Regulation, the trickle-down effect, disclosure, and board gender diversity

Submitted by

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I certify that all material in this thesis which is not my own work has been identified and that any material that has previously been submitted and approved for the award of a degree by this or any other University has been acknowledged.

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Abstract

The first paper of this thesis (Chapter 1) provides evidence demonstrating how the trickle-down effect is influenced by the introduction of regulation on board gender diversity. In 2011, a new soft law regulation was suddenly introduced for firms listed on the United Kingdom's FTSE 350 index, the regulatory intervention put forward recommendations to increase the representation of women on the boards of FTSE 350 listed firms. There is evidence of a positive relationship between women on boards and women's representation in senior management during the pre-regulation era – referred to as the trickle-down effect. However, the introduction of regulation had the unintended consequence of weakening the relationship between women on boards and women in senior management.

The second paper of this thesis (Chapter 2) explores the relationship between women on boards and the likelihood of a firm disclosing information on board gender diversity. This paper uses the United Kingdom as its research setting, a national context in which a 'comply or explain' principle was introduced to encourage firms to provide disclosures on board gender diversity. Evidence is found suggesting a positive relationship between women's representation in the boardroom and disclosures on board gender diversity. Furthermore, this positive effect is most prominent when there is a critical mass of women (i.e., three or more women) at board level. Further analyses establish the robustness of this effect.

The final paper of this thesis (Chapter 3) leverages advances in natural language processing to provide a new methodology to assist researchers wanting to inductively analyse large volumes of gender diversity disclosures. Specifically, this paper illustrated the application of topic modelling applied to a large database

of diversity statements retrieved from the websites of listed firms – whilst also providing a guide outlining each stage of the topic modelling process for researchers.

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List of Abbreviations

ASX	Australian Securities Exchange
CEO	Chief executive officer
CSR	Corporate social responsibility
ED	Executive Director
ESG	Environmental, social and governance
EU	European Union
FRC	Financial reporting council
FTSE	Financial times stock exchange
HTML	Hypertext markup language
IV	Instrumental variable
KLD	Kinder Lindenberg Domini
LASSO	Least absolute shrinkage and selection operator
LDA	Latent dirichlet allocation
LIWC	Linguistic inquiry and word count
NED	Non-executive director
NLP	Natural language processing
OLS	Ordinary least squares
ROA	Return on assets
ROE	Return on equity
SEC	Securities and exchange commission
Tf-idf	Term frequency by inverse document frequency
US	United States
UK	United Kingdom

USA	United States of America

List of Publications

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Paper 1 (Chapter 2): **Page, A.**, Sealy, R., Parker, A., & Hauser, O. (2023). Regulation and the trickle-down effect of women in leadership roles. The Leadership Quarterly. https://doi.org/10.1016/j.leaqua.2023.101721.

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Others:

Liu, F., **Page, A.**, and colleagues (2020). Abrupt decline in tropospheric nitrogen dioxide over China after the outbreak of COVID-19. Science Advances, eabc2992.

Carboni, I., Cross, R., **Page, A.**, & Parker A. (2019). Invisible network drivers of women's success. Organisational Dynamics, 100735.

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Dedicated to my family, supervisors, friends, and Achilles.

Chapter 1

1. Introduction

1.1. Regulation and Women on Boards

Since Norway became the first country to introduce regulation on board gender diversity in 2003[1], considerable debate has followed regarding which regulatory policies or initiatives are best suited to achieve gender equality on corporate boards (Gabaldon, Mensi-Klarbach, & Seierstad, 2017; Hamplová, Janeček, & Lefley, 2022). Within discussions amongst both business, political, and academic circles, consensus has led to two types of regulation to increase the representation of women on boards: hard law regulation (i.e., a legislative-based reform) and the soft law regulation (i.e., a voluntary governance code-based reform)[2].

Hard law regulation, enforced by precise legally binding obligations (Abbott & Snidal, 2000), is seen as a fast way to increase the representation of women on boards (Chandler, 2016; De Vita & Magliocco, 2018). This approach towards increasing the representation of women at board level is more common in countries that favour gendered policies as their institutional framework (Terjesen, Aguilera, & Lorenz, 2015). In contrast, soft law regulation, characterised by weakened legislative obligations (Abbott & Snidal, 2000), aims for gradual increases in the number of women on boards, and, in doing so, seeks to persuade

[1] It should be noted, Israel introduced a soft law gender quota requiring one female director for publicly listed firms since 1999 (Poletti-Hughes & Dimungu-Hewage, 2023).

[2] Hard law regulation has also been referred to as: the radical approach (e.g., Mensi-Klarbach & Seirstad, 2020); legislative-based reform (e.g., Ding et al., 2022); and binding (Barroso et al., 2024). Soft law has been referred to as: the liberal approach (e.g., Mensi-Klarbach & Seirerstad, 2020); governance code reform (e.g., Ding et al., 2022); comply-or-explain (e.g., Poletti-Hughes & Dimungu-Hewage, 2023) and non-binding (e.g., Barroso et al., 2024).

key actors to change norms around the selection and nomination of female board members (Sojo, Wood., Wood., & Wheeler, 2016). Soft law regulation, because it has a moderate legislative focus, avoids the costs of hard law regulation – which is especially evident in national contexts where firms value their autonomy and challenge interference by national governments (Abbot & Snidal, 2000). A key question for academics and practitioners concerns whether "is it best to prescribe outcomes and force compliance, or suggest outcomes and permit flexibility around their achievement?" (Klettner, Clarke, & Boersma, 2016, p. 413). Put simply, a key question for research in the field of regulation on board gender diversity[3] is whether a soft law or hard law approach should be implemented.

There has been a long-standing debate over the benefits and costs of soft law versus hard law regulation (Aguilera & Cuervo-Cazurra, 2009; Keay, 2014). So far, much research investigating the impact of both hard law or soft law regulation focuses on firm outcomes at a single country level, with an emphasis on firm value and operating performance (e.g., Ahern & Dittmar, 2012; Eckbo, Nygaard, & Thorburn, 2022; Yang et al., 2019). Antecedents leading to the introduction of regulation has also caught the attention of scholars (e.g., Terjesen, Aguilera, & Lorenz, 2015; Seierstad et al. 2017). Historically, this body of literature broadly reflects the two streams of research on regulation: first, why regulation is introduced, and second, what is the effect (or impact) of regulation on firm outcomes. However, following Kirsch's (2018) call for a greater number of comparative studies analysing differences between hard law and soft law

[3] Studies on regulation and women on boards were labelled as "regulation on board gender diversity" in the widely cited review of literature on the gender composition of corporate boards by Kirsch (2018, p. 355).

regulatory approaches, an emerging body of studies are focusing on the differences between regulations around the globe. This body of research is wide ranging and extends across disciplines in academia – e.g., Management (e.g., Mensi-Klarbach & Seirerstad, 2020), Economics (e.g., Ding et al., 2022), Law (e.g., Harnay, Llense, Rebérioux, & Roudaut; 2024), Accounting (e.g., Wang, Nadeem, Malik, & Xiong, 2024), Finance (e.g., Barroso et al., 2024), and Politics (e.g., Revillard & Tuffy, 2023) – and uses multi-national samples to compare the impact of different types of boardroom gender diversity regulation.

Recent comparative studies reveal that hard law regulation yields more successful outcomes towards increasing the representation of women at board level, when comparing against national contexts where soft law regulation has been introduced (Allemand et al., 2022; Harnay, Llense, Rebérioux, & Roudaut; 2024; Humbert, Kelan, & Clayton-Hathway, 2019; Kowalewska, 2021; Poletti-Hughes & Dimungu-Hewage, 2023). Consistent findings have also been found when authors have used alternative outcome measures, hard law regulation on board gender diversity also has a more pronounced impact – relative to soft law – on increasing the disclosure of management earnings forecasts (Wang, Nadeem, Malik, & Xiong, 2023) and firm corporate social responsibility (Ding et al., 2022), but also having positive outcomes by decreasing firm carbon emissions (Barroso, Duan, Guo, & Kowalewski, 2024). Generally, when using multinational samples, there is a growing consensus amongst the literature that hard law regulation produces a more positive impact on the representation of women on boards – with this positive effect spilling over into other firm level outcomes beyond female board representation.

That said, however, it has been argued that hard law regulation is not necessary to achieve desired outcomes on board gender diversity, soft law regulation yields positive results when introduced in the correct national environment. Some scholars argue that the prevailing institutional context surrounding the introduction of soft law regulation is a key factor influencing its success, more positive outcomes are observed when there is political support for soft law regulation when it is introduced (Mensi-Klarbach & Seirerstad, 2020) and in national contexts that support the inclusion of women in the labour market (Kowalewska, 2021; Poletti-Hughes & Dimungu-Hewage, 2023). Therefore, both hard regulation and soft regulation can yield positive outcomes, but it is argued that the effectiveness of soft law regulation is heavily influenced by the national context of the country in which it is introduced.

Thus, in the years since Kirsch's (2018) comprehensive review of research in the field of regulation on board gender composition, a third stream of research has emerged. This stream of research is one that explores both hard law and soft law regulation (e.g., Mensi-Klarbach & Seirerstad, 2020), thus reflecting a shift in academic attention towards focusing on the design, use, and impact of different forms of regulation seen across the globe. In sum, research on regulation and women on boards has three streams: one explores the antecedents of regulation, such as institutional and cultural contexts (e.g., Terjesen, Aguilera, & Lorenz, 2015); a second focuses on the effects/impact of regulation (e.g., Grosvold & Brammer, 2011); and finally, and most recently, a third stream that compares the differences between soft law and hard law regulation.

The motivation of this doctoral thesis centres on exploring the impact of soft law regulation on gender board diversity and its consequences beyond the

boardroom. In particular, this thesis considers importance of regulation as a factor that influences the spillover of female representation at board level into the senior management level immediately below – commonly referred to as the trickle-down effect (Gould, Kulik, & Sardeshmukh, 2018). In addition, this thesis also explores how the presence of women at board level influences disclosures on board gender diversity in a soft law regulatory context – namely the United Kingdom – and this thesis develops an automated machine learning methodology to aid the study of gender diversity disclosures within corporate documents.

This thesis contributes to literature in three ways. First, this thesis reveals that the effect of soft law regulation weakens the trickle-down effect between women on board and women in senior management. In essence, the representation of women at board and senior management team positions are no longer as strongly correlated after regulation is implemented. In this respect, this thesis challenges the theoretical view that the trickle-down effect is driven by the processes of in-group preference (e.g., Biswas, Chapple, Roberts, & Stainback, 2021). Instead, this thesis argues the introduction of regulation on board gender diversity could lead to decoupling practices that weaken the trickle-down effect, where a firm complies with regulation on board gender diversity to gain recognition and praise, when in fact below board level they do not fully endorse or internalize these efforts. Thus, when it comes to regulation on board gender diversity, this thesis argues an institutional perspective can provide a theoretical understanding of how introduction of regulation could lead to a weakening of the trickle-down effect (Scott, 2008; Terjesen et al., 2015), as firms are more likely to engage in decoupling (Bromley & Powell, 2012), otherwise referred to as ceremonial conformity or ‘window dressing’.

Second, this thesis adds to research on board group dynamics (e.g., Anderson et al., 2011; Bilimoria & Wheeler, 2000; Bilimoria, 2000; Daily & Dalton 2003; Zelechowski & Bilimoria, 2004). In a context where soft law has been introduced, this thesis provides robust evidence for a positive relationship between women on boards and disclosures on board gender diversity, but for this positive impact to take effect women need to reach a critical mass at board level (when three of more women serve on the board). Therefore, by providing evidence to suggest that the presence of women on boards increases the likelihood of a firm disclosing information on board gender diversity, this thesis contributes towards the increasingly established theoretical perspective that women's presence at board level increases ethical behaviour and corporate governance practices (Ben-Amar, Chang, & McIlkenny, 2017; Katmon, Mohamad, & Norwani, 2019; Radu & Smaili, 2022; Seebeck & Vetter, 2021; Wahid, 2019).

Finally, this thesis contributes to the field of corporate communications – specifically literature on gender diversity disclosures. To date, research analysing text-based gender discourses has exclusively relied upon traditional qualitative methods of analysis – drawing upon diversity management perspective to explore qualitative themes within disclosures (e.g., Gurrier & Wilson, 2011; Jonsen et al., 2019; Pasztor, 2019; Uysal, 2013). Such methods have received critique for the high human effort required to code qualitative data, which often restricts studies to the analysis of a small number of qualitative documents (Jung et al., 2009). The use of traditional qualitative methods serves as a severe constraint as many countries have introduced soft law regulation on board gender diversity, which often legally require firms to publish disclosures on board gender diversity. Through the use of topic modelling, this thesis presents a methodological

approach which allows researchers to inductively generate topics from a large body of text-based disclosures, this method allows future research to inductively discover new theoretical constructs, or alternatively, explore how language within diversity disclosures is related to existing theoretical constructs. The topic modelling method provided in this thesis allows future research to analyse a large number of gender diversity disclosures to provide an insight into how firms construct, communicate, and manage perceptions of gender within their operating environment.

The rest of this introductory chapter is as follows. The next section provides the research background and context. The following sections provide a general background to the two empirical research papers that form Chapters 2 and 3 of this thesis, and in addition, to present the research questions, objectives, and contributions, including a methodological one in Chapter 4. The chapter proceeds by discussing the research context for this thesis, followed by the theoretical development that led to the construction of research questions and objectives. Then the chapter is concluded with main contributions and a research structure.

1.2. Research Background

Since the turn of the twenty-first century the composition of corporate boards, most notably the representation of women at board level, has attracted considerable attention from policy makers, national governments, and wider society. Historically, there is little doubt that men have held the vast majority of corporate directorships and women are overwhelmingly underrepresented at board level (Evtushenko & Gastner, 2019). This has led to the implicit (and often explicit) assumption that women face barriers preventing their progression up the corporate hierarchy to senior leadership positions, frequently referred to as the

'glass ceiling' (Morisson, White, & Van Velsor, 1987). In recent years, following highly visible corporate governance scandals – such as the corporate failures of Lehman Brothers, Northern Rock, and Enron – governments, investors, and other important stakeholders have become increasingly concerned with the danger of groupthink on boards mostly comprised of individuals who share the same background, experience, and gender (Lagarde, 2010; Morris, 2009). The underrepresentation of women at board level has been a key issue for policy makers and national governments, and consequently, many national governments have put in place initiatives to increase the representation of women at board level (for reviews see, Ding et al., 2022; Fauver, Hung, Taboada, & Wang, 2022; Humbert, Kelan & Clayton-Hathway, 2019; Kang, Ashton, Orujov, & Wang, 2023). A key debate for national governments is whether countries should develop hard law regulation, such as the Norwegian legal gender quota, or whether to impose soft law regulation, such as the Spanish gender equality act.

Around the globe, many countries have followed the well-known example of Norway. In 2003, the Norwegian government put in place a gender-quota requiring forty percent of board seats in listed firms are held by the under-represented gender. Two years later, following low levels of compliance, the Norwegian government mandated the quota and put in place economic fines for noncompliance – the ultimate sanction for noncompliance was forced liquidation, a penalty for breaching corporate law. Norwegian listed firms were given two years to comply with the quota law, and, when this time had passed (January 2008), all Norwegian listed firms had at least forty percent of board seats held by the under-represented gender. Belgium, Italy, Germany, India, and Israel have since introduced quota regulation which – like the Norwegian case – includes

sanctions for noncompliance (Ding et al., 2022). This type of intervention is often referred to as hard law regulation, as it reflects a legally binding obligation to meet targets or quotas regarding board gender diversity, with sanctions for noncompliance (Klettner, Clarke, & Boersma, 2014; Terjesen, Aguilera, & Lorenz, 2015). Recently, in 2022, the use of a hard law gender quota was extended across all member nations of the European Union (EU) by the European Parliament (European Parliament, 2022).

Alternatively, other countries have adopted a voluntary soft law regulatory approach towards increasing female representation at board level. For example, in 2011, the British government introduced a voluntary target that recommended FTSE 350 listed firms should have a minimum of twenty-five percent female board member representation by 2015 (Department for Business, Innovation & Skills, 2011). One year later, in 2012, the United Kingdom's (UK) corporate governance code was amended by the Financial Reporting Council (FRC) to include further recommendations regarding 'best practice rules' on reporting on the issue of board gender diversity within the annual reports of firms listed on the FTSE 350 stock exchange – one recommendation encouraged firms to develop and publish a disclosure on board gender diversity (Financial Reporting Council, 2012). Furthermore, FTSE 350 firms were annually tracked and evaluated by the Davies Committee, backed by the UK government, on their progress towards the aim of a minimum of twenty-five percent female board members by 2015 (Department for Business, Innovation & Skills, 2012). Unlike the Norwegian approach, compliance in the UK context was driven by the expectation that firms will conform with and internalise voluntary recommendations – this proved to be the case with the average representation of women on boards of the FTSE 350

rising from nine percent in 2011 to twenty-one percent in 2015 (Department for Business, Innovation & Skills, 2015). A soft law regulation could reflect any form of a non-binding policy instrument designed to increase women's participation at board level, such as recommendations in governance codes, requirements, policies, 'comply or explain' principles, and, in some cases, voluntary quotas or targets (Gabaldon, De Anca, Mateos de Cabo, & Gimeno, 2016; Terjesen et al., 2015). Many countries – such as Australia, Finland, Canada, UK, and The United States of America (see, Kang et al, 2023) – have introduced voluntary soft law regulation to increase the representation of women on boards.

The introduction of hard law regulation refers to a legally binding instrument that prevents firms from not meeting quotas on female board participation via coercive penalties. In contrast, soft law regulation reflects a non-binding approach towards improving women's representation at board level, with compliance being driven by clear and precise recommendations, warnings, and monitoring a firm's board gender diversity.

Inspired largely by the highly visible Norwegian quota, regulation on board gender diversity across the globe has caught the attention of scholars. As highlighted by Kirsch's (2018) comprehensive review of academic literature on board gender composition, research on regulation tends to follow one of two streams. One explores the antecedents of regulation, such as institutional and cultural contexts (e.g., Terjesen, Aguilera, & Lorenz, 2015) or the influences of actors (e.g., Seierstad et al. 2017); the other focuses on the effects of regulation (e.g., Grosvold & Brammer, 2011). Much of the initial research on the effect of regulation on board gender diversity exclusively focused on national contexts where hard law quota regulation has been introduced – notably in Norway (e.g.,

Ahern & Dittmar, 2012; Bertrand, et al., 2019; Eckbo, Nygaard, & Thorburn, 2022; Matsa & Miller, 2013; Olsen, Schøne, & Verner, 2013; Seierstad & Opsahl, 2011; Yang et al., 2019; Wang & Kelan, 2013), but also in Italy (e.g., Ferrari et al., 2022) and France (e.g., Aktaş, Gattai, & Natale, 2021; Arnaboldi, Casu, Kalotychou, & Sarkisyan, 2019; Nekhili, Gull, Chtioui, & Radhouane, 2019).

In recent years, an increased amount of scholarly attention has been directed towards national contexts where soft law regulation has been introduced. To date, recent research on soft law regulation has focused on: the effectiveness of soft law regulation in increasing women on boards (e.g., Conde-Ruiz, Garcia, & Yañez, 2019; Mateos de Cabo, Terjesen, Escot, & Gimeno, 2019; Oldford, 2022; Sarabi & Smith, 2021); factors influencing the success of soft law regulation (e.g., Gregorič, Oxelheim, Randøy, & Thomsen, 2017; Humbert et al., 2019; Kang, Ashton, Orujov, & Wang, 2023; Martínez-García, Sacristán-Navarro, & Gómez-Ansón, 2022; Mensi-Klarbach & Seierstad, 2020); and, finally, the broader outcomes soft law regulation has for women at board level (e.g., Allemand, Bedard, Brullebaut, & Deschenes, 2022; Mateos de Cabo, Grau, Gimeno, & Gabaldon, 2022).

Whilst prior research has done much to advance knowledge of the impact of soft law regulation on women at board level (e.g., Mateos de Cabo et al., 2019; Allemand et al., 2022), much more remains to be explored regarding the extended impact of soft law regulation. Research on the extended impact of regulation – i.e., research on the impact of regulation beyond the mandated representation of women at board level – has mostly focused on the introduction of hard law regulation, with a particular focus on the impact of regulation on firm financial outcomes – where results have been mixed (Ahern & Dittmar, 2012;

Eckbo et al., 2018; Fernandez-Mendez & Pathan, 2023; Ferrari et al., 2022; Matsa & Miller, 2013; Nygaard, 2011; Olsen, Schøne, & Verner; 2013; Yang et al., 2019).

Apart from the aforementioned impact of regulatory interventions on firm financial performance, the issue of regulation having an impact on other outcomes beyond the representation of women at board level is still not well developed, as scholarly attention has been largely focused on firm financial performance (Kirsch, 2018). The lack of focus on alternative outcomes associated with the introduction of regulation is particularly pertinent to research and practice on soft law regulation, as soft law regulation is often expected to have an extended impact on the disclosure of information on board gender diversity outcomes – as soft law is often introduced through a 'comply or explain' principle where disclosure relating to compliance is mandatory (e.g., Financial Reporting Council, 2012) – and that soft law is also introduced with the assumption "the effect of more women on boards of listed companies cascade out into senior leadership roles" (Department for Business, Innovation & Skills, 2015, p.18).

As a consequence, this thesis contributes towards research in the field of regulation on board gender diversity by empirically examining the extended impact of soft law regulation beyond the representation of women in the boardroom. Specifically, the purpose of this thesis is to examine the indirect effect of soft law regulation on both the gendered trickle-down effect; the link between women on boards and disclosures on board gender diversity in a soft law 'comply or explain' context; and exploring themes within gender diversity disclosures in a national context where soft law regulation has been introduced.

1.3. Research Context: Soft law regulation in the United Kingdom

The UK follows a soft law approach towards corporate governance where non-binding recommendations are detailed within the corporate governance code – starting with the 1992 Cadbury report of corporate governance (Aguilera et al., 2006). Whilst these codes can be defined as soft law regulation, and therefore are not legally binding, firms operating under them face normative pressure to comply with recommendations. The use of soft law regulation has become a highly effective method for enforcing desired governance practices nationally and making firms internalise their demands (Aguilera & Cuervo-Cazurra 2004, 2009). This method of diffusing desired corporate governance practices underpins the UK's approach towards addressing gender imbalance on corporate boards.

After many other countries made efforts towards regulating board gender diversity, often through the use of hard law regulation (e.g., the Norwegian quota), the UK government appointed Lord Davies of Abersoch to lead an enquiry into why so few women make it to board level positions on large UK listed firms – at that moment in time, in 2010, only twelve percent of board level seats were occupied by women (Sealy, Graham, & Doldor, 2010). The enquiry commenced with interviews and a public consultation to identify the obstacles that prevented women reaching the boardroom and made recommendations for the government, all of which would be published in a formal report in February 2011.

