instrument has zero explanatory power, suggesting that the instrument is not accidentally picking some intrinsic differences across firms with close board sizes that for some reason differentially revealed themselves from 2015 onwards.

4.2.2 Dynamics

We also explore the dynamics of the first stage in Figures 3 and 4. We plot coefficients from a regression similar to (1) and (2), where instead of $Post_{ct}$ we use the full set of dummy variables for years (the year before announcement is excluded to avoid perfect multicollinearity, and all coefficient magnitudes are measured relative to this year). Since the period between announcement

and compliance years is different by country, for illustrative purposes we plot the dynamics for the UK only, and highlight 2011 and 2015 on the graph as these are the announcement and compliance years, respectively. As we observe in Figure 4, the relative differences between firms with closely-held board sizes get pronounced only at and after the compliance year. These are also the years for which one cannot reject the hypothesis that the coefficient is 1 (which would be if firms complied on average to the minimum and did not change board sizes from their ex ante values). It does not however mean that firms do not respond to the policy after announcement, but rather that the relative response of firms with 5 vs 4 members is the same, as of those with 9 vs 8 members. This can be seen in Figure 3, where the difference between boards of 5 and 4 members is positive and increasing starting from announcement, and also from Appendix Figure 1, where we show that the average share of women in the UK gradually increases from 2011 onwards. Perhaps the most striking evidence comes when we compare boards of 5 and 4 in the UK to the US in Appendix Figure 2. We see that while on average the share of women in boards increases over time both in the UK and the US, there is no difference between boards of 4 and 5 in the US, but there is a striking difference between such boards in the UK, and it exists only after announcement. This is precisely what our simplest instrument captures.

It is also evident that there are no differences between firms with closely-held board sizes before the announcement, in any of the graphs. While this is reassuring and suggests that there is no pre-selection of firms into boards of different sizes on the basis of share of women, this is also expected from the way the instrument and the discontinuity sample is constructed.

5 The Effect of Gender Diversity on Firm Value, Operating Performance, and Board Characteristics

5.1 The effect of Gender Diversity on Tobin's Q

5.1.1 Average effect

We now employ our strategy to estimate the effects of gender diversity on firm performance and

other variables. We start by considering Tobin's Q – the most common measure of firm value – as the dependent variable and report reduced-form results (and IV-2SLS where possible) in Table 5 Panel A. We additionally include industry-country-year fixed effects in all specifications (based on Thomson Reuters 52 industry groups), to make sure the differences in Q are not accidentally driven by non-random composition of board sizes across different industries and shocks to them. In columns 1 and 2 we use the simplest instrument, $Right_i$, and in columns 3 and 4 – the predicted minimum share of women, $MinShare_i$. The coefficient 1.514 in column 1 suggests that firms to the right of the discontinuity have on average 1.5 units higher Tobin's Q, that those to the left of the discontinuity, after quotas were introduced vs any potential difference before. Given the strong first-stage estimates, this coefficient can also be estimated as IV-2SLS, which additionally gives the magnitude of interest, rather than just the sign. Just below Panel A we report the respective coefficients with their standard errors. The coefficeint of 23.86 means that for a one within-firm standard deviation in the share of women (which is about 10 pp in our data), Tobin's Q on average increases by 2.4 units (which is about 1.3 within-firm standard deviations of this variable). This suggests that women do have an economically large effect on Tobin's Q, across European listed firms.

In column 2 we redo the analysis for the UK only, and the results are similar. In columns 3 and 4 we move to the second instrument, which is based on intensities and thus can take care of any potential effects of an additional board member to the right of the discontinuity, also estimating the results for all firms in the sample, and for the UK separately. While the reduced-form coefficients are obviously different in magnitude, once we rescale them into the actual magnitudes of interest – the IV-2SLS effects of women on firm value, – we see the same magnitude as with the first instrument. This is remarkable, given that they are based on slightly different samples (largest kink vs all kinks) and slightly different identification assumptions, suggesting that this average positive effect of women on Tobin's Q is very robust.

5.1.2 Timing of the effect

Since we are exploring Tobin's Q and this is based on market values, and given the fact that the predicted shares of women can be predicted already upon announcement (once the quota and

the relevant discontinuity is revealed), it is possible that the change in Tobin's Q happens already after announcement, before any change in board composition takes place. In Panel B we therefore also look at the same reduced-form difference-in-difference results, but with the post-period defined as of announcement. As we see, the results are virtually identical, suggesting that the change in Tobin's Q happens already upon announcement and persists after compliance.

It is also important to note that there is no such difference before announcement: in Appendix Table 1 we consider placebo regressions, similar to those in Table 4, but now with Tobin's Q as the dependent variable, and show that there are no difference-in-difference changes between firms with these closely-held board sizes before the announcement (columns 1 to 4). Neither there are any contemporaneous differences among such firms in the US (columns 5 to 8), where we use the same years and the same discontinuity samples as in the UK.

5.1.3 Country-level analysis

It may be difficult to provide comparable results for each country separately, for several reasons. First, not only the regulation is different in terms of how obligatory compliance is on paper, but also de facto, whether the sanctions for non-compliance are significant enough in the specific country environment. Furthermore, the speed of compliance with the quota may be different, e.g. depending on how easy it is to change board members. As such, the timing of the effects on various dependent variables may also be quite different across countries. Given these many degrees of freedom, we want to be as agnostic as possible about such choises to minimize any data mining concerns. This is especially important given small samples of listed companies in each country, which are either way too small to credibly and robustly estimate the effect of interest for each single country separately.

Being agnostic about these choices has a necessary drawback of reducing the power to find any results. We nevertheless attempt to decompose the overall average effect from Table 5, at least for countries with at least 50 firms in discontinuity sample, to see if it is driven entirely by the UK, or there is at least any evidence from other countries as well. Using the second instrument so that to keep as many observations as possible, we estimate the reduced-form results for all countries together, the UK (these two repeat what we've seen in Table 5 columns 3 and 4), and then for France (the second-largest in terms of the number of firms), for Italy (the third largest with 56

firms), and for all other countries – in Table 6 columns 1 to 5.[6] We see that there is no effect of women share on Tobin's Q in France on average, but there is a large and positive effect in Italy (significant at 1% level), and slighly positive, but not statistically significant effect among all other countries together.

While it is entirely possible that there is no effect on Tobin's Q among French firms, at least 7 years post quota announcement, or that the small changes that the instrument induces in a 40%-quota setting are not powerful enough to bring real changes for the firms, it is also possible that there is some heterogeneity across firms, as well as that market reaction is not very strong for firms outside of the main indexes. To shed light on this, we redo this analysis for a subsample of the largest European firms (those above 5 bln Euro in market value in the year before announcement) in columns 5 to 8, again slicing by country (the UK, France, and now all other countries together, as we cannot separate Italy with only 10 large firms there).

We see that among these largest firms, the effect on Tobin's Q is also positive. It also has similar magnitudes for all largest firms on average (column 6) as compared to firms of all sizes (column 1), and the same for the UK (columns 7 vs 2). It is also interesting to see that despite a zero average effect for France (column 3), it is positive and statistically significant at 5% level for the largest French firms (column 7). Its economic magnitude is also similar to that in the UK, suggesting that this is not just a UK phenomenon. Finally, the effect for the largest firms from other countries is also positive and significant, although its magnitude is probably not reliable given a very small and heterogeneous sample of only 37 firms across 5 countries, so we only report it for completeness.

