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Female directors, board-gender quotas and firm performance: evidence from Norway

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ABSTRACT

The opponents to board gender quotas point out the utility argument, according to which, the impossibility of appointing the best candidates will have a negative impact on firm performance. Norway is the case study to investigate the impact of board gender quota regulations on firm performance. Because a gender quota was voluntary from 2004 to 2006 and mandatory afterwards, it allows us to investigate the respective impact of voluntary and mandatory gender quota regulations. The research design takes advantage of this unique research setting and implements difference-in-differences estimations. Previous studies examining the Norwegian context, however, do not differentiate between the voluntary and mandatory implementation of the quota. After controlling for several methodological issues that were unnoticed by these studies, we report sound evidence that the Norwegian quota did not have any negative impact on firm performance. Furthermore, results also suggest that when the quota was applied voluntarily, it had some positive effects on performance. These findings contradict most of the extant evidence and have interesting implications.

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1. Introduction

Supra-national institutions such as the United Nations (UN) or the European Commission (EC) of the European Union (EU), as well as many national governments, consider gender equality in leadership as one of the biggest challenges that corporations currently face. The UN's 2030 Sustainable Development Agenda includes gender equality in leadership as one of its goals (UN, 2015) and, likewise, the EC's Gender Equality Strategy 2020–2025 identifies equality in leadership as a main challenge for achieving effective gender equality (EC, 2020).

Drawing on the agency theory and the resource dependence theory as the theoretical framework, the present study examines the impact of the Norwegian BGQ

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regulation on firm performance. Norway has become the study case to investigate the effects of BGQ on firm performance (Ahern & Dittmar, 2012; Dale-Olsen et al., 2013; Eckbo et al., 2022; Matsa & Miller, 2013; Yang et al., 2019), accounting quality (García-Lara et al., 2022), tax avoidance (Garcia-Blandon et al., 2022), the labor market (Bertrand et al., 2018) or gender stereotypes (Smith et al., 2021). In 2003 Norway passed a new legislation establishing a minimum 40% representation for both sexes on the BoD of publicly listed companies. Initially, the compliance with the BGQ was voluntary, though it became mandatory in 2006. The fact that Norway was a pioneer country in the adoption of BGQs, and the particularly serious implications for the non-compliant firms (liquidation) explain why most studies on the impact of BGQs on performance focus on Norway. Furthermore, the interest in investigating the Norwegian experience is also explained by the fact that the Scandinavian region is widely acknowledged as one of the most gender-equal areas in the world. According to Borchorst and Siim (2008), social equality became a core value in the Scandinavian region over the former century, with feminist organizations having a principal role in the fight for gender equality. Hernes (1987) argues that gender equality was an intrinsic dimension of the Scandinavian welfare state, and this differentiates Scandinavia from other European countries. However, prior studies examining the Norwegian experience do not consider that there were in fact two BGQs in Norway: a voluntary quota from 2004 to 2006 and a mandatory quota afterwards. This situation provides a unique opportunity to investigate the respective impacts of both types of regulations on firm performance. Additionally, because the effects of the appointment of female directors are likely to be different when this appointment is the result of a (to some extend) voluntary decision by the firm or when mandated by law, mixing the periods of voluntary and mandatory quota may lead to misleading results.

This study intends to contribute to the management literature by addressing the aforementioned gap. To the best of our knowledge, for the first time the effects of the Norwegian regulation are examined differentiating between the periods of voluntary and mandatory application of the quota. Hence, the study will inform the ongoing debate about the respective costs and benefits of the soft and hard regulatory approaches to gender inequality in leadership (Terjesen et al., 2015). Additionally, the research design used in this study may capture the impact of female directors on firm performance better than prior research. First, because previous studies limit the potential effects of the incorporation of women into BoDs to the year 2007 (Dale-Olsen et al., 2013), 2008 (Yang et al., 2019) or 2009 (Matsa & Miller, 2013). It should be noted that the percentage of female directors in Norway almost doubled between 2005 and 2007.[1] Therefore, these studies confine the analysis of the effects of the incorporation of a large number of female directors on firm performance to just one or two years after these appointments took place. This may impede to adequately capture the actual impact of BGQs on firm performance, as the role of the BoDs is essentially strategic (Forbes & Milliken, 1999; Pugliese et al., 2009). That means that the effects of the board's decisions will mainly occur several years after these decisions are made. To deal with this issue, we examine a larger post-quota period than most prior studies. Second, our research design controls for the confounding effect represented by the fact that the appointment of female directors on Norwegian

boards due to the BGQ reduced the average tenure of the BoDs. Given the positive relationship between tenure and performance (Garcia-Blandon et al., 2019a), the negative impact on performance that Matsa and Miller (2013) and Yang et al. (2019) attribute to the BGQ might be the consequence of lower board tenure.

Confronting most of the extant evidence, this study rejects that the voluntary BGQ passed in 2003, the 2006 mandatory BGQ or both of them jointly considered, have had a negative impact on the financial performance of Norwegian firms. This result is robust, as it holds without exception for all the indicators of performance, and also across a battery of sensitivity analyses. Finally, we also provide some evidence that the voluntary BGQ might even have a positive impact on performance.

The article continues as follows. The next Section summarizes the Norwegian BGQ regulation. Then, Section 3 discusses the previous literature and develops the hypotheses. Afterwards, Section 4 summarizes the design of the research and describes the sample. Finally, Sections 5 and 6 present and discuss the results of the analysis, respectively, and the study ends with the conclusions and the likely implications.