The Davies Report was the start of the UK's soft law regulatory intervention towards addressing gender imbalance on corporate boards. The report, titled "Women on boards", put forward eleven recommendations to increase the representation of women on FTSE 350 listed firms (Department for Business, Innovation & Skills, 2011). It was these recommendations that formed the UK soft

law regulation on board gender diversity. The most critical recommendation was for firms to meet a voluntary target of having twenty-five percent of board level positions held by women by 2015. To ensure firms internalised the voluntary target, the UK government also backed two other interventions. First, several months after the report, the government backed a “Six-month Monitoring Report” that would evaluate and monitor all FTSE 350 firms on their progress towards achieving the twenty-five percent voluntary target (Sealy, Doldor, Singh & Vinnicombe, 2011), every six months until the target date of 2015. Second, the government changed the UK corporate governance code to require listed firms to set out in their annual report a written disclosure on boardroom gender diversity (Financial Reporting Council, 2012). In the years leading up to 2015, from the perspective of firms listed on the FTSE 350 index, the soft law regulation introduced by the UK government had three key objectives: first, for them to comply with voluntary targets on board gender diversity; second, for firms to publish a disclosure on board gender diversity in their annual report; and finally, to be aware that their progress towards addressing gender imbalance at board level would be frequently monitored and evaluated.

More recently, the Hampton-Alexander Review (Department for Business, Innovation & Skills, 2015) revised the voluntary target to recommend that FTSE listed firms had thirty-three percent female representation at board level by 2020, including their executive teams – this target was later increased to forty percent (Department for Business, Energy & Industrial Strategy, 2021).

The main rationale underlying the soft law regulation imposed in the UK was the “business case” argument (FTSE Women Leaders, 2019; McHarg & Nicolson, 2006). This argument states women’s presence at board level improves financial

outcomes for the firm, making the case that there is a wider economic benefit from appointing women at board level. Indeed, when commenting on the recommendations in the initial Lord Davies Report, Home Secretory for the UK government Theresa May said “A company with a board that reflects the people it serves is better able to understand its customers, and there is growing evidence that companies with more women on their boards outperform their male-dominated rivals” (Department for Business, Innovation & Skills, 2011, para. 18). In the wake of the global financial crisis, and more recently the COVID-19 pandemic, the soft law regulation imposed in the UK has been framed by the government as a way of encouraging firms to “tap into” an under-utilised pool of female talent that will help them remain competitive and respond to changing market demands[4].(Grosvold, Rayton, & Brammer, 2016).

Regarding progress on the appointment of women on UK boards, a recent report has revealed that the soft law regulatory approach has been successful – in 2023, large UK firms ranked second only to France internationally regarding women’s representation at board level (FTSE Women Leaders, 2023). Through the use of a combination of gender related targets and governance codes, firms listed on the FTSE 350 index have seen the proportion of women at board level rise from twelve percent (2011) to forty percent (2023). Furthermore, the quality of public disclosure of information on board gender diversity has also improved since the introduction of soft law regulation, with the proportion of listed firms disclosing information increasing from fifty-six percent to ninety-eight percent

[4] This is in contrast to other counties, such as Spain, where the introduction of regulation was motivated by social justice – highlighting that mandating women’s representation at board level is in line with the democratic constitution and the right for equal opportunity.

(Financial Reporting Council, 2018). The UK approach, therefore, reflects an effective soft law regulation that has improved both the representation of women at board level and the disclosure of information on board gender diversity.

1.4. Research Theoretical Framework

1.4.1. The effect of regulation on board gender diversity

From the late 2000s, in line with an increasing number of countries introducing regulation on board gender diversity, an emerging body of academic research has become concerned with the effects of introducing regulation to increase women's representation at board level. Most of the literature on the impact of women on boards focuses on the relationship between the effect of board gender composition and firm performance (for review see, Kirsch, 2018; Terjesen, Sealy, & Singh, 2009). Several empirical studies have particularly considered the impact of legislative quotas on firm performance (e.g., Ahern & Dittmar, 2012; Ferrari et al., 2022; Yang et al., 2019). The results of such studies have been mixed. Much of the initial research on the impact of regulation on firm performance focused on the widely studied Norwegian hard law quota, were the effect of gender balancing quota had negative implications on firm accounting returns and operating profits (Ahern & Dittmar, 2012; Matsa & Miller, 2013). Such findings have caught the attention of scholars, and, consequently, these papers have led to much debate (see, Eckbo et al., 2018; Olsen, Schøne, & Verner; 2013). Nygaard (2011) shows that the negative effect depends on asymmetric information between the independent members of the board and company managers. Moreover, Eckbo and colleagues (2018) highlighted that negative findings observed in Norway are limited to 2008 (i.e., the year of the global financial crisis) and they also show that the negative result vanishes once standard errors are properly clustered,

considering that the quota occurs for all firms on the same date. This empirical debate has continued, a recent paper in the field identified a null effect of the Italian gender quota on firm performance (Ferrari et al., 2022). It would seem that empirical literature on the impact of board gender quotas on firm performance has yielded mixed and inconclusive effects with null (Ferrari et al., 2022; Olsen, Schøne, & Verner; 2013), positive (Eckbo et al., 2018; Fernandez-Mendez & Pathan, 2023), and negative (Ahern & Dittmar, 2012; Matsa & Miller, 2013; Yang et al., 2019) findings being observed.

The mixed empirical findings of the impact of regulation on firm performance mirror theoretical literature in which some theories – such as agency (Jensen & Meckling, 1976) and upper echelons theory (Hambrick, 2007; Hambrick & Mason, 1985) – argue that gender diversity at board level should have positive outcomes for the firm; whereas other theories – such as role incongruity theory (Pfeffer & Salancik, 1978) – suggest the presence of women at board level could have negative outcomes for the firm. As a consequence of such inconclusive findings, scholarly attention on this particular field of investigation on the extended effect of regulation has focused on the need to address issues associated with endogeneity and causality (see, Yang et al., 2019).

Literature has also analysed the effect of regulation on measures associated with labour outcomes for women. Results in this area are more consistent. Empirical research, once again focusing on the Norwegian quota, argues that the quota had positive implications on the qualifications held by female directors in the post-reform period, implying that new female directors appointed after the quota were more experienced than their predecessors in terms of educational and professional experience (Bertrand, et al., 2019; Wang & Kelan, 2013) –

consistent findings were also observed when the Italian hard law quota was introduced (Ferrari et al., 2022). Collectively, these studies highlight that hard law gender quotas have the intended consequences of altering selection processes for board members, which in turn change the overall composition of the corporate board. However, whilst hard law quotas have led to an increase in the proportion of women at board level, research has also highlighted that hard law regulation could lead firms to draw from the same small pool of female directors (Seierstad & Opsahl, 2011) and appoint women who share the same privileged social background as existing male directors (Bhattacharya, Khadka, & Mani, 2022).

All aforementioned studies restrict their analysis to contexts where hard law regulation has been introduced. In fact, to be more precise, much of the research on regulation on board gender diversity focuses on the effect of hard law quotas on the focal Norwegian quota (e.g., Ahern & Dittmar, 2012) with several studies focusing on hard law quotas introduced in France and Italy (Arnaboldi, et al., 2020; Ferrari et al., 2022; Nekhili, et al., 2020). In these national contexts, where hard law regulation has been introduced, non-compliant firms face penalties such as delisting, nonregistration, and fines. However, these findings may not be generalisable to national contexts where soft law regulation has been introduced, where firms are anticipated to comply without risk of sanctions for noncompliance. Soft law regulation has been introduced in many countries (e.g., Finland, UK, USA, and Canada) and empirical literature on the effect of this specific type of regulation on gender diversity has received increased scholarly attention.

Beyond research on hard law quotas, the soft law regulation literature reflects an emerging body of empirical research. Given soft law regulation is voluntary and non-binding, a body of research has sought to establish the effectiveness of

soft law regulatory approaches aimed at increasing the representation of women at board level. Research focused on the Spanish gender equality act, which recommended that all large private and public firms have forty percent of women at board level by 2015, has revealed that the number of firms complying with the quota was very low, and, ultimately, this result was driven by a lack of commitment by the Spanish government towards the soft law quota (Conde-Ruiz, Garcia, & Yañez, 2019; Mateos de Cabo, Terjesen, Escot, & Gimeno., 2019). In March 2023, low compliance with the Spanish soft law regulation led to the national government to convert the regulation into hard law, meaning firms faced penalties for non-compliance with the quota (Kassam, 2023). However, research in other national environments has shown that soft law regulation is effective in improving the representation of women at board level, such as in Canada (Oldford, 2022) and the United Kingdom (Sarabi & Smith, 2021). When comparing soft law regulation globally, recent empirical research argues a soft law approach is most effective when the regulation has clear deadlines and precise thresholds for female board participation, in contrast soft regulation is least effective when it is implemented using voluntary frameworks with ambiguous targets and a lack of enforcement (Kang et al., 2023). Previous research also shows that the efficiency of soft law approaches depends on country level factors such as the level of gender equality (European Institute for Gender Equality, 2020; Humbert, Kelan & Clayton-Hathway, 2019; Mensi-Klarbach & Seierstad, 2020) and firm specific factors, such as resistance to female board participation (Gregorič, Oxelheim, Randøy, & Thomsen, 2017) or firm ownership and control structure (Martínez-García, Sacristán-Navarro, & Gómez-Ansón, 2022).

Alternatively, rather than focusing on the effectiveness of soft law regulation, a body of research has focused attention on other outcomes for women appointed to boards who operate in national contexts where soft law regulation has been introduced. For instance, social network research has revealed that the introduction of soft law regulation reduces the influence of interlocking director networks (i.e., the old boys network) on the appointment of female directors (Allemand, Bedard, Brullebaut, & Deschenes, 2022) and improves the 'closeness' of female directors to other directors in their social network (Mateos de Cabo, Grau, Gimeno, & Gabaldon, 2022).

Whilst literature on soft law and hard law regulation has done much to advance our understanding on the impact of regulation on women in focal board level positions, much more remains to be explored regarding whether regulation has extended benefits lower down in the corporate hierarchy. Indeed, when a hard law or soft law approach is introduced, it has been assumed that regulation designed to increase women's presence at board level will also "trickle-down" to increase the representation of other women in senior management (Kirsch, 2018). Interestingly, this implicit (and sometimes explicit) assumption, commonly referred to as the trickle-down effect (Gould, Kulik, & Sardeshmukh, 2018), is a motivating factor for many national governments to introduce regulation on the representation of women at board level. For example, when soft law targets and reporting requirements were introduced in the UK, the national government stated, "we hope to see the effect of more women on boards of listed companies cascade out into senior leadership roles" (Department for Business, Innovation & Skills, 2015, p.18). Furthermore, research on the hard law Norwegian quota argued "public policies aimed at increasing female representation on boards of

directors, such as the quota recently adopted in Norway, may lead to general spillovers in management" (Matsa & Miller, 2011, p.639). It is therefore widely assumed that a regulatory intervention to increase women's representation at board level should strengthen the trickle-down effect.

However, at present there is a dearth of research exploring whether the introduction of regulation (hard law or soft law) on board gender diversity strengthens or weakens the trickle-down effect. Traditional theoretical literature on ingroup preference suggests regulation designed to increase women at board level should improve women's representation in the senior management team (e.g., Byrne, 1971; Kanter, 1977, Tajfel & Turner, 1979), whereas a small body of contradictory empirical research suggests regulation could have a negative impact on the trickle-down effect (Bertrand et al., 2019; Gould et al., 2018). In light of the absence of a comprehensive theoretical explanation that explicitly conceptualizes a clear and concise relationship between regulation and the trickle-down effect, the introduction of regulation on board gender diversity offers a useful empirical opportunity to test contradicting views regarding the impact of regulation on the trickle-down effect. Whilst a growing body of research has explored the impact of hard law and soft law regulation on women in focal board level positions (e.g., Mateos de Cabo et al., 2019) and firm financial outcomes (e.g., Ahern & Dittmar, 2012), there is a lack of research exploring how the introduction of regulation on board gender composition influences the relationship between women's representation on boards and gender diversity in senior management levels. Therefore, the first paper of this thesis seeks to answer the following research question:

"how is the gender-based trickle-down effect between the corporate board and senior management team influenced by unexpected soft law regulation on board gender diversity?"

1.4.2. Soft law regulation and Board Gender Diversity Disclosure

Soft law regulation on board gender diversity is often implemented through the use of national corporate governance codes. A corporate governance code is a set of best practice rules designed to address deficiencies in corporate practice (e.g., gender imbalance at board level) by suggesting recommendations on the preferred composition of the board of directors and information disclosure (Haxhi & Aguilera, 2012). Although the content of soft law regulatory codes varies widely across nations, they are effective tools for increasing accountability and diffusing desired corporate practices (Aguilera & Cuervo-Cazurra, 2004, 2009).

Whilst nations have introduced soft law regulatory codes on board gender diversity, compliance is often encouraged through the use of 'comply or explain' principles. The essence of the 'comply or explain' principle is that compliance with recommendations made by the soft law code is not mandatory, but that disclosure relating to compliance is mandatory. In the Netherlands, for example, the 'comply or explain' principle within their corporate governance code is supported by law, meaning that Dutch firms must disclose information in annual reports relating to compliance with code recommendations (Haxhi & van Manen, 2010) – similar provisions are also in place in Germany. Many countries who have implemented soft law regulation on board gender diversity have used codes of corporate governance that operate using a 'comply or explain' principle requiring disclosure relating to recommendations on gender diversity at board level. For example, the Australian ASX corporate governance code requests that listed firms disclose

information within their annual report on objectives, policies, and progression towards addressing board gender diversity (Australian Securities Exchange, 2010). Also, following consultation with investors and stakeholders, both the United States SEC and the UK corporate governance code have introduced rules encouraging the disclosure of information on gender diversity on the corporate boards of listed firms (Financial Reporting Council, 2012; US Securities and Exchange Commission, 2009). Thus, often when soft law interventions have been introduced to increase female participation at board level, firms also face pressure to disclose information on board gender diversity in their annual reports. Previous research has linked women's representation at board level with many types of corporate disclosures, including, but not limited to: environmental, social and governance (ESG) information (e.g., Arayssi, Dah, & Jizi, 2016; Barako & Brown, 2008); corporate social responsibility reporting (e.g., Frias-Aceituno, Rodriguez-Ariza & Garcia-Sanchez, 2013; Rao & Tilt, 2016; Hoang, Abeysekera, & Ma, 2018); carbon disclosures (e.g., Ben-Amar, Chang, & McIlkenny, 2017); and corporate risk disclosures (e.g., Seeback & Vetter, 2022). Such findings mirror the theoretical perspective put forward by many researchers suggesting that female directors possess certain characteristics, or gender differences (e.g., diverse backgrounds, values, perceptions, experiences, expertise, and so on), that exert a positive impact on the disclosure of information regarding a firm's practices. For example, Fernandez-Feijoo and colleagues (2012) argue that women's presence at board level leads a board to benefit from their "feminine characteristics" and consequently they are highly committed to CSR disclosure. Based on the findings of theoretical and empirical research on CSR disclosures, alongside research on corporate communications literature, it could be argued

that firms with a higher proportion of women at board level should be more likely to disclose information on board gender diversity (Ben-Amar, Chang, & McIlkenny, 2017; Point & Singh, 2003; Seeback & Vetter, 2022; Windscheid et al., 2017).

The flipside of this perspective, however, is that disclosure on board gender diversity does not necessarily imply actual interventions to increase the representation of women at board level. Indeed, the use of a 'comply or explain' principle could also offer a firm the ability to engage in the practice of 'window dressing' (Terjesen et al., 2015), where the firm's board actively engage on reporting the virtues of board gender diversity whilst not fully internalising these efforts – akin to the well-established "decoupling" principle which puts forward the argument that disclosure and internal practice (i.e., women's actual presence at board level) could become misaligned (for review see, Bromley & Powell, 2012). Therefore, a sceptical view could be put forward, firms could use board gender diversity disclosures as window dressing, meaning firms with a lower proportion of women at board level could be more likely to disclose information on board gender diversity.

There is a need to establish if (or to what extent) the representation of women at board level is related to corporate disclosures on board gender diversity. At present there is a dearth of research exploring the link between the representation of women at board level and the likelihood of a firm disclosing information on board gender diversity. Taking advantage of the interesting setting following the enactment of soft law gender diversity disclosure requirements in the UK, the second research paper of this thesis seeks to answer the following research question:

"what is the relationship between women on boards and the disclosure of information on board gender diversity?"

1.4.3. The content of board gender diversity disclosures

A stream of research on corporate communications has examined ways in which firms communicate disclosures on gender diversity. In this body of research, a diversity management perspective is often used, positing that organisations present gender as a concept that helps firms generate a competitive business advantage. The disclosure of information on gender diversity plays a critical role in indicating firm values to corporate stakeholders (Singh & Point, 2006), and in doing so, enhancing the firm's reputation as an attractive employer (Walker, Feild, Bernerth, & Becton, 2012; Windscheid et al., 2016).

Prior work in the field of corporate communication has analysed the qualitative themes within gender diversity disclosures across different contexts, mainly through the analysis of disclosures published on company websites and annual reports. For example, in their landmark study, Point and Singh (2003) compare diversity disclosures on corporate websites across eight European countries, and conclude at that time, firms in the UK were more likely to use a diversity management perspective than other countries. More recent research analysing the themes within corporate disclosures has continued to analyse different countries. Whilst it has been confirmed that the prevalence of a diversity management perspective is common in the UK (Gurrier & Wilson, 2011), research has also shown the use of a diversity management perspective has gained popularity in the corporate disclosures of other countries including France, Germany, Spain, the US (Jonsen et al., 2019; Pasztor, 2019; Uysal, 2013),

Portugal (Barbosa & Cabral-Cardoso, 2010), Bangladesh (Hossain, Alam, & Mazumder, 2021), and South Korea (Mehng, Sung, & Leslie, 2019).

Put together, this body of work has given some insight into the frequency and type of diversity disclosures made by firms, as well as the qualitative themes within them – with the most prevalent theme in disclosures being the diversity management perspective, whereby firms frame gender diversity as something that can be utilised and managed to produce meaningful business-related benefits (e.g., Point & Singh, 2003). Whilst this body of research on gender diversity disclosures has done much to explain the content within gender diversity disclosures, this body of literature is not without its limitations.

To date, research analysing text-based gender discourses has exclusively relied upon traditional qualitative methods of analysis. Such methods have received criticism for the high human effort required to code qualitative data, which often restricts studies to the analysis of a small number of qualitative documents (Jung et al., 2009). This poses a severe constraint on research in the field of analysing gender diversity disclosures, especially given many countries have soft law corporate governance codes that require disclosures on board gender diversity. For example, in the UK and Germany, publicly listed firms are required to report disclosures on gender diversity for upper management and board level positions within corporate documents (Financial Reporting Council, 2018; Windscheid et al., 2015). Thus, a potential sample of gender diversity disclosures could reflect a dataset containing thousands of text-based documents. The manual analysis of such a dataset would reflect an impossible task for one researcher to complete alone, especially if traditional qualitative methods are employed.

Furthermore, owing to a reliance on qualitative methods, research in the field has mostly focused on testing the generalisability of Point and Singh's (2003) findings in alternative national contexts, with some studies even focusing on specific industry sectors (e.g., Gröschl, 2011; Kele & Cassell, 2022). As a result, a more sophisticated analysis of gender diversity disclosures has not been published to date. To this end, it is clear to see, a new tool and methodology is required that allows researchers to analyse large volumes of gender diversity disclosure data.

The third paper in this thesis seeks to propose a new instrument for the automated content analysis of gender diversity disclosures. By presenting a tool for automatically analysing themes within gender diversity disclosures, this paper will provide a foundation on which future scholars expand existing research analysing corporate disclosures on gender diversity. This paper, therefore, has the following objective:

"to outline how researchers can use automated machine learning techniques to study gender diversity disclosures within corporate documents."

1.5. Research Implications and Contributions

This thesis contributes to literature in several ways. First, there is very little known regarding the impact regulation has on the trickle-down effect – whereby the representation of women at board level is positively associated with the representation of women in lower levels of management. There is a contradiction amongst literature regarding the potential impact of regulation on board gender diversity. Whilst it has been argued that the exogenous shock of regulation should strengthen the trickle-down effect (Matsa & Miller, 2011), empirical research suggests that mandated gender diversity does not correlate with the

representation of women within the firm (Bertrand et al., 2019) – challenging empirical findings that establish positive trickle-down effects stemming from women at board level (e.g., Bilimoria, 2006; Matsa & Miller, 2011; Skaggs, Stainback, & Duncan, 2012) and the widespread assumption that regulation should strengthen the trickle-down effect. The results from this study provide support for the assumption that regulation on board gender diversity leads to the weakening of the trickle-down effect between the corporate board and senior management team – in essence, the representation of women at board and senior management team positions are no longer as strongly correlated after regulation was implemented in the UK. With respect to theory, our results do not support the view that regulation, through the use of quotas or targets, will strengthen the relationship between the representation of women at board and senior management levels, which has been suggested by theory used in prior literature on the trickle-down effect (e.g., Biswas, Chapple, Roberts, & Stainback, 2021), for instance, similarity-attraction paradigm (Byrne, 1971) or social identity theory (Tajfel & Turner, 1979).

Second, there is limited evidence on the relationship between women on boards and corporate disclosures relating to board gender diversity. For instance, two qualitative studies, separated by fifteen years, have both highlighted the need for research to investigate how gender diversity statements are related to the representation of women in senior positions (see, Point & Singh, 2003; Windscheid et al., 2017). Accordingly, this thesis will answer this call, a key contribution is adding to the limited volume of empirical research on the link between the representation of women on boards and disclosures on board gender diversity.

Third, this thesis contributes to literature by presenting a new methodology for the analysis of gender diversity disclosures. This thesis presents a new tool to the field, that allows scholars to conduct automatic content analysis of gender diversity statements disclosed in annual reports or company websites, and provides an illustration of how the tool can be used to perform analyses exceeding the capabilities of current research in the field – which has been restricted to the use of manual context analysis techniques (e.g., Point & Singh, 2003). Aside from helping scholars automatically analyse gender diversity disclosures, this thesis also acts as a foundation on which scholars can explore how themes within disclosures are linked to their antecedents and outcomes.