To sum up, we find no evidence of women affecting firms values negatively, as some single-country studies based on Norway may suggest. If any, most of the evidence across European countries demonstrates a zero to positive effect on Tobin's Q.

[6] Since the first stage is not strong in these much smaller samples, the IV-2SLS effects cannot be consistently estimated, so we do not report them in what follows. The reduced-form, however, can provide the comparable magnitudes across countres, since it does not rely on the strength of the first stage, and being an OLS it is always unbiased, as long as the identification assumptions are met.

5.2 The effect of Gender Diversity on Other Variables

5.2.1 Performance decomposition, Leverage, and Employment

In this most common definition, Tobin's can be decomposed into $1+MV/TA-BV/TA$, i.e. the difference between the ratios of market value of equity to total assets and book value of equity to total assets (plus 1). To see which of the two parts drives the main result, we redo the analysis with these two ratios as dependent variables in Table 7 for all countries (Panel A) and UK separately (Panel B). We observe that both parts contribute to an increase in Tobin's Q: market value of equity to assets rises by about 0.9, while book value of equity to assets drops by about 0.6, for every 10pp of women in boards. These coefficients are similar across panels.

So why do firms have higher market, but lower book values at the same time? This can be consistent with at least four (non-mutually exclusive) explanations: decrease of the scale (e.g. writing off some unproductive assets), higher leverage, higher dividends paid, and a temporary negative performance shock (that drills down retained earnings). In Table 7 we explore each of them. We observe that firms do not significantly decrease total assets (column 3), and neither they increase debt-to-assets ratios (column 4). Nor they increase dividends: neither in dividend yield (column 5), nor in probability of paying any dividend or dividend payout (unreported for brevity). This suggests that the first three explanations are not likely to be responsible for the observed effect on Tobin's Q. At the same time, there is evidence that return on assets falls a lot (column 6), by about 0.12-0.13 for each 10 pp increase in the predicted share of women. This means that there is a negative effect on operating performance, and it is worth exploring the operating side in more detail.

In columns 7, 8, and 9 we consider sales to assets ratio, gross profit to assets ratio, and operating expenses to assets ratio. As we see, it is sales that drop dramatically, by about 0.5 for each 10 pp increase in the predicted share of women, yielding a significant change in gross profits. At the same time the ratio of operating expenses to assets does not change (and neither do R&D or labor expenses, as a share of assets, unreported, though the number of observations is much smaller for these variables), suggesting that the change in ROA is mostly driven by a huge decrease in sales.

While the general fall in ROA is consistent with evidence in Matsa and Miller (2013), the underlying reason is different (lower sales rather than higher labor expenses). To further see that we explore whether this fall in asset turnover happens together with any employment changes. In Table 8 we present results on labor productivity (log sales per worker, column 1), annual employment growth (column 2), as well as indicators for large labor decreases (columns 3 to 6) and increases (columns 7 to 9). We observe that this drop in sales and profits is not accompanied by a drop in labor productivity. This means that it is not the quality of workers that diminishes (similarly, there is no change in average wages, unreported). Instead, it is the amount of labor that falls, as can be seen from a significantly lower annual employment growth, of about 0.15-0.18 for each 10 pp increase in the predicted share of women. This is further supported by evidence on a higher probability of large downsizings (above 5 and 10 pp of the labor force). There is no similar increase in probability of large expansions, suggesting that labor does not overall become more volatile, and it is not just a turbulent time of changes when employee turnover increases following changes in management.

To sum up, the overall picture is consistent with the following story. Firms with more women in boards experience larger employment decreases and lower employment growth, that reflects in the fall in sales and profits per unit of assets. While we cannot distinguish whether it is women directors who actively fire these employees, or it is the employees who leave because they might not like the new board structure, thereby disrupting operations, it is important to note that this is not accompanied by a negative market reaction. If any it is positive, suggesting that these operating changes are viewed as positive by the market (which would be e.g. the case if firms were in fact scaling down inefficient operations).

5.2.2 Board Characteristics

The last piece of evidence comes from exploring the average characteristics of the board, such as age, number of qualifications, share of independent non-executive directors, network size, and time in company. The results are reported in Table 8, with Panel A for all countries and Panel B for the UK. As we see all results consistently indicate that the average characteristics of the boards do not change with female presence. If any, boards with more women appear to be slightly

better on observables (consistent with evidence in Bertrand et al, 2019), but none of these effects is statistically significant.[7] This supports the interpretation that employees do not leave the company because of worse characteristics of female directors.

5.3 Other Possible Explanations

5.3.1 Board Size and Exclusion Restriction

One potential explanation for the observed differences could be the adustment of boad size as a response to regulation: firms to the right of the threshold may choose to remove one board member in order to not have to hire too many women directors. At the same time, smaller board sizes may increase performance per se (see e.g. Jenter et al., 2019, for recent quasi-experimental evidence). While there is some adjustment in the board size on average (as can be seen by Appendix Table 2 columns 5 and 6), two things are important. First, it is not present for firms with 4 vs 5 directors (neither post-announcement, in column 1, nor post-compliance, in column 4), and thus the sharp increases in Tobin's Q in this group of firms cannot be at all attributed to board size adjustments.

And second, even from the average specifications (such as in column 6), the implied effect on Tobin's Q, had it all been explained by board size adjustment, would amount to $(4,608/2,145 =)$ 2.15-increase in Tobin's Q per each one fewer board member. This is several orders of magnitude larger than the 0.05-0.06 estimates of board size effects presented by Jenter et al, 2019, meaning that only about 1/40 of the total effect on Tobin's Q can be attibuted to board size adjustments per se.

6 Conclusion

In this paper we explore the effects of increased female presense in corporate boards on value, operating performance, leverage, and employment of firms, for a set of European countries that introduces soft or hard regulation with respect to the share of women. We use a novel identification

[7] Since our setup is a very close comparison of boards that end up having slightly different female shares post-quota (as a result of a quasi-random sorting into boards of close sizes), it is also possible that these small differences in female shares are not enough to significantly shift average characteristics of the boards.

strategy that allows estimating causal effects under the minimally possible assumptions in a setting with a universal quota. Unlike some of the studies based on Norway, we find no evidence of a negative effect on the value of the company (as measured by Tobin's Q), if any the evidence shows that it is positive, suggesting that Norway is perhaps too special to generalize the results for all countries. We further dig into possible causes of that and observe that market and book values of equity move in opposite directions, reinforcing the effects on Tobin's Q. Interestingly, we find evidence of disruptive operations, such as lower sales to assets ratios, that further reflect in lower operating performance. This is combined with lower employment growth and larger downsizings. However, since these operating performance decreases are not accompanied by lower market values (if any the effects are positive), this suggests that these firms might have in fact scaled down their inefficient operations, consistent with evidence on women being less prone to empire building.

Our results have important policy implications. With a general socially-based move towards gender equality, many countries have pushed quotas in corporate boards, yet the effects on shareholder value and firm policies have been debatable. We show that there is no negative effect on value, and boards do not become less competent with more women on boards. Having more women on boards, besides being socially important, therefore, does no appear to go against corporate interests.