2. The Norwegian BGQ legislation

The legislation passed in Norway during the first decade of the century has been extensively discussed in prior studies (e.g. Ahern & Dittmar, 2012; Dale-Olsen et al., 2013; Teigen, 2015). Hence, this section simply aims to summarize the institutional setting in which this study is conducted. Even though the mandatory BGQ was finally enacted in 2006, the process which conducted to its approval started in 1999 with a consultation audit regarding a major revision of the Gender Equality Act. Although the gender quota motion was eventually withdrawn (Teigen, 2015), later on, in December 2003, the reform of the Companies Act requiring a minimum 40% representation for both genders on the boards of public limited companies was passed. While the law was initially based on voluntary compliance, it established that if the 40% threshold was not met by July 2005, the quota would become mandatory (Dale-Olsen et al., 2013). The idea that Norwegian firms would comply with the BGQ on a voluntary basis was soon proven wrong, as by July 2005 the presence of women on boards was far below the 40% threshold (Dale-Olsen et al., 2013). Consequently, the BGQ became mandatory in 2006, although establishing a two-year transition period which made it fully effective since January 2008. Firms that did not comply with the quota by this date were forced to dissolve. Requirements to comply were issued to 77 non-compliant firms in January 2008, and by April of this same year, all public limited firms were following the law (Ahern & Dittmar, 2012).

3. Background and hypothesis

3.1. Voluntary BGQ

The effects of the presence of female directors on the boardroom on firm performance can be analyzed from different theoretical lenses. One of them is the agency theory, that stresses the role of the board of directors in the monitoring of the firm's managers (Fama & Jensen, 1983). If women are better able to perform this

monitoring function than men (Adams & Ferreira, 2009; Carter et al., 2003), female directors could reduce the agency problems of the firm and, thus, improve its performance. From another perspective, the resource dependence theory (Pfeffer & Salancik, 1978) also provides a suitable framework for the analysis of the appointment of female directors, as it highlights the importance of BoD linkages in order to reduce uncertainty and to guarantee the access to essential resources. Hillman et al. (2007) adapt this framework to the specific case of the women's presence on boards, pointing out several benefits. First, women contribute to board's diversity, and more diverse boards do not only have a broader range of perspectives but likely improve efficiency (for instance, in relation to information searching). Second, since directors provide legitimacy to the organization (Certo, 2003; Davis & Mizruchi, 1999), female directors will improve the legitimization of the firm. The third benefit is in the field of communication, commitment and resources as, 'by virtue of their different experience sets, beliefs, and perspectives, women have the potential to link organizations to different constituencies than men' (Hillman et al., 2007, p. 944).

Regarding the extant evidence on the relationship between female directors and performance, Post and Byron (2015) meta-analysis shows that female directors are positively related to accounting-based indicators of performance, and also that the relationship is more positive in countries with stronger shareholder protection. Additionally, in countries with greater (lower) gender parity a positive (negative) relationship is observed. Later, Jeong and Harrison (2017) meta-analysis concludes that the presence of women in the upper echelons of the firm is weakly but positively associated with both accounting-based and market-based indicators of performance.

According to the above studies, considering that in terms of shareholder protection Scandinavia is in an intermediate position between common-law and civil-law countries (LaPorta et al., 1998) but leads the gender equality rankings (Plantenga et al., 2009), we expect a positive impact of board gender diversity on both accounting and market-based financial performance.

Based on the above theoretical discussion and on the available empirical evidence, which was reported for contexts characterized by the voluntary appointment of female directors, the first hypothesis of this study states:

> *Hypothesis 1 (H1):* The voluntary BGQ passed in Norway at the end of 2003 had a positive impact on financial performance.

3.2. Mandatory BGQ

However, the usefulness of the above studies for the investigation of the impact of the mandatory BGQ passed in 2006 on firm performance is limited. When the appointment of female directors is mandated by the law, the opponents of this regulation argue that it will lead to less competent women to replace more competent men. This argument draws upon the limited supply view of qualified female directors (Sultana et al., 2020), which states that the application of BGQs will increase the demand for qualified female directors without a similar increase in the supply of these directors. Sultana et al. (2020) conclude that the association between the number of female directors on the audit committee and audit quality weakened in

Australia after the introduction of gender diversity guidelines, thus supporting the limited supply view. Therefore, one should not necessarily expect the same sort of relationship between the presence of women on boards and performance before and after the enactment of the mandatory quota regulation.

Dale-Olsen et al. (2013), Matsa and Miller (2013) and Yang et al. (2019) have examined the Norwegian setting using difference-in-differences analysis (diff-in-diff). Dale-Olsen et al. (2013) limit the study to the years 2003 (pre-quota period) and 2007 (post-quota period), consider only Norwegian firms, and conclude that the quota did not have significant effects on the return on assets (ROA). Matsa and Miller (2013) and Yang et al. (2019) observe a decrease in the ROA of Norwegian firms after the BGQ, compared to firms from other Scandinavian countries not affected by the quota. The pre- and post-treatment periods include the years 2003–2006 and 2007–2009 in Matsa and Miller (2013), and the years 2002–2003 and 2004–2008 in Yang et al. (2019). Besides, Yang et al. (2019) report insignificant results when performance was measured by the Tobin's Q. However, these studies include years with different quota regulations in the pre- and post-quota periods. Hence, in the post-quota period, Dale-Olsen et al. (2013) and Yang et al. (2019) mix the cumulative effects of the 2003 voluntary quota and the 2006 mandatory quota, whereas Matsa and Miller (2013) include years without quota (2003) and years with a voluntary quota (2004–2006). Ahern and Dittmar (2012) also examine the impact of the Norwegian BGQ on performance, although, unlike the above articles do not implement diff-in-diff but a fixed-effects within an instrumental variable approach. The treated and control groups are constructed depending on when firms implement the board changes required by the new legislation. They analyze a panel data sample of publicly listed Norwegian firms between 2001 and 2009, and conclude that the BGQ caused a significant decline in financial performance as measured by the Tobin's Q. Finally, in a recent paper Eckbo et al. (2022) replicate the studies of Ahern and Dittmar (2012) and Matsa and Miller (2013), and put into question the negative effects of the Norwegian quota on Tobin's Q and ROA reported by these studies. After controlling for several methodological issues that were unnoticed in Ahern and Dittmar (2012) and Matsa and Miller (2013), the main conclusion in Eckbo et al. (2022) is that the Norwegian quota did not have a significant impact on firm performance.