Finally, this thesis contributes to literature focusing on regulation designed to increase board gender diversity. To date, literature exploring the impact of regulation has mainly focused on hard law initiatives, most notably the Norwegian quota (e.g., Ahern & Dittmar, 2012; Bertrand et al., 2019; Seierstad & Opsahl, 2011). Although this body of literature has done much to contribute towards our understanding of regulation, there is still little research focusing on national contexts where soft law regulation has been implemented. In such contexts, such as the UK, compliance with targets or quotas is voluntary and non-compliance does not result in punishment. Also, when soft law is introduced regarding board gender diversity, firms also are confronted with corporate governance codes that require a firm to disclose information on board gender diversity. It is clear to see that soft law regulation is distinct from hard law regulation, and as a consequence, deserves greater attention by scholars. This thesis therefore presents the UK as a contrasting empirical context to nations who have implemented hard law regulation.

1.6. Research structure and outline

This thesis consists of five chapters. Below is a summary of each chapter:

Chapter 1: This chapter introduced the research and empirical context. It identifies the key objectives, research questions, theoretical framework, and anticipated contributions of knowledge.

Chapter 2: This chapter is an empirical research paper that answers the following research question "how is the gender-based trickle-down effect between the corporate board and senior management team influenced by unexpected soft law regulation on board gender diversity?". This research paper, published in The Leadership Quarterly (see, Page, Sealy, Parker, & Hauser, 2023) utilises a new soft law regulation introduced in the United Kingdom. An event study design is used in which the change in regulation is treated as an exogenous shock, we utilize this shock to investigate how regulation influences the trickle-down of women's representation from board level to senior management. We find evidence of a positive relationship between women on boards and women's representation in senior management during the pre-regulation era – otherwise referred to as the trickle-down effect. However, the introduction of regulation had the unintended consequence of weakening the relationship between women on boards and women in senior management. These results suggest that the trickle-down effect varies between different contexts and settings. We discuss the implications for research and practice.

Chapter 3: This chapter is an empirical research paper that answers the following research question "what is the relationship between women on boards and the disclosure of information on board gender diversity?". Again, following on from Chapter 2, the empirical context of the United Kingdom is utilised, where a

'comply or explain' principle of corporate governance was introduced to encourage FTSE 350 listed firms to provide a text-based disclosure on board gender diversity in their consolidated annual reports. The empirical findings provide evidence of a positive relationship between the representation of women in the boardroom and the disclosure of information on board gender diversity. Furthermore, there is also evidence to suggest that a critical mass of women at board level also increases the likelihood of disclosure. This chapter goes onto discuss implications for research and practice.

Chapter 4: This chapter presents the use of topic modelling, a specialised machine learning technique, as a method for automatically investigating the content within large volumes of gender diversity disclosures. Published in a book titled Handbook of Research Methods on Gender and Management (see, Page & Sealy, 2021), this chapter provides a step-by-step guide outlining each stage of the topic modelling process, along with the application of a relevant example analysing the diversity disclosures of large US firms. The chapter serves as a new instrument for the automated content analysis of gender diversity disclosures, opportunities, and limitations for the use of topic modelling as a research method are discussed.

Chapter 5: This chapter presents the key conclusions emerging from the exploration of the extended impact of soft law regulation on board gender diversity. Specifically, the two research questions: (Chapter 2) how is the gender-based trickle-down effect between the corporate board and senior management team influenced by unexpected introduction of soft law regulation on board gender diversity? And second, (Chapter 3) what is the relationship between women on boards and the disclosure of information on board gender diversity?

And finally (Chapter 4) the objective of presenting a new methodology to outline how researchers can use automated topic modelling techniques to study gender diversity disclosures within corporate documents. The chapter provides a discussion of findings, empirical and theoretical contributions, implications for policy and practice, limitations, and future directions, and finally, concluding remarks are provided.

Chapter 2

2. Regulation and the Trickle-down Effect of Women in Leadership Roles

2.1. Abstract

We use an event study design to provide evidence demonstrating how the trickle-down effect is influenced by the introduction of regulation on board gender diversity. In 2011, a new regulation was suddenly introduced for firms listed on the United Kingdom's FTSE 350 index, the regulatory intervention put forward recommendations to increase the representation of women on the boards of FTSE 350 listed firms – the most critical recommendation was a voluntary target of having twenty-five percent of board positions held by women. We argue this change in regulation represents an exogenous shock, we utilize this shock to investigate how regulation influences the trickle-down of women's representation from board level to senior management. We find evidence of a positive relationship between women on boards and women's representation in senior management during the pre-regulation era – otherwise referred to as the trickle-down effect. However, the introduction of regulation had the unintended consequence of weakening the relationship between women on boards and women in senior management. Our results suggest that the trickle-down effect varies between different contexts and settings. We discuss the implications for research and practice.

Key Words: gender diversity, regulation, women on boards, trickle-down effect, exogenous shock.

2.2. Introduction

Historically, women face barriers as they move up the corporate hierarchy. Those women who overcome these barriers face the implicit and widespread expectation that their representation at board level will "trickle-down" to increase the representation of other women in senior management (Kirsch, 2018). Interestingly, this implicit assumption, commonly referred to as the trickle-down effect[5] (Gould, Kulik, & Sardeshmukh, 2018), is a motivating factor for many national governments to introduce regulation[6] on the representation of women at board level. For example, in a report on their regulatory target, the UK government stated, "we hope to see the effect of more women on boards of listed companies cascade out into senior leadership roles" (Department for Business, Innovation & Skills, 2015, p.18). Furthermore, a highly influential study on the trickle-down effect suggests "public policies aimed at increasing female representation on boards of directors, such as the quota recently adopted in Norway, may lead to general spillovers in management" (Matsa & Miller, 2011, p.639). It is therefore widely assumed that a regulatory intervention to increase women's representation at board level should strengthen the trickle-down effect. The introduction of regulation concerning the representation of women on boards has become widely adopted by many nations across the globe (Terjesen, Aguilera, & Lorenz, 2015). The sudden implementation of regulation in a firm's

[5] Literature has also referred to this relationship as a gender spillover (e.g., Matsa & Miller, 2011). We chose to not use the term spillover as it has not been ubiquitously adopted across research in this field.

[6] Regulation is typically introduced in two ways, using either hard law (statutory impositions with penalties for violation) or soft law (non-binding regulation with codes of good governance principles).

environment could be considered an exogenous shock[7], as it reflects an abrupt change event that dramatically affects individuals, firms, and society (Meyer, 1982). Whilst there is evidence to suggest regulation on board gender diversity has a significant impact on women's representation at board level (Bennouri, De Amicis, & Falconieri, 2020; De Cabo, Terjesen, Escot, & Gimeno, 2019; Grosvold & Brammer, 2011; Sojo, Wood, Wood, & Wheeler, 2016; Wang & Kelan, 2013), research focusing on Norwegian firms suggests that, in the post-regulation environment, mandated gender diversity at board level has no association with the representation of women within the firm (Bertrand, Black, Jensen, & Lleras-Muney, 2019). Such findings imply that whilst regulation improved the representation of women in focal board level positions, these benefits did not trickle-down into the firm. The empirical findings on Norway's gender quota contradicts prior research that establishes positive trickle-down effects stemming from women at board level (e.g., Bilimoria, 2006; Matsa & Miller, 2011; Skaggs, Stainback, & Duncan, 2012) and challenges the widespread assumption that regulation should strengthen the trickle-down effect, which could be rationalized by well-established theories on an ingroup preference between individuals of the same gender – such as similarity-attraction paradigm (Byrne, 1971), social identity theory (Tajfel & Turner, 1979), and homosocial reproduction (Kanter, 1977).

At present there is a dearth of research exploring whether the introduction of regulation on board gender diversity strengthens or weakens the trickle-down

[7] Exogenous shocks reflect sudden, unexpected, and far-reaching events, such as: economic crises, the occurrence of natural disasters, or changes in regulation (Bernile, Bhagwat, & Rau, 2017; Stoker, Garretsen, & Soudis, 2019; Yang, Riepe, Moser, Pull, & Terjesen, 2019).

effect. Traditional theoretical literature in sociology and psychology on ingroup preference suggests regulation designed to increase women at board level should improve women's representation in the senior management team (e.g., Byrne, 1971; Kanter, 1977, Tajfel & Turner, 1979), whereas a small body of contradictory empirical research suggests regulation could have a negative impact on the trickle-down effect (Bertrand et al., 2019; Gould et al., 2018). In light of the absence of a comprehensive theoretical explanation that explicitly conceptualizes a clear and concise relationship between regulation and the trickle-down effect, the introduction of regulation on board gender diversity offers a useful empirical opportunity to test contradicting views regarding the impact of regulation on the trickle-down effect. Whilst a growing body of research has explored the impact regulation has on the relationship between board gender diversity and firm financial outcomes (see, Ahern & Dittmar, 2012; Arnaboldi, Casu, Kalotychou, & Sarkisyan, 2020; Carbonero, Devicienti, Manello, & Vannoni, 2021; Ferrari, Ferraro, Profeta, & Pronzato, 2022; Garcia-Blandon, Argilés-Bosch, Ravenda, & Castillo-Merino, 2022; Lara, Penalva, & Scapin, 2022; Matsa & Miller, 2011; Nekhili, Gull, Chtioui, & Radhouane, 2020; Yang, Riepe, Moser, Pull, & Terjesen, 2019), there is a lack of research exploring how the introduction of regulation on board gender composition influences the relationship between women's representation on boards and gender diversity in senior management levels.

In the present study, we explore how the gender-based trickle-down effect between the corporate board and senior management team is influenced by unexpected regulation on board gender diversity. The context of our study is the United Kingdom's Financial Times Stock Exchange (FTSE) index from 2007 to

2018. During this period, specifically in 2011, the United Kingdom (UK) Government abruptly implemented regulation in which eleven recommendations were proposed to increase women's representation on the boards of FTSE 350 listed firms (Department for Business, Innovation & Skills, 2011), the most critical recommendation was for firms to meet the voluntary target of having twenty-five percent of board positions held by women. This was contrary to the neo-liberal foundations that are deeply embedded in the UK with a powerful resistance to radical initiatives of 'meddling' government interventions in the business world. The introduction of regulation could be considered an exogenous shock, an unprecedented and unexpected event, in which corporate boards were abruptly confronted with new external regulatory goals, expectations, and norms concerning the representation of women at board level (Doldor, Sealy, & Vinnicombe, 2016). In the present study, we are able to harness this event, in which regulation was unexpectedly introduced, to explore whether the introduction of regulation on female board representation has a positive or negative impact on the trickle-down effect.

This study makes two contributions to literature. First, we bring a novel perspective to research on trickle-down effects through exploiting the introduction of regulation on female board representation in the United Kingdom. We add to a growing body of literature investigating factors that influence trickle-down effects between board and senior management (e.g., Ali, Grabarski, & Konrad, 2021; Bertrand et al., 2019), an area of research previously identified as needing further investigation (Kirsch, 2018). Our results provide support for the assumption that regulation on board gender diversity leads to the weakening of the trickle-down effect between the corporate board and senior management team – in essence,

the representation of women at board and senior management team positions are no longer as strongly correlated after regulation was implemented in the United Kingdom. With respect to theory, our results do not support the view that regulation, through the use of quotas or targets, will strengthen the relationship between the representation of women at board and senior management levels, which has been suggested by theory used by prior literature on the trickle-down effect (e.g., Biswas, Chapple, Roberts, & Stainback, 2021), for instance, similarity-attraction paradigm (Byrne, 1971) or social identity theory (Tajfel & Turner, 1979).

Second, we extend prior research on the effects of regulation. To date, most studies exploring regulation have focused upon financial performance (e.g., Ahern & Dittmar, 2012) and women's access to board positions (e.g., Seierstad & Opsahl, 2011; Sojo et al., 2016). We contribute by exploring the impact of regulation on the trickle- down effect, an area of research which has lacked empirical investigation. We contribute to literature by studying the impact of regulation on unitary board structures in the United Kingdom, rather than the widely studied European mandatory hard law regulation applied to supervisory boards[8] (e.g., Ahern & Dittmar, 2012; Ferrari et al., 2022).

[8] Internationally, there are unitary and two-tier models of corporate governance. A unitary board can be defined as one group containing non-executive (i.e., external or outsider directors) and executive directors (i.e., management or insider directors), used for example in the United Kingdom and the United States. The two-tier system separates the board into two distinct groups: the executive board (management) and the supervisory board (non-executive directors), this system exists in, for example, Germany, Austria, and Norway. Both systems exist in France. This difference is pertinent because the executives operate within the firm, working with other senior and mid-level management. The two-tier versus unitary board system could have implications for the impact of regulation on the trickle-down effect stemming from women's representation at board level.

This paper proceeds as follows. First, we provide a review of literature on the trickle-down effect and subsequently explore how this could be influenced by regulation. Second, we describe the data and methods. Third, we investigate if regulation on board gender diversity in the United Kingdom had an impact on the trickle-down effect. Finally, we discuss our results and conclude.

2.2.1. The trickle-down effect: A review

Over the last two decades, researchers have been increasingly interested in trickle-down effects where the perceptions, attitudes, or behaviours of individuals located at one level of the management hierarchy influence the perceptions, attitudes, or behaviours of individuals located in management levels immediately below (for a review see, Wo, Schminke, & Ambrose, 2019). Past work has demonstrated trickle-down effects between management levels across a wide range of phenomena, including justice perceptions (Ambrose, Schminke, & Mayer, 2013; Tepper & Taylor, 2003), transformational leadership (Bass, Waldman, Avolio, & Bebb, 1987; Bormann & Diebig, 2021), ethical or abusive behaviour (Aryee, Chen, Sun, & Debrah, 2007; Mawritz, Mayer, Hoobler, Wayne, & Marinova, 2012; Mayer, Kuenzi, Greenbaum, Bardes, & Salvador, 2009), and perceived support (Shanock & Eisenberger, 2006).

A related, albeit separate, body of literature also establishes the presence of trickle-down effects in the representation of women between levels of management (see, Ali, et al., 2020; Bilimoria, 2006; Biswas, Chapple, Roberts, & Stainback, 2021; Biswas, Roberts, & Stainback, 2021; Gould et al., 2018; Matsa & Miller, 2011; Skaggs et al., 2012). This form of trickle-down effect suggests that “diversity begets diversity” (Cook & Glass, 2015, p.137). In this fashion, an increase in women’s representation in a higher level of management is expected

to trickle-down to lower levels of management. In their landmark study Cohen, Broschak and Haveman (1998) were amongst the first to identify a trickle-down effect concerning women's representation in the firm, such that women's chances of being hired or promoted into a focal level of management was greater when there is a higher proportion of women in the management level above.

Subsequent research into the trickle-down effect of women's representation in the firm has mainly focused on trickle-down effects stemming from board level. Women's representation at board level has been shown to trickle-down to increase women's representation in executive board positions (Bozhinov, Joecks, & Scharfenkamp, 2021; Matsa & Miller, 2011), executive officer positions (Bilimoria, 2006; Gould et al., 2018), middle management positions (Ali et al., 2021), management positions (Skaggs et al., 2012) and finally, top earner positions (Bilimoria, 2006).

Literature exploring this gendered trickle-down effect draws from a wide variety of established theoretical frameworks, such as similarity-attraction paradigm (Byrne, 1971), social identity theory (Tajfel & Turner, 1979), homosocial reproduction (Kanter, 1977), and homophily (Ibarra, 1993), to argue that women in senior leadership positions can promote the representation of other women within the firm, as people tend to associate and interact with others who they see as having similar attributes, values, and dispositions. The key problem with existing literature using these theoretical frameworks, which promote the concept of in-group preference, concerns the fact that the theoretical mechanisms employed, such as the principle of homosocial reproduction, are seldom (if ever) measured by researchers exploring the trickle-down effect stemming from women

at board level. The scale of this issue becomes evident when there is reason to suggest women at board level may not actively promote gender equality or advocate for the promotion of women lower down in the corporate hierarchy, as suggested by the widely debated and criticized “queen bee phenomenon” (e.g., Derks, Van Laar, & Ellemers, 2016; Ellemers, Van den Heuvel, de Gilder, Maass & Bonvini, 2004). This lack of promotion or advocation from women on boards, however, can also be explained by the dynamics of tokenism (Kanter, 1977), when women are in the extreme minority at elite levels. The trickle-down effect could, therefore, be more complex than the simple linear relationship existing between women’s representation at board level and women’s subsequent representation in senior management.

It appears likely that the two variables of interest when studying the trickle-down effect, i.e., the representation of women at board level and the representation of women in senior management, are endogenously determined. In short, the positive trickle-down effect observed by prior literature (e.g., Bilimoria, 2006; Matsa & Miller, 2011) may actually be the result of omitted variable bias (Antonakis, Bendahan, Jacquart, & Lalive, 2010). For instance, the trickle-down effect could be associated with firm policies designed to benefit women at all levels of the management hierarchy. As a consequence, a growing body of research has explored additional factors that may shape the relationship between women on boards and women’s representation in management positions. This small body of research has identified that the trickle-down effect is influenced by: critical mass at board level (Biswas, Chapple, Roberts, & Stainback, 2021), board independence (Biswas, Roberts, & Stainback, 2021), and industry gender composition (Ali et al., 2021). This small, albeit growing, body

of literature reflects a move towards understanding factors that influence the trickle-down effect, an area of research recently cited as a critical area for empirical investigation (Kirsch, 2018). At present, there is an assumption that regulation on female board representation could serve as a factor that strengthens the trickle-down effect (e.g., Matsa & Miller, 2011). Given the prevalence of well-established theories suggesting that women, like men, prefer to associate with similar others (e.g., Ibarra, 1993, Kanter, 1977), there is reason to assume regulation designed to increase women on boards is likely to strengthen the relationship between women on boards and gender diversity in senior management. However, empirical research is yet to establish the impact of regulation on the trickle-down effect. Given that regulatory interventions on board gender composition have been widely introduced in nations across the globe, it is important to establish how – and to what extent – the introduction of regulation influences the trickle-down effect.

2.2.2. Regulation on board gender diversity and the trickle-down effect

Across the globe, national regulation on board gender composition often takes one of two forms: hard law regulation or soft law regulation (Terjesen & Sealy, 2016; Terjesen et al., 2015; Terjesen, Sealy & Singh, 2009). Many countries have adopted hard law regulation on board gender diversity, including but not limited to Germany, France, Spain, Norway, and Italy. Whereas other countries, such as the United Kingdom, have adopted soft law regulation on board gender composition.

Soft law regulation is characterized by the absence of legal arrangements concerning compliance with ‘standards’ or ‘best-practice rules’ on a focal issue (Abbot & Snidal, 2000). Soft law regulation is based upon the principle that firms

are expected to comply with normative standards and rules that are not legally binding but still have relevance to society, governments, or other important firm stakeholders (Terjesen et al., 2015). Examples of soft law regulation include voluntary initiatives, codes of conduct, commitments, guidelines, or recommendations laid down by external institutions with no legally binding force. Soft law regulation on women on boards can be defined as a non-binding recommendation (e.g., a voluntary target or quota) set by an external institution (e.g., a national government), where compliance is driven by the expectation that a firm will conform with normative standards concerning women's representation at board level (Terjesen et al., 2015; Terjesen & Sealy, 2016). For example, in 2013, the Dutch government introduced recommendations that encouraged listed firms to have thirty percent of board level positions occupied by women, with no penalty for non-compliance.

Alternatively, hard law regulation reflects a legal obligation to comply with standards on a focal issue. The mandatory standards set by hard law regulation are characterized by "a high level of formalization and strong sanctions for noncompliance" (Gatti, Vishwanath, Seele, & Cottier, 2019, p. 965). When hard law regulation is imposed on a firm, compliance with rules and requirements are legally binding and non-compliance results in sanctions. Hard law regulation on women on boards can be defined as a legally binding minimum standard (e.g., a mandated target or quota) set by an external institution regarding the representation of women on a firm's board, with penalties for non-compliance. For example, in 2005, the Norwegian government enforced a hard law board gender quota which legally required firms to have a female board representation

of forty percent and non-compliant firms faced the punishment of being delisted from the stock exchange (Eckbo, Nygaard, & Thorburn, 2022).

Although this dichotomous segmentation into ‘hard law’ and ‘soft law’ is useful to understand regulatory initiatives, given changing environments firms are situated within, the line separating soft law and hard law regulation may actually become blurred (Gatti et al., 2019). For example, the UK voluntary target on board gender diversity (soft law regulation) was introduced in a national environment where UK listed firms are legally required under listing rules to address voluntary codes, because of the UK’s ‘comply or explain’ governance environment (Financial Reporting Council, 2014). Therefore, the introduction of regulation targeting board gender diversity, via either hard law or soft law, reflects a significant change event in a national policy in which firms are pressured to comply with the expectations of the regulatory intervention.

However, it is conceptually relevant to acknowledge that while firms may comply with the principles of regulation, the introduction of regulation could lead to decoupling practices (for a review see, Bromley & Powell, 2012). That is, firms might be publicly recognized and praised for making efforts for endorsing regulatory requirements, when in fact they do not fully internalize these efforts – meaning the introduction of regulation could have important implications on trickle-down effects observed by prior literature.

Existing studies exploring the impact of regulation on board gender diversity have typically focused upon firm financial performance (e.g., Ahern & Dittmar, 2012) or women’s access to board positions (e.g., Wang & Kelan, 2013). With regards to the impact of regulation on firm performance, research on the Norwegian gender quota has found evidence to suggest the quota law led to a

decline in accounting returns for mandated firms (Ahern & Dittmar, 2012), as well as a decline in operating profits (Matsa & Miller, 2013). Other studies have also explored the impact of regulation on firm economic performance in Spain (De Cabo et al., 2019), France (Arnaboldi et al., 2020; Nekhili et al., 2020), and Italy (Arnaboldi et al., 2020; Carbonero et al., 2021; Ferrari et al., 2021). With respect to the impact of regulation on women's access to board level positions, research has established that the Norwegian regulatory quota improved women's representation in CEO and chairperson positions (Wang & Kelan, 2013), whilst also creating a small elite of women directors, referred to as "golden skirts", who initially held a disproportionate number of board level positions (Seierstad & Opsahl, 2011). Whilst this growing body of research has improved our understanding of how regulation influences board gender diversity and firm financial outcomes, far less work has examined how regulation influences the relationship between board gender diversity and gender representation below board level.

A limited body of research has started to explore how regulation on board gender composition could have an impact on the trickle-down effect. Most closely aligned to our work is research looking into the Norwegian quota (Bertrand et al., 2019). Alongside exploring gender pay gaps between executives in Norway, Bertrand et al. (2019) found that during the prolonged introduction of the Norwegian quota, the mandated representation of women on boards was not positively associated with proportions of employees who were: women, women with MBAs, women with children, women who were top earners, or women working part time (Bertrand et al., 2019). These results suggest that whilst the Norwegian quota benefited women's representation on boards, it did not have

extended benefits for women outside of the regulated board level positions. That said, it is important to consider these findings alongside corporate governance in Norway. Norwegian firms have supervisory boards, meaning they have minimal links to management within firms. This may have broader implications for the trickle- down effect, as there is limited reason to assume an increase in the mandated representation of women on supervisory boards should have a link with the representation of women within the firm.