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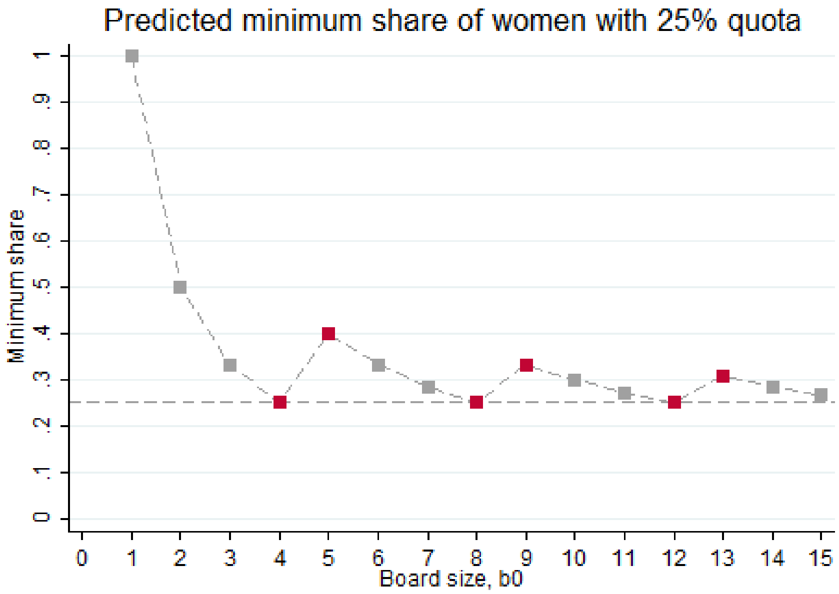
Figures and Tables

Figure 1



Note: This figure plots the minimum share of women that firms must have to comply with the 25% quota, as a function of board size. The discontinuity samples are highlighted in red.

