Valuation Effects of Norway's Board Gender-Quota Law Revisited

Finance Working Paper N° 463/2016
February 2022

B. Espen Eckbo
Dartmouth College and ECGI

Knut Nygaard
Oslo Metropolitan University and University of Sheffield

Karin S. Thorburn
Norwegian School of Economics, CEPR and ECGI

ECGI Working Paper Series in Finance

Valuation Effects of Norway's Board Gender-Quota Law Revisited

Working Paper N° 463/2016

February 2022

B. Espen Eckbo
Knut Nygaard
Karin S. Thorburn

This paper was previously circulated under the title "Board gender-balancing and firm value." We appreciate the helpful comments and suggestions of Ren´ee Adams (Editor), the Associate Editor, two referees, Øyvind Bøhren, Eric de Bodt, Marie Dutordoir, Karin Hederos Eriksson, Jasmin Gider, Marc Goergen, Angelica Gonzales, Ian Gregory-Smith, Peter Limbach, Markus Lithell, Michele Lowry, Maria Teresa Marchica, Trond Randøy, Bruce Sacerdote, Miriam Schwartz-Ziv, Randall Thomas, Belen Villalonga, Ralph Walkling, Joshua T. White, and Shan Zhao. Markus Lithell provided excellent research assistance. Earlier versions of this paper were presented at the Academic Conference on Corporate Governance at Drexel University, the BI Norwegian School of Management Workshop on Corporate Governance and Investment, the Careers, Women, and Wages Workshop at the Norwegian School of Economics, the Conference on Corporate Governance and Executive Compensation at Baruch College, the Edinburgh Corporate Finance Conference, the European Center for Corporate Control Studies, the European Finance Association annual meetings, the Financial Management Association European meetings, the Global Corporate Governance Colloquia at Stanford Law School, the Nordic Corporate Governance Network Workshop, the Oslo Summer Corporate Finance Workshop, the Board Diversity Quotas Conference at Stockholm University, the Symposium of the Society for Financial Studies, the University of British Columbia Summer Finance Conference, and the Work, Pensions, and Labour Economics Conference at the University of Sheffield. We have also benefited from the seminar presentations at Bristol University, Dartmouth College, Institute for Industrial Economics (Stockholm), Karlsruhe Institute of Technology, Oslo Business School, Penn State University, Rutgers University, University of Bonn, Universita Cattolica del Sacro Cuore (Milan), University of Exeter, University of Groningen, University of Hamburg, University of Lancaster, University of Manchester, University of Ottawa, University of Pennsylvania, University of Sheffield, and Vanderbilt University. Financial support from the Centre for Corporate Finance at Norwegian School of Economics, Finans|Bergen, the Lindenauer Forum for Governance Research at the Tuck School of Business, and Professor Wilhelm Keilhaus Minnefond is gratefully acknowledged.

Abstract

We highlight the complexities in estimating the valuation effects of board gender quotas by critically revisiting studies of Norway's pioneering board gender-quota law. We use Ahern and Dittmar (2012)'s short-run event study to illustrate (1) the difficulties in attributing quota-related news to specific dates, (2) the need to account for contemporaneous cross-correlation of stock returns when judging the statistical significance of event-related abnormal stock returns, and (3) the fundamental difficulty of separating quota-induced valuation effects from the influences of firm characteristics and macroeconomic events such as the financial crisis. We provide new evidence suggesting that the valuation effect of Norway's quota law was statistically insignificant. Overall, our evidence suggests that, at the time of the Norwegian quota, the supply of qualified female director candidates was high enough to avoid the negative consequences of the quota highlighted previously in the literature.

Keywords: gender quota; board diversity; valuation effect; return correlation; long-run performance

JEL Classifications: G14, G34

B. Espen Eckbo*
Tuck Centennial Professor of Finance
Dartmouth College, Tuck School of Business at Dartmouth
100 Tuck Hall
Hanover, NH 03755, United States
phone: +1 603 646 3953
e-mail: b.espen.eckbo@dartmouth.edu

Knut Nygaard
Associate Professor
Oslo Metropolitan University,
Pilestredet 35, 0166 Oslo
0166 Oslo, Norway
phone: +47 67 23 82 50
e-mail: Knut.Nygaard@oslomet.no

Karin S. Thorburn
Research Chair Professor of Finance
NHH Norwegian School of Economics, Department of Finance
Helleveien 30
5045 Bergen, Norway
phone: +47 5595 9283
e-mail: Karin.Thorburn@nhh.no

*Corresponding Author

Valuation effects of Norway's board gender-quota law revisited*

B. Espen Eckbo[†] Knut Nygaard[‡] Karin S. Thorburn[§]

May 25, 2021

Management Science, forthcoming

Abstract

We highlight the complexities in estimating the valuation effects of board gender quotas by critically revisiting studies of Norway's pioneering board gender-quota law. We use Ahern and Dittmar (2012)'s short-run event study to illustrate (1) the difficulties in attributing quota-related news to specific dates, (2) the need to account for contemporaneous cross-correlation of stock returns when judging the statistical significance of event-related abnormal stock returns, and (3) the fundamental difficulty of separating quota-induced valuation effects from the influences of firm characteristics and macroeconomic events such as the financial crisis. We provide new evidence suggesting that the valuation effect of Norway's quota law was statistically insignificant. Overall, our evidence suggests that, at the time of the Norwegian quota, the supply of qualified female director candidates was high enough to avoid the negative consequences of the quota highlighted previously in the literature.

JEL classification: G14, G34

Keywords: gender quota; board diversity; valuation effect; return correlation; long-run performance

*This paper was previously circulated under the title "Board gender-balancing and firm value." We appreciate the helpful comments and suggestions of Renée Adams (Editor), the Associate Editor, two referees, Øyvind Bøhren, Eric de Bodt, Marie Dutordoir, Karin Hederos Eriksson, Jasmin Gider, Marc Goergen, Angelica Gonzales, Ian Gregory-Smith, Peter Limbach, Markus Lithell, Michele Lowry, Maria Teresa Marchica, Trond Randøy, Bruce Sacerdote, Miriam Schwartz-Ziv, Randall Thomas, Belen Villalonga, Ralph Walkling, Joshua T. White, and Shan Zhao. Markus Lithell provided excellent research assistance. Earlier versions of this paper were presented at the Academic Conference on Corporate Governance at Drexel University, the BI Norwegian School of Management Workshop on Corporate Governance and Investment, the Careers, Women, and Wages Workshop at the Norwegian School of Economics, the Conference on Corporate Governance and Executive Compensation at Baruch College, the Edinburgh Corporate Finance Conference, the European Center for Corporate Control Studies, the European Finance Association annual meetings, the Financial Management Association European meetings, the Global Corporate Governance Colloquia at Stanford Law School, the Nordic Corporate Governance Network Workshop, the Oslo Summer Corporate Finance Workshop, the Board Diversity Quotas Conference at Stockholm University, the Symposium of the Society for Financial Studies, the University of British Columbia Summer Finance Conference, and the Work, Pensions, and Labour Economics Conference at the University of Sheffield. We have also benefited from the seminar presentations at Bristol University, Dartmouth College, Institute for Industrial Economics (Stockholm), Karlsruhe Institute of Technology, Oslo Business School, Penn State University, Rutgers University, University of Bonn, Universita Cattolica del Sacro Cuore (Milan), University of Exeter, University of Groningen, University of Hamburg, University of Lancaster, University of Manchester, University of Ottawa, University of Pennsylvania, University of Sheffield, and Vanderbilt University. Financial support from the Centre for Corporate Finance at Norwegian School of Economics, Finans|Bergen, the Lindenauer Forum for Governance Research at the Tuck School of Business, and Professor Wilhelm Keilhaus Minnefond is gratefully acknowledged.

[†]Dartmouth College, Norwegian School of Economics, and ECGI. b.espen.eckbo@dartmouth.edu

[‡]Oslo Business School at Oslo Metropolitan University. knut.nygaard@oslomet.no

[§]Norwegian School of Economics, CEPR, and ECGI. karin.thorburn@nhh.no

"[Norway's gender] quota caused a significant drop in the stock price at the announcement of the law and a large decline in Tobin's Q over the following years... The quota led to younger and less experienced boards,., and deterioration in operating performance."
— Kenneth R. Ahern and Amy Dittmar, *Quarterly Journal of Economics*, 2012, p.137 (abstract).

1 Introduction

In December 2005, the Norwegian government required public limited companies (ASA) to have gender-balanced boards within two years—or face forced liquidation. The introduction of this new law was motivated by gender politics unrelated to firm performance (*Odelstingsproposisjon* 97, 2002–2003), and the law only regulates board diversity.[1] Hence, *prima facie*, it provides a particularly interesting quasi-experimental setting, which Ahern and Dittmar (2012) (henceforth AD) exploit to show that the valuation effect of board gender quotas is negative (above quote). We highlight the difficulties inherent in identifying the valuation effects of quotas by revisiting AD's analysis as well as other extant evidence and show that the forced board gender balancing did *not* impose significant costs on shareholders. Our analysis and new evidence are also of general methodological interest because several other countries have since followed Norway's lead by adopting their own mandatory board gender quotas.[2]

There are two commonly discussed economic hypotheses in this context. The first is that restricting shareholders' free choice of directors results in lower board effectiveness. Firms may be forced to appoint female directors with less chief executive officer (CEO) experience, which may lower firm value (Fahlenbrach, Low, and Stulz, 2010; Ahern and Dittmar, 2012).[3] The second hypothesis holds that the quota increases the efficiency of board elections by reducing the influence of the male director "old boys" network (*Odelstingsproposisjon* 97, 2002–2003) and by increasing director independence and monitoring (Adams and Ferreira, 2009; Duchin, Matsusaka, and Ozbas, 2010; Masulis and Mobbs, 2011). Also, shareholders may benefit from the addition of a broader skillset when adding female directors (Kim and Starks, 2016; Bernile, Bhagwat, and Yonker, 2018; Adams, Akyol, and Verwijmeren, 2018).

Norway's pioneering quota law has attracted substantial empirical investigation of these two hypothe-

[1] In contrast, the 2002 Sarbanes Oxley Act (SOX) in the U.S. responded to negative performance following accounting scandals (e.g., Enron), and it mandates complex governance changes ranging from costly new internal control systems to enhanced director fiduciaries (Chhaochharia and Grinstein, 2007; Duchin, Matsusaka, and Ozbas, 2010).

[2] Belgium, France, Germany, Iceland, Italy, the Netherlands, Portugal, and Spain, and the state of California, have all recently passed gender-balancing requirements for private firms. These countries typically impose substantially lower penalties for non-compliance than Norway does. See Kuzmina and Melentyeva (2020) for studies of EU members, and Hwang, Shivdasani, and Simintzi (2018), and Greene, Intintoli, and Kahle (2020) for evidence on the state of California.

[3] Under this view, the cost of expanding board size—to make room for female directors while retaining male directors—places an upper bound on the expected shareholder-borne cost of the quota.

ses. Bertrand, Black, Jensen, and Lleras-Muney (2019) document that the new female directors ushered in by the quota were observably more qualified than their female predecessors in terms of education and professional experience and had a higher income. This suggests that the supply of qualified female director candidates was high enough to avoid significant shareholder-borne costs of the quota. Nevertheless, AD report a significantly negative market reaction to the initial quota announcement (in February of 2002), as well as a long-term decline in Tobin's Q of all-male boards through year-end 2009.[4]

The main objective of this paper is to resolve the tension between the evidence of increased female director qualifications and AD's estimates of a large, negative stock market reaction to quota news for firms with all-male boards in 2001. We begin by using AD's event study to highlight key difficulties involved in estimating the valuation effects of quotas. First, we emphasize that because quotas may be politically contentious, public debate about quotas may make it difficult to correctly identify news events that significantly change the market's prior probability of a quota law. In this context, we show that AD missed a second important event inside their five-day event window that *lowered* this prior probability. Moreover, using AD's event-study methodology, we show that the negative market reaction reported by AD should have been attributed to this second, probability-reducing event, which effectively reverses their main conclusion.

Second, we use AD's event study to highlight the general econometric requirement in event studies of adjusting standard errors of abnormal stock returns for any contemporaneous cross-correlation of returns. This adjustment, which AD ignore, is crucial whenever the event in question affects all sample firms simultaneously in calendar time, which is the case for legal and regulatory shocks. Economic factors driving stock returns tend to generate pervasive positive contemporaneous return correlations across securities. A simple way to account for this cross-correlation is to form a portfolio of the sample firms affected by the quota shock and use the estimated standard error of the portfolio's abnormal return (Schwert, 1981; Kothari and Warner, 2007; Kolari and Pynnönen, 2010). Implementing this portfolio approach results in statistically insignificant abnormal stock returns to *both* quota-related news events within AD's event window. Moreover, when we expand the analysis to include all the subsequent important quota-related news events, we again find insignificant abnormal stock returns. We also follow

[4] AD's conclusion received substantial attention in the financial press. For example, *The Financial Times* wrote "[Norway's quota caused] a large decline in Tobin's Q...over the following years" (August 20, 2011), while *The Economist* printed that "[Norway's gender quota] led to large numbers of inexperienced women being appointed to boards, and...has seriously damaged those firms' performance" (July 21, 2011). Also, *The Wall Street Journal* wrote that "[the quota law] damaged shareholder value in the companies affected" (June 11, 2012).

up with firm-level cross-sectional regressions of abnormal stock returns, which fail to reject the hypothesis of a value-neutral market reaction to the quota news.

Following the analysis of the short-term market reaction to quota news, we turn to the long-run stock price performance from February 2002 to April 2008 (when all regulated firms complied). We show that the portfolios of firms with (i) all-male boards in 2001 and (ii) at least one female director in 2001 both exhibit zero long-run stock return performance against standard risk-factor benchmarks. A long-short investment strategy in these two portfolios also exhibits a statistically insignificant long-run stock return performance. This exercise, which is similar in spirit to studies examining the performance of firms with high and low governance scores more generally (Gompers, Ishii, and Metrick, 2003), corroborates our short-term event-study evidence.

Next, we revisit AD's instrumental variable (IV) analysis to highlight that identifying the causal effects of quotas is complicated because of the endogenous nature of board composition. AD conclude that their IV analysis provides evidence of a large (20%) quota-induced reduction in Tobin's Q of firms with all-male boards. Specifically, AD instrument the annual board composition with the fraction of female directors in the year 2002 interacted with year dummies until 2009. However, we argue that this instrument is endogenous and fails the exclusion restriction for an unbiased IV test. As AD show in one of their tables, the fraction of female directors in 2002 is highly correlated with firm size, which itself directly affects Tobin's Q and hence arguably violates the exclusion restriction.