In contrast, in Australia – as is the case in the United States and United Kingdom – firms have a unitary board structure, meaning both non-executive (i.e., outsider) and executive (i.e., insider) directors are present at board level. Given the link between the board and firm management, a trickle-down effect could be observed from women's representation in firms with a unitary board. Consistent with this assumption, research establishes a positive trickle-down effect between the board and executive team of listed Australian firms (Gould et al., 2018). The Australian Stock Exchange introduced new reporting requirements that required the disclosure of information[9] on the issue of gender diversity throughout all levels of the firm (Australian Institute of Company Directors, 2010). Interestingly, despite not focusing on regulation targeting female board representation, the introduction of the new reporting requirements in Australia slowed down the pre-existing trickle-down effect that was present between the board and executive team of Australian listed firms (Gould et al., 2018).

[9] Reporting requirements in Australia required listed firms to disclose the following information within annual reports: 1) the disclosure of objectives for increasing gender diversity throughout the firm; 2) the measurement and progression towards objectives; 3) the disclosure of a diversity policy, as well as a strategy for implementation of the policy (Australian Institute of Company Directors, 2010). It is important to note these new reporting recommendations applied to all levels within listed firms, and also considered the issue of diversity – including gender, age, ethnicity, and cultural background.

Although the limited body of existing literature (i.e., Bertrand et al., 2019; Gould et al., 2018) has informed our understanding of how the trickle-down effect could be influenced by regulatory interventions, much more remains to be understood regarding the impact of regulation targeting board gender composition. Little is known about how the introduction of regulation on board gender diversity impacts the trickle-down effect. At present, existing literature has investigated how trickle-down effects are influenced by changes in reporting requirements (Gould et al., 2018) or has investigated the time-period after a quota has been introduced (Bertrand et al., 2019). As a result, to the best of our knowledge, it remains unclear how the trickle-down effect between board and senior management positions is influenced by the introduction of regulation on board gender composition.

The exploratory question we ask in the present study is whether the trickle-down effect improves or declines as a result of the introduction of regulation on board gender diversity. Findings, either positive or negative, would have important implications for evidence that women's representation on boards affect women's representation in senior management. First, if there is indeed evidence to suggest a causal relationship between women on boards and women in senior management (i.e., a trickle-down effect), the new regulation should strengthen the relationship between women on boards and the representation of women in senior management, this would be evidence of the trickle-down effect proposed by past research and policy makers (e.g., Department for Business, Innovation & Skills, 2015; Matsa & Miller, 2011). Such findings would be in line with the traditional theoretical concept of in-group preference between individuals of the

same gender (Byrne, 1971; Kanter, 1977; Tajfel & Turner, 1979). Alternatively, if firms merely conform with the priorities and pursuit of meeting targets at board level, often referred to as “window dressing”, the introduction of regulation will lead to changes in the representation of women on boards having no impact on the representation of women in senior management (Bertrand et al., 2019; Gould et al., 2018).

In what follows, we outline the empirical context of our study. This context (i.e., the United Kingdom FTSE 350 index) allowed us to utilize the introduction of regulation on board gender diversity – a change event that could be considered an exogenous shock. In light of the inconclusive empirical reports and the absence of a theory that captures a clear and concise impact of regulation on the trickle-down effect, the empirical context used in the present study granted us the ability to explore how the trickle-down effect is influenced by regulation on board gender diversity.

2.3. Method

2.3.1. Corporate governance in the United Kingdom

In September 2010, Lord Davies conducted a brief consultation period with a number of stakeholders, including senior business leaders, entrepreneurs, executive search firms, investors, and women business leaders, concerning the issue of gender diversity on boards. This consultation examined the business case for gender diversity on boards and the obstacles faced by women in seeking to get onto boards (Doldor et al., 2012).

The resulting review was published as a report – titled “Women on Boards” – in February 2011 and put forward eleven recommendations to increase women’s representation on the boards of all FTSE 350 listed firms (Department for

Business, Innovation & Skills, 2011). The most critical recommendation was for firms to meet the voluntary target of having twenty-five percent of board level positions held by women by 2015[10]. While not legally binding, the report was widely viewed as a regulatory intervention backed by the UK government, albeit at arm's length, (e.g., Forbes, 2011; Peev, 2011), and additional measures brought in by the government (which we discuss below) to monitor compliance cemented this view. These recommendations were supported by the UK government, with the then business Secretary, Vince Cable, adding that the government will "engage with business in considering his recommendations" and "encourage regulators, investors and executive search firms to take forward those recommendations" (Department for Business, Innovation & Skills, 2011). Thus, from 2011, FTSE 350 listed firms were pressured by external stakeholders to comply with recommendations on board gender diversity (Vinnicombe et al., 2021). The focal voluntary target was later revised to thirty-three percent in 2016[11] (Department for Business, Innovation & Skills, 2015) and most recently it was increased to forty percent in 2021 (Department for Business, Energy & Industrial Strategy, 2021).

[10] Whilst the voluntary twenty-five percent target was initially introduced for FTSE 100 firms in February 2011, recommendation 1 of the February 2011 Women on Boards Report stated that "all Chairmen of FTSE 350 companies should set out the percentage of women they aim to have on their boards in 2013 and 2015 […] chairmen should announce their aspirational goals within the next six months" (Department for Business, Innovation & Skills, 2011, p. 4). Furthermore, just a few months later in 2011, the first government backed "Six-month Monitoring Report" clearly evaluated and monitored all FTSE 350 firms on their progress towards achieving the twenty-five percent voluntary target by 2015 (Sealy, Doldor, Singh & Vinnicombe, 2011). Therefore, there was an expectation all FTSE 350 should comply with the twenty-five percent target, as well as other recommendations targeting all FTSE 350 firms.

[11] In our robustness checks we control for the increase in the target by eight percentage points in 2016, which is within the range of dates of our data; our results remain unchanged.

Importantly for our study, regulation was introduced relatively rapidly at the beginning of 2011, with little warning and less than four months after a brief consultation began, allowing us to suggest this event reflects an exogenous shock and take advantage of it for the purpose of our study.

Corporate governance environment before and after the introduction of regulation. Before 2011 there was a general lack of external pressure placed on FTSE 350 firms to consider the issue of gender diversity at board level. The approach of FTSE listed boards was described as “based on voluntarism and the good will of chairmen, rather than mandatory intervention by government” (Sealy, Vinnicombe, & Singh, 2008, p.12).

The introduction of regulation meant that these boards were abruptly confronted with pressure to voluntarily comply with new external regulatory goals, expectations, and norms concerning increasing the percentage of women at board level. In fact, after the publication of Lord Davies’ 2011 report, additional monitoring measures were introduced to help identify the effect of the report’s recommendations. After 2011, FTSE 350 listed firms were being annually monitored, evaluated, and reviewed by external institutions, such as the annual “Women on Boards Review” published by the UK government (e.g., Department for Business, Innovation & Skills, 2012), the Financial Reporting Council corporate governance code adherence report (e.g., Sealy & Vinnicombe, 2012a; Sealy, Turner, Pryce, & Vinnicombe, 2014), and the annual “Female FTSE board report” published by Cranfield University (e.g., Sealy & Vinnicombe, 2012b, Vinnicombe, Doldor, & Sealy, 2018). The period after 2011 reflects a corporate governance environment in which FTSE listed firms were not only pressured by

external stakeholders to comply with regulation on board gender composition, but also were continuously monitored and evaluated by external institutions.

Corporate boards vs. senior management. In the public discussions and consultations on leadership diversity, most of the attention has been focused on gender diversity at board level. This reflects a general view that “gender-diverse boards have a positive impact on [firm] performance. It is clear that [gender diverse] boards make better decisions where a range of voices, drawing on different life experiences, can be heard.” (Department for Business, Innovation & Skills, 2011, p.3). An often implicit, and sometimes explicit, reason for encouraging more female representation at board level is the belief that it sets the “tone” for lower levels of the firm and will trickle-down, leading to more gender diversity in management levels below the board. This belief was shared by the UK government, who assumed increases in board gender diversity should cause “a ripple effect of women taking up prominent positions in different areas of the workplace” (Department for Business, Innovation & Skills, 2015, p.18). However, neither the 2011 report in the UK, nor similar regulatory interventions introduced in other countries, specified any targets or measures to incentivize the increase of the proportion of women in senior management positions. Based on available public data, it is possible, however, to monitor whether any such trickle-down effects did occur by measuring the gender diversity of senior management. We use the UK FTSE 350 index as an empirical setting to investigate how regulation on board gender diversity influenced the trickle-down of female representation from the board level to senior management positions.

2.3.2. Data collection and sample

The UK regulation for gender diversity on corporate boards applied to all firms listed on the FTSE 350 index. We therefore use data from publicly listed firms that were consistently listed on the FTSE 350 index during all years of the study sample period of 2007 to 2018. Firms listed on the FTSE index were subjected to the introduction of regulation from the 24th of February 2011, the time-period after this date reflects a change in which FTSE listed firms faced pressure to increase the proportion of female directors at board level to comply with soft law regulatory recommendations. Therefore, given the regulation was introduced at the beginning of 2011, we treat the time-period from 2011 in the UK as our time-based treatment. We collect data from 2007 to 2018 to provide a complete picture of the transformation of the trickle-down effect stemming from UK listed corporate boards.

Most restrictions on our sample selection are in line with prior research. Like prior research, our data is limited to firms who are subjected to the regulation on board gender diversity (Bertrand et al., 2019), in our analyses we focus on firms listed on the FTSE 350 index. We only consider firms who have complete information on all board level, senior management level and firm level variables (Yang et al., 2019). Our prospective sample was drawn from firms listed on the FTSE 350 Index in 2011. In total, 119 firms were not considered as they were not consistently listed on the FTSE 350 index for all years in the study time-period (i.e., 2007 to 2018). Furthermore, 12 firms were removed from the analysis owing to missing data. As a result of these restrictions, we had a sample of 2628 firm-year observations from 219 FTSE listed firms between 2007 and 2018.

We use 2007 as the start of sample time-period, 4 years before the soft law regulation was introduced in 2011. Though we could use an earlier year as the start of our study time-period, doing so is costly, as we look further back in time (before 2007) the volume of data available deteriorates, 19 firms from our original sample of 219 had data missing in the years immediately before 2007. As a consequence, we used the period of 2007-to-2010 as our “pre-regulation time-period”. Furthermore, we use 2018 as the end point for our sample time- period, 7 years after regulation was introduced for FTSE 350 listed firms. Whilst a later year could have been used to extend the sample time-period, more recent data on many firms was not available to us – of our sample of 219 firms, only 59 firms had data available for the years after 2018. Thus, we used 2011-to-2018 as our “post- regulation time-period”.

Corporate board positions. We collect board of director information from the BoardEx database. As the UK has a unitary board system, BoardEx defines a FTSE board member as an individual who holds either a non-executive director (i.e., outsider) or an executive director (i.e., insider) position within the firm. For each board member we recorded the individual’s position on the board (i.e., non-executive director, executive director, or chairperson) and gender.

Senior management positions. For our analysis, we require the distinction between board level and senior management positions. BoardEx provides this information on its online database and defines a senior manager as “an individual who holds a position below the board within a firm.” Senior managers most commonly hold titles such as ‘Divisional Director’, ‘Regional Director’, or ‘Head of (function)’, and typically were either on the Executive Committee (one level

directly below the board and reporting directly to the Chief Executive) or were reporting into the Executive Committee[12] (Sealy, Doldor & Vinnicombe, 2016) – see Table A1 in the Appendix for the most frequent senior management roles. For each senior manager we had information on both their role and gender.

Other firm indicators. Following prior research on gender and corporate governance (e.g., Adams & Ferreira, 2009; Ahern & Dittmar, 2012; Post & Byron, 2015), we also collected firm-level data for each firm-year observation. To limit the number of missing values within our dataset we collected data using the following method: first, we collected firm level data from the FAME database. Second, if data was missing from the FAME database, we then searched for firm data using CompuStat databases; and finally, we searched for missing data by looking within firm annual reports.

Variables of interest

The trickle-down effect. Research has measured the trickle-down effect by modelling the relationship between the percentage of women at board level and the percentage of women in senior management. The use of a percentage value[13], rather than raw count data or ratios, is a commonly used approach when analysing female representation in senior leadership (e.g., Adams & Ferreira, 2009; Terjesen, Couto, & Francisco, 2016) and when investigating the trickle-down effect (e.g., Ali et al., 2021; Biswas, Chapple, Roberts, & Stainback, 2021;

[12] In the UK, the term 'senior management' is defined as individuals who were members of the Executive Committee and also their direct reports (Department for Business, Energy & Industrial Strategy, 2016).

[13] To account for the risk of percentage values producing inaccurate parameter estimates in our regressions (Certo, Busenbark, Kalm, & LePine, 2020) we repeated our analyses using the total head count of women in board and senior management positions (see, Table A3).

Biswas, Roberts, & Stainback, 2021; Gould et al., 2018; Matsa & Miller, 2011; Skaggs et al., 2012).

The outcome variable is the percentage of women within a firm's senior management team. This measure was calculated as the percentage of women in senior management within a focal year. Specifically, we took the total number of female senior managers and divided this figure by the total number of senior managers within a firm; this figure was then multiplied by one hundred to calculate the percentage of women in senior management.

The predictor variable is the percentage of women at board level. This measure is defined as the number of women at board level divided by the total number of board members then multiplied by one hundred. In our analyses, the relationship between the outcome and predictor variables indicated the strength of the trickle-down effect within a firm – that is, a positive coefficient signals that the percentage of women at board level was associated with (i.e., "trickled down" to) the percentage of women in senior management positions.

Control variables

We control for firm-year-specific variables that may be related to, or influence, the trickle-down effect.

Senior management team size. In line with prior research on trickle-down effects (e.g., Matsa & Miller, 2011), we controlled for the size of the senior management team, measured by summing the total number of individuals within a firm's senior management team.

Firm size. We also include firm size, measured as the natural logarithm of the total number of employees within a firm. Prior research has controlled for firm size when exploring the trickle-down effect (see, Ali et al., 2021; Bilimoria, 2006;

Biswas, Chapple, Roberts, & Stainback, 2021; Gould et al., 2018), as larger firms may face external pressure to have greater gender diversity within management positions.

Governance related controls. We accounted for several governance factors that could be related to managerial gender diversity. We include board size, calculated as the total number of board members within a firm. We also controlled for board independence, measured using the proportion of non-executive directors to overall board size, as a more independent board is better able to steer decision processes in a way that favours firm stakeholders (Linck, Netter, & Yang, 2008; Ryan & Wiggins, 2004).

Empirical approach

The period of 2007 to 2018 was chosen because the timeframe contains a sudden shock in 2011, whereby an intervention by the UK government set regulatory targets for board gender diversity across all firms listed on the FTSE 350 index – we believe this sudden change in regulation represents an abrupt exogenous shock.

Event study design. We employ an event study design, utilizing the introduction of regulation in 2011, to help alleviate endogeneity concerns common in this setting: that companies who choose to have more women on their board are also more likely to have more women in senior management (Antonakis et al., 2010). The implementation of the regulatory target served as an external (arguably exogenous) shock that is independent of any firm level factors, which allows us to identify changes of board diversity and senior management diversity after the introduction of regulation. That is, by leveraging the time-period after regulation is introduced (i.e., 2011 to 2018), we can study the extent to which

female representation in senior management may or may not have increased as a result of (exogenously) increasing female board representation through the use of regulation.

To qualify as an event study, one needs to argue that the event was largely unanticipated and no confounding factors occurred at the same time as the event occurred (Campbell, Lo, & MacKinlay, 1997). We argue these assumptions are met in our context. First, it is unlikely that the UK government's announcement in February 2011 was anticipated: while the government had supported annual independent reports on the gender diversity of corporate boards, conducted regularly since 1999 (e.g., Sealy, Vinnicombe, & Singh, 2008), at no prior point had there been discussion of regulatory interventions (Sealy, Doldor, Vinnicombe, Terjesen, Anderson & Atewologun, 2017). Second, we are not aware of any other confounding factor that could otherwise explain the increase in female representation that coincided with the introduction of the regulatory target in 2011: to the best of our knowledge, there was no other regulatory intervention, normative appeal or coordinated effort to increase the representation of women on boards for all FTSE 350 firms, other than the UK government's announcement of the 2011 regulation on board gender diversity. As a result, and consistent with advocates in prior literature (Adams, 2016; Hoffman & Lord, 2013; Sieweke & Santoni, 2020), the use of this method allows us to suggest that any change to the trickle-down effect in the post- regulation period (i.e., 2011 to 2018) could be the result of a sudden (arguably exogenous) shock of new regulation on board gender diversity.

3.2.3. Estimation technique

The purpose of our event study is to investigate how regulation on board gender composition influences the trickle-down effect. Our data was collected in a panel format, meaning our data is characterized as the repeated observations of a firm over time – such data is also referred to as "longitudinal" (Bliese, Schepker, Essman, & Ployhart, 2020). The data's panel structure allowed us to use ordinary least square estimation techniques, we estimated our panel models using Stata 16.0 statistical software (StataCorp, 2019).

Event study using ordinary least squares (OLS) estimation. We first investigate the variation in the trickle-down effect before and after regulation was announced in 2011. In line with prior research using an event study design (e.g., Bøhren, & Staubo, 2014; Halbesleben, Wheeler, & Paustian-Underdahl, 2013; Hale, Ployhart, & Shepherd, 2016; McFarland, Reeves, Porr, & Ployhart, 2020; Wiersema & Zhang, 2011), we dummy coded the introduction of new regulation by assigning a value of 0 to each year prior to the new regulation and a value of 1 for the years following the implementation of regulation, such that the regulation dummy is coded 0 in the pre-regulation period (2007–2010) and coded 1 in the post-regulation period (2011–2018).

Initially, to investigate the impact of regulation on the trickle-down effect, we estimate the following empirical model using an OLS regression:

$$PWSM_{it} = \beta_1 PWB_{it} + \beta_2 Regulation_t + \beta_3 PWB_{it} \times Regulation_t + \varepsilon_{it} \quad (1)$$

where $_i$ indexes firms and $_t$ indexes time. $PWSM_{it}$ is the measure of the percentage of women in senior management in firm $_i$ at time $_t$, PWB_{it} is the percentage of female board members for firm $_i$ in year $_t$, $Regulation_t$ is a dummy for the years before and after the introduction of regulation. To test the relationship

(i.e., the “trickle down” effect) between female representation at the board and in senior management before the introduction of regulation, we examine the sign and significance of percentage of women directors on the board ($\beta_1 PWB_{it}$). To test a change in the trickle-down effect after the introduction of regulation, we examine the sign and significance of the interaction between the percentage of women on the board and the regulation dummy ($\beta_3 PWB_{it} \times Regulation_t$). Finally, ε_{it} is the error term. In line with prior research investigating the impact of regulation (e.g., Ahern & Dittmar, 2012; Yang et al., 2019), standard errors are clustered at the firm level to avoid serial correlation (Antonakis, Bastardoz, & Rönkkö, 2021; Cameron, Gelbach, & Miller, 2011; Cameron & Miller, 2015). To further validate our results, we also run additional analyses to establish the robustness of the results.

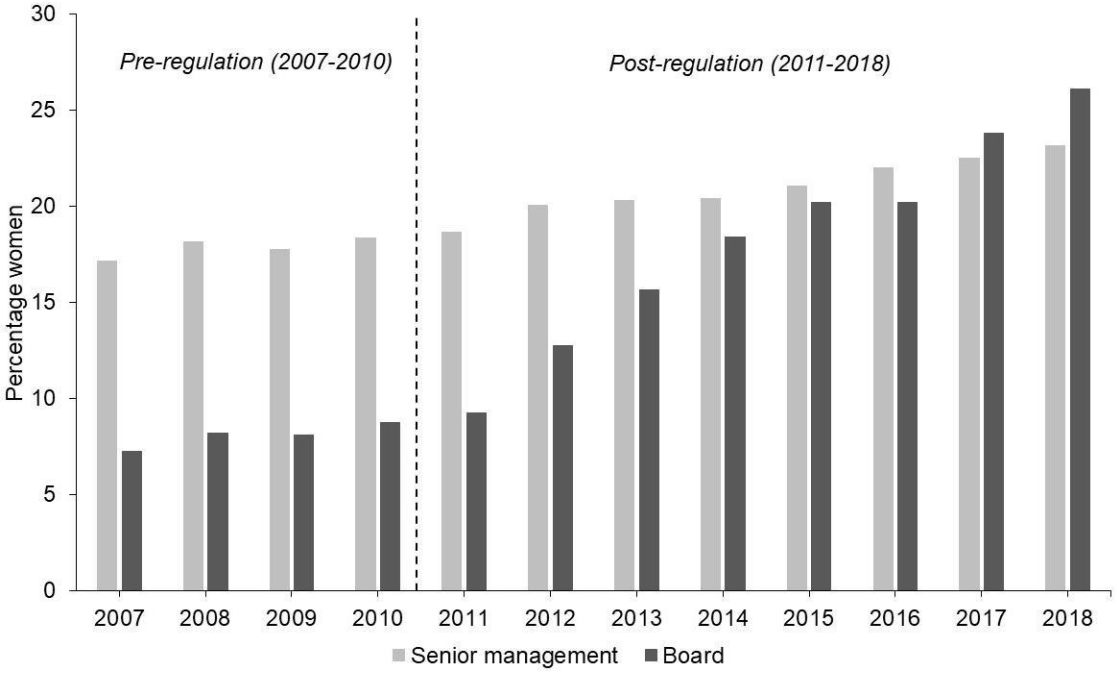
2.4. Results

2.4.1. Descriptive statistics

The United Kingdom’s soft law regulatory target for the percentage of women at board level was set at the beginning of 2011. The new regulation, announced in February 2011, states that twenty-five percent of board members should be women. Before regulation was introduced, nineteen firms within our sample complied with the regulatory target in 2010. After the introduction of regulation, an increased number of firms complied with the voluntary target for gender diversity on boards, with over 120 firms complying with the target in 2018 (see, Figure A1 in the Appendix). Therefore, since the introduction of the regulatory target in 2011, FTSE listed firms have responded to regulation on the representation of women at board level.