As discussed in the introduction, aside from mixing the effects of the voluntary and mandatory BGQs, the above studies generally use rather short periods for the assessment of the impact of BGQ on performance. Therefore, these studies implicitly assume that the appointment of female directors will have immediate (or quasi) effects on performance.

After the examination of the related literature, and paying particular attention to the studies based on diff-in-diff research designs, we formulate the second hypothesis, as follows:

> *Hypothesis 2 (H2):* The mandatory BGQ passed in Norway in 2006 had a negative impact on financial performance.

3.3. Voluntary and mandatory BGQ

Finally, once the possible impacts of the voluntary and mandatory quota regulations on financial performance have been considered separately, the last hypothesis of this

study refers to the cumulative effects of the joint quota regulation process. Consistently with the opposite effects on performance of the voluntary and the mandatory quota regulations predicted by H1 and H2, respectively, the last hypothesis is posed in the null form:

Hypothesis 3 (H3): The BGQ regulation passed in Norway between 2003 and 2006 did not have a significant impact on financial performance.

4. Research design and sample

As Matsa and Miller (2013), Dale-Olsen et al. (2013) and Yang et al. (2019), this study implements a diff-in-diff design. The BGQ provided an exogenous shock which diminishes the endogeneity concerns of the analysis (Kausar et al., 2016). Hence, as prior studies, we treat the BGQ scenario as a natural experiment and identify changes in the indicators of performance (ROA, return on equity (ROE) and Tobin's Q) for the Norwegian firms affected by the reform, and then compare these changes with the changes in performance for a control group formed by firms from other Scandinavian countries not affected by the reform. In diff-in-diff models it is important to have relatively similar treatment and control groups. Hence, as Matsa and Miller (2013) and Yang et al. (2019), we take advantage of the fact that Scandinavia is a homogeneous region from the perspective of company law legislation, this being the consequence of a long tradition of cooperation (Gregorič & Hansen, 2017). By comparing the performance of Norwegian and other Scandinavian firms before and after the BGQ, the diff-in-diff design allows us to control for the bias caused by the omission of relevant variables, therefore, mitigating endogeneity concerns (Kausar et al., 2016).

The treated group consists of publicly listed non-financial Norwegian firms, whereas the control group is formed by similar firms from Denmark, Finland and Sweden, whereas the pre- and post-treatment periods are defined as follows:

- Voluntary quota analysis: pre-treatment: 2002–03; post-treatment: 2004–06.
- Mandatory quota analysis: pre-treatment: 2004–06; post-treatment: 2007–10.
- Joint voluntary and mandatory quota analysis: pre-treatment: 2002–03; post-treatment: 2007–10.

The first analysis compares the performance of Norwegian firms during the years when the voluntary quota regulation was into-effect with the situation when no gender quota existed. Subsequently, in the second analysis the comparison is between performance after the mandatory quota was passed and the situation under the voluntary quota regulation. Finally, the third analysis examines the cumulative effects of the joint quota regulation process.

The research design is based on Equations *(1)* and *(2)*. Both equations share the dependent and control variables, and are estimated with panel data models with fixed effects. *TREAT* is a dummy variable indicating whether a firm belongs to the treated or control group. In Equation *(1)* *POST03* is a dummy variable which takes the value of 1 for the observations of the post-treatment period (2004–2006), and 0 otherwise,

and *TREATxPOST03* is the interaction variable. For the assessment of hypothesis H1, Equation *(1)* is estimated for the research period: 2002–2006. According to H1, we expect *TREATxPOST03* to present a positive and significant coefficient. Subsequently, in Equation *(2)*, *POST06* is a dummy variable which takes the value of 1 for the observations of the post-treatment period (2007–2010), and 0 otherwise, and the interaction variable is now *TREATxPOST06*. The estimation of Equation *(2)* for the research period between 2004 and 2010 allows us to assess the hypothesis H2. According to H2, we predict a negative and significant coefficient for *TREATxPOST06*. Equation *(2)* also allows us to test hypothesis H3. In this analysis, the estimation period includes the years 2002–03 and 2007–10 and, according to H3, we do not anticipate the sign of the coefficient for *TREATxPOST06*.

$$FINPERF_{it} = \alpha + \beta * POST03_t + \lambda * TREATxPOST03_{it} + \delta * CONTROLS_{it} + \pi * FIRMFE + £ * YEARFE + \varepsilon_{it} \quad (1)$$

$$FINPERF_{it} = \alpha' + \beta' * POST06_t + \lambda' * TREATxPOST06_{it} + \delta' * CONTROLS_{it} + \pi' * FIRMFE_i + £' * YEARFE_t + \zeta_{it} \quad (2)$$