We provide substantial evidence that supports this critique of AD's IV analysis. First, we show (as do AD) that their instrumentation has no significant effect on Q until the financial crisis—when it decreases Q. We then show that simply replacing AD's instrumentation with firm size in the year 2002 (interacted with year dummies) generates similar IV regression results. This is consistent with a fundamental firm-size effect, rather than the 2002 board gender composition, driving AD's results. In another experiment, we exclude the five large government-controlled firms in AD's sample, which due to their superior access to capital performed relatively well during the financial crisis (Beuselinck, Cao, Deloof, and Xia, 2017) for reasons unrelated to their 2002 board composition. This five-firm exclusion is sufficient to eliminate the statistical significance of the second-stage effect on Q. In sum, we conclude that AD's significant IV coefficient estimate has little to do with the quota constraint *per se*.

Finally, we address two pieces of evidence often used to support AD's finding of a negative valuation effect of the quota. First, Matsa and Miller (2013) find that the operating performance of ASA drops significantly relative to private limited companies (AS), which are not regulated by the quota law.[5] We show that this ROA decline is most likely unrelated to the quota itself. Second, AD and Bøhren and Staubo (2014) claim that the quota caused a substantial number of ASA-to-AS conversions to avoid the quota constraint. However, by manually searching news and press releases, we show that no listed ASA delisted for reasons other than merger and acquisition (M&A) or bankruptcy—complex transactions that are almost certainly not driven by the quota restriction. For unlisted ASA, there are conversions throughout the entire sample period. However, we find that these unlisted-ASA conversions are uncorrelated with the board gender composition after controlling for year fixed effects, which Bøhren and Staubo (2014) do not include. Year fixed effects are required to control for the strong quota-induced time trend in the fraction of female directors.

2 Quota restriction, timeline, and sample characteristics

In this section, we first detail the quota restriction, which is necessary to define our central variable: the fraction of additional female directors required to comply with the quota ($Shortfall$). We then provide an overview of all the main quota events that took place. This overview is new to the literature and subsequently used in our event study (Section 4). These events highlight that the public debate may cause the market's perception of the likelihood of a quota law to fluctuate and even change sign. Finally, we show the characteristics of our sample of ASA firms.

2.1 The quota restriction

The quota applies to boards of ASA, but not to the much bigger population of AS. Under Norway's codetermination law, shareholders elect one set of directors and the employees elect another set of directors (up to one-third of the board). Since the quota applies to shareholder-elected directors only, they are the exclusive focus of this paper. Directors are nominated by an independent committee and typically appointed for a term of two years. Overall, director elections are substantially influenced by shareholders, reflecting the fact that shareholder concentration is generally high (shown in Section 2.3).

As shown in columns (1) and (2) of Table 1, the quota mandates that, in a board with three directors, at least one must be female and at least one male (the gender-balancing requirement). Moreover, there

[5] Norwegian ASA compares to the UK PLC while AS compares to the UK Ltd corporate form.

must be at least two women on boards with four to five members (the average board size among ASA), three women on six to eight-member boards, and four women on a nine-member board. Finally, for a board with ten or more members, the fraction of female (and male) directors must be at least 40%.

These restrictions imply that the fraction of female directors required to comply with the quota varies substantially with board size. To reflect this variation, columns (3)–(5) of Table 1 define $Shortfall_{it}$ as the difference in year t between firm i's fraction of female directors required by the quota and that of its current board. Throughout the paper, we use $Shortfall_{it}$ to measure the quota constraint facing an individual ASA in a given year t. Note that, since the required fraction of female directors varies with board size, the firm can affect $Shortfall_{it}$ by either replacing male directors or changing board size.

2.2 Legislative timeline and news events

We focus our event study on the five news event dates listed in Table 2, all of which gradually increased the probability of a quota law. After two government white papers (in 1999 and 2001), which discussed ways of increasing the number of women on corporate boards, a quota received unexpected government support. On Friday, February 22, 2002 (event 1), the minister of industry and trade, Ansgar Gabrielsen, took the market by surprise by declaring his support for a mandatory gender quota in an interview with *Verdens Gang*, Norway's leading national tabloid newspaper (translated headline: "Sick and tired of the old men's club!"). His support was surprising because it contradicted the official policy of his political party—the conservative party ("Høyre")—which was the largest party of the coalition government.

Likely due to the internal party-political opposition caused by his contradiction, Gabrielsen publicly retracted his support the next day (Saturday, February 23), and hence *lowered* the market's assessment of the likelihood of a quota law relative to the day before. His retraction was widely noted by market participants, as it appeared in Norway's major national business daily *Dagens Næringsliv* (translated headline: "Gabrielsen no longer supports a quota"). Table 2 lists both news announcements under news event (1) because of their rapid succession (Friday and Saturday) and because both fall inside AD's five-day event window centered on Friday, February 22. In Section 3.2, we separate the two opposing announcements in our analysis of the market reaction to the quota-related news events, which AD's analysis does not do (AD do not mention Gabrielsen's retraction on February 23).

In the week following February 23, parliamentary members of the conservative party kept publicly reiterating the party's opposition to a quota imposed on private company boards. Given this clear stance against a quota, it came as another surprise when, in the evening of March 7, 2002, the coalition government proposed a gender-quota law at a press conference. The surprise decision was reported in the media the next day (International Women's Day, event 2 in Table 2). *Dagens Næringsliv*'s headline that day reads (translated): "The conservative party outmaneuvered."[6] Taking a lead, the Cabinet promised compliance by government-owned firms within one year. The law proposal was submitted to Parliament more than one year later, after business hours on Friday, June 13, 2003, and the market learned this information the following Monday, June 16 (event 3). The proposal contained a provision stating that the quota law would be canceled if firms complied voluntarily by 2005. The law was passed by Parliament's lower chamber ("Odelstinget") and the upper chamber ("Lagtinget") in late 2003 and was formally amended to Corporate Law on December 19, 2003. To take effect, the quota had to be mandated by the Cabinet after reviewing voluntary compliance through 2005.

Although many firms immediately began to increase female director representation, the degree of voluntary compliance in 2005 was ultimately deemed insufficient by the newly elected coalition government led by the labor party ("Arbeiderpartiet"). The conservative party, nevertheless, continued to oppose mandating the quota and, if the law were to be mandated, insisted on imposing a soft sanction for non-compliance. On December 1, 2005, the Prime Minister announced that the quota would be mandated and most likely include sanctions for non-compliance in the form of fines (event 4). However, when the Cabinet mandated the law on December 9 (event 5), the sanction effectively became forced liquidation—the ultimate penalty for violation of Norwegian corporate law. Existing firms were given two years to comply, and by April 2008, all firms subject to the quota had complied.

2.3 Sample characteristics and board changes

We use the population of ASA. There are 1,150 unique ASA and 6,873 firm-years in the sample period, 1998–2013. Specifically, the ASA population consists of 409 unique listed ASA and 888 unique unlisted ASA, of which 147 firms are listed in some years and unlisted in other years. We obtain the ASA from the *Brønnøysund Register Centre*, 1998–2013, through the database constructed by Berner, Mjøs, and Olving (2013).[7] Column (1) of Table 3 shows that, in a typical year, there are 174 listed ASA and 255 unlisted

[6] The Christian democratic party ("Kristelig Folkeparti")—the smaller government coalition party—had been open to the idea of a quota all along.

[7] We made the following corrections: The firm with organization number 912618900 is AS throughout the sample period. The firms 993020044 and 993020087 are not domestic registered, and 930192503 and 977241774 are not so from 2007. The firms 914778271, 923609016, 943753709, 981276957, and 982463718 are government-controlled.

ASA. In terms of asset size (Column 3), listed ASA average more than three times that of unlisted ASA. We supplement with data from Norwegian tax authorities (2004–2013), Column (4) shows that stock ownership is, on average, highly concentrated and largely time-invariant: the largest shareholder has an average stake of 35% in listed ASA and 56% in unlisted ASA.[8] Column (5) of Table 3 and Figure 1 show that the fraction of female directors in all ASA rose from about 5% in 2001 to roughly 40% by early 2008. Moreover, Column (6) shows that the fraction of female chairs increased substantially from basically zero before 2001 to around 10% toward the end of the sample period.

As directors' CEO experience is generally viewed as adding board effectiveness and thus valued by investors (Fich, 2005; Fahlenbrach, Low, and Stulz, 2010; Kang, Kim, and Lu, 2018), Column (8) describes board CEO experience, defined as experience as a CEO in an ASA or one of the 1% largest AS by revenue in the past three years. We select the top 1% AS because the annual population of about 100,000 AS is overwhelmingly dominated by tiny firms: 46% of all AS have at most one employee, 58% have at most two, and 90% have at most ten. The annual number of employees averages 657 for listed ASA, 209 for unlisted ASA, and 45 for the 1% largest AS.[9] Notice first that, as shown in Column (7) and by Bertrand, Black, Jensen, and Lleras-Muney (2019), the fraction of female CEOs is generally low: in our sample, it increases from 2% in 1998 to 5% for listed ASA and 10% for unlisted ASA in 2013. Column (8) shows the fraction of a board's directors with CEO experience. For the average listed and unlisted ASA, the board's CEO experience is stable at around 17% over the sample period.

Turning to board size, Figure 1 shows that the average size of ASA boards remained at five shareholder-elected directors throughout the sample period. For a five-member board in 2003, quota compliance implied replacing 1.5 male directors with females, bringing female directors to two. Panel A of Figure 2 plots the ASA board-size frequency distribution in 2001 and 2008. It shows a narrowing of the distribution (significant at the 5% level with a non-parametric Kolmogorov–Smirnov test), reflecting a shift from four to five and six to five board members. That is, while the quota did not cause a change in average board size, there is less variation around the average in 2008. This lower variation possibly reflects a desire to minimize quota-induced costs at the margin.[10]

[8] The listed ASA are predominantly in Offshore/Shipping, Telecom/Technology, and Manufacturing, while the unlisted ASA are in Financial Services and Telecom/Technology.

[9] To be included, an AS must meet the following restrictions: total assets > 0, revenue > 0, long-term assets ≥ 0, current assets ≥ 0, current debt ≥ 0,long-term debt ≥ 0, short-term debt ≥ 0, total assets $>$ cash balances, and total assets $>$ (current assets–current debt). Subsidiaries not reporting consolidated accounts are excluded.

[10] As shown in Table 1, increasing the board from four to five members allows a firm to appoint two females while retaining three (rather than two) males, and reducing board size from six to five directors allows the firm to appoint two (rather than

Finally, Panel B of Figure 2 plots the frequency distribution of the number of board seats in ASA and the 1% largest AS held by male and female ASA directors in 2001 and 2008. As shown, these directorships are highly dispersed in both years: more than two-thirds of individual directors hold only one board seat. Moreover, the distribution is largely similar for male and female directors. Consistent with Bertrand, Black, Jensen, and Lleras-Muney (2019), Panel B suggests that the supply of qualified female director candidates was sufficiently high to prevent a disproportionally high seat concentration among female directors.

3 Revisiting AD's event study

In this section, we highlight important econometric issues in event studies of news announcements affecting the likelihood of laws and regulations by critically revisiting AD's main event-study conclusion. AD report that the first event listed in Table 2 (Friday, February 22, 2002) caused a significantly negative valuation effect for OSE-listed companies with all-male boards. We first replicate AD's abnormal return estimates as closely as possible using their sample of firms, return data, and econometric methodology. We then bring two important missing components into AD's analysis, which uses the five-day window (-2,2) centered on Friday, February 22. The first is the news announcement on Saturday, February 23, 2002, which is ignored by AD and which *reduced* the likelihood of a quota. The second missing component in AD's analysis is a correction for the contemporaneous cross-correlation of stock returns, which exists when the event affects all firms simultaneously in calendar time.

3.1 A close replication of AD's event study

Panel A of Table 4 copies the average five-day abnormal stock returns from AD's Table III. For each of the 94 OSE-listed ASA in their sample, the cumulative abnormal return (CAR) is computed as follows:

$$CAR_i(-2,2) = \sum_{\tau=-2}^{2} (r_i - r_{i,match})_\tau \,, \tag{1}$$

where r_i is firm i's return on event day τ and $r_{i,match}$ is the average return to U.S.-listed companies in firm i's Global Industry Classification Standard (GICS) industry. Day 0 is Friday, February 22, 2002,

three) females while retaining three males.

when the Minister of Industry and Trade, Gabrielsen, surprisingly announced his support of a board gender quota (the first event in Table 2). AD's stock return data are from Compustat Global for the listed ASA and from the Center for Research in Securities Prices (CRSP) for the industry-matched U.S. firms. AD classifies the sample firms based on their board composition in the year 2001—prior to the February 2002 news event—obtained from firms' annual reports.

In Panel A of Table 4, the average $CAR_i(-2,2)$ is -2.57%, which is significantly negative at the 1% level. The p-value is computed based on the cross-sectional standard deviation of $CAR_i(-2,2)$. Furthermore, columns (2)–(4) show that the negative market reaction is concentrated among firms with zero female directors in 2001 ($Zero_{2001}$). In Column (4), *Zero-Pos* is the difference in average abnormal return between the firms with all-male boards ($Zero_{2001}$) and firms with at least one female director (Pos_{2001}). This difference is -3.52%, which is highly significant. Based on this evidence, AD conclude that the average market reaction to the February 22, 2002 quota event, which increased the likelihood of a future quota law, was significantly negative.

We attempt to replicate Panel A using information from AD. This includes Eq. (1), the names of their 94 sample firms and, as closely as possible, their return data from Compustat Global and CRSP.[11] As AD do not provide complete information on their data selection criteria, we restrict the matching firms to NYSE/Amex/Nasdaq common stocks of firms incorporated in the U.S. (CRSP share codes 10 and 11). Moreover, in the presence of multiple share classes, we select the share class with the highest trading volume over the estimation period. Importantly, as AD provide no information on how they treat non-trading days inside the five-day event window, we adopt two alternative return assumptions in panels B and C.

First, in Panel B (which contains two sub-panels B1 and B2) of Table 4, we require at least one trade within the five-day event window. As it turns out, it is necessary to include multi-day returns—some of which extend prior to day -2—to generate a $CAR(-2,2)$ estimate for all of AD's 94 sample firms. As shown in Panel B1, the average $CAR(-2,2)$ of -2.83% is statistically significant at the 1% level when we, like AD, include multi-day returns and assume that these returns are cross-sectionally independent. For the 69 firms with all-male boards ($Zero_{2001}$) in Column (2), the average $CAR(-2,2)$ is -3.89% and, as in Panel A, significantly different from that of firms with at least one female director (Pos_{2001}) in

[11]We thank Kenneth Ahern for providing the names of the 94 firms. While AD's board data are from annual reports, ours are from *Brønnøysund Register Centre*. In the latter data source, 69 firms (vs. 68 in AD) had zero female directors in 2001. This one-firm difference does not affect our statistical inferences.

Column (3). Thus, when requiring at least one trade within the five-day event window, we can include all the 94 firms in AD's sample and reach the same statistical inference as AD. In Panel C, we modify the return requirement in Panel B by requiring trades on two consecutive days between day -3 and +2. This restricts the sample available for estimating AD's $CAR(-2, 2)$ from 94 to 79 firms (and to 65 firms if we instead require an exact five-day return). For this subsample, the average $CAR(-2, 2)$ is -3.26% for $Zero_{2001}$ and 0.11% for Pos_{2001}. Moreover, as shown in Column (4), the difference in the mean is significant at the 10% level.