While the introduction of regulation clearly intended to increase the percentage of women at board level, it is unclear to what extent the regulatory target could also impact the percentage of women in senior management positions below board level, known as a trickle-down effect. Figure 1 presents the mean values of the percentage of women at board level and senior management positions from 2007 to 2018, including a dashed vertical line to indicate when regulation was introduced by the UK government in February 2011.

Figure 1. The percentage of women at board level and senior management positions across the study time-period.



Amongst our sample of FTSE 350 listed firms, the average percentage of women at board level changed markedly from 8.37% in 2007 to 26.19% in 2018. As Figure 1 shows visually, this sharp increase in the percentage of women at board level coincides with the introduction of regulation. While the percentage of women at board level remained roughly consistent during the pre-regulation

period with a modest increase being observed from 8.37% during 2007 to 9.35% during 2010, the most dramatic change occurs during the post-regulation time-period: the percentage of women at board level increased from 10.43% during 2011 to 26.19% during 2018.

In contrast, the average percentage of women in senior management increased from 18.04% during 2007 to 23.34% during 2018. Unlike the change in percentage of women at board level, the increase in the percentage of women in senior management was relatively modest both during the pre-regulation period (rising from 18.04% in 2007 to 18.75% in 2010) and the post-regulation period (from 19.17% in 2011 to 23.34% in 2018), an increase of just 4.17% as opposed to 15.76% on the boards in the same period.

In sum, these descriptive results suggest several patterns. First, the (modest) percentage changes between 2007 and 2010 for women at board level and senior management roughly coincided, suggesting that they were correlated before the regulation was introduced. This is typically referred to as the trickle-down effect. Second, the regulatory target succeeded in increasing the percentage of women at board level. Third, however, the percentage of women in senior management did not increase at the same pace as the increase of female representation at board level. Put differently, the introduction of regulation could have weakened the trickle-down effect flowing from the board to senior management positions. In the next sections, we study these patterns econometrically, using OLS regressions (see, Table A2 in the Appendix for summary statistics and correlation matrix of variables).

2.4.2. Event study of the effect of regulation on the trickle-down effect

We begin our empirical analysis using ordinary least squares (OLS) regressions to investigate the effect of the introduction of a regulation targeting female representation on boards – an exogenous shock at the beginning of 2011 – on the trickle-down effect.

First, we employ OLS regressions to investigate the relationship between the exogenous shock of regulation, the percentage women at board level, and the percentage of women in senior management positions (see, Table 1).

Table 1 summarizes our results. We conduct an OLS regression for the full time-period (2007–2018) by estimating the effect of the interaction between regulation and the percentage women at board level on the outcome variable, the percentage women in senior management.

Table 1 illustrates our findings using OLS regressions. The dependent variable is the percentage of women in senior management. Table 1 presents our base model, containing only the percentage of women at board level and the regulatory target. Table 1 presents that during the pre-regulation period (2007 to 2010), the percentage of women at board level is significantly and positively associated with the percentage of women in senior management positions ($\beta = 0.352$, $p = 0.002$, $SE = 0.114$). While the percentage of women in senior management positions did increase between 2007 (the baseline year in the model) and 2011 (the introduction of the regulation), the interaction between the regulation dummy and women on boards is significant and negative ($\beta = -0.290$, $p = 0.006$, $SE = 0.105$). This negative interaction term implies that the previous (positive) association coefficient of 0.352 in the pre-regulation period is offset by the (negative) association coefficient of −0.290 in the post-regulation period, which results in a

weakened relationship between women on boards and women in senior management after the (exogenous) introduction of regulation. The average marginal effects of Table 1 revealed that whilst there was a significant and positive trickle-down effect in the pre-regulation period ($\beta = 0.352$, $p = 0.002$, $SE = 0.114$), there was no longer a significant marginal effect of the percentage of women at board level on the percentage of women in senior management in the post-regulation period ($\beta = 0.061$, $p = 0.406$, $SE = 0.073$).

To better illustrate the implications of the interaction model presented in Table 1, we conducted another set of OLS analyses. Here, we studied the relationship between percentage of women at board level and percentage of women in senior management positions separately for each year. The year-by-year coefficients illustrate the trickle- down effect (or lack of) in every year before and after the introduction of the regulation in 2011.

As Table A3 shows, the association between women on boards and women in senior management is mostly positive and significant in the pre-regulation period (2007–2010), but then—with the introduction of regulation—the magnitude of this relationship reduces substantially and is no longer significant in any year in the post-regulation period (2011–2018). In short, Table A3 demonstrates the relationship between women on boards and women in senior management is weakened by the introduction of regulation, which suggests there is no causal link between female representation at board level and female representation in senior management.

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Table 1.

OLS regressions with women in senior management (%) as the dependent variable.

	Women in Senior Management
Women on Board	0.352**
	(0.114)
Regulation	4.954**
	(1.535)
Regulation*Women on Board	-0.290**
	(0.105)
Constant	15.144**
	(1.508)
Number of firms	219
Observations	2628
R-squared	0.022
Adj. R-squared	0.021

Note: This table presents OLS regressions on the representation of women in senior management. Robust standard errors are clustered by firm and reported in parentheses. † p<0.1, * p<0.05, ** p<0.01

2.4.3. Additional analysis

In this section, we conduct a series of additional analyses to assess the sensitivity of our results to changes in variable definitions and model specifications.

It is possible that our findings may be influenced by some forms of omitted variables, and thus the potential for omitted variable bias needs to be addressed. For instance, prior research suggests that the size of a firm is associated with

women's representation in management positions (e.g., Ali et al., 2021; Bilimoria, 2006). The empirical question, therefore, is whether our results are robust to the inclusion of missing variables. Therefore, as a robustness analysis, we repeat our analyses using the following regression model in Equation (2):

$$PWSM_{it} = \beta_1 PWB_{it} + \beta_2 Regulation_t + \beta_3 PWB_{it} \times Regulation_t + \delta \boldsymbol{X}_{it} + \alpha_i + \varepsilon_{it} \quad (2)$$

With denoting control variables that δX_{it} include board size, board independence, senior management size, and firm size (Ali et al., 2021; Bilimoria, 2006; Biswas, Roberts, & Stainback, K., 2021; Gould et al., 2018; Linck et al., 2008; Matsa & Miller, 2011; Ryan & Wiggins, 2004). To further validate our results, we also hold constant firm fixed effects (αi) to account for unobserved heterogeneity related to differences between firms. Accordingly, we go on to estimate all models with firm fixed effects and control variables.

The results presented in Table 2 show the findings are robust to the inclusion of control variables and firm fixed effects. Table 2 once again, as seen in Tables 1 and A2, exhibits that in the pre-regulation period the percentage of women at board level is significantly and positively associated with the percentage of women in senior management positions (β = 0.253, p = 0.003, SE = 0.085). While the interaction between the regulation dummy and women on boards is negative (β = −0.146, p = 0.077, SE = 0.082), meaning the trickle-down effect was weakened after the introduction of regulation. The average marginal effects of Table 3 once again show a positive trickle-down effect in the pre-regulation period (β = 0.253, p = 0.003, SE = 0.085) and a weaker relationship between women at board level and women in senior management in the post- regulation period (β = 0.106, p = 0.013, SE = 0.042). The results of Table 2 show the trickle-down effect

was weakened after the introduction of regulation, thus confirming our main results are robust to the inclusion of control variables.

Table 3 presents our findings using a time-lagged measure of the percentage of women at board level[14]. Taking advantage of the time-based structure of our dataset, we repeated our analyses using lags of one (i.e., *t*-1) and two years (i.e., *t*-2) for the percentage of women at board level – firms with data absent in lagged time-periods were removed from the analyses. The results of the regressions are consistent with our previous findings. As reported in Table 3, there was a significant and positive relationship between female board representation and women's representation in senior management when using both a one-year lag (Model 2: β = 0.284, p = 0.001, SE = 0.088) and a two-year lag (Model 4: β = 0.288, p = 0.002, SE = 0.090). The interaction between the regulation dummy and women on boards remained significant and negative, implying the relationship between women on boards and women in senior management is weakened in the post- regulation period when using a one-year lag (Model 2: β = −0.193, p = 0.028, SE = 0.087) and two-year lag (Model 4: β = −0.186, p = 0.042, SE = 0.090). Our findings therefore remain consistent when we include one-year and two-year lags between female board representation and female representation in senior management.

[14] The sample used in Table 3 contains 200 firms, 19 firms from our original sample had data missing when using lags of two years (i.e., *t*-2).

Table 2.
Fixed effect regressions with women in senior management (%) as the dependent variable.

	Model 1	Model 2
Women on Board	0.246**	0.253**
	(0.085)	(0.085)
Regulation	3.412**	3.336*
	(1.302)	(1.322)
Regulation*Women on Board	-0.152†	-0.146†
	(0.082)	(0.082)
Board Size		0.252
		(0.221)
Board Independence		3.703
		(4.513)
Senior Management Size		-0.018
		(0.74)
Firm Size		-2.155**
		(0.904)
Constant	16.062**	18.348**
	(1.046)	(4.958)
Firm fixed effect	Yes	Yes
Number of firms	219	219
Observations	2628	2628
R-squared	0.032	0.037
Adj. R-squared	0.031	0.035

Note: This table presents fixed effect regressions on the representation of women in senior management. Robust standard errors are clustered by firm and reported in parentheses. † p<0.1, * p<0.05, ** p<0.01

Table 3.
Fixed effect regressions with women in senior management (%) as the dependent variable and time lagged independent variables.

	Model 1	Model 2	Model 3	Model 4
Regulation	3.786**	3.595**	3.660**	3.496*
	(1.440)	(1.460)	(1.416)	(1.436)
Women on Board (1 year lag)	0.281**	0.284**		
	(0.088)	(0.088)		
Regulation*Women on Board (1 year lag)	-0.201**	-0.193**		
	(0.088)	(0.087)		
Women on Board (2 year lag)			0.286**	0.288**
			(0.090)	(0.090)
Regulation*Women on Board (2 year lag)			-0.195*	-0.186*
			(0.091)	(0.090)
Board Size		0.171		0.167
		(0.211)		(0.210)
Board Independence		6.932		6.831
		(4.572)		(4.577)
Senior Management Size		-0.029		-0.032
		(0.074)		(0.073)
Firm Size		-2.054*		-2.018*
		(0.912)		(0.937)
Constant	16.370**	17.243**	16.481**	17.391**
	(1.078)	(4.997)	(1.038)	(4.969)
Firm fixed effect	Yes	Yes	Yes	Yes
Number of firms	200	200	200	200
Observations	2400	2400	2400	2400
R-squared	0.031	0.036	0.030	0.036
Adj. R-squared	0.029	0.033	0.029	0.033

Note: This table presents fixed effect regressions on the lagged representation of women in senior management. Robust standard errors are clustered by firm and reported in parentheses. † p<0.1, * p<0.05, ** p<0.01

Table 4 presents our findings in consideration of the unitary board structures used by UK listed firms[15]. A unitary board structure is commonly used in most UK and US firms, a unitary board contains a single set of directors who are either

[15] The sample used in Table 4 contains 195 firms, 24 firms were omitted because they had unitary boards comprising of only non-executive directors – 23 of the 24 omitted firms has a standard industrial classification description stating 'activities of investment trusts'.

non-executive (i.e., external or outsider directors) or executive directors (i.e., management or insider directors). We replicate our analyses to consider these separate board level roles. First, we calculate the percentage of executive female directors (i.e., Women ED), we took the total number of female executive directors and divided this figure by the total number of executive directors within a board; this figure was then multiplied by one hundred. Second, we calculate the percentage of non-executive female directors (i.e., Women NED), we took the total number of female non-executive directors and divided this figure by the total number of non-executive directors within a board; this figure was then multiplied by one hundred. Initially, as reported in Table 4, there was a significant and positive trickle-down effect in the pre-regulation period when focusing on women in executive director positions (Model 2: β = 0.085, p = 0.025, SE = 0.037). However, the interaction between the regulation dummy and women in executive director positions is significant and negative (Model 2: β = −0. 111, p = 0.005, SE = 0.039), meaning the trickle-down effect stemming from executive director positions was weakened after the introduction of regulation. The average marginal effects confirm that the association between women in executive director positions and women in senior management is positive and significant in the pre-regulation period (β = 0.085, p = 0.024, SE = 0.037), but then the magnitude of this relationship reduces substantially and is no longer significant in the post-regulation period (β = −0.026, p = 0.396, SE = 0.031). In short, there is a substantially weakened correlation between female representation in executive board level positions and female representation in senior management after the introduction of regulation in 2011.

Table 4.
Fixed effect regressions with women in senior management (%) as the dependent variable, percentage of women executive directors (Women ED) and percentage of women non-executive directors (Women NED) are the independent variables.

	Model 1	Model 2	Model 3	Model 4
Regulation	4.769**	4.995**	3.999**	4.141**
	(1.027)	(1.067)	(1.346)	(1.359)
Women ED	0.091*	0.085*		
	(0.042)	(0.037)		
Regulation*Women ED	-0.120**	-0.111**		
	(0.041)	(0.039)		
Women NED			0.168**	0.171*
			(0.081)	(0.079)
Regulation*Women NED			-0.089	-0.074
			(0.079)	(0.079)
Board Size		0.207		0.194
		(0.228)		(0.229)
Board Independence		4.261		3.173
		(4.480)		(4.494)
Senior Management Size		-0.069		-0.091
		(0.072)		(0.075)
Firm Size		-1.843*		-2.467*
		(0.916)		(0.965)
Constant	18.133**	20.972**	16.823**	22.948**
	(0.683)	(5.233)	(1.108)	(5.346)
Firm fixed effect	Yes	Yes	Yes	Yes
Number of firms	195	195	195	195
Observations	2340	2340	2340	2340
R-squared	0.042	0.047	0.046	0.054
Adj. R-squared	0.040	0.044	0.045	0.051

Note: This table presents fixed effect regressions on the lagged representation of women in senior management. Robust standard errors are clustered by firm and reported in parentheses. † p<0.1, * p<0.05, ** p<0.01

During the study time-period the voluntary target set for FTSE listed firms was revised in 2016, increasing from 25% to 33% (Department for Business, Innovation & Skills, 2015). Although our study treats the introduction of regulation in 2011, and the proceeding time-period as a post-regulation context where regulation is in effect, we check to ensure our results hold when controlling for

the revision of the board gender diversity target in 2016. The results displayed in Table A5 are consistent with our main findings and show that our results remain unchanged when we control for the revision of the regulatory target in 2016.

Finally, we repeat our analyses excluding controls for board size and senior management size. Certo et al. (2020) highlight several concerns regarding the use of control variables that are related to the predictor or dependent variable. In our analyses two control variables (i.e., board size and senior management team) are also the denominator for the dependent variable (i.e., women in senior management) and predictor variable (i.e., women on board). We therefore check to ensure our results hold when excluding controls for board size and senior management size. The results displayed in Table A6 are consistent with our main findings.

2.5. Discussion

We investigate how the trickle-down effect between women on boards and women in senior management is influenced by the introduction of regulation on board gender diversity. Using an event study design, we were able to explore the trickle-down effect before and after the introduction of soft law regulation in the United Kingdom. Our findings reveal that in the pre-regulation period the representation of women at board level trickled-down and was positively related to the representation of women in senior management positions. However, the introduction of regulation on board gender composition led to a substantial weakening of that relationship. The sudden introduction of regulation on board gender composition, therefore, had the unintended consequence of weakening the relationship between the representation of women at board level and the representation of women in senior management. Thus, whilst a firm might comply

with the extrinsic requirements put forward by regulation on gender diversity, this does not necessarily lead the same firm to have an intrinsic desire to also increase women's representation in senior management. We interpret this finding as suggesting the trickle-down effect observed in prior literature is not causal, but instead driven by endogenous factors in the non-regulated environment where the same unobserved factors (e.g., firm level policies to increase women in management positions) are at play regarding the relationship between women's representation in both board and senior management roles, which is no longer the case when regulation becomes the driving factor for women on boards.

2.5.1. Implications for research and practice

Our results are relevant to academics, investors, stakeholders, and policy makers. This study presents evidence on the impact of regulation on board gender diversity, introduced in the United Kingdom. Other countries have also introduced regulation on board gender diversity (e.g., Germany, France, Italy, Spain, Belgium, and the Netherlands). Our results contradict the implicit and widespread belief that regulatory interventions facilitate the trickle-down effect (e.g., Department for Business, Innovation & Skills, 2015; Matsa & Miller, 2011). Furthermore, our results hint at the possibility that the trickle-down effect may vary across different contexts and settings, matching the pattern in the prior literature that the trickle-down effect tends to be more robust in settings without regulation on board gender composition (Bertrand et al., 2019).

This study also extends prior research on the trickle-down effect by investigating the impact of the sudden (arguably exogenous) introduction of regulation. Prior research investigating the trickle-down effect provided clues

regarding the impact of regulatory change. For instance, no trickle-down effect was observed during the extended period in which the Norwegian board gender diversity quota was introduced (Bertrand et al., 2019). However, the UK context could be considered substantively different. In the present study, we find evidence suggesting that the sudden and unprecedented change in regulation on board gender diversity substantially weakens a pre-existing trickle-down effect that occurred between the board and senior management. Our results contribute to the increasing body of research investigating the factors influencing the trickle-down effect (Ali et al., 2021; Bertrand et al., 2019; Biswas, Chapple, Roberts, & Stainback, 2021; Biswas, Roberts, & Stainback, 2021; Gould et al., 2018). Specifically, this study's contribution shows how a previously established trickle-down effect is negatively impacted by the introduction of regulation on board gender diversity – implying that the trickle- down effect observed in a non-regulated environment is endogenous, driven by unobserved factors that influence both women on boards and women in senior management.

Our results, therefore, do not support the view that regulatory interventions to increase women on boards leads to a strengthening of the trickle-down effect. This assumption is grounded in traditional theories of ingroup preference that suggest women, and men, prefer to socialize, interact, and work with same gender others (e.g., Byrne, 1971; Ibarra, 1993). Rather, our results suggest that regulation weakens the trickle-down effect, supporting the notion that regulation does not guarantee an improvement in gender diversity at board level will also extend to senior management positions (Bertrand et al., 2019; Gould et al., 2018). Hence, our results suggest that whilst firms conform with the priorities and pursuit

of meeting targets (or quotas) on board gender diversity, the introduction of regulation will lead to a breakdown in the relationship between women on boards and women in senior management.

This study also contributes to literature on the impact of regulation on board gender diversity. To date, literature exploring the impact of regulation has mainly focused on the Norwegian quota (e.g., Ahern & Dittmar, 2012; Bertrand et al., 2019; Seierstad & Opsahl, 2011). Although this body of literature has done much to contribute towards our understanding of regulation, we believe the particular nature of the Norwegian governance and socio-political environment, should be given greater consideration by researchers. Specifically, listed Norwegian firms have boards comprising of supervisory (i.e., non- executive/outsider) directors and have no representation from firm management. This is distinct from the unitary board structures used in most anglophone countries across the globe. Therefore, the Norwegian gender quota was directed towards supervisory directors only. We suggest that any regulatory intervention at board level is less likely to have an impact on management structures within Norwegian firms, as executive directors (i.e., senior management) would not be present within the board nor have much contact with the newly diversified directors. This negates accepted explanations of trickle-down, such as the similarity attraction paradigm (Byrne, 1971), social identity theory (Tajfel & Turner, 1979), homosocial reproduction (Kanter, 1977), and homophily (Ibarra, 1993), as supervisory directors are not involved with the hiring or promotion of senior managers (Cohen et al., 1998). We believe the context of the Norwegian governance system, and more egalitarian socio-political environment, could have important implications for research on the impact of regulation, especially with respect to research on

trickle-down effects. Our study therefore presents the United Kingdom as a contrasting empirical context. The unprecedented soft law regulation introduced in the United Kingdom's more neoliberal free-market business context arguably qualifies as an exogenous shock, as it was abruptly introduced in 2011 with very little warning. The regulatory intervention in the United Kingdom targeted unitary boards comprising of both non-executive and executive directors, who are engaged with management on a day-to-day operational basis. Therefore, there is reason to suspect regulation affecting the composition of the board is more likely to impact on lower-level management structures within regulated firms. Thus, rather than focusing on the notable Norwegian case, our use of regulation in the United Kingdom meant we were able to investigate how the introduction of regulation impacted the trickle-down effect.

Finally, our findings also have two important implications for policy makers, investors, and other stakeholders. Our results suggest that regulation on board gender composition is associated with a disconnect between women's representation between the corporate board and senior management team. Policymakers could resolve this issue by increasing the relevance of regulation for management teams located below board level. For instance, this could be achieved through setting soft law or hard law regulation on the representation of women in the senior leadership positions below board level (also suggested by Klettner, Clarke, & Boersma, 2016). Second, the representation of women at board level has traditionally been used as an indication to establish if a firm engages in acceptable social and ethical corporate practice concerning the issue of gender diversity, in national environments where regulation on board gender diversity has been implemented (for a review, see, Terjesen et al., 2015). Our

results suggest that when women's representation on a firm's board is regulated, either through the use of soft law or hard law, the representation of women on boards could reflect a less accurate measure of a firm's orientation towards the promotion of gender diversity within the workplace. This could be the result of "window dressing", where a firm complies with regulation on board gender diversity to gain recognition and praise, when in fact below board level they do not fully endorse or internalize these efforts. Therefore, investors and other stakeholders should consider the representation of women in other (non-regulated) senior positions below board level, such as the senior management team, as a more accurate measure of a firm's orientation to promote gender diversity.

2.5.2. Future directions and limitations

Much more remains to be explored concerning how trickle-down effects are impacted by exogenous shocks. While our findings address the consequences of regulation on board gender composition, it is possible that other exogenous shocks external to the firm could have an impact on trickle-down effects between the board and lower management levels. For example, unexpected global natural disasters, economic recessions, pandemics, or disclosures of sexual misconduct (e.g., #MeToo) could have important implications for the endogenous trickle-down effect existing between the board and lower-level management teams. Exploring the impact of exogenous shocks may be a fruitful area for future research, particularly given the existing literature on trickle-down effects has largely neglected to explore how external events can influence the trickle-down of behaviours, attitudes, perceptions, or representation of women between

management levels. Thus, our findings suggest that exogenous shocks, or change events (Hoffman & Ocasio, 2001), in a firm's external environment could influence trickle-down phenomena.

In the present study we explore the impact of regulation on the trickle-down effect. This presents an opportunity for future research to further explore the mechanisms explaining why regulation has an impact on the trickle-down effect. At present, it remains unclear if individual firms who showed the trickle-down effect in the pre- regulation period continued to display the trickle-down effect after regulation is introduced. Future research could address this by performing a comparative study investigating the impact of the exogenous shock on the trickle-down effect between 'firms who have an intrinsic interest in gender diversity' versus 'firms who are merely complying with regulation'. Insights from literature on institutional decoupling (for a review see, Bromley & Powell, 2012) could provide a lens through which to investigate this comparison between firms. An investigation into the mechanisms driving the findings observed in the present study could reflect a useful and insightful area of future investigation in this field of research.