The dependent variable in Equations *(1)* and *(2)* is financial performance (*FINPERF*), proxied by accounting-based (*ROA*, *ROE*) and market-based (*TOBINSQ*) indicators. Equations *(1)* and *(2)* also include the usual control variables in the related literature (e.g. Ahern & Dittmar, 2012; Dale-Olsen et al., 2013). Previous studies have found these variables to be important determinants of financial performance. Hence, the control variables included in Equations *(1)* and *(2)* are the following: firm size (*SIZE*), firm age (*AGE*), level of financial leverage (*LEVERAGE*), systematic risk (*BETA*), research and development expenses (*R&D*), investment intensity (*CFFI*) and liquidity (*CASH*). Finally, both Equations also include firm (*FIRMFE*) and year (*YEARFE*) fixed effects, but not country or industry fixed effects as they are not compatible with panel data estimations with fixed effects. Table 1 provides the exact definitions for the above variables.

A key issue in diff-in-diff is that both the treated and control groups must share a parallel trend in the dependent variable during the pre-treatment period. Considering that the control group has not been affected by the new regulation, any behavior by the treated group departing from the parallel trend after the change in regulation is interpreted as caused by the new regulation. To check for the existence of a parallel trend in performance, Table 2 shows the average annual changes of *ROA, ROE* and *TOBINSQ* for the treated and control groups from 2003 to 2006. The last column summarizes the results of the *t*-test of differences of means between both groups. The null hypothesis is that the mean differences are insignificantly different from zero. In the analyses of the voluntary BGQ and the joint voluntary and mandatory BGQ, this assumption holds for all the performance indicators. As for the analysis of the mandatory BGQ, mean differences for *ROA*, *ROE* and *TOBINSQ* are also insignificant at the conventional statistical levels (p-value < 0.05). Even though for the year 2006, both *ROA* and *TOBINSQ* present marginally significant differences (p-value < 0.10), we conclude that the parallel trend assumption holds in our sample.

Table 1. Definition of the variables.

Dependent variable *(FINPERF):*	
ROA (Return on Assets)	Earnings before interest and taxes divided by total assets, in percentage.
ROE (Return on Equity)	Net income divided by the book value of equity, in percentage.
TOBINSQ (Tobin's Q)	The market value of equity plus the book value of debt divided by the book value of total assets.
Variables of interest	
TREAT (Treated group)	A dummy variable which takes the value of 1 when the observation corresponds to a Norwegian firm, and 0 otherwise.
POST03 (Post treatment period)	A dummy variable which takes the value of 1 for the observations of year 2004 or later, and 0 otherwise.
POST06 (Post treatment period)	A dummy variable which takes the value of 1 for the observations of year 2007 or later, and 0 otherwise.
TREATxPOST003 (Interaction variable)	The interaction variable between *TREAT* and *POST03*.
TREATxPOST06 (Interaction variable)	The interaction variable between *TREAT* and *POST06*.
Control variables:	
SIZE (Firm's size)	The logarithm of total assets.
AGE (Firm's age)	The logarithm of the number of years since the firm was founded.
LEVERAGE (Financial Leverage)	Total liabilities divided by total assets.
BETA (Systematic risk)	The five year's beta coefficient of the firm.
R&D (Research and development intensity)	Research and development expenses divided by revenues.
CFFI (Investment intensity)	Cash-flow to investments over total assets.
CASH (Liquidity)	Cash and short-term investments over current liabilities.

Source: authors calculations and estimations.

Table 2. Annual changes in mean *ROA*, *ROE* and *TOBINSQ* for the treated and control groups during the pre-treatment periods.

Variable	Year	Treatment group	Control group	*P*-value
ROA	2003	0.276	0.004	0.462
ROA	2004	−0.166	−1.047	0.753
ROA	2005	0.351	0.755	0.789
ROA	2006	−0.369	0.963	0.092
ROE	2003	−0.556	−0.303	0.635
ROE	2004	0.943	2.398	0.573
ROE	2005	−0.118	−0.302	0.768
ROE	2006	−0.062	0.498	0.586
TOBINSQ	2003	0.313	0.235	0.522
TOBINSQ	2004	0.279	0.172	0.348
TOBINSQ	2005	0.234	0.171	0.556
TOBINSQ	2006	0.020	0.253	0.055

Source: authors calculations and estimations.

The sample includes non-financial firms from Norway, Denmark, Sweden and Finland listed in the stock market during the research period (2002–2010). It consists of 253 firms with the following country composition: Denmark (44), Finland (47), Norway (46) and Sweden (116). Due to the lack of data for some firms in certain years the sample has the structure of an unbalanced panel dataset. The variables in Equations *(1)* and *(2)* are obtained from Capital IQ, a Standard & Poor's database.

Table 3 summarizes the descriptive statistics for the variables. To minimize the problems caused by outlier observations, variables are winsorized at the top and bottom 1% level. The average *ROE* in the sample is more than twice the value of the *ROA*, while *TOBINSQ* is clearly above the threshold of 1. Moreover, the results for *BETA* indicate relatively low systematic risk, whereas *LEVERAGE* shows a balanced composition of the firm's capital structure between debt and equity.