As pointed out by AD as well, the percentage of female directors in 2001 is highly correlated with firm size. Note also that AD's 94 OSE-listed sample firms are a magnitude smaller than the U.S. matching firms in Eq. (1)—they are not matched on firm size, whether belonging to $Zero_{2001}$ or Pos_{2001}. It is, therefore, possible that AD's difference in average CAR across $Zero_{2001}$ and Pos_{2001} is driven by differences in OSE-listed firm size rather than the quota constraint. We examine this possibility in Panel B2 of Table 4. While maintaining the sample sizes in B1, B2 redefines (in this panel only) $Zero_{2001}$ (Pos_{2001}) to be the 69 smallest (25 largest) sample firms, measured by total revenue in 2001. The average $CAR_i(-2, 2)$ of the redefined $Zero_{2001}$ and Pos_{2001} are now -3.66% and -0.53%, respectively, which are significantly different at the 10% level in Column (4). The similarity of the abnormal returns in panels B1 and B2 suggests that AD's abnormal return difference in Column (4) may reflect differences in firm size rather than board composition. We return to the potential role of firm size in the cross-sectional regressions in Section 4.2 and when discussing AD's analysis of Tobin's Q in Section 5.2.

3.2 Adjusting for the second event inside AD's event window

In Panel D of Table 4, we introduce a day-by-day analysis of AD's five-day event window. Although AD do not report day-by-day results, this allows us to examine whether AD's large negative average $CAR(-2, 2)$ is driven by the February 22 news, as they assume, or the next day's *probability-decreasing* event. To be included, a firm must have a one-day return on the event day in question, which produces 64–67 abnormal return (AR) observations per day. We continue to use AD's method for computing p-values, i.e., assuming cross-sectional independence of the individual AR_i.

Recall from Table 2 that the Minister of Industry and Trade on Saturday, February 23, 2002, *publicly retracted* his support for the quota expressed one day earlier. His retraction was consistent with his own ruling party's negative view on a board gender-quota law at the time. Thus, while his Friday support statement likely increased the market's assessment of the probability of a quota law, his next-day (Saturday) retraction of the support lowered this probability assessment. The market reaction to the Saturday news event is reflected, at the very earliest, in the stock price on the next trading day, Monday, February 25, which is day +1 in AD's five-day event window. Thus, it is not possible to infer from AD's results whether their negative average $CAR(-2, 2)$ represents the market's reaction to the first (Friday's) or the second (Saturday's) quota-related news announcement. In particular, if the negative $CAR(-2, 2)$ is driven by the Friday announcement, then the conclusion must be that the market reacted negatively to the prospect of a new quota law. However, if the negative $CAR(-2, 2)$ is driven by Saturday's announcement—showing up the next Monday—then the opposite conclusion follows: the market was disappointed that the quota law was now *less* likely than previously anticipated.

To resolve the issue of which day in AD's five-day window drives their negative average $CAR(-2, 2)$, we estimate the average abnormal return for each day within their event window. In Panel D of Table 4, we denote the one-day average abnormal return estimate as $AR(\tau)$, where $\tau = -2, ..., 2$ denotes the day inside the five-day event window. Note first the statistically insignificant AR on Friday, February 22. That is, contrary to AD's inference, the average market reaction to the news that increased the likelihood of a future quota law was *not* significantly different from zero, even under AD's assumption of zero cross-correlation of returns.[12] However, the average market reaction on Monday, following Saturday's probability-reducing quota news, is *negative* and statistically significant, with $AR = -1.99\%$. Moreover, as shown in columns (2)–(4), this negative market reaction is concentrated among firms with all-male boards. In sum, AD assign their evidence of significantly negative abnormal returns to the wrong event. Using their data and methodology, the correct conclusion is that the market reacted negatively to news that a quota law would be *less likely* than previously anticipated. This reversal fails to support the hypothesis that the market considered the quota law to be costly for shareholders and even suggests the opposite market reaction.

We next turn to our second critical assessment of AD's event-study methodology: p-values that are biased downward due to their assumption of cross-sectionally independent abnormal stock returns.

[12]Neither a t-test for difference in mean nor a Wilcoxon rank-sum test for difference in median indicates that the quota announcement on Friday, February 22, 2002, affected firms labeled $Zero_{2001}$ or Pos_{2001} differently.

3.3 Adjusting AD's p-values for return cross-correlation

Stock returns tend to move in the same direction in calendar time regardless of any heterogeneous firm-level impact of a news announcement. Therefore, AD's assumption that the individual returns, $CAR_i(-2,2),\ i = 1, ..., 94$, are cross-sectionally independent over the five-day calendar-time period biases downward their p-value of the average $CAR_i(-2,2)$. To illustrate the magnitude of this bias, let all firms have an identical individual standard deviation of daily returns (σ) and pairwise daily return correlation (ρ). The standard deviation of the average return across N firms is (Kothari and Warner, 2007):

$$\sigma_N(\rho) = \sqrt{\frac{1}{N}\sigma^2 + \frac{N-1}{N}\sigma^2\rho}, \tag{2}$$

and the bias from assuming $\rho = 0$ is therefore

$$\frac{\sigma_N(\rho)}{\sigma_N(0)} = \frac{\sigma_N(\rho)}{\sqrt{\sigma^2/N}} = \sqrt{1 + (N-1)\rho}. \tag{3}$$

For example, with $\rho = 0.10$, which is a typical average pairwise return correlation on the OSE (Næs, Skjeltorp, and Ødegaard, 2008) and in the U.S. stock markets (de Bodt, Eckbo, and Roll, 2020), AD's sample size of $N = 94$ means that $\sigma_N(\rho) = 3.2\sigma_N(0)$. In other words, the true standard deviation would in this case be 3.2 times greater than a standard deviation assuming zero contemporaneous cross-correlation of returns. Interestingly, this simple illustration is close to the empirical bias in AD's p-values identified below.

To properly adjust AD's significance levels for $\sigma_N(\rho)$, it is necessary to introduce a time-series analysis into the event study. We, therefore, run the following portfolio time-series regression:

$$r_{pt}^{-I} = \alpha_p + AR_p d_t + \epsilon_{pt}, \tag{4}$$

where $r_{pt}^{-I} \equiv \frac{1}{N}\sum_{i=1}^{N}(r_i - r_{i,match})_t$ is the equal-weighted average daily abnormal return using AD's definition in Eq. (1). The estimation period is trading day -252 through day 2, where day 0 is February 22, 2002, and it uses daily stock returns from Compustat Global and CRSP. The dummy variable d_t takes a value of one during AD's event window (-2,2) and zero otherwise. Thus, AR_p is simply the daily average abnormal stock return over the five-day event window, and $5AR_p$ is the average $CAR_i(-2,2)$.

Moreover, as the portfolio return r_{pt}^{-I} fully absorbs whatever contemporaneous cross-correlation exists at time t, the standard error of AR_p is $\sigma_{AR}(\rho)$, which corresponds to $\sigma_N(\rho)$ in the illustration above. We use the correct t-statistic $5AR_p/\sigma_{5AR_p}(\rho) = AR_p/\sigma_{AR_p}(\rho)$ to test the null-hypothesis that AD's average abnormal return, $CAR(-2, 2)$, is equal to zero.[13]

Recall from Panel C of Table 4 that, when we restrict each firm to have one or more one-day returns in the event window (-2,2), AD's sample is reduced from 94 to 79. This is the base-sample for the results reported in Panel A of Table 5. We again start with AD's five-day window, but this time use the time-series portfolio regression in Eq. (4) to incorporate the cross-sectional correlation. The average $CAR(-2, 2) = 5AR_p$ is -2.20% and, as expected, almost identical to the average $CAR(-2, 2)$ reported in Panel C of Table 4. However, the p-values are now much higher, to the point where one can no longer reject the hypothesis of $AR_p = 0$ even for the subsample of all-male boards (Column 2).

Panel B reports the day-by-day portfolio estimates of abnormal returns, again requiring a one-day return in the event window. Importantly, the abnormal return on Monday, February 25, 2002, is now also insignificantly different from zero, as are all individual days in AD's five-day event window.[14] In sum, AD's conclusion of a statistically significant negative market reaction to the quota announcement, as well as the significance of Monday, February 25, in our expanded day-by-day analysis, all require the untenable assumption of a zero contemporaneous cross-correlation of stock returns.

In sum, in this section, we have shown that AD's negative abnormal return estimate for firms with all-male boards is driven by the second (Saturday's) probability-decreasing announcement and *not* by Friday's probability-increasing announcement, which effectively reverses their main conclusion. We also show that adjusting for the cross-correlation of stock returns created by an event that affects all firms simultaneously in calendar time results in p-values that are too large to reject the null hypothesis of zero abnormal returns for either of the two events inside AD's five-day event window—otherwise estimated using AD's abnormal return definition. Hence, the evidence is consistent with a neutral valuation effect of the quota.

[13]While not tabulated, we have verified that our results are robust to estimating the abnormal returns using a system of seemingly unrelated regressions (SUR), with a single ordinary least squares (OLS) regression for each sample firm, and computing standard errors accounting for the residual cross-correlation (Kolari and Pynnönen, 2010). The SUR approach produces coefficient estimates identical to our portfolio approach. However, it is less efficient because it substantially increases parameter estimation error (Sefcik and Thompson, 1986).

[14]While not tabulated, this conclusion also holds if we include a dummy variable in Eq. (4) for day t being a Monday in the estimation period. This confirms that there is no so-called weekend effect (French, 1980) driving our abnormal return estimates.

4 A comprehensive multi-event analysis

In this section, we perform a comprehensive analysis of the market reaction to all five quota events listed in Table 2. This allows us to incorporate the possibility of changing market priors in response to news events that reflect the ongoing public debate into the analysis. We first introduce the portfolio-based approach, which is required to control for any contemporaneous cross-correlation of stock returns, and then provide cross-sectional estimates of the determinants of firm-level abnormal returns.

4.1 The portfolio-based approach

To maximize test power (Brown and Warner, 1980, 1985), we use the standard two-day event window (-1,0), which ends with the public announcement date (day 0). Note that this two-day window allows us to estimate the market reaction to February 22, 2002, without it being confounded by the second announcement on event day +1 (February 25). For the same reason, we do not include February 25 here, as its day -1 is February 22 (the market reaction on February 25 is already properly estimated and reported in Panel B of Table 5).

For each of the five events, we estimate $CAR(-1,0) = 2AR_p$ for a portfolio of OSE-listed firms using the return-generating process:

$$r^e_{pt} = \alpha_p + \beta_p r^e_{wt} + AR_p d_t + \varepsilon_{pt}, \tag{5}$$

where r^e_{pt} is the daily equal-weighted return (converted to USD using the daily exchange rate) in excess of the daily 3-month U.S. Treasury bill, d_t is a dummy for the event window (-1,0), and r_{wt} is the daily excess return on the Morgan Stanley Capital International (MSCI) stock market world index. The regression starts 252 trading days prior to and ends on event day 0, excluding days of prior events, if any. To be included in portfolio p, a firm must have a minimum of 100 one-day return observations from *Oslo Børsinformasjon* and a one-day return observation on both days in the two-day event window. This leads to portfolios with the number of listed firms ranging from 132 to 146 across the five events.[15]

In Table 6, *High shortfall* firms have a female director $Shortfall$ at or above the median in the preceding year-end. Columns (1)–(4) use samples of OSE-listed Norwegian ASA, while columns (5)–(7) use samples of OSE-listed Norwegian ASA (treated) and OSE-listed foreign-domiciled (control) firms

[15] Daily stock returns from *Oslo Børsinformasjon* are computed using differences in (log of) daily closing prices, adjusted for splits and dividends. If a closing price is missing in the estimation period, it is replaced by the bid-ask midpoint, if available. Twenty percent of the estimation-period returns are generated from bid-ask prices.

in the oil/offshore sector. At the bottom of the table, we re-estimate the model across all five events simultaneously, with the dummy variable d taking a value of one in the event window (-1,0) for all five events, which produces $CAR_{1-5}(-1,0) = 10AR_p$. This last estimation begins 252 days prior to the first event (February 22, 2002) and ends on the day of the fifth event (December 9, 2005). This particular estimation is added as an overall check on the sum of the market reactions to the five events.

Except for event 2 (March 8, 2002), none of the five news events in Table 6 generate statistically significant abnormal stock returns. Moreover, none of the five events generate significant abnormal returns for the long-short portfolio in Column (4), which is long in *High shortfall* and short in *Low shortfall* ASA. This conclusion also holds for *All events* using $CAR_{1-5}(-1,0)$.[16] As to the positive $CAR(-1,0)$ on March 8, 2002, news searches reveal that, on this day, Parliament approved a plan for the development and operation of the Snøhvit natural gas field in the Barents Sea.[17] Note that Column (5) reports a weakly positive $CAR(-1,0)$ for the 31 OSE-listed ASA operating in the oil/offshore sector, while Column (6) shows a similar market reaction of the ten OSE-listed foreign-domiciled oil/offshore companies, which are not subject to the quota law. Finally, Column (7) reports a small and statistically insignificant abnormal return to a portfolio long in domestic and short in foreign oil/offshore firms. Thus, the positive abnormal returns on March 8, 2002, appear to be industry-driven, rather than a phenomenon tied to Norwegian incorporation and hence the quota law.

4.2 Cross-sectional determinants of abnormal returns

In this section, we perform cross-sectional (OLS) regressions at the firm level to test whether the market reaction to quota news events depends on the shortfall of female directors as well as other firm-specific characteristics. If the quota constraint is costly, firm i's abnormal return in response to event k, $CAR_{i,k}(-1,0)$, should be more negative the more binding the quota constraint, i.e. negatively correlated

[16] While not tabulated, this conclusion holds with an alternative three-day event window (-1,1), irrespective of the risk adjustment. Moreover, our inferences are unaffected if we instead use a simple mean-adjusted return model ($r_t = \alpha + AR_k d_{kt} + \varepsilon_t$), a lead-lag market adjustment to account for non-synchronous trading, as in Scholes and Williams (1977) ($r_t = \alpha + \beta_1 r_{w,t-1} + \beta_2 r_{wt} + \beta_3 r_{w,t+1} + AR_k d_{kt} + \varepsilon_t$), or a four-factor model (Fama-French factors and momentum, from Ken French's website).