Figure 2

Distribution of Board Size as of pre-announcement year

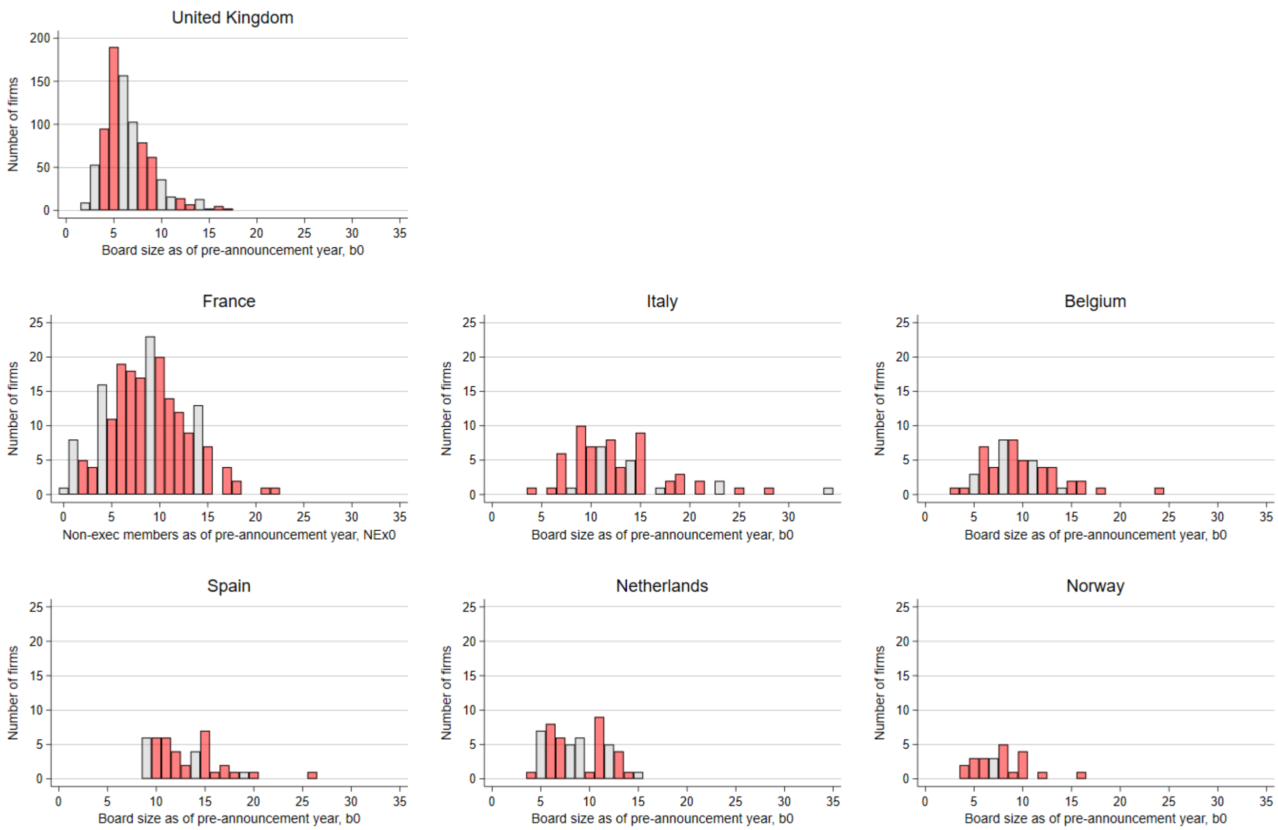


Figure 3

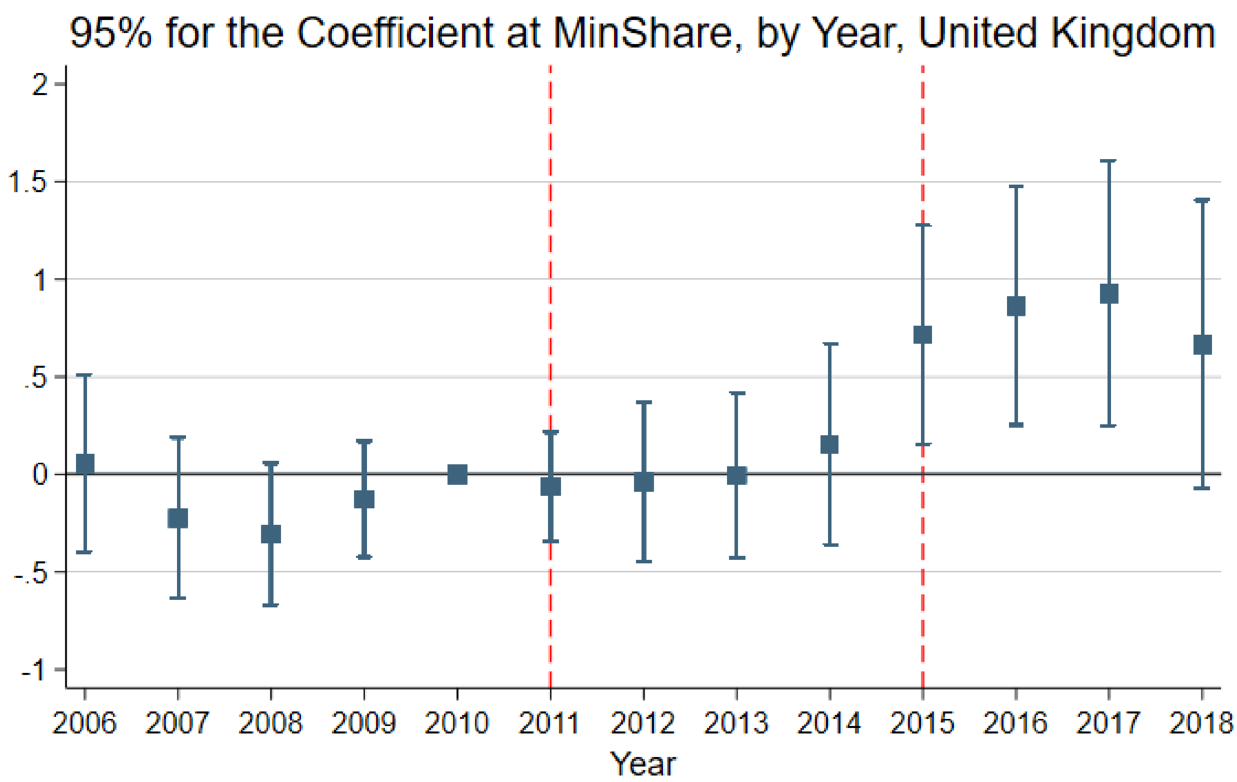
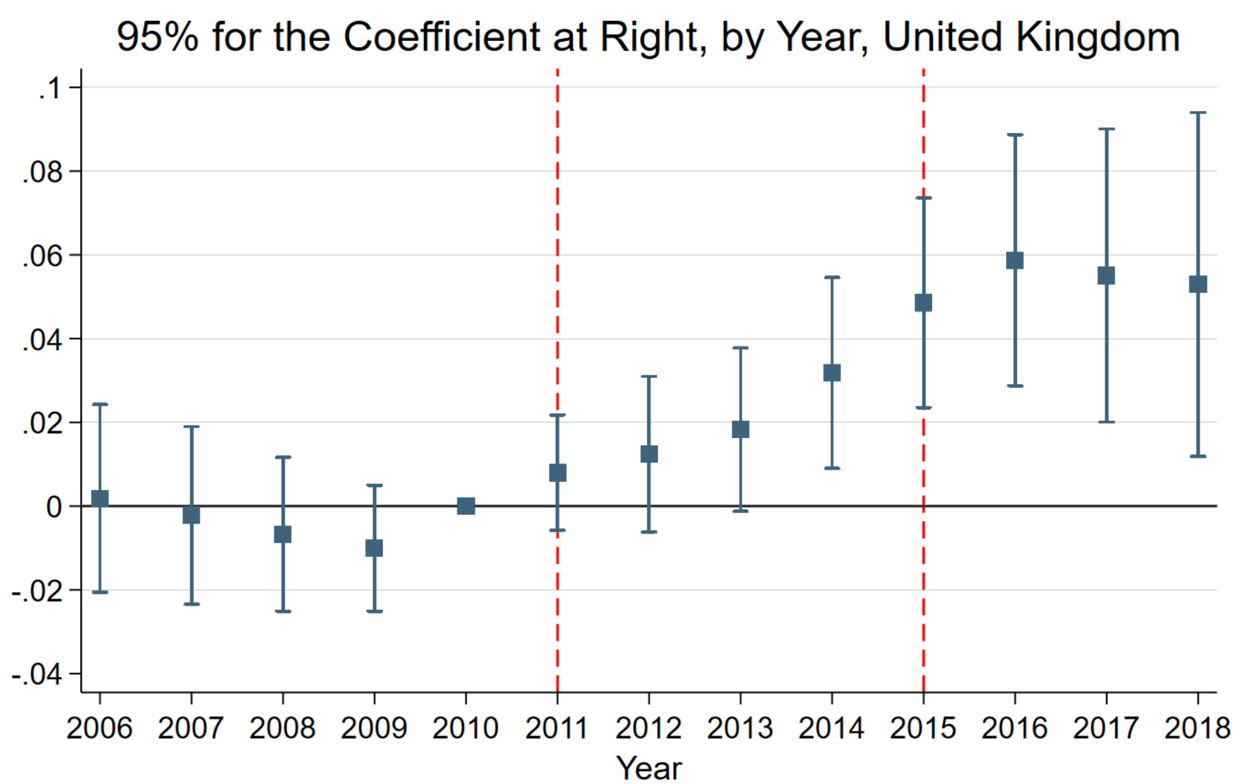
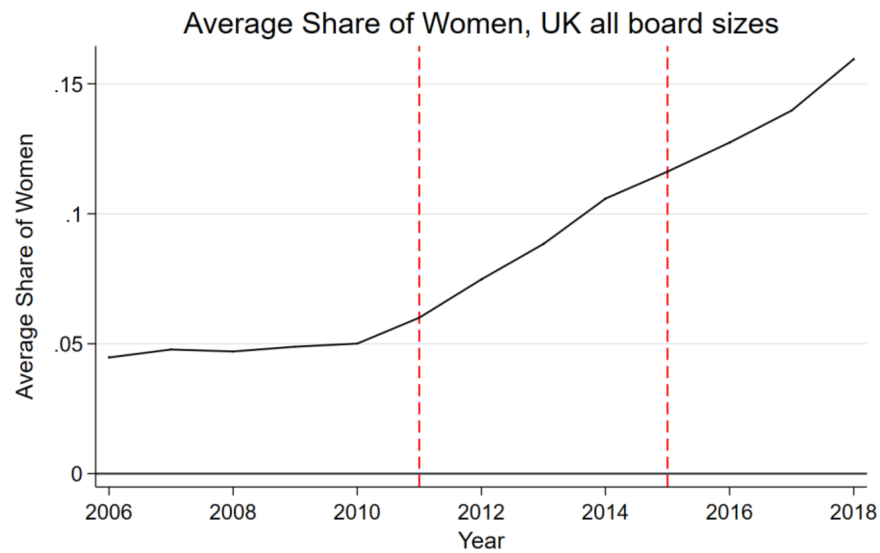


Figure 4

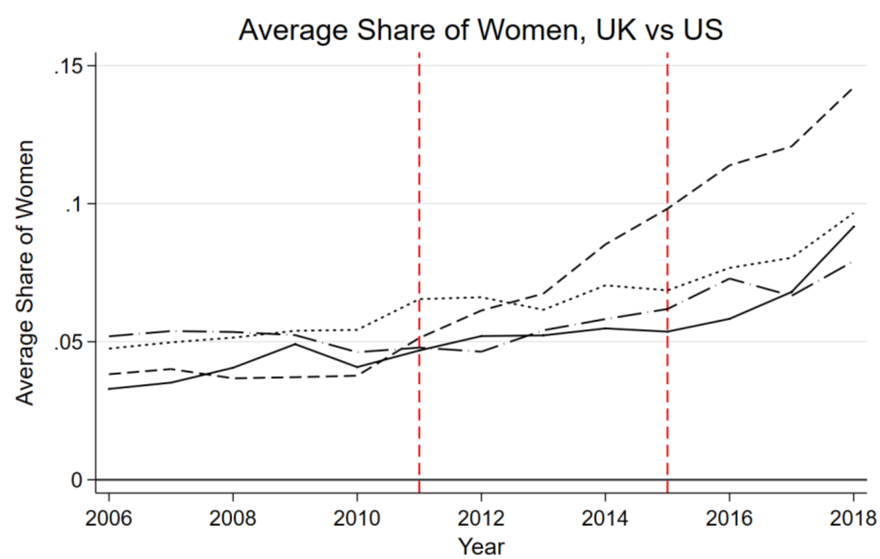


Appendix Figure 1



Note: This figure plots average shares of women in listed companies in the UK, by year.