Table 3. Summary statistics.*

	Mean	St.Dev	Median	p25	p75	min	max
ROA	4.64	4.916	4.388	1.556	7.886	−4.526	13.519
ROE	11.15	15.8	12.247	1.166	21.881	−20.225	37.393
TOBINSQ	1.729	1.123	1.364	0.975	2.12	0.477	4.732
*POST03***	0.6	0.49	1	0	1	0	1
*TREATxPOST3***	0.109	0.312	0	0	0	0	1
*POST06****	0.571	0.495	1	0	1	0	1
*TREATxPOST6****	0.104	0.305	0	0	0	0	1
*POST06*****	0.667	0.472	1	0	1	0	1
*TREATxPOST6*****	0.121	0.326	0	0	0	0	1
SIZE	7.593	1.992	7.568	6.212	8.994	4.18	11.248
AGE	3.741	1.146	4.078	2.996	4.615	0	5.198
LEVERAGE	0.533	0.182	0.56	0.414	0.659	0.152	0.941
BETA	0.654	0.504	0.646	0.137	1.066	0	1.433
R&D	0.02	0.048	0	0	0.002	0	0.17
CFFI	−0.063	0.066	−0.049	−0.095	−0.021	−0.232	0.043
CASH	0.61	0.848	0.265	0.121	0.652	0.02	3.321

*Given the different research periods defined in the three analyses conducted in this study, the values in the Table for the dependent variables and the control variables correspond to the whole research period: 2002–2010.
**The values for these variables correspond to the research period used in the analysis of the effects of the voluntary quota regulation: 2002–06.
***The values for these variables correspond to the research period used in the analysis of the mandatory quota regulation: 2004–10.
****The values for these variables correspond to the research period used in the analysis of the joint effects of the voluntary and mandatory quota regulation: 2002–03 and 2007–10.
Source: authors calculations and estimations.

Table 4 shows the pairwise correlation coefficients with significance values. Panel A provides the correlations for the variables in Equation *(1)* for the research period 2002–2006. Then, Panels B and C display the correlations for the variables in Equation *(2)* for the analysis of the mandatory quota (2004–10) and the joint quota regulation (2002–03 and 2006–10), respectively. As expected, the three performance indicators (*ROA, ROE* and *TOBINSQ*) present positive and significant correlations between them. Interestingly, in the analysis of the voluntary quota (Panel A), the interaction variable *TREATxPOST03* has a positive and significant correlation with both *ROE* and *TOBINSQ*, suggesting a positive impact of the voluntary quota on performance. However, in Panel B, the correlation between the interaction variable *TREATxPOST06* and performance is only significant for the ROA, although with a negative sign. This suggests a negative impact of the mandatory quota on performance. Finally, in Panel C, the correlation between *TREATxPOST06* and performance weakens, being significant only for *TOBINSQ* (at marginal levels with p-value < 0.10) and maintaining the positive sign as in Panel A. Overall, these results are consistent with the hypotheses of the study. Finally, the generally low correlations observed between the independent variables included in each analysis, with only one coefficient over 0.5 in absolute values (the correlation between *LEVERAGE* and *CASH*), do not anticipate multicollinearity problems in the estimations.

5. Results of the study

5.1. Analysis of the voluntary BGQ

The results of this analysis are summarized in Table 5. As anticipated, the Hausman test (untabulated) supports the use of fixed effects in the estimations (p-value $<$

Table 4. Pairwise correlations with significance values.

Panel A: Analysis of voluntary quota regulation (2002–2006)

Variables	*ROA*	*ROE*	*TOBINSQ*	*POST03*	*TREATxPOST03*	*SIZE*	*AGE*	*LEVERAGE*	*BETA*	*R&D*	*CFFI*
ROA	1.000										
ROE	0.843***	1.000									
TOBINSQ	0.284***	0.199***	1.000								
POST03	0.193***	0.240***	0.220***	1.000							
TREATxPOST03	0.003	0.071**	0.097***	0.285***	1.000						
SIZE	0.161***	0.184***	−0.159***	0.022	−0.010	1.000					
AGE	0.220***	0.194***	−0.038	0.047*	−0.061**	0.426***	1.000				
LEVERAGE	0.000	0.071**	−0.302***	−0.017	0.050*	0.318***	0.162***	1.000			
BETA	0.025	0.008	0.346***	0.104***	0.039	0.131***	0.042	−0.174***	1.000		
R&D	−0.141***	−0.180***	0.245***	0.017	−0.099***	−0.117***	−0.157***	−0.357***	0.142***	1.000	
CFFI	−0.177***	−0.109***	−0.116***	−0.071**	−0.040	0.017	−0.010	−0.027	0.038	0.008	1.000
CASH	−0.227***	−0.237***	0.309***	−0.005	0.122***	−0.357***	−0.290***	−0.641***	0.100***	0.447***	0.090***

Panel B: Analysis of mandatory quota regulation (2004–2010)

Variables	*ROA*	*ROE*	*TOBINSQ*	*POST06*	*TREATxPOST06*	*SIZE*	*AGE*	*LEVERAGE*	*BETA*	*R&D*	*CFFI*
ROA	1.000										
ROE	0.840***	1.000									
TOBINSQ	0.297***	0.191***	1.000								
POST06	−0.025	−0.051**	−0.057**	1.000							
TREATxPOST06	−0.062**	−0.038	0.007	0.295***	1.000						
SIZE	0.100***	0.147***	−0.249***	0.086***	0.041*	1.000					
AGE	0.118***	0.126***	−0.109***	0.062***	−0.055**	0.430***	1.000				
LEVERAGE	0.005	0.099***	−0.282***	−0.012	0.031	0.331***	0.185***	1.000			
BETA	0.018	−0.002	0.148***	0.073***	0.050**	0.179***	0.087***	−0.097***	1.000		
R&D	−0.128***	−0.175***	0.261***	0.016	−0.095***	−0.127***	−0.141***	−0.335***	0.045*	1.000	
CFFI	−0.143***	−0.070***	−0.137***	0.009	−0.049**	0.030	0.051**	−0.030	0.024	0.011	1.000
CASH	−0.191***	−0.209***	0.368***	−0.039*	0.129***	−0.340***	−0.258***	−0.605***	0.008	0.387***	0.050**