[17] Parliament also approved the installation and operation of an onshore plant to process liquefied natural gas from the field. The Snøhvit project, with estimated investments exceeding \$6.3 billion, was the first natural gas development in the Barents Sea and Europe's first gas liquefaction project.

with *Shortfall*. For each event k, the regression specification is:

$$CAR_{ik}(-1,0) = \alpha_k + \gamma_{1k} Shortfall_{ik} + \gamma_{2k}\mathbf{X_{ik}} + \kappa_i + u_{ik}. \quad k = 1,\ldots,5. \tag{6}$$

In addition to $Shortfall$, the vector of controls $\mathbf{X}$ includes several firm characteristics. *Largest owner* is the percent ownership of the largest shareholder. *Government control* is a dummy variable indicating government ownership of at least 30% of the outstanding shares. *Codetermination* is a dummy indicating that quota-induced females and employee directors together have a majority of the board seats. *Risk* is the firm's daily stock return volatility in the year prior to the event and *Total assets* is the log of book value of total assets. All variables are defined in Table 7.

As is commonly known, board characteristics are endogenous and correlated with firm characteristics. Hence, since $Shortfall$ is correlated with firm size, we include *Total assets* to help control for size effects on the board composition that are unrelated to the quota itself. *Largest owner* and *Government control* capture large owners that have considerable influence over director appointments. *Codetermination* and *Risk* are meant to capture, respectively, the possibility that new and relatively inexperienced female directors form coalitions with labor representatives on the board and that they may be excessively risk averse, to the detriment of shareholders. The regressions also include industry fixed effects (κ_i) allocating each OSE-listed ASA to one of ten industry sectors. The results are shown in Table 8. Importantly, the regressions fail to identify significant effects of $Shortfall$ on the event returns for all five events.

In sum, the average abnormal return estimates in Table 6, which account for the contemporaneous cross-correlation of stock returns, fail to reject the null hypothesis of a zero two-day market reaction to the gender-quota news announcement in Table 2, whether individually or jointly. Moreover, regardless of the quota event, the cross-sectional regression coefficient estimates in Table 8 fail to reject that the individual (firm-level) abnormal stock returns are uncorrelated with the fraction of female directors.[18]

5 Long-run performance estimates

Under market efficiency, the average market reaction to the quota news announcement—estimated in Section 4—represents an unbiased estimate of the true valuation effect of the quota constraint. Therefore,

[18] The fraction of female directors varies both with the number of female directors and board size. While not reported, we have verified that our conclusion is robust to using, as an alternative, the number of female director shortfall.

if the valuation effect is truly close to zero—as suggested by our evidence of a statistically insignificant market reaction—there should be no subsequent (long-run) quota-induced abnormal performance of the OSE-listed firms. In this section, we first test this proposition conditional on a model generating expected returns. This analysis, which is similar in spirit to extant studies of the long-run performance of stock portfolios of high versus low governance quality (Gompers, Ishii, and Metrick, 2003), therefore serves as a useful check of the main statistical inference in Section 4.1. We then turn to AD's time-series analysis of Tobin's Q and critically examine their inference, which is at odds with our evidence of statistically insignificant event-induced abnormal stock returns.

5.1 Long-run portfolio performance

We measure long-run abnormal portfolio performance using the parameter α_p in the following three-factor model:

$$r^e_{pt} = \alpha_p + \beta_{p1} r^e_{wt} + \beta_{p2} HML_t + \beta_{p3} SMB_t + \varepsilon_{pt}, \quad t = 2/2002, ..., 4/2008. \tag{7}$$

where r^e_{pt} is now the monthly USD-denominated stock return to portfolio p of domestic OSE-listed ASA, which is converted to USD using the monthly exchange rate, in excess of the current month's 3-month U.S. Treasury bill. r^e_{Wt} is the monthly return on the MSCI world stock market index in excess of the current month's 3-month U.S. Treasury bill. HML_t and SMB_t are monthly returns to the global value and size factors (Fama and French, 1993) found on Kenneth French's website.

Table 9 shows α_p estimates for three alternative equal-weighted portfolios. In columns (1)–(3), the return-generating process is from Eq. (7), while columns (4)–(6) add a global momentum risk factor, MOM (Carhart, 1997), also found on Kenneth French's website. The first portfolio, $Zero_{2001}$, contains an average of 98 OSE-listed ASA with all-male boards in 2001. The second portfolio, Pos_{2001}, contains an average of 32 firms with at least one female director in 2001, while the third portfolio, $Zero$–Pos, is long in $Zero_{2001}$ and short in Pos_{2001}. The abnormal performance parameter α_p is insignificantly different from zero for all three portfolios. That is, even for a portfolio that goes long in firms that are the most affected by the quota ($Zero_{2001}$) and short in the least affected firms (Pos_{2001}), there is no long-run abnormal stock performance. This evidence supports our conclusion from the short-run event study of a value-neutral market reaction to forced board gender balancing.

5.2 A critique of AD's IV test for effects on Tobin's Q

In this section, we revisit AD's instrumental variable analysis to highlight that identifying the causal effects of quotas is complicated because of the endogenous nature of board composition. AD examine the long-term effects of the quota on Tobin's Q using a two-stage IV regression, referring to Stevenson (2010)'s study of the effect of female athletic participation on education and professional outcomes. AD's IV analysis is designed to account for the effect of firms' endogenous quota compliance timing over the six-year period 2003–2009. To achieve this, the base for their instrumentation in the first step is the 2002 fraction of female directors, which they interact with year dummies for 2004 to 2009. However, as discussed below, this instrumentation most likely fails the exclusion restriction and hence is invalid in AD's context.

To illustrate AD's IV procedure, we employ our variable $Shortfall$, which corresponds to AD's fraction of female directors but will produce an opposite coefficient sign in a regression on Tobin's Q. AD's first step regression can then be written as follows:

$$Shortfall_{it} = \alpha + Shortfall_{i,2002} \sum_{t=2004}^{2009} \beta_t \tau_t + \theta_i + \tau_t + u_{it}, \quad t = 2003, ..., 2009, \tag{8}$$

where θ_i and τ_t are firm and year fixed effects, respectively, and the summation is zero in 2003. The second-step regression is

$$Q_{it} = \alpha + \beta \widehat{Shortfall}_{it} + \theta_i + \tau_t + \epsilon_{it}, \quad t = 2003, ..., 2009, \tag{9}$$

where $\widehat{Shortfall}_{it}$ is the predicted value from the first step. We use *Oslo Børsinformasjon* to measure Q (see Table 7) for a definition.[19] As shown in Column (1) in Panel A of Table 10, our estimation of Eq (9) results in a coefficient estimate for $\widehat{Shortfall}_{it}$ of 1.91, which is statistically significant at the 5% level and almost identical to AD's estimate of -1.94. The change in the sign is, of course, because AD use the fraction of female directors, whereas we use the inverse shortfall ($Shortfall$). This coefficient estimate is what prompts AD to conclude that "[Norway's gender quota] led to value losses of upwards of 20% for

[19] We eliminate firm-years with Q$\leq$ 0 and winsorize the remaining observations at 1% and 99% each year. While AD employ industry-adjusted Q, we follow the recommendation of Gormley and Matsa (2014) and exclude the industry adjustment. Our total number of firm-years is 820 (compared to 630 in AD), reflecting our access to board composition data in *Brønnøysund Register Centre* and stock return data from *Oslo Børsinformasjon*.

the firms with [all-male boards]" (p. 168).[20]

Column (1) in Panel B of Table 10 shows that the instrument $Z_{it} \equiv Shortfall_{i,2002} * \tau_t$ ($t = 2004, ..., 2009$) is a good predictor of $Shortfall_{it}$. Formally, the hypothesis of joint instrument irrelevance across years, i.e. that $Cov(Z_{it}, Shortfall_{it}) = 0$ for all t=2004,...,2009, is strongly rejected with an F-value of 85.9. Therefore, the instrumentation meets the inclusion restriction (Angrist and Pischke, 2009). However, it is difficult to argue in economic terms that the instrument also meets the exclusion restriction. This restriction requires Z_{it} to impact Q_{it} only through $\widehat{Shortfall}_{it}$, so that $Cov(Z_{it}, \epsilon_{it}) = 0$. This condition is unlikely to be met since board characteristics are endogenous and correlated with firm characteristics, which in turn affect Q. Therefore, Z_{it} is most likely correlated with the error term ϵ_{it} in Eq. (9). Note also that because the instrument Z_{it}, by construction, has a time-varying effect on Q, this correlation is not eliminated by AD's inclusion of year- and firm-fixed effects in Eq. (9). Hence, we argue that the endogeneity bias caused by latent time-varying, omitted variables is not eliminated and the exclusion restriction is violated.

Table 10 provides new evidence that supports the above argument. First, consider the impact of $Shortfall_{2002} * \tau_t$ in the reduced-form regression estimation in Column (2) of Panel B. This reduced-form regression has regressors identical to Eq. (8) but uses Q_{it} as the dependent variable. Note that $Shortfall_{i,2002} * \tau_{2008}$ is the only statistically significant coefficient estimate. That is, it appears that the presumed effect of the 2002 board composition on Q did not appear until 2008. A similar conclusion emerges from AD's reduced-form regression (Panel B of their Table IV). They explain this late impact of $Shortfall_{i,2002}$ on Q with firms' last-minute quota compliance.

However, as discussed above, since the fraction of female directors in 2002 is endogenous and correlated with firm size, instrument exogeneity is likely violated ($Cov(Z_{it}, \epsilon_{it}) \neq 0$). To examine whether the IV result of AD is driven by firm size rather than board composition *per se*, Column (3) shows the result of replacing $Shortfall_{2002}$ with $log(Sales_{2002})$ in the instrumentation. Notice first that $log(Sales_{2002}) * \tau_t$ also satisfies the relevance condition (F-value of 44.1 in Panel B). More importantly, the second-stage coefficient estimate is highly significant (Panel A), which suggests that larger firms in 2002 performed better than smaller firms did, in particular during the period 2007–2009 (Column 4 of Panel B). This

[20]Beginning in 2005, listed firms were required to report using the International Financial Reporting Standards (IFRS), switching from Norwegian General Accepted Accounting Principles (NGAAP). While not tabulated, adding three firm characteristics from Table 7—*Total assets*, *Leverage*, and *Board size*—as regressors in the IV test does not change our inferences.

challenges AD's interpretation that the fraction of female directors in 2002 is the fundamental driver of Q. It is more likely that the fundamental driver is firm size, which correlates with the 2002 board gender composition.

Moreover, we suggest an alternative explanation for the late impact of $Shortfall_{i,2002}$ on Q that recognizes firms' differential responses to the financial crisis. To illustrate, note that four of the five government-controlled sample firms fully complied with the proposed quota already in 2002 (and the fifth in 2003). Moreover, as their government connection gave these firms superior access to capital, they performed relatively well during the financial crisis (Beuselinck, Cao, Deloof, and Xia, 2017) for reasons other than their 2002 board composition. This suggests that a proper test of AD's proposition should exclude these five firms. As shown in columns (5) and (6), when we exclude the five government-controlled firms, the coefficient estimate for $\widehat{Shortfall}$ in the second IV stage becomes statistically insignificant, as does the coefficient estimate for $Shortfall_{2002} * \tau_{2008}$ in the reduced-form regression. In other words, the shortfall of female directors has no statistical impact on Q once the five government-controlled firms are excluded from AD's IV regression.

Finally, we highlight yet another weakness of AD's IV analysis. Recall from Table 4 that AD correctly classify their sample firms' board composition at year-end 2001 as exogenous to the market reaction to the February 22, 2002, quota news event. In contrast, in their IV analysis, they instead use the board composition at year-end 2002 as providing an exogenous cross-sectional distribution of the fraction of female directors.[21] This is problematic because, following the March 8, 2002, announcement, as much as 29% of the OSE-listed firms reduced $Shortfall$ at the annual shareholder meetings in the spring of 2002.[22] As shown in Column (7) of Table 10, replacing $Shortfall_{2002}$ with $Shortfall_{2001}$ indeed results in a coefficient estimate on $\widehat{Shortfall}$ of 0.69, which is statistically insignificant.

Overall, the Q-analysis in Table 10 casts serious doubt on the validity of AD's inference from their IV test, and it corroborates our main conclusion of a largely value-neutral effect of the quota law.[23]

[21] "We use the 2002 annual reports to measure exogenous variation in the mandated board change, a full year before the quota was passed in December 2003" AD, p. 161.

[22] Recognizing this endogeneity, AD's statement that "[t]o verify that the gender of the boards was not yet impacted in 2002, we compare the gender composition of the boards in 2001 to 2002 and find that the majority of the firms had the same gender composition in both years" (p. 161) does little to resolve this obvious problem of endogeneity.

[23] We have also verified that replacing $Shortfall_{2002}$ with the number of missing female directors under the quota requirement fails to produce a statistically significant coefficient estimate in the second-stage IV regression. Also, while finding an IV instrument that works in AD's setting goes beyond the purpose of this paper, we experimented with the instrument used by Adams and Ferreira (2009) in a different context: the fraction of male directors on the board who sit on other boards on which there are female directors. In our setting, this instrument fails the inclusion restriction (i.e., is uncorrelated with $Shortfall$) once we add year fixed effects to account for the time trend caused by quota compliance.

6 Additional corroborating evidence

The evidence in Section 4 suggests that the Norwegian gender quota imposed few if any costs on shareholders of OSE-listed ASA. In this section, we broaden the debate by revisiting the conclusions of two additional studies that, like AD, argue that the quota imposed large costs on ASA. The first is Matsa and Miller (2013), who report estimates of a significant decline in the post-quota operating performance of ASA relative to AS. The second study is Bøhren and Staubo (2014), who conclude that many ASA switched legal form to AS to escape a costly quota constraint.

6.1 Changes in operating profitability

Using a difference-in-differences regression over the period 2003–2009, Matsa and Miller (2013) report a post-2006 decline in return on assets (ROA, defined as EBIT/total assets, see Table 7) for listed ASA relative to a sample of matched AS. While they also examine an alternative control group of Nordic listed companies, we focus on their use of Norwegian AS. They estimate the quota effect on ROA using the following type of OLS regression:

$$ROA_{it} = \gamma_0 + \gamma_1 ASA_i * Comply_t + \gamma_2 \mathbf{X_{it}} + \theta_i + \tau_t + \epsilon_{it}, \tag{10}$$

where $Comply_t$ takes a value of one for the period 2007–2009 and $\mathbf{X_{it}}$ is a vector of firm characteristics. Their coefficient estimate on $ASA * Comply$ is –0.027 (columns 1 and 2 of their Table 3). They conclude that this reduction in short-term profits in the post-quota period is because listed ASA "undertake fewer workforce reductions than comparison firms, increasing relative labor costs and employment levels" (abstract).

Matsa and Miller (2013)'s difference-in-differences analysis (Eq. 10) assumes that listed ASA and (unlisted) AS exhibit otherwise identical responses to aggregate shocks. This assumption is questionable since the choice of being a listed ASA or an AS is endogenous and may be correlated with latent time-variant factors not captured by the fixed effects. While we do not attempt to resolve this concern, we revisit Eq. (10) after broadening the treatment group to include unlisted ASA. Also, we use a longer sample period to address whether the negative ROA effect identified by Matsa and Miller (2013) lasts beyond the financial crisis period.