Appendix Figure 2



Note: This figure plots average shares of women in listed companies in the UK and the US with board sizes of 4 and 5 (as of 2010), by year.

Solid line: _____ UK, 4
Dash line: - - - - UK, 5
Dotted line: .... US, 4
Dash-dot line: _._._. US, 5

Table 1. Summary of Quotas and Soft Regulation in European Countries in Sample

Country	Quota or soft regulation in place	Minimum % required	Pre-anouncement placebo years in sample	Regulation announcement year	Compliance year	Post-compliance years in sample	N
UK	Self-regulation – from 2012 on the basis of principles of UK CG Code (following the Lord Davies' recommendation). The recommended target for listed companies in FTSE 100: 25%, by 2015 is applicable to all board members. FTSE 350 companies recommended setting their own aspirational targets to be achieved.	25%	2008-2010	2011	2015	2015-2018	458
France	Quota of 40% applicable to non-executive directors in large listed and nonlisted companies.	40%*	2007-2009	2010	2017	2017-2018	137
Italy	Quota of one-third of each gender for listed companies and state-owned companies to be achieved by 2015.	33%	2008-2010	2011	2015	2015-2018	56
Belgium	Quota for executives and non-executives in state-owned and listed companies-by 2017 and in listed SMEs-by 2019.	33%	2008-2010	2011	2017	2017-2018	41
Netherlands	Target of 30 % in the boards of large companies by 2016 - "comply or explain" mechanism.	30%	2010-2012	2013	2016	2016-2018	32
Spain	A gender equality law obliging public companies and IBEX 35-quoted firms with more than 250 employees to attain a minimum 40% share of each gender by 2015.	40%	2004-2006	2007	2015	2015-2018	31
Norway	Quota: in February 2002, the government gave a deadline of July 2005 for private listed companies to raise the proportion of women on their boards to 40%. In January 2006 legislation was introduced giving companies a final deadline of January 2008.	40%**	1999-2001	2002	2005	2005-2008	22
						Total:	777
US	Used as placebo	25%	2008-2010	2011	2015	2015-2018	1041

Sources: Davies (2012), European Commission (2016), Seierstad et al (2017)

N is the number of companies in the discontinuity sample as of Pre-announcement year, that have at least one observation post-compliance
* As this quota is applicable to non-executive directors only, we consider discontinuity samples that are based on the ex ante number of non-executive directors, rather than the total board size.

** For smaller boards the quota is stated in terms of the number of women, which we account in the analysis. Specifically, boards of less than 3 people should have at least 1 woman, boards of 4-5 people - at least 2 women, boards of 6-8 people - at least 3 women, and larger boards - at least 40% of women.

Table 2. Descriptive Statistics

Note: The table reports the number of observations as of post-compliance years only.

Variable	Mean	STD	N
Financials:			
Total Assets	21 bln	116 bln	2,675
ln (Total Assets)	20.010	2.909	2,675
Market Capitalization	3.9 bln	1.1 bln	2,692
ln (Market Capitalization)	19.648	2.580	2,692
Board Structure and Instrumental Variables:			
Board Size	7.827	3.620	2,692
Board Size as of pre-announcement year (b_{i0})	7.965	3.944	2,692
Share of female directors	0.193	0.159	2,692
Share of female directors as of pre-announcement year	0.059	0.085	2,692
Predicted minimum required share of women ($MinShare_i$)	0.351	0.075	2,692
Dummy for being to the right of the kink ($Right_i$)	0.526	0.499	2,692
Dependent Varables: Value and Performance			
Tobin's Q	1.756	2.201	2,675
Market Capitalization to Total Assets	1.201	1.601	2,675
Book Equity to Total Assets	0.488	0.421	2,675
Total Debt to Total Assets	0.185	0.199	2,668
Total Dividend to Market Capitalization	0.027	0.135	1,947
ROA	-0.017	0.253	2,664
Sales to Total Assets	0.882	0.765	1,877
Gross Profit to Total Assets	0.389	0.319	1,247
Operating Expenses to Total Assets	0.487	0.684	1,696
Dependent Varables: Employment			
Annual Employment Growth	0.064	0.441	2,016
Dummy for Downsizing >3 pp	0.232	0.422	2,016
Dummy for Downsizing >5 pp	0.175	0.380	2,016
Dummy for Downsizing >10 pp	0.067	0.251	2,016
Dummy for Expansion >3 pp	0.475	0.500	2,016
Dummy for Expansion >5 pp	0.379	0.485	2,016
Dummy for Expansion >10 pp	0.243	0.429	2,016
Dependent Variables: Board Characteristics			
Average age	58.058	4.689	2,690
Average number of Qualifications	1.702	0.602	2,692
Average director network size	942.201	706.714	2,692
Average time in company	7.814	4.301	2,692
Share of independent directors	0.520	0.255	2,692

Table 3. Share of Women, Right and Predicted Minimum Share: First-Stage Results

This table reports the results of estimating the following specification using the OLS framework:

$$Share_{it}=\gamma Post_{ct}Right_i+\lambda_{kct}+\lambda_i+v_{it} \text{ (columns 1 to 4) or}$$

$$Share_{it}=\gamma Post_{ct}MinShare_i+\lambda_{ct}Right_i+\lambda_{kct}+\lambda_i+v_{it} \text{ (columns 5 to 6),}$$

where $Share_{it}$ is the fraction of women directors of firm *i* in year *t* , $Post_{ct}$ is the (country-specific) dummy variable that takes value of 1 from compliance year to up to three years afterwards, and zero -- for the year before announcement and up to three years before that , $Right_i$ is the dummy for being to the right ofthe kink and $MinShare_i$ is the predicted minimum share of firm *i* (the instruments, defined in Section 2), λ_{kct} are kink-year fixed effects (specific to the country), λ_i are firm fixed effects. Standard errors are clustered at the firm level and are reported below the coefficients. All columns restrict sample to firms in the discontinuity sample, excluding the potentially non-affected firms (firms with $Share_{i0}$ above the quota). The number of firms and observations excludes singletons. * indicates 10% significance; ** 5% significance; *** 1% significance.