Panel C: Analysis of the voluntary and mandatory quota regulation (2002–2003 and 2006–10)

Variables	*ROA*	*ROE*	*TOBINSQ*	*POST06*	*TREATxPOST06*	*SIZE*	*AGE*	*LEVERAGE*	*BETA*	*R&D*	*CFFI*
ROA	1.000										
ROE	0.841***	1.000									
TOBINSQ	0.338***	0.263***	1.000								
POST06	0.087***	0.092***	0.057**	1.000							
TREATxPOST06	−0.029	0.003	0.041*	0.295***	1.000						
SIZE	0.132***	0.166***	−0.212***	0.088***	0.041*	1.000					

(*continued*)

Table 4. Continued.

Panel C: Analysis of the voluntary and mandatory quota regulation (2002–2003 and 2006–10)

Variables	*ROA*	*ROE*	*TOBINSQ*	*POST06*	*TREATxPOST06*	*SIZE*	*AGE*	*LEVERAGE*	*BETA*	*R&D*	*CFFI*
AGE	0.168***	0.160***	−0.097***	0.088***	−0.045*	0.422***	1.000				
LEVERAGE	0.006	0.080***	−0.240***	−0.016	0.030	0.355***	0.187***	1.000			
BETA	0.009	−0.002	0.151***	0.135***	0.068***	0.167***	0.097***	−0.085***	1.000		
R&D	−0.118***	−0.150***	0.242***	0.024	−0.094***	−0.127***	−0.151***	−0.335***	0.049**	1.000	
CFFI	−0.166***	−0.092***	−0.133***	−0.011	−0.057**	0.028	0.018	−0.041*	0.036	0.009	1.000
CASH	−0.191***	−0.194***	0.306***	−0.038	0.131***	−0.346***	−0.267***	−0.589***	0.010	0.388***	0.063***

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Source: authors calculations and estimations.

Table 5. Analysis of the impact of the voluntary quota regulation on performance.

VARIABLES	(1) *ROA*	(2) *ROE*	(3) *TOBINSQ*
POST03	1.611***	6.189***	0.643***
	(0.332)	(1.221)	(0.0817)
POST03xTREAT	0.408	4.761**	0.231
	(0.671)	(2.136)	(0.157)
SIZE	−0.324	1.563	−0.499***
	(0.482)	(1.578)	(0.133)
AGE	3.089**	3.446	0.640**
	(1.290)	(5.179)	(0.307)
LEVERAGE	−7.164**	−29.44***	0.337
	(2.819)	(7.541)	(0.357)
BETA	0.833	2.846	0.372***
	(0.524)	(2.029)	(0.115)
R&D	−16.56	−41.62	9.446***
	(24.07)	(67.98)	(3.315)
CFFI	−3.230*	−1.225	−0.977**
	(1.867)	(7.233)	(0.382)
CASH	−0.0290	−0.110	0.0162
	(0.560)	(1.242)	(0.101)
CONSTANT	−1.654	−1.813	2.135
	(5.891)	(22.52)	(1.546)
Observations	1,171	1,165	1,175
R-squared	0.203	0.212	0.330
F-value	10.32***	14.68***	17.86***
Firm FE	YES	YES	YES
Country FE	NO	NO	NO
Industry FE	NO	NO	NO
Year FE	YES	YES	YES

Results of the diff-in-diff estimations with fixed-effects. Pre-quota period: 2002–03; Post-quota period: 2004–06.
Robust standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.
Source: authors calculations and estimations.

0.01), and thus, we cannot include industry or country fixed effects, as they are time-invariant. Because the Breusch-Pagan test suggests heteroscedasticity in the estimations, significance tests are conducted with robust standard errors clustered by firm. Even though the pairwise correlation coefficients displayed in Table 4 do not suggest serious multicollinearity, we compute variance inflation factors to further assess this issue (untabulated). The relatively low values of these factors (average of 2.35 with a maximum of 6.07) confirm our initial expectations.

The *F*-test indicates that all three estimations are globally significant (p-value < 0.01). Our main interest in Table 5 refers to the interaction variable *POST03xTREAT,* which shows a positive coefficient in all three estimations, although only significant in the estimation for the *ROE* (p-value < 0.05). Thus, the impact of the voluntary BGQ on performance is positive or insignificant, depending on how performance is measured. The positive and significant coefficient for *POST03xTREAT* in the estimations for the *ROE* was anticipated by Table 4 (Panel A). Both the agency theory and the resource dependence theory suggest that the presence of women on the boardroom could be positively associated with financial performance. In the first case, because female directors may be able to reduce agency conflicts to a greater extent than male directors. Similarly, the resource dependence theory points out several benefits associated with the appointment of female directors. Unfortunately, we cannot compare these results with the evidence reported by prior studies also examining the

Table 6. Analysis of the impact of the mandatory quota on performance.