Our results from estimating Eq. (10) are shown in Table 11. The indicator variable $Comply_t$ is one for years $t \geq 2008$, as compliance was required by 12/2007, and zero otherwise. The vector $\mathbf{X}_{it}$ contains *Firm age*, *Size*, *Leverage*, *Largest owner*, *Board CEO experience*, *Board size*, and *Board busyness*, as defined in Table 7. To produce a control sample of AS of comparable firm size to ASA, we use the 1% largest AS by revenue.[24] We exclude financial firms and firm-year observations with missing dependent or control variable values. For each estimation period, we exclude firms with only one observation (they would be nulled out by the firm fixed effect) and firms that switch between ASA and Large AS over the estimation period (a firm cannot appear both in the treatment and control group). The total sample consists of 409 ASA and 1,687 large AS.

In columns (1) and (2) of Table 11, we use the 2003–2009 sample period in Matsa and Miller (2013). Much as in their paper, this produces a coefficient estimate for $ASA * Comply$ of –0.024 and –0.022, both significant at the 5% level. However, when we extend the sample period through 2013, the interaction variable $ASA * Comply$ becomes statistically insignificant (columns 3 and 4). Moreover, when we decompose $Comply_{it}$ into year-by-year effects ($ASA_i * \tau_t$), columns (5) and (6) show that there is a negative effect on ROA in 2008 only and a significantly *positive* effect in 2013 after the inclusion of firm characteristics.

In sum, Table 11 suggests that the negative treatment effect identified by Matsa and Miller (2013) is limited to the year 2008. As such, it may well be the result of a heterogeneous impact of the financial crisis on treated and control firms as opposed to tracing back to the quota constraint.[25]

6.2 Legal conversions

Recall that the quota law applies to ASA only, and a firm must be ASA to be listed on the OSE. AD and Bøhren and Staubo (2014) conclude that OSE-listed ASA left the stock exchange to avoid the quota constraint. In contrast, we show below that *no listed* ASA converted to AS for reasons other than being

[24] The large AS on average have an asset size that is similar to that of unlisted ASA and revenues between that of listed and unlisted ASA. In terms of board gender composition, the gender quota had a limited spillover effect on the boards of large AS, where the fraction of female directors increased from 8% in 2001 to 13% in 2013. This modest increase reflects a general trend throughout western economies over the sample period. For example, by 2013, the fraction of female directors was on average 18% in EU large publicly traded firms and 17% in U.S. Fortune 1000 firms. (Source: *http://ec.europa.eu./justice/gender-equality*, and *https://www.2020wob.com*).

[25] Our results are robust to using, as do Matsa and Miller (2013), a matched sample of AS as a control group. Referring to our ROA evidence, Miller (2018) suggests a labor cost channel: "[the short-term negative effect on ROA documented by Eckbo et al.] is consistent with profits at affected firms being lower during the recession years when they bore additional labor costs from retaining workers, but then rebounding relative to other firms during the recovery" (p. 549).

the target in an M&A transaction or liquidation in bankruptcy. Moreover, we show that the propensity of unlisted ASA to convert to AS is uncorrelated with the female director shortfall in the cross-section.

Note first that firms never publicly explain a conversion in terms of the quota law, and so the researcher must decide which observed conversions are reasonably driven by the quota constraint. AD choose to characterize a delisting following an M&A transaction as driven by quota avoidance. In contrast, we exclude M&A from the conversion analysis because these costly transactions are primarily driven by the synergy gains from merging the two firms (Betton, Eckbo, and Thorburn, 2008; Eckbo, 2014). Moreover, keep in mind that delisting just to avoid the quota constraint is costly due to the loss of listing benefits, which include liquidity and access to public equity. For unlisted ASA, however, converting to AS is low-cost because an unlisted ASA faces near-identical regulations as an AS in terms of accounting and governance standards (Bøhren and Staubo, 2014).[26]

Panel A of Figure 3 shows the annual number of non-financial listed ASA, delistings due to M&A and bankruptcy, and new lists, 2002–2009.[27] Financial firms are excluded because, until 2007, these firms were required by law to be ASA. Our conversion data from *Brønnøysund Register Centre* are complemented by a search of news and press releases for M&A involving a foreign acquirer. There are two main findings related to the listed ASA. First, as expected and shown in Panel A, not a single listed ASA delisted for a reason other than an M&A transaction or bankruptcy. Second, the total number of listed firms increased steadily over the sample period.[28]

Turning to Panel B of Figure 3, there was a steady decline in the total number of unlisted ASA between 2001 and 2009. A majority (61%) of the firms leaving the unlisted-ASA category were acquired in an M&A transaction or liquidated in bankruptcy, or went public (became listed ASA). This leaves a residual group of 156 ASA-to-AS conversions for unknown reasons in the years 2002–2009. These conversions are, therefore, candidates for empirically testing whether they were driven by the quota constraint *per se*. We use the following logit model to estimate the likelihood that these "unknown" conversions are correlated

[26]For an unlisted ASA that abandons plans to list on the OSE, there are few benefits of remaining an ASA while there are some extra costs relative to an AS. These costs include having to register the shares with Norway's securities registry (VPS) and some additional corporate governance restrictions.

[27]In 16% of the acquisitions, the firm continued as an unlisted ASA and thus remained regulated by the quota law.

[28]*The Economist* got this evidence wrong: "Companies fled the [Norwegian] stock market as quotas were faced in" (November 15, 2014, p.62).

with the female director shortfall:

$$Convert_{it} = \alpha + \gamma_1 Shortfall_{it} + \gamma_2 \mathbf{X}_{it} + \kappa_i + \tau_t + \epsilon_{it}. \tag{11}$$

As before, κ_i and τ_t are, respectively, industry and year fixed effects. The vector $\mathbf{X}_{it}$ of explanatory variables is as shown in Table 11. The dependent variable, $Convert_{it}$, equals one if the firm converts to AS next year $(t+1)$ and zero otherwise. Firms that convert are eliminated from the sample in the year of conversion because they are no longer ASA and hence have no option to convert. We include year fixed effects due to the strong downward time trend in $Shortfall$ as ASA comply with the quota regulation (Panel B of Figure 3). Our unbalanced panel contains 880 firm-years for 264 unlisted non-financial ASA, of which 156 convert over the period 2002–2009. While not tabulated, the coefficient estimate of γ_1 is a statistically insignificant 0.91 (the full regression results are available upon request). Thus, there is no evidence of a significant within-year (cross-sectional) correlation between the decision of an unlisted ASA to convert to AS and the firm's board gender composition.[29]

7 Conclusion

We highlight the complexities in identifying the true economic effects of board gender quotas by critically reexamining Norway's pioneering board gender-quota law. An important narrative from prior research is that this quota law caused an economically large decline in the market value of listed firms. However, we show that this narrative does not survive the scrutiny of the data. We reach this important conclusion not only within our larger sample and econometric analysis but also after addressing the most relevant prior studies on their own terms. The narrative emerging from the evidence of this paper is that the quota constraint imposed negligible costs on regulated firms, both in statistical and economical terms.

Several facts make an event study of the stock market reaction to Norway's board gender-quota law particularly powerful. As the first of its kind and initially resisted by the ruling political party, the quota law announcement took the stock market by surprise, as required for an event study to have power. Moreover, the severe penalty for non-compliance (forced liquidation) eliminated uncertainty about universal compliance. Also, important for the identification of causal effects, the quota law regulates

[29] Bøhren and Staubo (2014) find that firms with a low fraction of female directors are more likely to convert *at some point* during the period 2000–2009. However, we have verified that this correlation becomes insignificant once we include year fixed effects that control for the time trend in the fraction of female directors caused by quota compliance.

gender balancing *only* (no other corporate governance aspect) and was the result of a political decision unrelated to firm performance itself.

We use AD's short-run event study of the Norwegian quota to illustrate two critical econometric points: (1) the difficulty of attributing quota-related news to specific dates, and (2) the need to account for contemporaneous cross-correlation of stock returns when judging the statistical significance of an exogenous event that affects all firms simultaneously in calendar time. Our adjustments of AD's event study result in two changes to their conclusion of a significantly negative market reaction. First, using AD's estimation methodology, we show that their negative market reaction is in response to a second news event within their five-day event window that *decreased* (not increased) the likelihood of a quota law. This discovery effectively reverses AD's own conclusion. Second, when we account for the contemporaneous cross-correlation of stock returns, it is no longer possible to reject the hypothesis of a zero market reaction over AD's five-day event window. This conclusion also follows from our new and comprehensive analysis of several quota-related events and a cross-sectional analysis of individual (firm-level) abnormal returns.

We also perform additional tests that corroborate the conclusion of a value-neutral effect of the quota. First, long-run (risk-adjusted) stock return performance is statistically insignificant and identical across portfolios of firms with all-male boards (most affected by the quota) and boards with one or more female directors prior to the quota. Second, we analyze post-quota changes in Tobin's Q and operating profitability, and legal conversions. We show that the post-quota changes in Q and ROA (the latter compared to large unregulated AS) are statistically indistinguishable from zero, except in the financial crisis year of 2008—changes that are most likely unrelated to the quota itself. Moreover, contrary to claims in the prior literature, over the total sample period, no listed ASA left the stock exchange for reasons other than M&A or bankruptcy, and the number of listed firms increased during the implementation of the quota. We also find that the conversions undertaken by non-listed ASA are uncorrelated with the shortfall of female directors in the cross-section.

Overall, the evidence in this paper strongly suggests that firms and investors viewed Norway's forced gender-balancing law as a value-neutral regulatory constraint. A consistent explanation is that the supply of qualified female director candidates was sufficiently high to avoid a decline in firm value. Perhaps anticipating similar low-cost effects, several other countries have since decided to follow suit and adopted their own versions of board gender quotas.

References

Adams, Renée B., Ali C. Akyol, and Partick Verwijmeren, 2018, Director skill sets, *Journal of Financial Economics* 130, 641–662.

Adams, Renée B., and Daniel Ferreira, 2009, Women in the boardroom and their impact on governance and performance, *Journal of Financial Economics* 94, 1291–1309.

Ahern, Kenneth R., and Amy Dittmar, 2012, The changing of the boards: The impact on firm valuation of mandated female board representation, *Quarterly Journal of Economics* 127, 137–197.

Angrist, Joshua D. Greene, and Jorn-Steffen Pischke, 2009, *Mostly Harmless Econometrics: An Empiricist's Companion* (Princeton University Press).

Berner, Endre, Aksel Mjøs, and Marius Olving, 2013, Norwegian corporate accounts, Working Paper 42/13, Center for Applied Research at NHH.

Bernile, Gennaro, Vineet Bhagwat, and Scott Yonker, 2018, Board diversity, firm risk, and corporate policies, *Journal of Financial Economics* 127, 588–612.

Bertrand, Marianne, Sandra E. Black, Sissel Jensen, and Adriana Lleras-Muney, 2019, Breaking the glass ceiling? The effect of board quotas on female labor market outcomes in Norway, *Review of Economic Studies* 86, 191–239.

Betton, Sandra, B. Espen Eckbo, and Karin S. Thorburn, 2008, Corporate takeovers, in B. E. Eckbo, ed., *Handbook of Corporate Finance: Empirical Corporate Finance*, volume 2, chapter 15, 291–430 (Elsevier/North-Holland, Handbooks in Finance Series).

Beuselinck, Christof, Lihong Cao, Marc Deloof, and Xinping Xia, 2017, The value of government ownership during the global financial crisis, *Journal of Corporate Finance* 42, 481–493.

Bøhren, Øyvind, and Siv Staubo, 2014, Does mandatory gender balance work? Changing organizational form to avoid board upheaval, *Journal of Corporate Finance* 28, 152–168.

Brown, Stephen J., and Jerold B. Warner, 1980, Measuring security price performance, *Journal of Financial Economics* 8, 205–258.

Brown, Stephen J., and Jerold B. Warner, 1985, Using daily stock returns: The case of event studies, *Journal of Financial Economics* 14, 3–31.

Carhart, Mark M., 1997, On the persistence in mutual fund performance, *Journal of Finance* 52, 57–82.

Chhaochharia, Vidhi, and Yaniv Grinstein, 2007, Corporate governance and firm value: The impact of the 2002 governance rules, *Journal of Finance* 63, 1789–1825.

de Bodt, Eric, B. Espen Eckbo, and Richard Roll, 2020, Corporate rivalry and stock return comovement, Working paper, Dartmouth College.

Duchin, Ran, John Matsusaka, and Oguzhan Ozbas, 2010, When are outside directors effective?, *Journal of Financial Economics* 96, 195–214.

Eckbo, B. Espen, 2014, Corporate takeovers and economic efficiency, *Annual Review of Financial Economics* 6, 51–74.

Fahlenbrach, Rudiger, Angie Low, and Rene M. Stulz, 2010, Why do firms appoint CEOs as outside directors?, *Journal of Financial Economics* 97, 12–32.

Fama, Eugene F, and Kenneth R French, 1993, Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics* 33, 3–56.

Fich, E., 2005, Are some outside directors better than others? Evidence from director appointments by Fortune 1000 firms, *Journal of Business* 78, 1943–1971.

French, Kenneth R., 1980, Stock returns and the weekend effect, *Journal of Financial Economics* 8, 55–69.

Gompers, Paul A., Joy L. Ishii, and Andrew Metrick, 2003, Corporate governance and equity prices, *Quarterly Journal of Economics* 118, 107–156.

Gormley, Todd A., and Davis A. Matsa, 2014, Common errors: How to (and not to) control for unobserved heterogeneity, *Review of Financial Studies* 27, 617–661.

Greene, Daniel, Vincent J. Intintoli, and Kathleen M. Kahle, 2020, Do board gender quotas affect firm value? Evidence from California Senate Bill no. 826, *Journal of Corporate Finance* 60, article 101526.

Hwang, Sunwoo, Anil Shivdasani, and Elena Simintzi, 2018, Mandating women on boards: Evidence from the United States, Kenan Institute of Private Enterprise Research Paper No. 18-34.

Kang, Shinwoo, E. Han Kim, and Yao Lu, 2018, Does independent directors' CEO experience matter?, *Research and Finance* 22, 905–949.

Kim, Daehyun, and Laura T. Starks, 2016, Gender diversity on corporate boards: Do women contribute unique skills?, *American Economic Review* 106, 267–271.

Kolari, James W., and Seppo Pynnönen, 2010, Event-study testing with cross-sectional correlation of abnormal stock returns, *Review of Financial Studies* 23, 3998–4025.

Kothari, S. P., and Jerold B. Warner, 2007, Econometrics of event studies, in B. E. Eckbo, ed., *Handbook of Corporate Finance: Empirical Corporate Finance*, volume 1, chapter 1, 3–36 (Elsevier/North-Holland, Handbooks in Finance Series).

Kuzmina, Olga, and Valentina Melentyeva, 2020, Gender diversity in corporate boards: Evidence from quota-implied discontinuities, CEPR Discussion Paper DP14942.