Bin * Country * Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE		Yes	Yes	Yes	Yes	Yes
Right * Country * Year FE					Yes	Yes
Post-compliance years only	Yes					
Post-compliance vs pre-announcement years		Yes	Yes	Yes	Yes	Yes
Sample: Largest kink only	Yes	Yes				
Sample: Two largest kinks only			Yes			
Sample: All kinks				Yes	Yes	Yes
Panel A:			UK firms			
	1	2	3	4	5	6
$Post_{ct}$ * $Right_i$	0.0508***	0.0594***	0.0296**	0.0302***		
	(0.0147)	(0.0148)	(0.0118)	(0.0113)		
$Post_{ct}$ * $MinShare_i$					0.301***	0.952***
					(0.0901)	(0.302)
Number of firms	289	289	430	458	458	458
Observations	1,147	1,989	2,959	3,152	3,152	3,152
Adjusted R^2	0.0369					
Within R^2		0.158	0.260	0.287	0.290	0.296
1st stage F-statistic	12.04	16.09	6.31	7.19	11.13	9.91
Panel B:			All firms			
	1	2	3	4	5	6
$Post_{ct}$ * $Right_i$	0.0474***	0.0584***	0.0259***	0.0248***		
	(0.0130)	(0.0132)	(0.0100)	(0.00853)		
$Post_{ct}$ * $MinShare_i$					0.284***	0.789***
					(0.0821)	(0.266)
Number of firms	362	362	585	777	777	777
Observations	1,334	2,375	3,801	4,928	4,928	4,928
Adjusted R^2	0.239					
Within R^2		0.322	0.443	0.562	0.564	0.567
1st stage F-statistic	13.34	19.45	6.65	8.47	11.98	8.83

Table 4. Share of Women, Right and Predicted Minimum Share: Placebo Results

This table reports the results of estimating the following specification using the OLS framework:

$$Share_{it}=\gamma Post_{ct}Right_i+\lambda_{kct}+\lambda_i+\nu_{it} \text{ (columns 1 to 4) or}$$

$$Share_{it}=\gamma Post_{ct}MinShare_i+\lambda_{ct}Right_i+\lambda_{kct}+\lambda_i+\nu_{it} \text{ (columns 5 to 6),}$$

where $Share_{it}$ is the fraction of women directors of firm *i* in year *t*, $PseudoPost_{ct}$ is the (country-specific) dummy variable that takes value of 1 from three years to one year before announcement, and zero -- from seven to five years before announcement, $Right_i$ is the dummy for being to the right ofthe kink and $MinShare_i$ is the predicted minimum share of firm *i* (the instruments, defined in Section 2), as of base year, λ_{kct} are kink-year fixed effects (specific to the country), λ_i are firm fixed effects. The base year is four years before announcement. Standard errors are clustered at the firm level and are reported below the coefficients. All columns restrict sample to firms in the discontinuity sample, excluding the potentially non-affected firms (firms with $Share_{i0}$ above the quota). The number of firms and observations excludes singletons. * indicates 10% significance; ** 5% significance; *** 1% significance.

Bin * Country * Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE		Yes	Yes	Yes	Yes	Yes
Right * Country * Year FE					Yes	Yes
Pseudo Post-announcement ye	Yes					
vs pseudo pre-announcement years		Yes	Yes	Yes	Yes	Yes
Sample: Largest kink only	Yes	Yes				
Sample: Two largest kinks only			Yes			
Sample: All kinks				Yes	Yes	Yes
Panel A:	UK firms before announcement					
	1	2	3	4	5	6
$PseudoPost_{ct}$ * $Right_i$	0.0168	-0.00759	-0.00185	-0.00211		
	(0.0107)	(0.0104)	(0.00770)	(0.00729)		
$PseudoPost_{ct}$ * $MinShare_i$					-0.0291	-0.134
					(0.0615)	(0.195)
Number of firms	272	272	412	440	440	440
Observations	813	1,388	2,172	2,336	2,336	2,336
Adjusted R^2	0.000877					
Within R^2		0.0136	0.0155	0.0280	0.0281	0.0295
1st stage F-statistic	2.45	0.53	0.06	0.08	0.22	0.47
Panel B:	All firms before announcement					
	1	2	3	4	5	6
$PseudoPost_{ct}$ * $Right_i$	0.0124	-0.0119	-0.00586	-0.00432		
	(0.0102)	(0.00974)	(0.00685)	(0.00574)		
$PseudoPost_{ct}$ * $MinShare_i$					-0.0491	-0.205
					(0.0572)	(0.185)
Number of firms	334	334	547	708	708	708
Observations	999	1,732	2,905	3,791	3,791	3,791
Adjusted R^2	0.0367					
Within R^2		0.0361	0.0431	0.0838	0.0832	0.0904
1st stage F-statistic	1.48	1.49	0.73	0.57	0.74	1.22

Table 4 continued. Share of Women, Right and Predicted Minimum Share: Placebo Results

This table reports the results of estimating the following specification using the OLS framework:

$$Share_{it}=\gamma Post_{ct}Right_i+\lambda_{kct}+\lambda_i+\nu_{it} \text{ (columns 1 to 4) or}$$

$$Share_{it}=\gamma Post_{ct}MinShare_i+\lambda_{ct}Right_i+\lambda_{kct}+\lambda_i+\nu_{it} \text{ (columns 5 to 6),}$$

where $Share_{it}$ is the fraction of women directors of firm *i* in year *t* , $Post_{ct}$ is the (country-specific) dummy variable that takes value of 1 from compliance year to up to three years afterwards, and zero -- for the year before announcement and up to three years before that , $Right_i$ is the dummy for being to the right ofthe kink and $MinShare_i$ is the predicted minimum share of firm *i* (the instruments, defined in Section 2), λ_{kct} are kink-year fixed effects (specific to the country), λ_i are firm fixed effects. Standard errors are clustered at the firm level and are reported below the coefficients. All columns restrict sample to firms in the discontinuity sample, excluding the potentially non-affected firms (firms with $Share_{i0}$ above the quota). The number of firms and observations excludes singletons. * indicates 10% significance; ** 5% significance; *** 1% significance.

Bin * Country * Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE		Yes	Yes	Yes	Yes	Yes
Right * Country * Year FE					Yes	Yes
Post-compliance years only	Yes					
Post-compliance vs pre-announcement years		Yes	Yes	Yes	Yes	Yes
Sample: Largest kink only	Yes	Yes				
Sample: Two largest kinks only			Yes			
Sample: All kinks				Yes	Yes	Yes
Panel C:	US firms with UK-defined years					
	1	2	3	4	5	6
$Post_{ct}$ * $Right_i$	-0.0103	-0.00131	-0.00232	-0.000845		
	(0.0129)	(0.0105)	(0.00662)	(0.00612)		
$Post_{ct}$ * $MinShare_i$					-0.0113	-0.0421
					(0.0566)	(0.171)
Number of firms	406	421	930	1041	1041	1041
Observations	1,561	2,752	6,249	7,015	7,015	7,015
Adjusted R^2	0.00538					
Within R^2		0.0412	0.0501	0.0508	0.0509	0.0527
1st stage F-statistic	0.64	0.02	0.12	0.02	0.04	0.06

Table 5. Tobin's Q and the Share of Women: Reduced-form and Second-stage Results

This table reports the results of estimating the following specification using the OLS framework:

$$Y_{it}=\gamma Post_{ct}Right_i+\lambda_{kct}+\lambda_{sct}+\lambda_i+v_{it} \text{ (columns 1, 2, 5, 6) or}$$

$$Y_{it}=\gamma Post_{ct}MinShare_i+\lambda_{ct}Right_i+\lambda_{kct}+\lambda_{sct}+\lambda_i+v_{it} \text{ (columns 3, 4, 7, 8),}$$

where Y_{it} is Tobin's Q of firm *i* in year *t* , $Post_{ct}$ is the (country-specific) dummy variable that takes value of 1 from compliance year to up to three years afterwards (columns 1 to 4), or from announcement year to three years afterwards (columns 5 to 8), and zero -- for the year before announcement and up to three years before that , $Right_i$ is the dummy for being to the right ofthe kink and $MinShare_i$ is the predicted minimum share of firm *i* (the instruments, defined in Section 2), measured in the base year, λ_{kct} are kink-year fixed effects (specific to the country), λ_{sct} are industry-year fixed effects (specific to the country), λ_i are firm fixed effects. The base year is the year before announcement. Standard errors are clustered at the firm level and are reported below the coefficients. All columns restrict sample to firms in the discontinuity sample, excluding the potentially non-affected firms (firms with $Share_{i0}$ above the quota). The number of firms and observations excludes singletons. * indicates 10% significance; ** 5% significance; *** 1% significance.