We want to acknowledge some limitations in our study which could inform future research. First, our study focuses on a very specific context, the implementation of soft law regulation in the UK – where listed firms are recommended to comply with voluntary targets on female representation at board level. Therefore, it remains unclear if our results are generalizable to other countries, such as Germany or Italy, where mandatory hard law regulation has been implemented (Terjesen et al., 2015). In such contexts, where firms are punished for non-compliance with regulatory quotas, boards face increased

coercive pressure to comply with the demands of external regulation on board gender composition, and, consequently, this may further exacerbate the disconnect in the representation of women between the corporate board and senior management team. Thus, future research could investigate if our arguments hold in other national environments that have implemented alternative forms of regulation to those used in the United Kingdom.

Second, due to constraints accessing data on the representation of women below senior management positions, we were not able to investigate the trickle-down effect between board level and management positions further down the firm (e.g., middle management). In time, however, data on gender diversity across the corporate hierarchy may become available to researchers, allowing a deeper analysis into the trickle-down effects stemming from women's representation at board level.

Third, we acknowledge the analyses used in our study do not completely solve endogeneity issues associated with our independent variable, the representation of women on boards. Even though there might be reasons to believe our analytical approach, leveraging the argued exogenous shock, suffers from less endogeneity problems than other methods that rely purely on correlational approaches (Bun & Harrison, 2019), several variables in our analysis do correlate with the independent variable (see, Table A2) and we express caution regarding the causal interpretation of our results. A similar limitation is also present in our analysis of the time-lag variables, where causality cannot be inferred directly. We therefore recommend future research in this area employs additional (quasi-) exogenous methods (see, Antonakis et al., 2010; Matsa & Miller, 2013; Yang et al., 2019) such that only a treatment group is causally affected by the exogenous

variation (but not a comparable control group), to resolve endogeneity problem issues and establish causal effects.

Furthermore, as a result of explicitly leveraging the exogenous shock in the empirical context of the UK alone, we were unable to exclude unobserved confounds at the year level in our analyses – meaning we were unable to separate the causal impact of the impact of regulation from other macro year-level factors. Future research could alleviate this issue by using empirical methods (see, Yang et al., 2019) that would allow the inclusion of year fixed effects in regressions, thus controlling for unobserved heterogeneity across years within the study time period.

Finally, the European Commission Directive on improving the gender balance among directors of listed companies, originally proposed in 2012, reached an agreement in June 2022 such that 40% of non-executives on supervisory boards, or 33% of unitary board directors, must be of the “under-represented sex” by June 2026 (European Commission, 2022). This, then, may present more opportunities for academics to investigate and follow the changes in board composition and their trickle-down effects in multiple national contexts.

2.5.3. Conclusion

Our aim in this study was to explore the impact of regulation on the trickle-down effect. Specifically, our findings show that regulation weakens the trickle-down effect. Using the sudden introduction of regulation for FTSE listed firms in the United Kingdom, we provide evidence showing the trickle-down effect existed before regulation was introduced and was substantially weakened once regulation was implemented. Thus, by implementing regulation on board gender

diversity, national regulators may inadvertently weaken the endogenous trickle-down effect that previously existed between the representation of women at board level and the representation of women in senior management.

Chapter 3

3. Women on Boards and Disclosures on Board Gender Diversity

3.1. Abstract

This paper investigates the effect of female representation at board level on the likelihood of a firm disclosing information on board gender diversity. We use the context of the United Kingdom for the present study, in which a 'comply or explain' principle of corporate governance was introduced to encourage FTSE 350 listed firms to provide a text-based disclosure on board gender diversity in their consolidated annual reports. The present study focuses on the relationship between women on boards and a disclosure that relates to the composition of the board itself – rather than focusing on disclosures unrelated to the board, such as CSR disclosures, which have received much scholarly attention. Our empirical findings provide evidence of a positive relationship between the representation of women in the boardroom and the disclosure of information on board gender diversity. Furthermore, we also find evidence to support critical mass theory, as at least three women at board level is required to increase the likelihood of disclosure. These findings suggest that boards with higher female representation may have a positive effect on the likelihood of disclosure of information on board gender diversity. We discuss implications for research and practice.

Key Words: Gender Diversity; Disclosure; Women on Boards; 'comply or explain' Principle; Corporate Governance.

3.2. Introduction

"*The Board is composed of highly capable and committed individuals with a diverse range of technical skills, backgrounds, expertise, nationalities and perspectives. The Board is committed to continuing to improve its gender balance. In preparing for the searches for new independent Non-Executive Directors the Committee agreed that special consideration should be given to female candidates*" (Antofagasta PLC, 2014, p.84).

Gender diversity at board level is one of the most significant issues faced by firms in the present day. Across the globe, this issue has gained increased interest amongst national governments and other important societal institutions (Terjesen, Aguilera, & Lorenz, 2015). Even though women are increasingly occupying top-level positions on corporate boards (Catalyst, 2021), the pressure to promote the presence of women on boards endures as a salient global issue[16]. Several countries have imposed legislative initiatives to increase board gender diversity. The Norwegian government was amongst the first to impose a hard law regulation on board gender diversity in 2003, a legally binding quota with penalties for non-compliance, and similar regulative interventions were later adopted by many other countries including, but not limited to: Germany, France, and Italy. Furthermore, several countries – including the United Kingdom, United States, and Australia – have introduced soft law regulation in their national corporate governance codes or charters that provide recommendations on the gender composition of corporate boards (Terjesen et al., 2015; Terjesen & Sealy, 2016).

[16] The (under)representation of women in leadership positions is seen as a key factor towards meeting the United Nations Sustainable Development Goals (UN Women, 2022).

Compliance with soft law regulation is voluntary in nature, but compliance is encouraged through the use of ‘comply or explain’ principles (Kang et al., 2023).

When a firm is confronted with a ‘comply or explain’ principle on board gender diversity, compliance with the soft law recommendations is not mandatory, but a disclosure relating to compliance on board gender diversity is mandatory. For example, the UK’s ‘comply or explain’ corporate governance code states a listed firm’s annual report “should include […] a separate section describing the work of the nomination committee, including the process it has used in relation to board appointments; a description of the board’s policy on diversity, including gender; any measurable objectives that it has set for implementing the policy, and progress on achieving the objectives” (Financial Reporting Council, 2012, p. 29). Although ‘comply or explain’ principles are non-binding (or voluntary), research does suggest such codes are effective tools for spreading good governance practices and coercing companies into complying and internalising their demands (Aguilera & Cuervo-Cazurra 2004, 2009; Mateos De Cabo, Terjesen, Escot, & Gimeno, 2019; Page, Sealy, Parker, & Hauser, 2023). Indeed, seven years after the UK’s ‘comply or explain’ principle on board gender diversity was introduced, a large proportion of listed firms on the UK’s Financial Times Stock Exchange (FTSE) 350 index provided a board gender diversity disclosure in their annual consolidated reports (Financial Reporting Council, 2018).

Given that boards of directors play a major role in a firm’s corporate governance, the representation of women at board level is likely to have a positive influence on the voluntary disclosure of information on gender diversity at board level. Indeed, a plethora of research has established that the presence of women at board level is a vector that signals good governance and a driver of firm

transparency and accountability (Mantia, Bruna, Dang, & Houanti, 2018; Wasiuzzaman & Wan Mohammad, 2020). Whilst board gender diversity itself is an indicator of good governance practices, there is a wealth of evidence to suggest that female board members have a positive impact on a range of disclosure related activities (Sealy & Grosvold, 2024). Researchers have linked women's representation at board level with many types of disclosure practices, including, but not limited to: environmental, social and governance (ESG) information (e.g., Arayssi, Dah, & Jizi, 2016; Barako & Brown, 2008); corporate social responsibility reporting (e.g., Frias- Aceituno, Rodriguez-Ariza & Garcia-Sanchez, 2013; Rao & Tilt, 2016; Hoang, Abeysekera, & Ma, 2018); carbon disclosures (e.g., Ben-Amar, Chang, & McIlkenny, 2017); and corporate risk disclosures (e.g., Seeback & Vetter, 2022). Such empirical findings mirror the theoretical perspective put forward by many researchers suggesting that female directors possess certain characteristics, or gender differences (e.g., diverse backgrounds, values, perceptions, experiences, expertise, and so on), that exert a positive impact on the disclosure of information regarding a firm's practices. For example, Fernandez-Feijoo and colleagues (2012) argue that women's presence at board level leads a board to benefit from their "feminine characteristics" and consequently they are highly committed to CSR disclosure.

Prior empirical research has largely established positive links between women's presence on boards and various types of corporate disclosure, such as CSR, ESG, financial, and risk disclosure (for review see, Centinaio 2023). However, there is a dearth of research exploring the link between women's representation at board level and the likelihood of a firm disclosing information on board gender diversity. Whilst existing research in the field of corporate

communications has explored the themes of gendered disclosures reported in firm annual reports and websites (e.g., Adams & Harte, 1998; Benschop & Meihuizen, 2002; Grosser & Moon, 2008; Helms Mills, 2005; Point & Singh, 2003; Singh & Point, 2006; Tinker & Neimark, 1987), to the best of our knowledge the link between women's representation at board level and a firm's disclosure of information on board gender diversity remains unexplored. Indeed, several prior studies have highlighted the need for research to investigate how gender diversity disclosures are related to the actual representation of women in the firm (see, Point & Singh, 2003; Windscheid, Bowes-Sperry, Jonsen, & Morner, 2018).

Therefore, in the present study, we explore the relationship between women on boards and the disclosure of information on board gender diversity within a firm's consolidated annual report[17]. The context of our study is the United Kingdom's FTSE 350 index from 2012 to 2016. During this period, specifically in 2012, following the introduction of a voluntary target on board gender diversity in 2011 (Department for Business, Innovation & Skills, 2011), the UK Government abruptly implemented a 'comply or explain' principle in its corporate governance code that required firms to disclose information on board gender diversity within their annual report (Financial Reporting Council, 2012). Thus, during this time-period (i.e., 2012-2016), firms were expected to disclose information relating to board gender diversity within annual reports, often for the first time, specifically in the nominations committee section on the firm's annual report. Therefore, in the present study, the context of the United Kingdom offered an empirical context of

[17] To account for the risk of reverse causality in the present study, whereby prior year disclosure on board gender diversity could have impact on female representation at board, we run a regression model with time lagged independent variables in the additional analyses (see, Table A11).

change, in which firms experienced pressure to both actually increase women's presence on boards and disclose on their actions. We leverage this empirical context to produce a highly novel dataset of hand-collected diversity disclosures from 1180 firm-year observations, with the overall aim of exploring the impact women on boards have on firm disclosure on board gender diversity.

The present study provides several contributions to research in the field of corporate disclosures and corporate governance. First, this study contributes to literature on board group dynamics (e.g., Anderson et al., 2011; Bilimoria & Wheeler, 2000; Bilimoria, 2000; Daily & Dalton 2003; Zelechowski & Bilimoria, 2004) – especially to literature on tokenism and critical mass (Konrad, Kramer, & Erkut, 2008; Konrad, Kramer, Erkut, & Hooper, 2006). In a context where soft law has been introduced, this study provides robust evidence for a positive relationship between women on boards and disclosures on board gender diversity, but for this positive impact to take effect women need to reach a critical mass at board level (a context in which three of more women serve on the board). Therefore, by providing evidence to suggest that the presence of women on boards increases the likelihood of a firm disclosing information on board gender diversity, this study contributes towards the increasingly established consensus that the impact women have on board decision making substantially improves once women on boards are no longer considered as a token (Bear et al., 2010; Torchia et al., 2011).

Second, this study provides a novel insight into the nature of the link between women on boards and disclosures on board gender diversity – which to date has remained unexplored by prior research (Point & Singh, 2003; Windscheid et al., 2017). In addition, unlike prior research in the field of corporate disclosures, the

present study focuses on the relationship between women on boards and a disclosure that relates to the composition of the board itself – rather than focusing on disclosures unrelated to the board, prior research has mainly focused on CSR (see, Centinaio 2023).

Finally, this study also contributes towards literature in the field of corporate communications. To date, research in this area has focused on establishing the qualitative themes that are present in diversity policies published in a firm's annual report or website (e.g., Adams & Harte, 1998, Benschop & Meihuizen, 2002, Grosser & Moon, 2008, Helms Mills, 2005, Point & Singh, 2003, Singh & Point, 2006, Tinker & Neimark, 1987). Whilst this body of research has done much to advance our understanding of the qualitative content on diversity policies, often finding evidence of a diversity management perspective being widely used, the question remained unanswered whether such policies/disclosures were related to the presence of women in the firm (Windscheid et al., 2018). Our results suggest a higher proportion of women at board level increases the likelihood of a firm providing a disclosure on board gender diversity. Also, in doing so, this paper provides support for upper echelons theory (Hambrick, 2007; Hambrick & Mason, 1984), as our findings suggest female directors possess specific 'characteristics' that influence the likelihood of a firm disclosing information on board gender diversity.

The rest of this study is organized as follows: the next section describes the related literature and theoretical framework. The third section develops the hypotheses. The fourth section presents our sample and research methodology. In the fifth section, empirical findings are described. Finally, the sixth section concludes the paper.

3.3. Literature Review and Theoretical Framework

Prior research has argued that women facilitate better corporate governance and provide different perspectives at board level, when compared against homogenous all male boards (Daily, Certo, & Dalton, 2000; Rose, 2007). Many scholars assume the effectiveness of the board improves as the proportion of women at board level increases (Adams & Ferreira, 2009), this has been widely argued by exploring the impact of female representation at board level and measures of firm performance (Post & Byron, 2015). With respect to the link between women on boards and firm performance, the evidence provided by a plethora of studies has revealed that a consistent and robust relationship is yet to be established, with positive (e.g., Dezso & Ross, 2012; Isidro & Sobral, 2015; Terjesen, Couto, & Francisco, 2016), negative (e.g., Adams & Ferreira, 2009; Matsa & Miller, 2013), and null relationships (e.g., Carter, D'Souza, Simkins, & Simpson, 2010) being observed across research in this area. Such inconclusive findings may be the result of various factors influencing research in this area, such as differences in national contexts, methodologies, measures of performance, or omitted variables.

A related stream of research examines the relationship between women's presence on boards and the disclosure of firm information to a wide range of stakeholders. This body of research has mostly focused on exploring the impact of female directors on corporate social responsibility (CSR) – also called corporate social performance (Wood, 1991) – which can be broadly defined as the activities a firm undertakes to operate in a socially sustainable manner. In recent years, research has uncovered a positive link between women on boards and a large number of CSR related firm activities relating to: community,

corporate governance, diversity, employee relations, environment, human rights, and product related social issues[18] (e.g., Bear, Rahman, & Post, 2010; Boulouta, 2013; Byron & Post, 2016; Glass, Cook, & Ingersoll, 2016; Katmon, Mohamad, & Norwani, 2019; Post, Rahman, & McQuillen, 2014). A related body of literature has explored the relationship between women on boards and specific types of CSR disclosures, some required by codes of corporate governance, with the presence of women at board level increasing the likelihood of a firm disclosing information on a series of important societal issues, including: carbon emissions (Ben-Amar, Chang, & McIlkenny, 2017; Nuber & Velte, 2021); corporate risk (Seebeck & Vetter, 2021); cybersecurity risk (Radu & Smaili, 2022); financial reporting (Wahid, 2019), green innovation (He & Jiang, 2019; Nadeem et al., 2020); environmental performance (Lu & Herremans, 2019); sustainability performance (Galletta et al., 2022; Issa, Zaid, & Hanaysha, 2022; Zaid et al., 2020); and climate change (Caby et al., 2022). Whilst a large number of prior studies have revealed a positive relationship between women on boards and various CSR disclosures, much more remains to be understood regarding the link between the presence of women at board level and the disclosure of information on board gender diversity. As a consequence, research in this area is in its infancy and warrants further investigation.

According to an upper echelons theory, individuals at the level of senior management, most notably those in board level positions, exert significant influence on corporate decision making (Hambrick & Mason, 1984). Specifically, the demographics, backgrounds, and experiences of these individuals influences

[18] CSR performance if often operationalized using KLD (Kinder Lydenberg Domini) ratings (for review see, Rao & Tilt, 2016).

decision making processes and, in turn, this exerts an influence on firm outcomes (Hambrick, 2007). In the present study, we argue that the presence of women in the boardroom is an important driver in compliance with board gender diversity disclosure requirements. Based on prior research, we argue female directors have certain traits – e.g., being attuned to gender related issues (García-Sánchez, Oliveira, & Martínez-Ferrero, 2020) – that make boards with female directors more likely to advocate for the disclosure of information relating to board gender diversity.

3.3.1. Initiatives to increase female representation at board level.

The need to address the (under)representation of women on corporate boards is a global issue and has been largely driven by regulatory changes and the development of codes of corporate governance (Grosvold & Brammer, 2011). A key question for national government's determined to promote board gender diversity concerns what the most effective approach is towards addressing the issue. Across the globe, the response to increase the representation of women at board level takes two forms: hard law regulation or soft law regulation (Terjesen & Sealy, 2016; Terjesen et al., 2015; Terjesen, Sealy & Singh, 2009). Some countries have adopted hard law regulation on board gender diversity, including but not limited to Germany, France, Norway, and Italy. Hard law regulation is characterised by legally binding requirements to have a minimum proportion of women at board level, with non-compliance resulting in coercive sanctions. Whilst such regulatory interventions could be perceived as successful, the hard law approach has been criticised for benefiting only a small group of elite female directors – referred to as 'golden skirts' (see, Seierstad & Opsahl, 2011) – and this coercive (legally-binding) approach has been avoided by many governments

in nations with neo-liberal foundations, which often have politicians and firms who hold a powerful resistance to ‘meddling’ government interventions in the business world (Grosvold et al., 2016). As a consequence, many countries – such as the United Kingdom, Australia, and the United States – have adopted a ‘comply or explain’ principle towards addressing the underrepresentation of women at board level.

A ‘comply or explain’ principle, defined as a soft law intervention because of their laissez-faire or voluntary nature, is mostly exercised through a legal obligation or normative pressure to comply with ‘standards’ or ‘best-practice rules’ to promote female board participation. Although these ‘comply or explain’ codes of corporate governance are not legally binding, they have become very effective tools for diffusing governance practices and to pressure listed firms to comply with (and internalise) recommendations. Such codes of governance are intended to increase transparency for investors and stakeholders regarding a firm’s approach towards promoting women’s representation at board level, whilst also making board members accountable for promoting the issue of gender diversity. For instance, the Financial Reporting Council updated the UK corporate governance code, following the highly influential Lord Davies report into the underrepresentation of women on boards (Department for Business, Innovation & Skills, 2011), to put in place a ‘comply or explain’ principle that requires listed firms to individually publish disclosures on board gender diversity. Similarly, the Australian ASX corporate governance code requests that listed firms disclose information within their annual report on objectives, policies, and progression towards addressing board gender diversity (Australian Securities Exchange, 2010). Also, following consultation with investors and stakeholders, the United

States (US) SEC introduced rules encouraging the disclosure of information on gender diversity on the corporate boards of US listed firms (US Securities and Exchange Commission, 2009). Thus, moving beyond national contexts where mandatory hard law regulation has been imposed, which have been extensively studied by prior research (e.g., Ahern & Dittmar, 2012; Ferrari, Ferraro, Profeta, & Pronzato, 2022; Matsa & Miller, 2013), there are many countries who have instead introduced ‘comply or explain’ principles in their codes of corporate governance which place pressure on firms to disclose information on board gender diversity in their annual reports (for review see, Terjesen et al., 2015).

Relatively little is known whether the presence of women at board level is associated with ‘comply or explain’ requirements to disclose information on board gender diversity. In the United Kingdom, the empirical context of the present study, a ‘comply or explain’ principle was introduced to the UK’s corporate governance code – rather than hard law regulation – that recommends firms disclose information on board gender diversity. The change to the UK’s governance code was introduced to promote transparency and accountability on the issue of board gender diversity. However, despite this implicit assumption, the relationship between women on boards and gender diversity disclosure practices is one that remains largely neglected by empirical research (Point & Singh, 2003; Windscheid et al., 2018).

Therefore, in both academic and practitioner circles, a key question is to what extent is there a link between the existing representation of women in board level positions and the likelihood of a firm disclosing information on board gender diversity? Despite the relevance of prior literature on the link between women on board and disclosure (e.g., Arayssi et al., 2016; Ben-Amar et al., 2017; Rao & Tilt,

2016; Seeback & Vetter, 2022), there is still much to learn on the contribution of women's presence at board level contributing towards board gender diversity disclosure practices. Specifically, relatively little is known about how women's presence on the board may affect the extent to which a firm incorporates board gender diversity into its corporate reporting practices.

3.3.2. Women on boards and Disclosure

The presence of women on boards has the potential to bring benefits to a firm by bringing fresh perspectives and ideas to the boardroom (Jamali et al., 2007), this argument is often referred to as the gender differences perspective – arguing that female directors possess specific 'characteristics' that set the apart from their male counterparts. It has been suggested that these characteristics change boardroom dynamics and therefore, provide more productive discussions when the board is making decisions (Bilimoria, 2000). For instance, first, it has been widely argued that women bring different perspectives, viewpoints, and non-traditional approaches to board discussions (Anderson, Reeb, Upadhyay, & Zhao, 2011), this could be due to women's different experiences – in the workplace and wider society – which are likely to impact board decisions (Daily & Dalton 2003; Zelechowski & Bilimoria, 2004). Also, it is argued that female board members are more likely to speak freely on issues which may be perceived as unpleasant – and therefore avoided – by other board members (Bilimoria & Wheeler, 2000). Furthermore, research also suggests that female directors are more sensitive towards improving gender equality across the firm (Bilimoria, 2006; Matsa & Miller, 2011; Skaggs, Stainback, & Duncan, 2012). These findings are aligned with upper echelon theory (Hambrick, 2007; Hambrick & Mason, 1984), positing that strategic decisions and actions of a firm are significantly

influenced by the demographic characteristics of the corporate board (Shahab et al., 2018). Given their concern for gender-related matters, it could be argued that women directors are more likely to engage with issues related to gender diversity within the firm.