Masulis, Ronald W., and Shawn Mobbs, 2011, Are all inside directors the same? Evidence from the external directorship market, *Journal of Finance* 66, 823–872.

Matsa, David A., and Amalia Miller, 2013, A female style in corporate leadership? Evidence from quotas, *American Economic Journal: Applied Economics* 5, 136–169.

Miller, Amalia R., 2018, Women and leadership, in Susan L. Averett, Laura M. Argys, and Saul D. Hoffman., eds., *The Oxford Handbook of Women and the Economy*, Oxford University Press, New York, chapter 22, 539–560 (Oxford University Press).

Næs, Randi, Johannes Skjeltorp, and Bernt Arne Ødegaard, 2008, Hvilke faktorer driver kursutviklingen på Oslo Børs?, *Norsk Økonomisk Tidskrift* 122, 36–81.

Scholes, Myron, and Joe Williams, 1977, Estimating betas from nonsynchronous data, *Journal of Financial Economics* 5, 309–328.

Schwert, G. William, 1981, Using financial data to measure the effect of regulation, *Journal of Law and Economics* 24, 121–158.

Sefcik, Stephan E., and Rex Thompson, 1986, An approach to statistical inference in cross-sectional models with security abnormal returns as dependent variable, *Journal of Accounting Research* 24, 316–334.

Stevenson, Betsey, 2010, Beyond the classroom: Using Title IX to measure the return to high school sports, *Review of Economics and Statistics* 92, 284–301.

Figure 1: Norwegian ASA board size and proportion of female directors, 1998-2013

The figure shows the average board size (left axis), defined as the number of shareholder-elected directors, and the number (left axis) and the fraction (right axis) of female directors. The two vertical lines bracket the two-year period 12/2005–12/2007 that ASA were formally given to comply with the quota. The figure uses the population of 1,150 Norwegian ASA, 1998-2013. Board data are from *Brønnøysund Register Centre*.

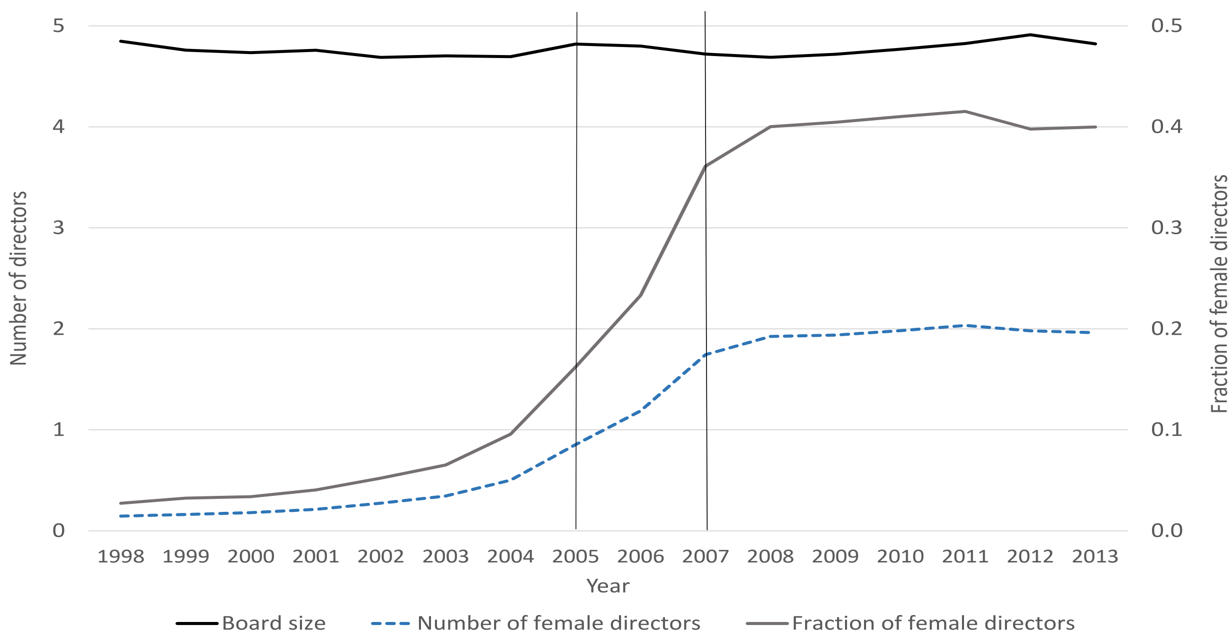
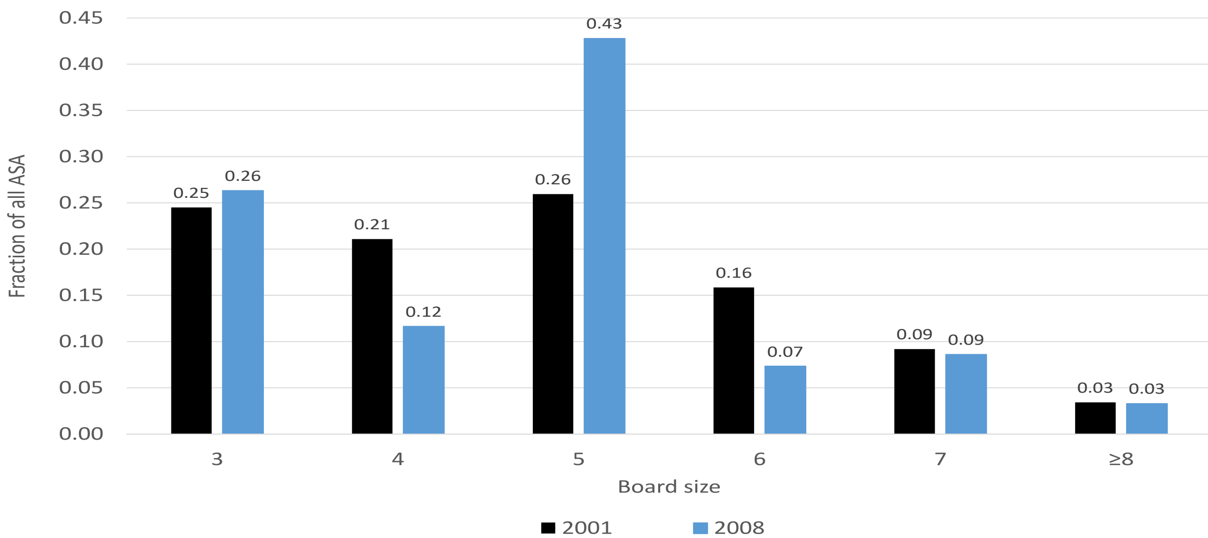


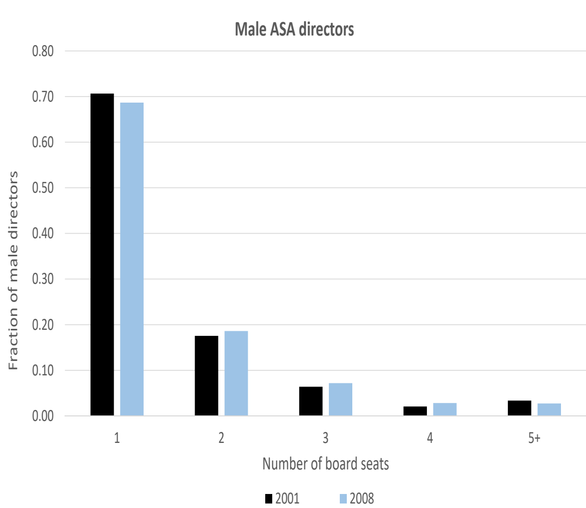
Figure 2: Frequency distribution of ASA board size and director board seats in 2001 and 2008

Panel A shows the frequency distribution of board size (the number of shareholder-elected directors) for the population of ASA in 2001 and 2008. Panel B plots the frequency distribution of the total number of board seats in ASA and the top 1% AS by revenue held by male and female ASA directors. Five and more board seats are reported under 5+. There are 555 ASA (1938 male and 104 female directors) in 2001 and 395 ASA (919 male and 581 female directors) in 2008. Board data are from *Brønnøysund Register Centre*.

A: ASA board size



Panel B: Male and female ASA directors' board seats in ASA and 1% largest AS



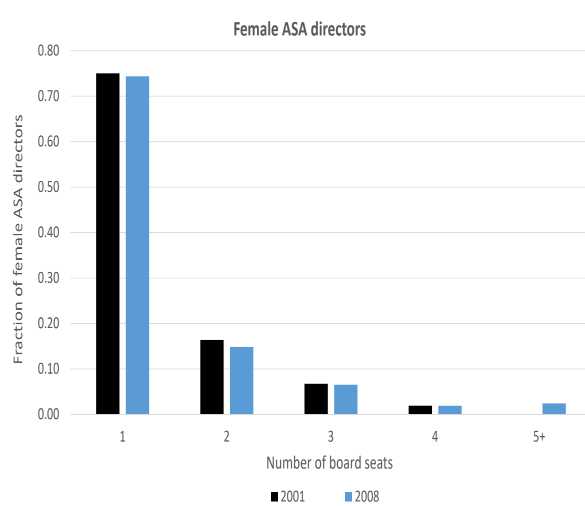
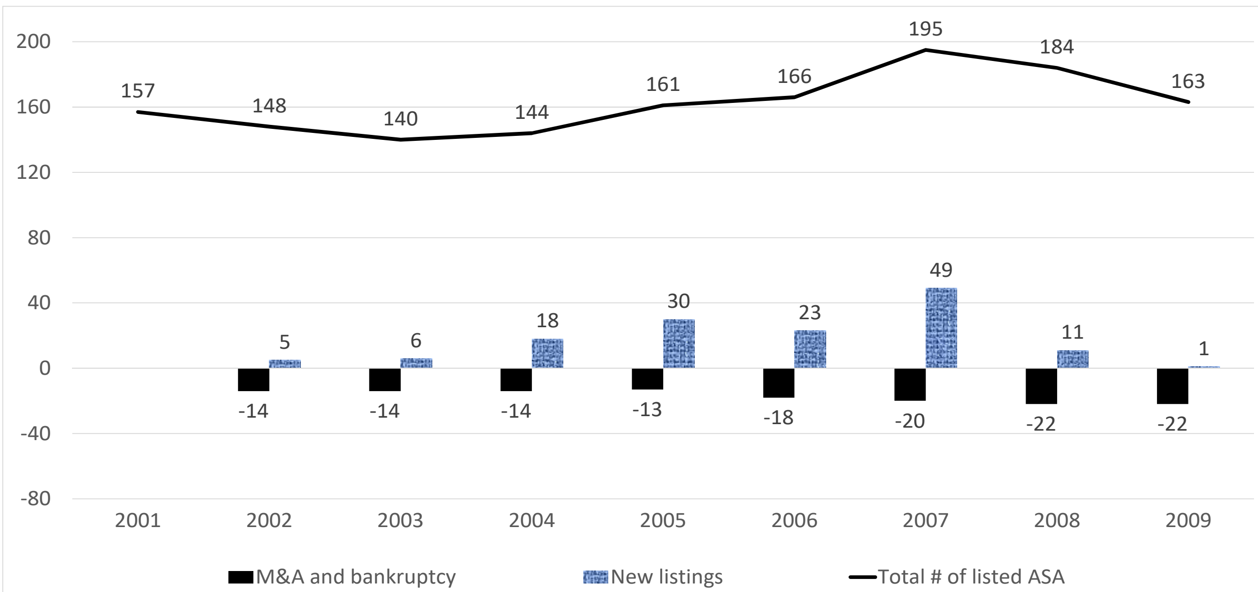


Figure 3: Total number and exits and entries of listed and unlisted ASA by year

The figure shows the total number of listed ASA (Panel A) and unlisted ASA (Panel B) at year-end, 2001-2009, and the number of exits and entries during the period 2002–2009. Firms enter and exit the legal form ASA by changing their bylaws, but typically give no reason for the change. No listed firm delist for reasons other than M&A or bankruptcy. Unlisted ASA exit because they are acquired or file for bankruptcy (192 firms), go public (51 firms), or for other reasons (156 firms). The sample is 288 listed and 467 unlisted non-financial ASA, 2002-2009. The data is from *Brønnøysund Register Centre*, complemented with manual searches of press releases and news for acquisitions by foreign firms.

Panel A: Listed ASA (no firm delists for reasons other than M&A and bankruptcy)



Panel B: Unlisted ASA (156 firms convert to AS for other reasons)

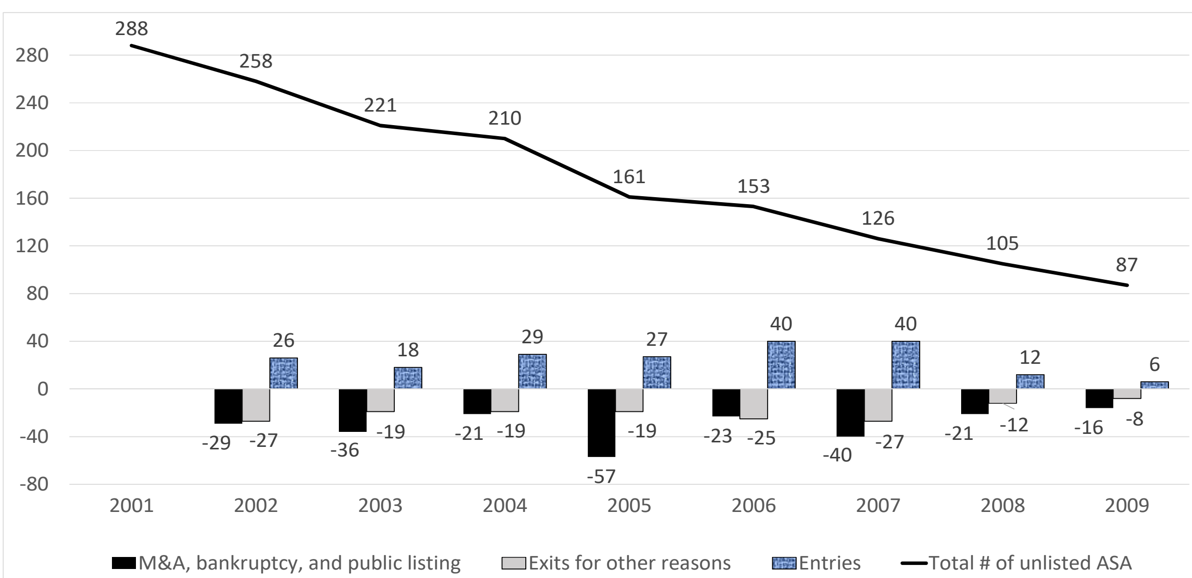


Table 1: Female directors required by Norway's board gender quota

The table shows how the required number and fraction of female directors vary with board size, defined as the number of shareholder-elected directors. *Shortfall* is the fraction of additional female directors required to comply with the quota for a given board size.