VARIABLES	(1) *ROA*	(2) *ROE*	(3) *TOBINSQ*
POST06	−0.958***	−3.226***	−0.220***
	(0.331)	(1.138)	(0.0793)
POST06xTREAT	−0.180	−2.480	0.0389
	(0.570)	(2.030)	(0.130)
SIZE	−0.0852	0.636	−0.336***
	(0.437)	(1.534)	(0.0989)
AGE	1.963*	2.303	0.914**
	(1.044)	(3.079)	(0.393)
LEVERAGE	−3.912**	−20.11***	0.357
	(1.520)	(6.163)	(0.424)
BETA	−0.515	−2.539**	0.202***
	(0.396)	(1.283)	(0.0756)
R&D	−33.84**	−82.56*	4.943
	(16.11)	(49.14)	(4.235)
CFFI	−4.727***	−13.99**	−1.031**
	(1.585)	(5.900)	(0.402)
CASH	−0.301	−0.493	0.225***
	(0.259)	(1.029)	(0.0606)
CONSTANT	2.034	15.39	0.573
	(5.069)	(16.55)	(1.698)
Observations	1,705	1,696	1,711
R-squared	0.099	0.086	0.193
F-value	8.16***	6.03***	20.89***
Firm FE	YES	YES	YES
Country FE	NO	NO	NO
Industry FE	NO	NO	NO
Year FE	YES	YES	YES

Results of the diff-in-diff estimations with fixed-effects. Pre-quota period: 2004–06; Post-quota period: 2007–10.
Robust standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.
Source: authors calculations and estimations.

Norwegian context, as none of them specifically investigates the effects of the voluntary quota regulation. However, it should be noted that, in the most comparable study to ours, Dale-Olsen et al. (2013)[2] report an insignificant impact of the quota on the ROA, and this result is consistent with Table 5 (Column *(1)*). Overall, the results in Table 5 provide weak support for the first hypothesis of the study (H1), that anticipated a positive impact of the voluntary BGQ on performance.

5.2. Analysis of the mandatory BGQ

Table 6 summarizes the results of this analysis based on the estimation of Equation *(2)* for the years between 2002 and 2010. As in the former estimations, fixed effects models are used and significance tests are conducted with robust standard errors clustered by firm. All three estimations are significant (p-value < 0.01), and *POST06xTREAT* presents insignificant coefficients in all them. Consequently, the performance of Norwegian firms did not significantly change in the post-quota period (2007–10) compared to the situation under the voluntary quota regulation (2004–06). This result seems robust as it holds for all three performance indicators. Therefore, the results in Table 6 do not support hypothesis H2.

As in the case of the voluntary quota regulation, the comparability of our results for the mandatory quota regulation analysis with previous studies is limited. Matsa

Table 7. Analysis of the impact of the cumulative effect of the voluntary and mandatory quota regulation on performance.

VARIABLES	(1) *ROA*	(2) *ROE*	(3) *TOBINSQ*
POST06	0.627	3.322**	0.362***
	(0.429)	(1.453)	(0.100)
POST06xTREAT	0.0941	2.075	0.283*
	(0.795)	(2.584)	(0.160)
SIZE	−0.190	0.423	−0.350***
	(0.429)	(1.401)	(0.104)
AGE	2.705***	3.453	0.678***
	(0.931)	(3.196)	(0.211)
LEVERAGE	−5.714***	−28.96***	0.286
	(2.167)	(6.133)	(0.272)
BETA	−0.435	−2.079	0.349***
	(0.430)	(1.371)	(0.0780)
R&D	−23.56*	−72.75*	3.055
	(13.14)	(37.57)	(2.485)
CFFI	−9.309***	−26.96***	−0.529
	(2.143)	(7.346)	(0.382)
CASH	0.142	0.475	0.0975
	(0.357)	(1.152)	(0.0784)
CONSTANT	−1.526	7.913	1.057
	(4.771)	(16.33)	(1.036)
Observations	1,432	1,425	1,434
R-squared	0.178	0.171	0.255
F-value	14.70***	13.85***	19.31***
Firm FE	YES	YES	YES
Country FE	NO	NO	NO
Industry FE	NO	NO	NO
Year FE	YES	YES	YES

Results of the diff-in-diff estimations with fixed-effects. Pre-quotas period: 2002–03; Post-quota periods: 2007–10.
Robust standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.
Source: authors calculations and estimations.

and Miller (2013) report a negative impact of the gender quota on the ROA, Yang et al. (2019) observe insignificant results for the ROA, although negative and significant results for an alternative accounting measure of performance as well as for market-based indicators of performance, whereas Eckbo et al. (2022) report insignificant effects for both the ROA and Tobin's Q. However, since Matsa and Miller (2013) and Eckbo et al. (2022) define the pre-quota period by the years 2002–06, they are in fact comparing the situation of financial performance of Norwegian firms after the enactment of the mandatory quota, with the situation during a period which includes years without quota and years with a voluntary quota, these last years also showing an increase in the number of female directors (Ahern & Dittmar, 2012). On the other hand, since Yang et al. (2019) define the post-quota period by the years between 2004 and 2008, their results cannot be strictly interpreted in terms of the effects of a mandatory quota regulation.