In light of the growing number of women in the upper echelons of firms, research has started to explore the relationship between women on boards and firm activities relating to diverse groups. Once again, drawing from a gender differences perspective, research has shown a positive link between the presence of women at board level and the likelihood of a firm engaging with LGBT-friendly HR policies (Everly & Schwarz, 2015); domestic-partner benefits and gender identity non-discrimination policies (Cook & Glass, 2016); corresponding with global reporting initiative directives on female empowerment (García-Sánchez et al., 2020), and the creation of chief diversity officer positions to manage workplace diversity (Shi, Pathak, Song, & Hoskisson, 2018). Research has also found that women's presence on corporate boards is associated with higher firm engagement with diversity initiatives, such as: supporting gender diversity in subcontracting, introducing hiring programs for people with disabilities, offering progressive LGBT policies, and having an overall commitment to diversity (Glass & Cook, 2018). Additionally, the presence of women on boards is associated with decreased likelihood of negative ethical outcomes, with scholars showing that firms with higher gender diversity at board level are associated with lower levels of social irresponsibility (Adhikari, Agrawal, & Malm, 2019). Combined, these findings suggest that the presence of women on boards could lead to more ethical and socially responsible governance decisions relating to the issue of diversity.

Overall, based on an upper echelons perspective (Hambrick, 2007; Hambrick & Mason, 1984), it could be argued that female directors wield significant influence in shaping board decision making, which ultimately could influence compliance with soft law recommendations relating to board gender diversity disclosures. Building on prior research suggesting that the presence of women in the boardroom is associated with corporate disclosure (e.g., Ben-Amar et al., 2017; Seebeck & Vetter, 2021), We thus present our first hypothesis:

Hypothesis 1: *There is a positive relationship between female representation at board level and the likelihood of a board gender diversity disclosure*.

3.3.3. Critical Mass Theory and Tokenism

Previous studies have highlighted the significance of critical mass in shaping the impact women directors have on firm outcomes (e.g., Torchia, Calabro, & Huse, 2011). Informed by Kanter's (1977) influential analysis of group interaction processes, it is argued that women are more likely to be differentiated from each other when their representation increases within a group and thus, they are better able to provide different experiences and perspectives to the group. As a group becomes gender balanced, female and male group members are better able to have productive discussions and this in turn improves performance (Apesteguia, Azmat, & Iriberri, 2012; Konrad, Kramer, Erkut, & Hooper, 2006).

In essence, critical mass theory postulates a "critical mass" – or threshold – of women at board level should be reached to help female directors change board dynamics. Literature on corporate boards argues that the biggest shift in board dynamics is witnessed when three or more (or above around 30%) women are present at board level, the presence of women becomes normalised and female

directors have a greater impact on board processes – leading to a positive effect on board performance (Konrad, Kramer, & Erkut, 2008; Konrad, Kramer, Erkut, & Hooper, 2006). In accordance with critical mass theory, empirical research has noted that a critical mass of women at board level is associated with higher levels of firm performance (Joecks, Pull, & Vetter, 2013; Richard, Kirby, & Chadwick 2013) firm innovation (Torchia et al., 2011). Furthermore, research on corporate disclosure has revealed that a critical mass of at least three women is necessary to establish a clear link between women on boards and many forms of disclosure, including but not to: corporate risk disclosure (Seebeck & Vetter, 2021), corporate CSR disclosure (Post, Rahman, & McQuillen, 2011); UN sustainable development goal disclosure (Mazumber, 2024); modern slavery disclosure (Moussa, Allam, & Elmarzouky, 2023); cyber security disclosure (Radu & Smaili, 2022); and ESG disclosure (De Masi et al., 2021). Therefore, it is argued that women directors have an impact on disclosure related activities, although the impact is most pronounced when a critical mass of women in the boardroom is achieved.

The need to play closer scholarly attention to threshold effects, like the shift to a critical mass of women directors at board level, has been noted as a critical area for empirical investigation (see, Kirsch, 2018). Therefore, we anticipate that the number of women at board level must reach a critical mass (i.e., three or more women) for women to have an impact on the disclosure of information on board gender diversity. We therefore present our second hypothesis as follows:

Hypothesis 2: *There is a positive relationship between critical mass on the board and the likelihood of a board gender diversity disclosure*.

In contrast, women could struggle to influence board dynamics when they face a context where they serve alone at board level. In such an environment, the sole female director acts as a token: being a single highly visible, stereotyped, excluded, and ignored by the majority group (of male directors). Indeed, when there are fewer female allies in the boardroom women exert less influence on board decision making, it is claimed that “one woman on the board is a token, two is a presence, and three is a voice” (Kristie, 2011, p. 22). According to literature on tokenism (Kanter, 1977), if one woman is present at board level problems arise resulting in negative effects on organisational outcomes. In such contexts, the token female director also conforms to the majority group and are unable to make any meaningful contributions to board decision making (Maass & Clarke, 1984), the token status of the female director implies their presence at board level is due to a desire for greater gender diversity rather than because of their status or qualifications (Yoder & Berendsen, 2001).

Several studies have supported this argument, with token women exerting little influence on board decision making and, ultimately, firm outcomes (Liu et al., 2014; Lucas-Pérez et al., 2015). There is a consensus amongst empirical studies (e.g., Bear et al., 2010; Torchia et al., 2011) that a token minority of women at board level little impact on the perspectives and relations between board members. Furthermore, that perceptions of tokenism are further exacerbated in contexts where gender diversity at board level is promoted by external legislation (Rixom, Jackson, & Rixom, 2023) – the empirical context of the present study is one in which “soft law” legislation has been implemented to improve board gender diversity. Due to the implications of “tokenism” it is argued that solo female directors will have a limited impact on the corporate decisions of the board.

Overall, we argue that women who are tokens at board level face barriers towards exerting their influence at board level, due to their status as tokens we believe sole female directors (serving on an otherwise male dominated board) will have a reduced impact on the disclosure of information on board gender diversity. We therefore present our third hypothesis:

Hypothesis 3: *There is a negative relationship between tokenism on the board and the likelihood of a board gender diversity disclosure*.

3.4. Method

3.4.1. Data collection and sample

We base our analyses on firms listed on the FTSE 350 index who were required to report disclosures on board gender diversity in annual reports. We use data from publicly listed firms that were consistently listed on the FTSE 350 index during all years of the study sample period of 2012 to 2016. Firms listed on the FTSE index were subjected to the introduction of a 'comply or explain' principle on board gender diversity when the UK corporate governance code was updated in 2012, following the publication of the Davies Report in 2011 (Department for Business, Innovation & Skills, 2011; Financial Reporting Council, 2012). Therefore, pressure to disclose information on board gender diversity was formally introduced in 2012, we treat the time-period from 2012 in the UK as the start of the study time-period. The 'comply or explain' initiative used in the UK was later reviewed and revised in 2016, with the voluntary target for the proportion of women at board level being increased to a minimum of thirty-three percent and additional reporting requirements were proposed (Department for Business, Energy, & Industry Strategy, 2016), we therefore treat the year of 2016 as the end of our study time-period.

Most restrictions on our sample selection are in line with prior research. Like prior research, our data is limited to firms who are subjected to external initiatives to increase board gender diversity (Bertrand et al., 2019), in our analyses we focus on firms listed on the FTSE 350 index. We only consider firms who have complete information on all board level and firm level variables (Yang et al., 2019). Our prospective sample was drawn from 350 firms listed on the FTSE 350 Index in 2012. In total, 91 firms were not considered as they were not consistently listed on the FTSE 350 index for all five years in the study time-period (i.e., 2012 to 2016). Furthermore, 23 firms were removed from the analysis owing to missing data. As a result of these restrictions, we had a sample of 1180 firm-year observations from 236 FTSE 350 listed firms between 2012 and 2016.

Disclosures on board diversity. We collect data on a firm's reporting on board diversity from their annual report corresponding to each firm-year. The retrieval of this data was consistent with a UK government commissioned report on board diversity reporting (Financial Reporting Council, 2018), corresponding with directions on board diversity reporting provided by the UK's corporate governance code in 2012 (Financial Reporting Council, 2012). The UK corporate governance code required a firm to provide a text-based (qualitative) disclosure within their annual report on the work of the board towards increasing diversity amongst individuals appointed to the board, with a focus on gender. The text-based disclosures of FTSE 350 listed firms were hand-collected, to form a highly unique database of disclosures on board diversity published in the annual reports of FTSE 350 listed firms between 2012 and 2016. In total, 1098 firm-year disclosures on board diversity were retrieved from annual reports – with 82 firm-year annual reports containing no text-based disclosure.

Corporate board positions. We collect board of director information from the BoardEx database. As the UK has a unitary board system, BoardEx defines a FTSE board member as an individual who holds either a non-executive director (i.e., outsider) or an executive director (i.e., insider) position within the firm. For each board member we recorded the individual's position on the board (i.e., non-executive director, executive director, or chairperson), tenure, nationality, and gender.

Other firm indicators. Following prior research on gender and corporate governance (e.g., Adams & Ferreira, 2009; Ahern & Dittmar, 2012; Post & Byron, 2015), we also collected firm-level data for each firm-year observation. To limit the number of missing values within our dataset we collected data using the following method: first, we collected firm level data from the FAME database. Second, if data was missing from the FAME database, we then searched for firm data using CompuStat databases; and finally, we searched for missing data by looking within firm annual reports.

3.4.2. Variables of interest

Disclosure on board gender diversity. Consistent with prior research using corporate disclosure as an outcome variable (e.g., Seebeck & Vetter, 2021), we coded a dataset of disclosures on board gender diversity – published in each firm-year annual report between 2012 to 2016 – to produce a dummy variable that equals 1 if the firm makes a disclosure on board gender diversity. The coding of data was aligned with the requirements of the Financial Reporting Council's corporate governance code which required firms to annually disclose information on board gender diversity within a firm's annual report – this disclosure could make reference to the work of the board (e.g., board appointments, targets,

progress towards targets, or the use of external search consultancies) regarding gender diversity at board level. Specifically, in line with a government commissioned report on board gender diversity disclosures (Financial Reporting Council, 2018), we dummy coded a value of 1 if a disclosure on board gender diversity contained any of the following key words: women, woman, female, or gender. An example of a disclosure that equals 1 (i.e., the firm makes a disclosure on board gender diversity) is provided below:

"The Board is committed to supporting women in reaching their full potential and we welcomed Lord Davies' Report on 'Women on Boards' and fully support its recommendations. We have announced our aspiration to continue to retain a minimum of 25% female representation on the Board. Whilst all appointments are made on merit, we seek to ensure the Board maintains an appropriate balance through a diverse mix of skills, experience, knowledge and background. Currently, the Board includes three women (27%) and four nationalities" (Intercontinental Hotels Group PLC, 2012, p. 58).

All other disclosures (as well as cases where no disclosure was provided) were coded 0, indicating that the firm's annual report makes no reference to board gender diversity. An example of a disclosure that equals 0 (i.e., makes no reference to board gender diversity) is provided below:

"Our policy is to have a broad range of skills, background and experience. While we will continue to ensure that we appoint the best people for the relevant roles, we recognise the benefits of greater diversity and will continue to take account of this when considering any particular appointment, although we do not set any particular targets" (Aggreko PLC, 2015, p. 77).

All predictor variables were lagged by one year (i.e., t-1). The predictor variables for the analysis are as follows:

Percentage of women at board level. This measure is defined as the number of women at board level divided by the total number of board members then multiplied by one hundred. The use of a percentage value, rather than raw count data or ratios, is a commonly used approach when analysing female representation at board level (e.g., Adams & Ferreira, 2009; Terjesen, Couto, & Francisco, 2016).

Blau board gender diversity. We substitute the use of a percentage value with the Blau index for heterogeneity (Blau, 1977) to test the robustness of our findings, the Blau index – like the use of percentage values – is a commonly used measure for diversity in corporate governance literature (e.g., Adams, Akyol, & Verwijmeren, 2018; Byron & Post, 2016). The Blau index for board gender diversity is calculated as follows:

$$H = 1 \sum_{C=1}^{k} \rho_c^2$$

Where *p* represents the percentage of group members in category *c* and *k* is the total number of categories (in the case of measuring gender diversity this totals two, male and female). The Blau index takes a value of 0 for a homogenous board (i.e., either all men or all women) and a value of 0.5 for a perfectly heterogenous board (i.e., equal number of men and women).

Critical mass and Tokenism. To test the effect of critical mass and tokenism, we created two binary variables in line with research on the differing board dynamics (Kramer, Konrad, Erkut, & Hooper, 2006). First, we record a binary variable for one woman on a board, often referred to as tokenism, this takes a

value of 1 when there is one sole woman who serves on the board and 0 otherwise. Second, to test the potential shift in board dynamics when critical mass is reached, we create a binary variable that takes the value of 1 when three or more women serve on the board and 0 otherwise[19].

Control variables

We control for firm-year-specific variables that may be related to, or influence, the decision to report on board gender diversity. Like the predictor variables, all control variables lagged the dependent variable by one year.

CEO related controls. We control for CEO duality, this is a context where a single individual holds the position of chair and chief executive officer, the presence of CEO duality could jeopardise the ability of a board to effectively monitor and steer board decision making, as the focal CEO wields high levels of power on board level proceedings (Zajac & Westphal, 1996). We also control for CEO nationality, this is a binary variable taking a value of 1 if the CEO is British and 0 otherwise – research has shown that board member nationality has been shown to sway board decision making towards the governance principles of their home nation (Hung, 2005). Finally, we control for CEO gender, this takes a value of 1 if the CEO is female and 0 if otherwise.

Governance related controls. We accounted for several governance factors that could be related to the disclosure of information on board gender diversity. We control for board independence, measured using the proportion of non-executive directors to overall board size, as a more independent board is better able to steer decision processes in a way that favours firm stakeholders (Linck,

[19] In our additional analyses we also test for the impact of a homogenous all-male board.

Netter, & Yang, 2008; Ryan & Wiggins, 2004). We also control for board tenure by creating a variable reflecting the average length of time a board members have held a position at board level, individuals with higher tenure may develop cognitive rigidity leading them to become “stale-in-the-saddle” which could lead a firm to resist external pressure to change (Hillman, Shropshire, Certo, Dalton, & Dalton, 2011; Miller, 1991).

Performance related controls. Firm performance is often conceptualised using both market-based measures of performance, Tobin’s Q, as well as accounting measures of performance, return on assets (ROA) and return on equity (ROE). Tobin’s Q is a ratio of a firm’s market value to its book value of assets. ROA is the ratio of a firm’s net income to its book value of assets. ROE is the ratio of a firm’s net income to its shareholders equity.

3.4.3. Estimation technique

The purpose of our study is to explore the extent to which the presence of women on boards is related to the disclosure of information on board gender diversity in annual reports. Our data was collected in a panel format, meaning our data is characterized as the repeated observations of a firm over time – such data is also referred to as “longitudinal” (Bliese, Schepker, Essman, & Ployhart, 2020). The data’s panel structure allowed us to use regression estimation techniques, we estimated our panel models using Stata 17.0 statistical software (StataCorp, 2021).

Similar to prior research on board gender diversity, our analysis could be is prone to the issue of endogeneity, since omitted variable bias may explain why board gender diversity is related to the disclosure of information on board gender diversity. Prior literature has discussed this endogeneity issue at length

(e.g., Adams & Ferreria, 2009; Antonakis et al., 2010; Yang et al., 2019). In line with literature (e.g., Adams & Ferreria, 2009; Ahern & Dittmar, 2012) we attempt to alleviate the issue of endogeneity by using an instrumental variable (IV) approach. In equation 1 we first present the first stage of the IV regression:

$$PWB_{it} = \beta_1 FirmSize_{it} + \delta \boldsymbol{X}_{it} + \theta_i + \theta_t + \varepsilon_{it} \quad (1)$$

In equation 1, $_i$ indexes firms and $_t$ indexes time. PWB_{it} is the measure of the percentage of women at board level in firm $_i$ at time $_t$, $FirmSize_{it}$ is the natural logarithm of total assets in firm $_i$ at time $_t$, and δX_{it} is a vector denoting control variables that include CEO duality, CEO nationality, CEO gender, board tenure, board independence, return on equity, return on assets, and tobin's q. We use firm size ($\beta_1 FirmSize_{it}$) as an instrument we use firm size –- logarithm of total assets at the end of the fiscal year – as a predictor for the percentage of women at board level in the focal firm in the same year. The use of firm size as an instrument is consistent with prior literature (see, Seeback & Vetter, 2022). We also hold constant industry fixed effects (θ_i) and year fixed effects (θ_t) to rule out time invariant industry characteristics and year-by-year trends. Finally, ε_{it} is the error term.

In the second stage of the IV regression model we estimate the impact of board gender diversity ($\beta_1 PWB_{it}$) on firms decision to report on board gender diversity ($GENDERREP_{it}$).

$$GENDERREP_{it} = \beta_1 PWB_{it} + \delta \boldsymbol{X}_{it} + \theta_i + \theta_t + \varepsilon_{it} \quad (2)$$

We test our remaining hypotheses, exploring if critical mass and tokenism influences the impact of women's representation at board level on the disclosure of information on board gender diversity, using the same IV regression technique

outlined in equation 1 and equation 2. We estimate the presence of women (one [tokenism] or exceeding three [critical mass]) at board level in the first stage of the IV regressions and then the impact of the respective board contexts on the disclosure of information on board gender diversity.

3.5. Results

3.5.1. Descriptive statistics

The United Kingdom's 'comply or explain' principle was introduced at the beginning of the study time-period, in 2012. The new change to the UK's corporate governance code required firms to voluntarily disclose information on gender diversity at board level (Financial Reporting Council, 2012).

With the introduction of a 'comply or explain' principle clearly intended to increase the firms reporting on board gender diversity, the number of firms (from our sample) providing a disclosure on board gender diversity grew from 184 firms (77%) in 2012 to 213 firms (90%) in 2016. It is also interesting to note that, despite facing external pressure to comply with the UK governance code, exactly 52 firms (33%) did not provide a report on gender diversity in 2012 – this figure did, however, fall to 23 firms (10%) by 2016.

In sum, these descriptive statistics suggest two patterns. First, the 'comply or explain' principle had the anticipated impact of encouraging firms to disclose information on board gender diversity within their annual reports. Second, however, a number of firms elected to avoid disclosing information on the issue of gender diversity – despite the normative and legislative pressure being exerted on them by external institutions. In the next sections, we study the impact of women on boards on the disclosure of information on board gender diversity, this will be done using econometric techniques – namely using IV regressions (see,

Table A7 in the Appendix for summary statistics and correlation matrix of variables).

3.5.2. The effect of women on boards on board gender diversity disclosure

Our first set of analyses investigate whether the percentage of women at board level has an effect on the disclosure of information on board gender diversity. To identify a causal relationship, we estimate the effect of disclosure on board gender diversity using firm size as an exogenous change in the percentage of women at board level.

Table 5 reports the IV regressions of board gender diversity disclosure on female board representation. All models also include control variables, industry fixed effects, and year fixed effects. Model 1 of Table 5[20] presents the first stage of IV regression, firm size is significantly and positively associated with the percentage of women at board level (Model 1: β = 1.626, *SE* = 0.307, *p-value* = 0.001), implying that the instrumental variable is associated with board gender diversity. Model 1 of Table 5 also presents the second stage of the IV regression, the effect for the percentage of women at board level is significant and positive (Model 1: β = 0.026, *SE* = 0.007, *p-value* = 0.001), this implies that the representation of women at board level is positively related to the disclosure of information on board gender diversity.

We also replicate our findings using an alternative measure for women's representation at board level. In Model 2 of Table 5, we repeat the analysis substituting the use of a percentage value with the Blau index for heterogeneity

[20] The results of Wald tests presented in Table 5 confirm concerns about endogeneity and support our use of an instrumental variable approach.

(Blau, 1977). Model 2 exhibits the first stage of the IV regression, revealing that firm size is significantly and positively associated with Blau board gender diversity (Model 2: β = 0.023, *SE* = 0.005, *p-value* = 0.001). Critically, Model 2 provides the second stage of the regression, this shows a positive and significant effect of Blau board gender diversity (Model 2: β = 1.876, *SE* = 0.487, *p-value* = 0.001), this reflects a positive relationship between Blau board gender diversity and the disclosure of information on board gender diversity. Our findings therefore remain consistent when we use an alternative measure of women's representation at board level.

Taken together, the results presented in Table 5 support our first hypothesis – which posits that there is a positive relationship between female representation at board level and the likelihood of a board gender diversity disclosure. Our results are in line with prior research that suggests a positive relationship between women on boards and the disclosure of information within corporate reports (e.g., Ben-Amar, Chang, & McIlkenny, 2017; Katmon, Mohamad, & Norwani, 2019; Seebeck & Vetter, 2021; Radu & Smaili, 2022). The positive relationship between women's representation at board level and the increased likelihood a disclosure on board gender diversity is in line with research suggesting women's presence on boards increases ethical firm behaviour and corporate governance.

3.5.3. The effect of critical mass and tokenism on board gender diversity disclosure

Our second set of analyses investigate whether differing board dynamics has an effect on the disclosure of information on board gender diversity. To explore the impact of critical mass (i.e., three or more women) and tokenism (i.e., one woman), we use the same method of analysis reported in Table 5.

Table 6 presents the IV regressions of board gender reporting on different board dynamics. All models also include control variables, industry fixed effects, and year fixed effects. Model 3 presents the results for the effect of one (token) woman at board level. Model 3 of Table 6 presents the first stage of IV regression, firm size is significantly and negatively associated with the presence of one woman at board level (Model 3: *β* = -0.065, *SE* = 0.019, *p-value* = 0.001), implying that the instrumental variable is associated with having one woman on the board. Model 3 of Table 6 also presents the second stage of the IV regression, the effect of having one token woman at board level is significant and negative (Model 3: *β* = -0.664, *SE* = 0.216, *p-value* = 0.002), this implies that having a token woman at board level is negatively associated with the disclosure of information on board gender diversity.

Model 4 of Table 6 presents the results of the effect of having critical mass at board level. Model 4 of Table 6 presents the first stage of the IV regression, firm size is positively and significantly associated with critical mass (Model 4: β = 0.105, SE = 0.019, p-value = 0.001). The second stage of the regression is also presented in Model 4, here the effect of critical mass is positive and significant (Model 4: β = 0.412, SE = 0.101, p-value = 0.001), this finding indicates a positive relationship between critical mass and the disclosure of information on board gender diversity. Put simply, when a board has reached critical mass (having three or more women) there is an increased likelihood a firm complies with the ‘comply or explain’ principle requiring firms to disclose information on board gender diversity in the consolidated annual report.

Table 5.
Instrumental variable regressions with the representation of women at board level as the dependent variable, and the disclosure on board gender diversity as the predictor variable.