Board size	Required number of female directors (1)	Required fraction of female directors (2)	*Shortfall* on board with 1 female (3)	2 females (4)	3 females (5)
3	1	0.33	0	0	0
4	2	0.50	0.25	0	0
5	2	0.40	0.20	0	0
6	3	0.50	0.33	0.17	0
7	3	0.43	0.29	0.14	0
8	3	0.38	0.25	0.13	0
9	4	0.44	0.33	0.22	0.11
10	4	0.40	0.30	0.20	0.10
>10	>4	≥0.40			

Table 2: News events increasing the probability of a board gender quota

(1) **Friday, February 22, 2002**: The minister of trade and industry, Ansgar Gabrielsen, surprisingly supports a gender quota in a newspaper interview, contrary to his political party's official stance (*Verdens Gang*).

Saturday, February 23, 2002: Gabrielsen retracts his support (*Dagens Næringsliv*). Over the following week, the parliamentary members of his political party publicly reiterate the party's negative stance on a quota.

(2) **March 8, 2002**: In a surprise announcement, the Cabinet proposes a board gender quota. Importantly, the law proposal will be enacted with a sunset provision in 2005, canceling the quota if firms comply voluntarily by then. The Cabinet promises compliance by government-owned firms within one year (*Dagens Næringsliv*).

(3) **June 16, 2003**: The market learns that the Cabinet sent the gender-quota proposal to the Parliament after business hours on Friday, June 13 (*Aftenposten*).

The quota proposal passes Parliament's lower chamber (*"Odelstinget"*) on November 27, 2003, and its upper chamber (*"Lagtinget"*) on December 9, 2003. The quota is formally amended to Norwegian Corporate Law on December 19, 2003. To take effect, the quota must be mandated by the Cabinet once the sunset provision expires in 2005.

(4) **December 1, 2005**: Female board representation is at 15% and falls short of the quota requirement. The newly elected Prime Minister announces that his Cabinet will mandate the gender quota and says that the sanction for non-compliance will likely be economic fines (*Verdens Gang*).

(5) **December 9, 2005**: The Cabinet mandates the quota, so it takes effect. The ultimate sanction for non-compliance is forced liquidation—the penalty for breach of corporate law. Existing ASA are given two years to comply (*Dagens Næringsliv*).

Table 3: FIRM AND BOARD CHARACTERISTICS FOR LISTED AND UNLISTED ASA, 1998-2013

The table reports firm and board characteristics for the population of listed (Panel A) and unlisted ASA (Panel B), 1998-2013. The mean revenue and total assets are reported in 2013 USD million and winsorized at the 1% tails. Board CEO experience is the fraction of the board's directors with CEO experience from an ASA or one of the largest 1% AS by revenue (about 1,000 firms per year) in the past three years. The last row in each panel lists the pooled average across all firm-years, except the number of firms, which lists the average annual N over the sample period. There are 409 unique listed ASA and 888 unique unlisted ASA, of which 147 firms are listed in some years and unlisted in others. Data is from Brønn øysund Register Centre, supplemented with ownership data from the Norwegian tax authorities for 2004–2013.

Year	Number of firms (1)	Mean revenue (2)	Mean total assets (3)	% ownership of largest shareholder (4)	% female directors (5)	% female chairs (6)	% female CEOs (7)	Board CEO experience (8)
A: Listed ASA								
1998	196	409	756	46	3.3	1.6	2.7	–
2001	169	417	827	29	5.3	0.6	3.8	20.5
2003	151	391	814	30	9.9	2.1	2.1	17.8
2005	174	446	910	31	22.2	1.7	1.1	17.0
2007	205	495	1098	33	38.9	2.9	2.9	18.5
2009	172	549	1127	36	41.1	4.1	3.5	17.7
2011	172	663	1236	34	41.5	10.5	4.1	17.2
2013	150	699	1373	34	41.6	8.8	4.7	15.6
Mean	174	501	1008	35	24.3	3.6	2.8	17.5
B: Unlisted ASA								
1998	247	46	133	54	2.3	0.4	1.7	–
2001	418	56	110	53	3.5	1.3	5.6	17.8
2003	346	74	226	56	5.0	2.8	5.7	16.2
2005	275	103	308	59	12.5	2.9	4.0	14.6
2007	260	93	369	58	33.9	6.9	6.2	13.4
2009	167	111	586	57	39.8	10.2	9.8	12.7
2011	126	197	651	55	41.5	11.1	13.6	15.0
2013	86	229	787	52	37.1	15.1	9.6	11.8
Mean	255	90	290	56	15.2	4.2	5.3	15.3

Table 4: Close replication and expansion of AD's event study around February 22, 2002

Panel A lists the average five-day $CAR(-2,2)$ around February 22, 2002 (our event 1 in Table 2) from AD's Table III. For each ASA, they estimate:

$$CAR_i(-2,2) = \sum_{\tau=-2}^{2} (r_i - r_{i,match})_\tau ,$$

where r_i is the return of firm i (from Compustat Global), $r_{i,match}$ is the average return to U.S.-listed companies in firm i's GICS industry (from CRSP), and τ is the five days in the event window. Panels B1, B2, and C show our estimates of AD's average five-day $CAR_i(-2,2)$ using AD's sample, methodology, and return data. Like AD, the p-values (in square brackets) are based on a standard error for the mean, which assumes that all return observations are independent, $\sigma_N(\rho = 0) = \sigma/\sqrt{N}$. Panels B1 and B2 allow for multi-day returns, while panels C and D require one-day returns in the event window, which reduces the sample size to 79 firms (only a subset of firms has a one-day return in Compustat Global on a given day in AD's event window). Except for Panel B2, the sample is split by firms' 2001 board gender composition into $Zero_{2001}$ (Column 2) and Pos_{2001} (Column 3). Panel B2 replaces the firms in $Zero_{2001}$ (Pos_{2001}) with the smallest (largest) firms by revenue. Panel D reports the daily average $AR_i = (r_i - r_{i,match})_\tau$ on each day τ in the five-day event window. AD's board data is from annual reports, while our board data is from *Brønnøysund Register Centre*, where 69 firms (vs. 68 in AD) had zero female directors in 2001 ($Zero_{2001}$). The p-value in Column 4 uses a t-test. Significance levels: *** 1%, ** 5%, and * 10%.

		All firms (1)	Firms with $Zero_{2001}$ (2)	Firms with Pos_{2001} (3)	Diff. in mean $Zero - Pos$ (4)
A: AD's own five-day average CAR (from AD's Table III)					
	$CAR(-2,2)$	-2.573***	-3.547***	-0.024	-3.523***
	p-value	[0.001]	[0.001]	[0.977]	[0.008]
	N	94	68	26	
B1: Estmating AD's five-day CAR allowing multi-day returns					
	$CAR(-2,2)$	-2.827***	-3.894***	0.115	-4.009***
	p-value	[0.001]	[0.000]	[0.913]	[0.007]
	N	94	69	25	
B2: Replacing $Zero_{2002}$ (Pos_{2002}) with the smallest (largest) firms					
	$CAR(-2,2)$	-2.827***	-3.658***	-0.533	-3.125*
	p-value	[0.001]	[0.000]	[0.724]	[0.082]
	N	94	69	25	
C: Estimating of AD's five-day CAR requiring one-day returns					
	$CAR(-2,2)$	-2.320**	-3.257***	0.106	-3.363*
	p-value	[0.017]	[0.010]	[0.930]	[0.054]
	N	79	57	22	
D: Daily AR estimates w/AD's methodology and one-day returns					
Feb 20 (Wed)	$AR(-2)$	-0.939*	-1.154*	-0.345	-0.810
	p-value	[0.053]	[0.060]	[0.634]	[0.388]
	N	64	47	17	
Feb 21 (Thu)	$AR(-1)$	0.416	0.037	1.626**	-1.589*
	p-value	[0.417]	[0.955]	[0.013]	[0.070]
	N	67	51	16	
Feb 22 (Fri)	$AR(0)$	-0.753	-0.695	-0.887*	0.192
	p-value	[0.254]	[0.453]	[0.099]	[0.855]
	N	66	46	20	
Feb 23 (Sat): Reversal announcement. OSE closed, no trading.					
Feb 25 (Mon)	$AR(1)$	-1.995***	-2.537***	-0.711	-1.826**
	p-value	[0.000]	[0.000]	[0.156]	[0.026]
	N	64	45	19	
Feb 26 (Tue)	$AR(2)$	0.405	0.286	0.672	-0.385
	p-value	[0.402]	[0.657]	[0.291]	[0.667]
	N	65	45	20	

Table 5: ADJUSTING AD'S EVENT STUDY FOR CONTEMPORANEOUS CROSS-CORRELATION OF RETURNS

The table revisits AD's event study by using their sample and data sources but adjusting for the cross-correlation of returns through a portfolio estimation of CAR(-2,2) around February 22, 2002 (event 1 in Table 2). We estimate a time-series regression of the model:

$$r_{pt}^{-I} = \alpha_p + AR_p d_t + \epsilon_{pt}.$$

The dependent variable $r_{pt}^{-I} \equiv \frac{1}{N}\sum_{i=1}^{N}(r_i - r_{i,match})_t$ is the equal-weighted portfolio of industry-matched returns, where r_i is the return of ASA i (from Compustat Global) and $r_{i,match}$ is the average return to U.S.-listed companies in firm i's GICS industry (from CRSP) on day t, and d_t is a dummy that takes the value of one for all days in the five-day event window (-2,2). Panel A shows the coefficient estimates $CAR(-2,2) = 5AR_p$ from the time-series regression. The p-values (in square bracket) use the standard error from the regression, $\sigma_{5AR_p}(\rho) = 5\sigma_{AR_p}(\rho)$, which accounts for the cross-correlation in returns. Panel B reports the daily AR in the five-day event window, using the same portfolio estimation but with five different dummies d_t (one for each day). We require a firm to have at least a single one-day return in the event window. This reduces the sample size to 79 firms in Panel A (from AD's 94). The number of observations is lower in Panel B because only a subset of firms have a one-day return in Compustat Global on a given day in the event window. The board data is from *Brønnøysund Register Centre*. The sample is split by firms' 2001 board gender composition into zero female directors ($Zero_{2001}$, Column 2) and at least one female director (Pos_{2001}, Column 3). Significance levels: *** 1%, ** 5% and * 10%.

		All firms (1)	Firms with $Zero_{2001}$ (2)	Firms with Pos_{2001} (3)	Diff. in mean $Zero - Pos$ (4)
A: Time-series portfolio estimation of the five-day CAR (one-day returns)					
	$CAR(-2,2)$	-2.203	-3.364	0.924	-4.288
	p-value	[0.521]	[0.356]	[0.796]	[0.116]
	N	79	57	22	
B: Time-series portfolio estimation of the daily AR (one-day returns)					
Feb 20 (Wed)	$AR(-2)$	-0.806	-1.014	-0.231	-0.784
	p-value	[0.598]	[0.532]	[0.885]	[0.518]
	N	64	47	17	
Feb 21 (Thu)	$AR(-1)$	0.549	0.176	1.740	-1.563
	p-value	[0.720]	[0.913]	[0.276]	[0.197]
	N	67	51	16	
Feb 22 (Fri)	$AR(0)$	-0.620	-0.555	-0.773	0.218
	p-value	[0.685]	[0.732]	[0.628]	[0.857]
	N	66	46	20	
Feb 23 (Sat): Reversal announcement. OSE closed, no trading.					
Feb 25 (Mon)	$AR(1)$	-1.862	-2.397	-0.597	-1.800
	p-value	[0.224]	[0.140]	[0.708]	[0.138]
	N	64	45	19	
Feb 26 (Tue)	$AR(2)$	0.538	0.426	0.785	-0.359
	p-value	[0.725]	[0.793]	[0.622]	[0.767]
	N	65	45	20	

Table 6: ABNORMAL RETURNS TO PORTFOLIOS OF OSE-LISTED FIRMS ON KEY QUOTA EVENT DATES

The table reports cumulative abnormal stock returns, $CAR(-1,0) = 2AR_p$, for portfolios of OSE-listed firms, estimated using the return-generating process:

$$r^e_{pt} = \alpha_p + \beta_p r^e_{wt} + AR_p d_t + \varepsilon_{pt},$$

where r^e_{pt} is the daily equal-weighted return (converted to USD using the daily exchange rate) in excess of the daily 3-month U.S. Treasury bill, d_t is a dummy for the event window (-1,0), and r^e_{wt} is the daily excess return on the MSCI stock market world index. The five events are defined in Table 2. High shortfall firms have a female director $Shortfall$ (the fraction of additional female directors required by quota, see Table 1) at or above the median in the preceding year. Portfolios are re-sorted each year-end. Columns (1)–(4) use samples of Norwegian firms subject to the quota. Columns (5)–(7) use samples of OSE-listed Norwegian (treated) and foreign (control) firms in the oil/offshore sector. N denotes the number of firms in each portfolio. To be included in the portfolio, a firm must have one-day return observations on both days in the event window and ≥100 observations in the estimation period (-252, -2). We exclude any earlier event date in the estimation period. For $CAR_{1-5}(-1,0) = 10AR_{1-5}$, we re-estimate the model with the dummy variable d taking a value of one in the event window (-1,0) for all five events. Daily stock returns are from *Oslo Børsinformasjon*. Information on board composition is from *Brønnøysund Register Centre*. Significance levels are *** 1%, ** 5%, * 10%.

	All firms (1)	High shortfall (2)	Low shortfall (3)	High –Low (4)	Domestic oil/offshore (5)	Foreign oil/offshore (6)	Domestic – Foreign (7)
(1) February 22, 2002							
$CAR(-1,0)$	-0.009	-0.012	0.001	-0.013	-0.000	-0.019	0.018
p-value	[0.557]	[0.493]	[0.953]	[0.419]	[0.986]	[0.476]	[0.477]
N	143	93	41		32	11	
(2) March 8, 2002							
$CAR(-1,0)$	0.033**	0.036**	0.030*	0.005	0.038**	0.050*	-0.012
p-value	[0.033]	[0.036]	[0.091]	[0.729]	[0.048]	[0.053]	[0.630]
N	146	96	41		31	10	
(3) June 16, 2003							
$CAR(-1,0)$	0.000	0.005	-0.006	0.011	-0.016	0.009	-0.024
p-value	[0.998]	[0.828]	[0.756]	[0.569]	[0.532]	[0.811]	[0.499]
N	135	73	53		27	11	
(4) December 1, 2005							
$CAR(-1,0)$	0.001	-0.001	0.003	-0.005	0.008	-0.004	0.012
p-value	[0.947]	[0.933]	[0.809]	[0.509]	[0.662]	[0.887]	[0.482]
N	132	67	65		31	13	
(5) December 9, 2005							
$CAR(-1,0)$	0.009	0.007	0.011	-0.004	0.008	0.016	-0.008
p-value	[0.533]	[0.657]	[0.425]	[0.584]	[0.649]	[0.534]	[0.640]
N	133	67	66		30	13	
All events (1)-(5)							
$CAR_{1-5}(-1,0)$	0.037	0.038	0.043	-0.005	0.045	0.062	-0.017
p-value	[0.308]	[0.354]	[0.285]	[0.879]	[0.349]	[0.362]	[0.783]
N	138	79	53		30	12	

Table 7: VARIABLE DEFINITIONS

The main data source is *Brønnøysund Register Centre*. Data for *Risk* and *Q* are from *Oslo Børsinformasjon*. Ownership is complemented with data from the Norwegian tax authorities (2004–2013). Log refers to the natural logarithm.