	Panel A: Post-compliance vs pre-announcement years				Panel B: Post-announcement vs pre-announcement years			
	All countries	UK	All countries	UK	All countries	UK	All countries	UK
	1	2	3	4	5	6	7	8
Bin * Country * Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Right * Country * Year FE			Yes	Yes			Yes	Yes
Industry * Country * Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample: Largest kink only	Yes	Yes			Yes	Yes		
Sample: All kinks			Yes	Yes			Yes	Yes
$Post_{ct}$ * $Right_i$	1.514***	1.621***			1.378***	1.527***		
	(0.542)	(0.588)			(0.497)	(0.548)		
$Post_{ct}$ * $MinShare_i$			18.61***	20.10***			18.67***	20.87***
			(6.894)	(7.548)			(6.243)	(7.023)
Number of firms	361	288	775	456	291	354	775	456
Observations	2,359	1,974	4,900	3,128	2,474	1,984	5,307	3,136
Implied IV-2SLS coefficient	23.86**	24.65**	22.98**	23.23**				
(standard error)	(9.522)	(9.990)	(11.00)	(11.18)				

Table 6. Tobin's Q and the Share of Women: Country-Level Analysis

This table reports the results of estimating the following specification using the OLS framework:

$$Y_{it}=\gamma Post_{ct} MinShare_i+\lambda_{ct} Right_i+\lambda_{kct}+\lambda_{sct}+\lambda_i+\nu_{it},$$

where Y_{it} is Tobin's Q of firm *i* in year *t*, $Post_{ct}$ is the (country-specific) dummy variable that takes value of 1 from compliance year to up to three years afterwards (columns 1 to 4), or from announcement year to three years afterwards (columns 5 to 8), and zero -- for the year before announcement and up to three years before that, $Right_i$ is the dummy for being to the right ofthe kink and $MinShare_i$ is the predicted minimum share of firm *i* (the instruments, defined in Section 2), measured in the base year, λ_{kct} are kink-year fixed effects (specific to the country), λ_{sct} are industry-year fixed effects (specific to the country), λ_i are firm fixed effects. The base year is the year before announcement. The sample consists of all firms (in columns 1 to 5) or only largest firms (in columns 6 to 9, defined as those with market capitalization above 5bln Euro in the base year). Standard errors are clustered at the firm level and are reported below the coefficients. All columns restrict sample to firms in the discontinuity sample, excluding the potentially non-affected firms (firms with $Share_{i0}$ above the quota). The number of firms and observations excludes singletons. * indicates 10% significance; ** 5% significance; *** 1% significance.

	All firms					Largest firms			
	All countries	UK	France	Italy	BE+NE +SP+NO	All countries	UK	France	IT+BE+NE +SP+NO
	1	2	3	4	5	6	7	8	9
Bin * Country * Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Right * Country * Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry * Country * Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample: All kinks	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$Post_{ct}$ * $MinShare_i$	18.61***	20.10***	0.827	13.69***	1.115	16.74**	16.09*	21.10**	374.8***
	(6.894)	(7.548)	(4.245)	(3.518)	(3.493)	(8.393)	(9.469)	(8.921)	(8.034)
Number of firms	775	456	137	56	126	100	27	36	37
Observations	4,900	3,128	666	384	722	606	186	179	241

Table 7. Q Decompositon, Leverage, and Operating Performance: Reduced-form Results

This table reports the results of estimating the following specification using the OLS framework:

$$Y_{it}=\gamma Post_{ct}MinShare_i+\lambda_{ct}Right_i+\lambda_{kct}+\lambda_{sct}+\lambda_i+v_{it},$$

where Y_{it} is the dependent variable of firm *i* in year *t*, $Post_{ct}$ is the (country-specific) dummy variable that takes value of 1 from compliance year to up to three years afterwards, and zero -- for the year before announcement and up to three years before that, $Right_i$ is the dummy for being to the right ofthe kink and $MinShare_i$ is the predicted minimum share of firm *i* (the instruments, defined in Section 2), measured in the base year, λ_{kct} are kink-year fixed effects (specific to the country), λ_{sct} are industry-year fixed effects (specific to the country), λ_i are firm fixed effects. The base year is the year before announcement. Standard errors are clustered at the firm level and are reported below the coefficients. All columns restrict sample to firms in the discontinuity sample, excluding the potentially non-affected firms (firms with $Share_{i0}$ above the quota). The number of firms and observations excludes singletons. * indicates 10% significance; ** 5% significance; *** 1% significance.

Bin * Country * Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Right * Country * Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry * Country * Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample: All kinks	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel A: All countries **Dependent variable:**	**ME/TA**	**BE/TA**	**lnTA**	**TDEBT/TA**	**DIV/ME**	**ROA**	**Sales/TA**	**GP/TA**	**OPEX/TA**
	1	2	3	4	5	6	7	8	9
$Post_{ct}$ * $MinShare_i$	8.714*	-6.113**	-1.995	-0.233	0.110	-1.182***	-4.863***	-1.545**	1.781
	(4.525)	(2.633)	(2.197)	(0.397)	(0.112)	(0.443)	(1.725)	(0.714)	(1.766)
Number of firms	775	775	775	775	738	775	586	411	516
Observations	4,900	4,901	4,901	4,891	3,975	4,872	2,765	1,822	2,490

Panel B: UK **Dependent variable:**	**ME/TA**	**BE/TA**	**lnTA**	**TDEBT/TA**	**DIV/ME**	**ROA**	**Sales/TA**	**GP/TA**	**OPEX/TA**
	1	2	3	4	5	6	7	8	9
$Post_{ct}$ * $MinShare_i$	9.231*	-6.724**	-2.795	-0.250	0.016	-1.349***	-5.230***	-1.684**	1.987
	(4.949)	(2.883)	(2.376)	(0.431)	(0.058)	(0.484)	(1.874)	(0.767)	(1.876)
Number of firms	456	456	456	456	438	456	336	262	348
Observations	3,128	3,128	3,128	3,119	2,635	3,102	1,793	1,350	1,920

Table 8. Employment and the Share of Women: Reduced-form Results

This table reports the results of estimating the following specification using the OLS framework:

$$Y_{it}=\gamma Post_{ct}MinShare_i+\lambda_{ct}Right_i+\lambda_{kct}+\lambda_i+v_{it},$$

where Y_{it} is Tobin's Q of firm *i* in year *t*, $Post_{ct}$ is the (country-specific) dummy variable that takes value of 1 from compliance year to up to three years afterwards, and zero -- for the year before announcement and up to three years before that, $Right_i$ is the dummy for being to the right ofthe kink and $MinShare_i$ is the predicted minimum share of firm *i* (the instruments, defined in Section 2), measured in the base year, λ_{kct} are kink-year fixed effects (specific to the country), λ_i are firm fixed effects. The base year is the year before announcement. Standard errors are clustered at the firm level and are reported below the coefficients. All columns restrict sample to firms in the discontinuity sample, excluding the potentially non-affected firms (firms with $Share_{i0}$ above the quota). The number of firms and observations excludes singletons. * indicates 10% significance; ** 5% significance; *** 1% significance.