5.3. Analysis of the joint effects of the voluntary and mandatory BGQs

This analysis examines the cumulative impact of the whole BGQ regulation on performance. Accordingly, the pre-quota period now includes the years 2002 and 2003 and the post-quota period the years between 2007 and 2010. Compared to the

situation before the voluntary BGQ, the number of female directors in Norway increased considerable in the post-quota period. Table 7 summarizes the estimates of Equation *(2)* for the research period defined by the said pre- and post-quota periods. As before, the estimations are performed with fixed effects panel data models, whereas significance tests are conducted with robust standard errors clustered by firm. The interaction variable *POST06xTREAT* presents an insignificant coefficient in the estimations with *ROA* and *ROE* as the measures of performance, though a positive and significant coefficient in the estimation with *TOBINSQ* (p-value < 0.1). Therefore, the joint BGQ regulation had a neutral impact on accounting-based indicators of performance and a weak but positive impact on financial performance. This latter result was anticipated by Table 4 (Panel C). Overall these results provide partial support for hypothesis H3, as it was formulated in the null form.

As in the former analyses, the comparability of the results in Table 7 with prior studies is limited. However, in this case, Yang et al. (2019) is the closest study to ours. Hence, they also use the years 2002 and 2003 as the pre-quota period, whereas the post-quota period includes the years between 2004 and 2008. In this case, the last period includes years under voluntary and under mandatory quotas. Unlike our results, Yang et al. (2019) observe a negative impact of the regulation on accounting-based indicators of performance; however, they also find an insignificant impact of the reform on the Tobin's Q. Even though the evidence we provide showing a positive or neutral impact of the joint quota regulation contradicts the neutral or negative effects showed by Yang et al. (2019), it is worth mentioning that both studies agree that the impact of the quota on market-based indicators of performance is more positive (or less negative) than on accounting-based indicators.

6. Sensitivity analysis

Several analyses are conducted to assess the robustness of the findings reported in the former section. First, even though the Hausman test advocates estimations with fixed effects, we check the sensitivity of the results to the estimation method. Accordingly, Equations *(1)* and *(2)* are re-estimated with random-effects.[3] The new estimations (untabulated) support the results reported in Tables 5–7. The second analysis extends the length of the of the post-quota period, with the aim of capturing better the strategic role of the BoD. Hence, we re-estimate Equation *(2)* with a longer post-quota period (2007–14), and the new results (untabulated) show insignificant coefficients for the interaction variable *TREATxPOST06* in all the estimations. The third analysis controls for the fact that the appointment of a large number of female directors by Norwegian firms as a result of the BGQ necessarily reduced the average tenure of the board, and this could also affect firm performance. To conduct this analysis, Equation *(2)* is re-estimated after removing the years 2007 and 2008 from the post-quota period, as based on psychologists and learning scholars' findings (Ritter & Schooler, 2001), by the year 2009 most of the potential effects of the differences in board's tenure on performance between the control and treated groups should have disappeared. The new estimations show insignificant coefficients for the interaction variable *POST06xTREAT* in all cases (results untabulated). The last analysis accounts

for the possibility that differences in performance between Norwegian firms and their peers form other Scandinavia countries (e.g. a different industry composition[4]) had affected our results. Since the parallel trend assumption holds in our sample, we do not expect this to be the case, however, to further address this issue Equations *(1)* and *(2)* are re-estimated with matched samples of firms. To implement this analysis, we apply the propensity score method to obtain one-to-one matched samples of the treated and control groups with more homogenous characteristics. The results of the estimations with matched samples (untabulated) are strongly consistent with the evidence reported in Tables 5–7.

7. Conclusions, implications and limitations

This study rejects that the performance of Norwegian firms has been negatively affected by the board gender regulation approved during the first decade of the century. Regardless of whether performance is measured through accounting- or market-based indicators, it did not decline as a result of the gender quota. These results are robust to different estimations methods, firm samples and research periods. Additionally, results indicate that the quota may have had a positive impact on financial performance. This mainly holds for the voluntary quota regulation.

The evidence reported here has some interesting implications at various levels. Most importantly, while the success of the Norwegian approach in increasing the presence of women on boardrooms is undeniable, most of the available evidence so far indicating a negative impact on firm performance provided arguments to those contrary to the implementation of mandatory board gender quotas. The present study contradicts this evidence, and, therefore, weakens the strength of the anti-quota arguments. Consequently, it has interesting practical implications for regulators and policy makers as it may help to facilitate the enactment of board gender quotas in other countries, more or less inspired by the Norwegian experience. There are also potential implications for investors and stock market participants, as they should not expect lower financial performance of those firms affected by a gender quota regulation. Secondly, at a more academic level, corporate governance scholars investigating the effects of the appointment of women to the top ranks of the corporation should consider if these appointments are or not the result of a voluntary decision by the company.

This study is subject to several limitations. First, the relatively low number of observations for the treated group in the pre-treatment period may have affected the soundness of the analysis. Second, following Ferreira's (2015) remarks, even though we intend to maximize the comparability between the treated and control groups, differences in the legal and macroeconomic environments may have affected the results. Finally, the evidence must be contextualized to the geographical context investigated, which is regarded as one of the most gender-equal areas in the world. These limitations provide interesting research opportunities for further studies to explore.

Notes

1. According to Ahern and Dittmar (2012), in 2005 women held 21.64% of the seats and in 2007 this percentage was 40.80%.

2. Dale-Olsen et al. (2013) use the year 2003 as the pre-quota period and the year 2007 as the post-quota period. Therefore, they are in fact investigating the effects of three years of voluntary quota regulation (from 2004 to 2006) and only one year of mandatory quota regulation (2007).
3. Due to the estimation with random effects, both equations include the variable *TREAT* among the regressors and also industry, year and country fixed-effects, but not firm fixed-effects.
4. For instance, Garcia-Blandon et al. (2019b) provide evidence of industry-differences in the presence of women in leadership positions.

Disclosure statement

No potential conflict of interest was reported by the authors.

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