Variable name	Definition
A: Firm characteristics	
Firm age	Log of firm age since incorporation.
ROA	Return on assets (earnings before interest and taxes (EBIT) / total assets).
Total assets	Log of book value of total assets.
Size	Log of revenue.
Leverage	Ratio of book value of total debt to total assets.
Largest owner	Percent ownership by the firm's largest shareholder.
Government control	Dummy indicating that the government owns ≥30% of the shares.
Codetermination	Dummy indicating that the female directors required by the quota and the employee representatives together hold a majority of the board.
Risk	The firm's daily stock return volatility in the year prior to the event.
Q	(Total assets – book value of equity + market value of equity) / total assets. The market value of equity is the stock price times the number of shares outstanding (shares issued − treasury shares), using the end-of-year closing price. If a firm has more than one share class, the market value of equity is the combined market value of all share classes.
ASA	Public limited company ("*Allmenaksjeselskap*"), regulated by the quota.
AS	Private limited company ("*Aksjeselskap*"), not regulated by the quota.
Industry	Firms are allocated to ten different industry sectors: oil/offshore, telecom/technology, manufacturing, construction, wholesale/retail, finance, agriculture, transportation, electricity, and other services.
B: Board characteristics	
Board size	Number of shareholder-appointed directors on the board.
Board CEO experience	The fraction of the board's directors with CEO experience from an ASA or one of the 1% largest AS by revenue in the past three years.
Board busyness	The fraction of the board's directors that hold at least three board seats in an ASA or one of the 1% largest AS by revenue.
Shortfall	The difference between the fraction of female directors required by the quota and that of the current board.
High shortfall	Dummy indicating a *Shortfall* at or exceeding the median. In 2007, the median *Shortfall* is zero and we require $Shortfall > 0$.
Low shortfall	Dummy indicating a below-median *Shortfall*.
$Zero_{2001}$	Dummy equal to one if the firm has zero female directors in 2001.
Pos_{2001}	Dummy equal to one if the firm has at least one female director in 2001.
Comply	Dummy equal to one in years $t \geq 2008$ (reflecting quota compliance by 12/2007).

Table 8: CROSS-SECTIONAL REGRESSIONS FOR ANNOUNCEMENT RETURNS OF QUOTA KEY EVENTS

The table reports coefficient estimates in cross-sectional OLS regressions for the two-day cumulative abnormal return $CAR_{ik}(-1,0)$ on key quota news event dates, $k = 1,\ldots,5$ (Table 2). For each firm i, the daily average abnormal return AR_{ik} is estimated for each event k using the regression model in Table 6. The estimation period starts 252 days before each event and ends with the event (day 0). We require firms to have actual return observations on both days in the event window and $\geq$100 return observations in the estimation period. $CAR_{ik}(-1,0) = 2AR_{ik}$ is then regressed on *Shortfall* and the vector **X** of firm characteristics:

$$CAR_{ik}(-1,0) = \alpha_k + \gamma_{1k}Shortfall_{ik} + \gamma_{2k}\mathbf{X_{ik}} + \kappa_i + u_{ik}, \qquad k = 1,...,5,$$

where **X** contains the variables *Largest owner*, *Government control*, *Codetermination*, *Risk*, and *Total assets*, and κ_i is industry fixed effects. $Shortfall$ is the fraction of female directors missing to fill the quota requirement. All variables are from the year-end prior to the event and defined in Table 7. A constant is included, but not reported. The sample is OSE-listed ASA. Daily stock returns are from *Oslo Børsinformasjon*. Firm and board characteristics are from *Brønnøysund Register Centre*. Robust standard errors (White estimator) are reported in parenthesis. Stars indicate significance levels: *** 1%, ** 5%, * 10%.

	Date of the quota news event				
	22-Feb-2002	8-Mar-2002	16-Jun-2003	1-Dec-2005	9-Dec-2005
	(1)	(2)	(3)	(4)	(5)
$Shortfall$	-0.050	0.014	0.001	-0.013	-0.002
	(0.067)	(0.056)	(0.062)	(0.022)	(0.023)
Largest owner	-0.002	0.023	-0.019	-0.037*	0.016
	(0.025)	(0.029)	(0.038)	(0.019)	(0.018)
Government control	-0.001	-0.020	0.035	0.010	-0.015*
	(0.025)	(0.022)	(0.026)	(0.009)	(0.009)
Codetermination	0.011	-0.001	0.034**	0.001	0.006
	(0.019)	(0.015)	(0.016)	(0.005)	(0.005)
Risk	-0.776**	0.470*	0.568	-0.473*	-0.298
	(0.311)	(0.238)	(0.505)	(0.284)	(0.718)
Total assets	-0.002	0.009**	0.000	-0.002	-0.000
	(0.005)	(0.004)	(0.005)	(0.002)	(0.003)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.122	0.155	0.154	0.104	0.136
N (firms)	129	131	122	132	133

Table 9: LONG-RUN ABNORMAL PERFORMANCE OF PORTFOLIOS CLASSIFIED BY FEMALE REPRESENTATION

The table reports monthly abnormal stock returns for portfolios of listed ASA with zero or positive female representation in 2001, over the period February 2002 (start of quota legislative process) to April 2008 (full quota compliance). A $Zero_{2001}$ firm has zero female directors in 2001, while a Pos_{2001} firm has at least one female director in 2001. The monthly average number of firms in the $Zero_{2001}$ and Pos_{2001} portfolios are 98 and 32, respectively. In columns (1) - (3), the abnormal stock return is estimated using the following three-factor return-generating process:

$$r^e_{pt} = \alpha_p + \beta_{p1} r^e_{wt} + \beta_{p2} HML_t + \beta_{p3} SMB_t + \varepsilon_{pt}, \quad t = 2/2002, ..., 4/2008,$$

where r^e_{pt} is the monthly USD-denominated stock return to portfolio p of domestic OSE-listed ASA, converted to USD using the monthly exchange rate, in excess of the current month's 3-month U.S. Treasury bill. r^e_{Wt} is the monthly return on the MSCI world stock market index in excess of the current month's 3-month U.S. Treasury bill. SMB (size) and HML (value) are global risk factors from Ken French's website. Columns (4)–(6) include an additional global momentum risk factor (MOM), also from Ken French's website. Standard errors in parenthesis and significance levels are indicated by *** 1%, ** 5%, * 10%.

	$Zero_{2001}$ Portfolio (1)	Pos_{2001} Portfolio (2)	*Zero-Pos* Portfolio (3)	$Zero_{2001}$ Portfolio (4)	Pos_{2001} Portfolio (5)	*Zero-Pos* Portfolio (6)
α_p	-0.002	0.003	-0.005	-0.001	0.004	-0.005
	(0.006)	(0.005)	(0.004)	(0.006)	(0.005)	(0.004)
W^e	1.422***	1.419***	0.003	1.410***	1.373***	0.037
	(0.154)	(0.122)	(0.108)	(0.164)	(0.129)	(0.115)
HML	-0.143	0.320	-0.463	-0.128	0.376	-0.504
	(0.428)	(0.338)	(0.300)	(0.435)	(0.341)	(0.304)
SMB	1.120***	0.727***	0.393*	1.141***	0.804***	0.337
	(0.310)	(0.245)	(0.218)	(0.325)	(0.255)	(0.227)
MOM				-0.042	-0.160	0.118
				(0.189)	(0.148)	(0.132)
R^2	0.601	0.682	0.061	0.601	0.687	0.071
Observations (months)	75	75	75	75	75	75

Table 10: IV REGRESSIONS FOR TOBIN'S Q

Panel A reports estimates of the coefficient β from the second-stage instrumental variable (IV) regression:

$$Q_{it} = \alpha + \beta \widehat{Shortfall}_{it} + \theta_i + \tau_t + \epsilon_{it},$$

where θ_i and τ_t are firm and year fixed effects, respectively. $\widehat{Shortfall}$ is the fitted value from the first-stage IV regressions reported in the odd-numbered columns in Panel B:

$$Shortfall_{it} = \alpha + Base_i \sum_{t=2004}^{2009} \beta_t \tau_t + \theta_i + \tau_t + u_{it},$$

The even-numbered columns in Panel B report the reduced-form regressions, with Q_{it} as the dependent variable. The variable $Base$ is the 2002 shortfall of female directors, $Shortfall_{2002}$ (columns 1, 2, 5 and 6), log of Sales in 2002 (columns 3 and 4), and the 2001 shortfall of female directors, $Shortfall_{2001}$ (columns 7 and 8). The sample is 167 unique OSE-listed ASA and 820 firm-years 2003-2009. Five government-controlled firms are excluded in columns (5) and (6). Standard errors clustered by firm are reported in parenthesis. Significance levels: *** 1%, ** 5%, and * 10%.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sample:	All firms		All firms		Ex. gov-contr. firms		All firms	
A: Second-stage IV regression for Q_{it}								
$\widehat{Shortfall}$	1.912**		6.105**		1.680		0.694	
	(0.833)		(2.495)		(1.053)		(1.236)	
F	15.90		12.01		15.66		16.76	
R^2	0.128		-0.197		0.136		0.141	
N	820		734		785		790	
B: First-stage IV regression for $Shortfall_{it}$ and reduced-form regression for Q_{it}								
Base:	$Shortfall_{2002}$		$log(Sales)_{2002}$		$Shortfall_{2002}$		$Shortfall_{2001}$	
Regression:	First-stage IV	Reduced form	First-stage IV	Reduced form	First-stage IV	Reduced form	First-stage IV	Reduced form
Dep. variable:	$Shortfall_{it}$	Q_{it}	$Shortfall_{it}$	Q_{it}	$Shortfall_{it}$	Q_{it}	$Shortfall_{it}$	Q_{it}
$Base \times \tau_{2004}$	-0.121	0.569	-0.005	-0.039	-0.106	0.608	-0.080	0.604
	(0.075)	(0.362)	(0.004)	(0.025)	(0.099)	(0.452)	(0.087)	(0.448)
$Base \times \tau_{2005}$	-0.420***	1.025	-0.010*	-0.127	-0.478***	0.974	-0.274**	-0.427
	(0.103)	(0.873)	(0.006)	(0.085)	(0.129)	(1.134)	(0.114)	(0.960)
$Base \times \tau_{2006}$	-0.531***	0.244	-0.006	0.099	-0.560***	0.356	-0.450***	-0.386
	(0.101)	(0.743)	(0.008)	(0.060)	(0.135)	(1.010)	(0.134)	(0.630)
$Base \times \tau_{2007}$	-0.796***	-0.823	0.023***	0.136**	-0.791***	-0.750	-0.546***	-0.079
	(0.080)	(0.672)	(0.007)	(0.066)	(0.117)	(0.945)	(0.133)	(0.698)
$Base \times \tau_{2008}$	-0.906***	-1.591**	0.026***	0.183***	-0.957***	-1.539	-0.627***	-0.340
	(0.086)	(0.669)	(0.007)	(0.068)	(0.117)	(0.954)	(0.132)	(0.835)
$Base \times \tau_{2009}$	-0.964***	-1.149	0.028***	0.172**	-1.049***	-1.112	-0.634***	0.065
	(0.091)	(0.698)	(0.008)	(0.078)	(0.120)	(0.994)	(0.131)	(0.899)
F	85.88	10.97	44.08	12.05	87.05	10.85	45.54	10.93
R^2	0.660	0.164	0.640	0.208	0.665	0.164	0.624	0.144
N	829	829	742	748	794	794	799	799

Table 11: Quota-induced changes in operating performance

Columns (1)–(4) report coefficient estimates from the following OLS regression for firm i in year t:

$$ROA_{it} = \gamma_0 + \gamma_1 ASA_i \times Comply_t + \gamma_2 \mathbf{X_{it}} + \theta_i + \tau_t + \epsilon_{it},$$

where θ_i and τ_t are firm and year fixed effects, respectively. The dependent variable is firm i's operating profitability (ROA) in year t, defined as earnings before interest and tax (EBIT)/total assets. $Comply_t = 1$ for year $t \geq 2008$ and zero otherwise. The vector $\mathbf{X}_{it}$ contains the following firm characteristics: *Firm age*, *Size*, *Leverage*, *Largest owner*, *Board size*, *Board CEO experience*, *Board busyness*, and a constant (all suppressed). The variables are defined in Table 7. In columns (5) and (6), the model is:

$$ROA_{it} = \gamma_0 + ASA_i \sum_{2008}^{2013} \gamma_t \tau_t + \gamma_2 \mathbf{X_{it}} + \theta_i + \tau_t + \epsilon_{it},$$

The sample comprises 409 ASA (treated firms) and the 1,687 1% largest AS by revenue and year (control firms), 2003-2013. We exclude financial firms and firm-year observations with missing dependent or control variable values. For each estimation period, we exclude firms with only one observation (they would be nulled out by the firm fixed effect), and firms that switch between ASA and Large AS over the estimation period (a firm cannot appear both in the treatment and control group). The estimation period is 2003–2009 in columns (1)–(2) and 2003–2013 in columns (3)–(6). Standard errors clustered by firm are reported in parenthesis. Stars indicate significance levels: *** 1%, ** 5%, and * 10%.

	2003-2009		2003-2013			
	(1)	(2)	(3)	(4)	(5)	(6)
$ASA \times Comply$	-0.024**	-0.022**	-0.012	-0.000		
	(0.012)	(0.011)	(0.011)	(0.010)		
$ASA \times \tau_{2008}$					-0.049***	-0.042***
					(0.016)	(0.015)
$ASA \times \tau_{2009}$					-0.015	-0.011
					(0.015)	(0.014)
$ASA \times \tau_{2010}$					0.002	0.018
					(0.017)	(0.016)
$ASA \times \tau_{2011}$					-0.009	0.008
					(0.021)	(0.019)
$ASA \times \tau_{2012}$					0.004	0.023
					(0.020)	(0.017)
$ASA \times \tau_{2013}$					0.025	0.039**
					(0.017)	(0.017)
Firm characteristics	No	Yes	No	Yes	No	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.024	0.135	0.018	0.122	0.022	0.127
N (firm-years)	6,968	6,968	11,228	11,228	11,228	11,228

Electronic Access to the Working Paper Series

The full set of ECGI working papers can be accessed through the Institute's Web-site (www.ecgi.global/content/working-papers) or SSRN:

Finance Paper Series	http://www.ssrn.com/link/ECGI-Fin.html
Law Paper Series	http://www.ssrn.com/link/ECGI-Law.html