Bin * Country * Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Right * Country * Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample: All kinks	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel A: All countries

Dependent variable:	**Employment growth**	**Downsizing: Annual Decrease in Employment**			**Expansion: Annual Increase in Employment**		
		> 3 pp	**>5 pp**	**>10 pp**	**> 3 pp**	**>5 pp**	**>10 pp**
	1	2	3	4	5	6	7
$Post_{ct}$ * $MinShare_i$	-1.482*	1.793	2.362**	1.260*	-1.273	-1.117	-1.290
	(0.788)	(1.188)	(1.028)	(0.717)	(1.293)	(1.284)	(1.082)
Number of firms	697	697	697	697	697	697	697
Observations	3,967	3,967	3,967	3,967	3,967	3,967	3,967

Panel B: UK

Dependent variable:	**Employment growth**	**Downsizing: Annual Decrease in Employment**			**Expansion: Annual Increase in Employment**		
		> 3 pp	**>5 pp**	**>10 pp**	**> 3 pp**	**>5 pp**	**>10 pp**
	1	2	3	4	5	6	7
$Post_{ct}$ * $MinShare_i$	-1.824**	2.256	2.650**	1.208	-1.888	-1.713	-1.295
	(0.747)	(1.456)	(1.275)	(0.875)	(1.579)	(1.570)	(1.300)
Number of firms	381	381	381	381	381	381	381
Observations	2,277	2,277	2,277	2,277	2,277	2,277	2,277

Table 9. Board Characteristics and the Share of Women: Reduced-form Results

This table reports the results of estimating the following specification using the OLS framework:

$$Y_{it}=\gamma Post_{ct}MinShare_i+\lambda_{ct}Right_i+\lambda_{kct}+\lambda_{sct}+\lambda_i+v_{it} \text{ (columns 3, 4, 7, 8),}$$

where Y_{it} is the dependent variable of firm *i* in year *t*, $Post_{ct}$ is the (country-specific) dummy variable that takes value of 1 from compliance year to up to three years afterwards, and zero -- for the year before announcement and up to three years before that , $Right_i$ is the dummy for being to the right ofthe kink and $MinShare_i$ is the predicted minimum share of firm *i* (the instruments, defined in Section 2), measured in the base year, λ_{kct} are kink-year fixed effects (specific to the country), λ_{sct} are industry-year fixed effects (specific to the country), λ_i are firm fixed effects. The base year is the year before announcement. Standard errors are clustered at the firm level and are reported below the coefficients. All columns restrict sample to firms in the discontinuity sample, excluding the potentially non-affected

Bin * Country * Year FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Right * Country * Year FE	Yes	Yes	Yes	Yes	Yes
Industry * Country * Year FE	Yes	Yes	Yes	Yes	Yes
Sample: All kinks	Yes	Yes	Yes	Yes	Yes
	Average age	**Average number of qualifications**	**Average network size**	**Time in company**	**Share of independent directors**
Panel A: All countries					
	1	2	3	4	5
$Post_{ct}$ * $MinShare_i$	6.353	0.661	1,448	3.578	-0.00332
	(10.07)	(1.244)	(1,511)	(9.046)	(0.411)
Number of firms	777	777	777	777	777
Observations	4,926	4,928	4,928	4,928	4,928
Panel B: UK					
	1	2	3	4	5
$Post_{ct}$ * $MinShare_i$	9.737	0.758	1,385	3.099	-0.00464
	(10.76)	(1.342)	(1,642)	(9.686)	(0.434)
Number of firms	458	458	458	458	458
Observations	3,152	3,152	3,152	3,152	3,152

Appendix Table 1. Tobin's Q and the Share of Women: Placebo Results

This table reports the results of estimating the following specification using the OLS framework:

$$Y_{it}=\gamma PseudoPost_{ct}Right_i+\lambda_{kct}+\lambda_{sct}+\lambda_i+\nu_{it} \text{ (columns 1, 2, 5, 7) or}$$

$$Y_{it}=\gamma PseudoPost_{ct}MinShare_i+\lambda_{ct}Right_i+\lambda_{kct}+\lambda_{sct}+\lambda_i+\nu_{it} \text{ (columns 3, 4, 6, 8),}$$

where Y_{it} is Tobin's Q of firm *i* in year *t* , $PseudoPost_{ct}$ is the (country-specific) dummy variable that takes value of 1 from three years to one year before announcement (columns 1 to 4), compliance year to up to three years afterwards (columns 5 and 6), announcement year to up to three years afterwards (columns 7 and 8), and zero -- from seven to five years before announcement (columns 1 to 4), three years to one year before announcement (columns 5 to 8), respectively, $Right_i$ is the dummy for being to the right ofthe kink and $MinShare_i$ is the predicted minimum share of firm *i* (the instruments, defined in Section 2), as of base year, λ_{kct} are kink-year fixed effects (specific to the country), λ_{sct} are industry-year fixed effects (specific to the country), λ_i are firm fixed effects. The base year is four years before announcement (columns 1 to 4) and the year before announcement (columns 5 to 8), respectively. Standard errors are clustered at the firm level and are reported below the coefficients. All columns restrict sample to firms in the discontinuity sample, excluding the potentially non-affected firms (firms with $Share_{i0}$ above the quota). The number of firms and observations excludes singletons. * indicates 10% significance; ** 5% significance; *** 1% significance.

	Panel A: Pseudo-Post-announcement vs pseudo-pre-announcement years				Panel B: US firms with UK years			
					Post-compliance vs pre-announcement years		Post-announcement vs pre-announcement years	
	All countries	UK	All countries	UK				
	1	2	3	4	5	6	7	8
$PseudoPost_{ct}$ * $Right_i$	-0.423	-0.469			0.0726		-0.0633	
	(0.474)	(0.519)			(0.136)		(0.0869)	
$PseudoPost_{ct}$ * $MinShare_i$			-5.115	-5.702		2.032		-0.104
			(6.739)	(7.357)		(2.029)		(1.279)
Number of firms	335	273	705	441	396	1,017	398	1,018
Observations	1,725	1,386	3,755	2,330	2,575	6,831	2,658	6,923
Bin * Country * Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Right * Country * Year FE			Yes	Yes		Yes		Yes
Industry * Country * Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample: Largest kink only	Yes	Yes			Yes		Yes	
Sample: All kinks			Yes	Yes		Yes		Yes