	Model 1		Model 2	
	1st stage Women on Board (%)	2nd stage Disclosure on Board Gender Diversity	1st stage Women on Board (Blau)	2nd stage Disclosure on Board Gender Diversity
Women on Board (%)		**0.026****		
		(0.007)		
Women on Board (Blau)				**1.876****
				(0.487)
Firm Size	1.626**		0.023**	
	(0.307)		(0.005)	
CEO Duality	-3.017†	0.035	-0.044†	0.036
	(1.609)	(0.087)	(0.023)	(0.086)
CEO Nationality	-0.411	0.067*	0.001	0.054*
	(0.630)	(0.028)	(0.008)	(0.027)
CEO Gender	8.324**	-0.209*	0.099**	-0.173**
	(1.376)	(0.078)	(0.012)	(0.065)
Board Independence	8.646**	-0.163	0.110**	-0.139
	(2.590)	(0.126)	(0.034)	(0.119)
Board Tenure	-0.533**	0.003	-0.007**	0.002
	(0.113)	(0.006)	(0.001)	(0.006)
Tobin's Q	0.176	-0.003	0.001	-0.001
	(0.241)	(0.006)	(0.003)	(0.009)
Return on Assets	0.015	-0.001*	0.001	0.001*
	(0.015)	(0.001)	(0.001)	(0.001)
Return on Equity	0.008	-0.001	0.001	-0.001
	(0.005)	(0.001)	(0.005)	(0.001)
Constant	-12.776**	0.725**	-0.153*	0.682**
	(4.621)	(0.110)	(0.064)	(0.113)
Industry fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Number of firms	236	236	236	236
Observations	1180	1180	1180	1180
Adj. R-squared	0.250		0.260	
Wald test	$\chi^2 = 68.92$ Prob > χ^2 = 0.001		$\chi^2 = 75.12$ Prob > χ^2 = 0.001	

Note: This table presents instrumental effect regressions of board gender diversity disclosure and women on boards and control variables. Robust standard errors are reported in parentheses. † p<0.1, * p<0.05, ** p<0.01

Our findings are aligned with literature on critical mass and tokenism (Kanter, 1977). It has been argued that when a woman is perceived as being a token at board level they leverage little impact on board meetings dominated by the more populus majority (male) group. However, once a critical mass is reached, women exert more power and influence on board decision making. Our findings are in line with our second and third hypotheses, the likelihood of a firm disclosing information on board gender diversity is negative when there is one (token) woman at board level and positive when critical mass is reached. Whilst we express caution to assume board dynamics are the causal mechanism driving this effect, these results suggest that having three of more women at board level (i.e., critical mass) is associated with an increased gendered influence at board level – in our case, disclosure on board gender diversity.

Table 6.
Instrumental variable regressions with critical mass and tokenism as the dependent variables, and the disclosure on board gender diversity as the predictor variable.

	Model 3		Model 4	
	1st stage Women on Board (%)	2nd stage Disclosure on Board Gender Diversity	1st stage Women on Board (Blau)	2nd stage Disclosure on Board Gender Diversity
Tokenism		**-0.664****		
		(0.216)		
Critical Mass				**0.412****
				(0.101)
Firm Size	-0.065*		0.105**	
	(0.019)		(0.019)	
CEO Duality	-0.082	-0.100	-0.042	-0.028
	(0.082)	(0.100)	(0.055)	(0.079)
CEO Nationality	0.069*	0.102**	-0.057*	0.080**
	(0.029)	(0.035)	(0.061)	(0.025)
CEO Gender	-0.241**	-0.147*	0.081	-0.020
	(0.042)	(0.069)	(0.061)	(0.047)
Board Independence	0.277*	0.219	-0.174*	0.140
	(0.113)	(0.135)	(0.081)	(0.100)
Board Tenure	0.003	-0.001	-0.011**	-0.006
	(0.005)	(0.011)	(0.003)	(0.005)
Tobin's Q	-0.001	0.001	-0.004	0.003
	(0.012)	(0.011)	(0.009)	(0.008)
Return on Assets	0.001 †	0.002**	0.001	0.001**
	(0.001)	(0.001)	(0.001)	(0.001)
Return on Equity	0.001	0.001	0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Constant	0.669**	0.838**	-0.761**	0.707**
	(0.220)	(0.119)	(0.201)	(0.099)
Industry fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Number of firms	236	236	236	236
Observations	1180	1180	1180	1180
Adj. R-squared	0.065		0.147	
Wald test	$\chi^2 = 45.97$ Prob > χ^2 = 0.002		$\chi^2 = 74.75$ Prob > χ^2 = 0.001	

Note: This table presents instrumental effect regressions of board gender diversity disclosure, critical mass, tokenism, and control variables. Robust standard errors are reported in parentheses. † p<0.1, * p<0.05, ** p<0.01

3.5.4. Additional analyses

We conduct a series of additional analyses to further investigate the relationship between female board representation and the disclosure of information on board gender diversity.

First, we investigate the relationship between the representation of women on the corporate board and different measures of board gender diversity disclosure. In line with previous literature (Radu & Smaili, 2022; Seeback & Vetter, 2022), we investigate the relationship between the representation of women on a firm's board and the level of board gender diversity disclosure by the firm – measured by the logarithm of the total number of words in a disclosure published in the firm's annual report. Table 7 presents the IV regressions of the level of board gender diversity disclosure and representation of women on the board. Model 5 of Table 7 reveals that the effect of the percentage of women at board level is positive and significant (Model 5: β = 0.068, *SE* = 0.016, *p-value* = 0.001), this implies that the representation of women on the corporate board is positively related to the level of gender diversity disclosure within a firm's annual report, as measured by the total number of words in a disclosure.

Moreover, also acting as a test of the robustness of our analyses, we use an alternative form of board gender related disclosure. Specifically, we focus on whether a firm discloses a policy on board gender diversity – this type of disclosure goes beyond merely commenting on the issue of gender diversity, as the disclosure of a policy indicates how the firm treats and manages gender inequality at a given level of the corporate hierarchy (Singh & Point, 2006). Thus, using our unique dataset, we created a dummy variable that equals 1 if the firm discloses a policy on board gender diversity, and 0 if the annual report makes no

reference to the board having a policy on gender diversity. Model 6 of Table 7 reveals that the effect of the percentage of women at board level is again positive and significant (Model 6: β = 0.022, *SE* = 0.010, *p-value* = 0.032), this implies that the proportion of women on the corporate board is positively related to the likelihood of a firm disclosing a policy on board gender diversity. In essence, this finding suggests the presence of women at board level increases the probability that a firm discloses a policy towards the issue of board gender diversity. In summary, the results of Table 7 replicate our initial findings showing evidence to suggest that female representation at board level has positive implications on the disclosure of information on board gender diversity.

Second, we consider the relationship between female board representation and the textual sentiment (i.e., psychological tone) within disclosures on board gender diversity. To do this we transcribed our original dataset of board gender diversity statements using an automated computer text analysis program, the Linguistic Inquiry and Word Count (LIWC; Pennebaker, Boyd, Jordan, & Blackburn, 2015). The LIWC program analyses text files (e.g., board gender diversity disclosures) and computes the extent to which words in each file fall into empirically validated linguistic categories (e.g., Pennebaker & Francis, 1996; Pennebaker & King, 1999; Pennebaker et al., 2001). Given our analyses focus on a binary variable for disclosure on board gender diversity, we explore the use of gendered language in these disclosures by using the LIWC category “female references” as an outcome variable, in essence this measure reflects the proportion of a disclosure containing feminine words (e.g., she, her, female, woman, women). The results displayed in Model 7 of Table 8 are broadly consistent with our prior analyses, the effect of the percentage of women at board

level is positive and significant (Model 7: *β* = 0.109, *SE* = 0.029, *p-value* = 0.001), this finding reveals a positive relationship between women's representation at board level and the presence of female references within disclosures

Third, we conducted a series of analyses using different variable descriptions for the representation of women at board level. Initially, we compute female representation at board level as the total head count of women at board level. The results are displayed in Table A8 are consistent with our prior analyses, the effect of the total number of women at board level is positive and significant (Model 8: *β* = 0.124, *SE* = 0.032, *p-value* = 0.001) suggesting that the total head count of women at board level increases the likelihood of a disclosure on board gender diversity – indicating that our results are consistent when using a count-based measure for female board representation.

In addition, we also consider the unitary board structures used by firms listed in the UK, a unitary board can be defined as one group containing non-executive (i.e., external or outsider directors) and executive directors (i.e., management or insider directors). We replicate our analyses to consider these separate board level roles. First, we calculate the percentage of executive female directors (i.e., Women ED), we took the total number of female executive directors and divided this figure by the total number of executive directors within a board; this figure was then multiplied by one hundred. Second, we calculate the percentage of non-executive female directors (i.e., Women NED), we took the total number of female non-executive directors and divided this figure by the total number of non-executive directors within a board; this figure was then multiplied by one hundred. As reported in Table A9, there was a positive and significant effect from the percentage of women in executive (Model 9: *β* = 0.034, *SE* = 0.013, *p-value* =

0.010) and women in non-executive positions (Model 10: β = 0.027, *SE* = 0.009, *p-value* = 0.003). Our findings therefore remain consistent when taking into account women's representation in executive director and non-executive director positions.

We also consider the impact of a homogenous all-male board. To explore this, we replicated our IV methodology and created a dummy predictor variable that takes the value of 1 if a board contains only male directors (i.e., All-Male Board), and 0 if a board contains one or more female directors. As revealed in Model 11 of Table A10, the effect of a homogenous all-male board is highly negative and significant (Model 11: β = -0.683, *SE* = 0.193, *p-value* = 0.001) this result indicates that when a board is comprised of only male directors the likelihood of a disclosure on board gender diversity is markedly reduced. This result is consistent with our previous analyses suggesting the presence of women on boards increases the likelihood of a disclosure on board gender diversity.

Table 7.
Instrumental variable regressions with the percentage of women on the corporate board as the dependent variable, and the level of disclosure (i.e., log total words) and the disclosure of a policy on board gender diversity as the predictor variable.

	Model 5		Model 6	
	1st stage Women on Board (%)	2nd stage Level of Disclosure	1st stage Women on Board (%)	2nd stage Disclosure of policy on Board Gender Diversity
Women on Board (%)		**0.068****		**0.022***
		(0.016)		**(0.010)**
Firm Size	1.626**		1.626**	
	(0.307)		(0.307)	
CEO Duality	-3.017†	0.016	-3.017†	0.091
	(0.082)	(0.155)	(1.672)	(0.097)
CEO Nationality	-0.411	0.170*	-0.411*	0.043
	(0.637)	(0.057)	(0.637)	(0.035)
CEO Gender	8.323**	-0.592**	8.324**	-0.267*
	(1.275)	(0.174)	(1.275)	(0.109)
Board Independence	8.646**	-0.577	8.646**	0.013
	(2.287)	(0.243)	(2.287)	(0.152)
Board Tenure	-0.533**	0.011	-0.533**	0.004
	(0.108)	(0.013)	(0.108)	(0.008)
Tobin's Q	0.015	0.003	0.176	0.028*
	(0.016)	(0.022)	(0.263)	(0.014)
Return on Assets	0.015	0.001	0.015	-0.001
	(0.016)	(0.001)	(0.016)	(0.001)
Return on Equity	0.008†	-0.001	0.008†	-0.001
	(0.004)	(0.001)	(0.004)	(0.001)
Constant	-12.776**	1.726**	-12.776**	0.052
	(0.307)	(0.206)	(3.794)	(0.129)
Industry fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Number of firms	236	236	236	236
Observations	1180	1180	1180	1180
Adj. R-squared	0.250		0.250	
Wald test	$\chi^2 = 105.42$ Prob > χ^2 = 0.001		$\chi^2 = 74.75$ Prob > χ^2 = 0.001	

Note: This table presents instrumental effect regressions on the level of board gender diversity disclosure, the disclosure of a policy on board gender diversity, women on boards, and control variables. Robust standard errors are reported in parentheses. † p<0.1, * p<0.05, ** p<0.01

Table 8.
Instrumental variable regressions with the percentage of women at board level as the dependent variable and female references in disclosure as the predictor variable.

	Model 7	
	1st stage Women on Board (%)	2nd stage Female References in Disclosure
Women on Board (%)		**0.109****
		(0.029)
Firm Size	1.626**	
	(0.307)	
CEO Duality	-3.017†	0.491†
	(1.672)	(0.279)
CEO Nationality	-0.411	0.124
	(0.637)	(0.102)
CEO Gender	8.323**	-1.026**
	(1.275)	(0.313)
Board Independence	8.646**	-1.356**
	(2.287)	(0.436)
Board Tenure	-0.533**	0.021
	(0.108)	(0.023)
Tobin's Q	0.176	-0.080*
	(0.263)	(0.040)
Return on Assets	0.015	0.004†
	(0.016)	(0.002)
Return on Equity	0.008†	-0.001
	(0.004)	(0.001)
Constant	-12.776**	1.973**
	(3.794)	(0.370)
Industry fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Number of firms	236	236
Observations	1180	1180
Adj. R-squared	0.250	
Wald test	$\chi^2 = 68.30$	
	Prob > $\chi^2 = 0.001$	

Note: This table presents instrumental effect regressions of female references in board disclosure and women on boards and control variables. Robust standard errors are reported in parentheses. † p<0.1, * p<0.05, ** p<0.01

Finally, it is possible that, in addition to the observed findings, there is a case of reverse causality in the present study, whereby the prior year disclosure on board gender diversity has a positive impact on female representation at board level. To explore this possibility, the predictor and outcome variables have been swapped. The predictor variable, disclosure on board gender diversity, is lagged by one year (i.e., *t*-1) from the outcome variable of female board representation (at time *t*). To test evidence for reverse causality we ran the following OLS regression model:

$$\beta_1 PWB_{it} = GENDERREP_{it} + \delta \boldsymbol{X}_{it} + \theta_i + \theta_t + \varepsilon_{it} \qquad (3)$$

As shown in Model 12 of Table A11, the effect of a disclosure on board gender diversity was not statistically meaningful (Model 12: β = 0.839, *SE* = 0.802, *p-value* = 0.296), meaning we do not find evidence of reverse causality (e.g., a board gender diversity disclosure [*t*-1] having a positive female board representation [at time *t*]).

3.6 Discussion

This paper explores the impact of female board representation on the disclosure of information on board gender diversity in a firm's consolidated annual report. The disclosure of information on board gender diversity is required in many nations who have implemented 'comply or explain' principles within their governance codes to address the lack of gender diversity at board level. Such initiatives, supported by external regulators and national governments, consider disclosure to be an important step towards addressing the issue of gender inequality and promoting the representation of women in the upper echelons of management. Based on a sample of listed firms on the UK's FTSE 350 index, we find that the representation of women in the boardroom is positively related to the

disclosure of information on board gender diversity. Furthermore, we find that this positive effect is most prominent when there is a critical mass of women at board level. We interpret these findings as suggesting that the presence of women on boards increases the likelihood of firms complying with governance codes that request the disclosure of information on board gender diversity.

3.6.1. Implications for research and practice

Our results are of interest to academics, investors, stakeholders, public policy makers, and women in the workplace. This study provides evidence to suggest that the presence of women on boards increases the likelihood of a firm disclosing information on board gender diversity, as required by the UK's 'comply or explain' principle within its governance code. We therefore show that female directors enhance corporate disclosure transparency with regards to the issue of board gender diversity. Recently, many nations around the globe (e.g., Canada, Australia, and United States) have introduced 'comply or explain' principles that require a firm to publish information on the firm's progress towards improving board gender diversity. Whilst these codes of corporate governance have been introduced with the aim of placing voluntary (rather than mandatory) pressure on firms to improve women's representation at board level, past literature has proposed that a 'comply or explain' approach could lead to "window dressing" practices where a firm makes efforts towards externally endorsing board gender diversity when in fact, they do not fully internalise the practice of improving board gender diversity (Terjesen et al., 2015). Our empirical results do not support this argument, instead we show that the 'comply or explain' principle in the UK governance code is associated with transparent disclosures, where women's presence at board level is positively related to disclosures on board gender

diversity. We therefore provide evidence advocating the use of ‘comply or explain’ principles for improving board gender diversity.

The present study also makes contributions to several streams of literature. First, given that the link between women on boards and CSR disclosures is a topic of ongoing empirical investigation – with studies investigating the impact of female board representation on carbon emissions (Ben-Amar, Chang, & McIlkenny, 2017); CSR related issues (Katmon, Mohamad, & Norwani, 2019); corporate risk (Seebeck & Vetter, 2021); cybersecurity risk (Radu & Smaili, 2022); and financial reporting (Wahid, 2019) – the question of how female representation at board level is linked to disclosures on board gender diversity has become vital to explore. Firms assume ethical and legal responsibility to comply with codes of governance and our findings, consistent with prior literature, establish a positive link between women on boards and compliance with reporting requirements. Our results contribute towards the increasingly established theoretical perspective that women’s presence at board level increases ethical behaviour and corporate governance practices.

This study also contributes towards literature on board diversity policies. To date, research in this area has focused on establishing the qualitative themes that are present in diversity policies published in a firm’s annual report or website (e.g., Adams & Harte, 1998, Benschop & Meihuizen, 2002, Grosser & Moon, 2008, Helms Mills, 2005, Point & Singh, 2003, Singh & Point, 2006, Tinker & Neimark, 1987). Whilst this body of research has done much to advance our understanding of the qualitative content on diversity policies, often finding evidence of a diversity management perspective being widely used, the question remained unanswered whether the publication of such policies/disclosures was related to the presence

of women in the firm (Windscheid et al., 2018). Our results suggest disclosures on gender diversity are indeed related to women's presence in the firm. It should be noted, however, that our study focused on the corporate board – it remains to be established if our findings are generalisable to disclosures on gender diversity across the firm.

Our study also contributes towards research on the impact of regulation on board gender diversity. To date, literature exploring the impact of regulation has mainly focused on the hard law regulatory quotas, such as those introduced in Norway (e.g., Ahern & Dittmar, 2012; Bertrand et al., 2019; Seierstad & Opsahl, 2011; Yang et al., 2019) and Italy (e.g., Ferrari, Ferraro, Profeta, & Pronzato, 2022). Although this body of literature has done much to contribute towards our understanding of regulation, we believe the nature of the governance and socio-political environment should be given greater consideration by researchers. Many large western countries have avoided the use of hard law (legally binding) quotas or targets, as such countries have neo-liberal foundations that are strongly opposed to government meddling in the business world (Grosvold et al., 2016). As a consequence, 'comply or explain' principles have been used in these countries where firms voluntarily choose to comply with standards of best practice on the issue of board gender diversity. To date, researchers have often focused on the introduction of hard law quotas, whereas relatively little research has explored the impact of 'comply or explain' (soft law) initiatives to increase women's presence at board level. Our study therefore presents the United Kingdom as a contrasting empirical context. In the present study we explored the impact female directors have on compliance with 'comply or explain' principles, specifically disclosing information on board gender diversity. Thus, rather than

focusing on high-profile hard law regulatory initiatives (most notably the Norwegian quota), our use of a 'comply or explain' context allowed us to explore the link between women on boards and disclosures on board gender diversity – such disclosures are often requested when a 'comply or explain' principle is introduced to address women's (under)representation at board level.

Finally, our study has broader implications for women in the workplace. For women at all levels of the corporate hierarchy, our results reveal that women – especially when they are minority group members based on their gender – should ensure the demographic composition of the group contains a critical mass of women, this will increase the likelihood women will have a positive impact on group processes and decision making in the workplace (Apesteguia et al., 2012; Kanter, 1977; Konrad et al., 2006). In the absence of a critical mass, our results reveal that the tokenistic status of women limits their impact on group dynamics which, in turn, could limit the contribution of women to group outcomes. Also, building on the observed positive relationship between women in the upper echelons of the firm and disclosures on board gender diversity, another important implication of this study is that board gender diversity disclosures could reflect an accurate measure of a firm's orientation towards the promotion of women to senior levels of management within the firm – a disclosure on board gender diversity could signal to women that there is a reduced likelihood that a firm has a 'glass ceiling' (Morisson, White, & Van Velsor, 1987) preventing their progression up the corporate hierarchy to senior leadership positions.

3.6.2 Future directions and limitations

Much more remains to be explored concerning the mechanisms through which female board representation is linked to the disclosure of information on gender

diversity. While our findings address the possible influence of critical mass and tokenism theories, it is possible that other mechanisms could have an impact on the relationship between women on boards and disclosure. For example, the impact of women on boards could be influenced by board independence (Biswas, Roberts, & Stainback, 2021) and industry gender composition (Ali et al., 2021). At present, it also remains unclear whether the relationship between female board representation and disclosure is driven by compliance with soft law legislative initiatives or an internal desire within the boardroom to improve gender diversity. Future research could explore this by performing a comparative study investigating differences between 'firms who show an intrinsic interest in board gender diversity' (e.g., have historically championed female representation at board level) verses 'firms who are merely complying with legislative demands' (e.g., have only improved female representation post legislative changes). Drawing from literature on institutional decoupling (for review see, Bromley & Powell, 2012) one might anticipate observing weaker results amongst firms who are merely complying with regulation. An investigation into the mechanisms driving the findings observed in the present study could reflect a useful and insightful area of future investigation in this field of research.

In the present study we explore the impact of women on boards after the 'comply or explain' principle was introduced in the United Kingdom (i.e., post 2012). This approach has been used in similar research exploring the link between women and boards and gender diversity in Norway, after the regulatory quota was introduced (Bertrand et al., 2019). However, critically, the present study neglects to also explore the period before legislative change was made. This presents an opportunity for future research to treat the change to use a

'comply or explain' initiative as an exogenous shock, allowing a further investigation into how the change in legislation influences the relationship between women on boards and disclosures on board gender diversity. Prior literature has investigated how exogenous changes in regulation influence the relationship between female board representation and gender diversity within the firm (Page, Sealy, Parker, & Hauser, 2023). Also, it is possible to explore the impact of other unanticipated exogenous shocks – such as pandemics, recessions, or natural disasters – which could have important implications for the relationship between women on boards and disclosures on board gender diversity.

We want to acknowledge some limitations with our study which would inform future research. First, our study focuses on the specific context of the UK – where firms are legally required to comply with the corporate governance code, which uses a 'comply or explain' approach to improve gender diversity at board level. Therefore, it remains unclear if our results are generalisable to other national environments, such as Italy or Norway, where hard law mandatory regulation has been implemented (Terjesen et al., 2015). In such contexts, firm's face penalties for non-compliance with targets/quotas and are (often) not confronted with 'comply or explain' principles that require the disclosure of information on board gender diversity. Thus, future research could investigate if our findings hold in other national environments that have implemented alternative forms of legislation to improve board gender diversity.

Second, we acknowledge that the analyses used in our study does not completely resolve endogeneity issues associated with our predictor variable (i.e., the proportion of women on boards). Instead, we propose that future

research uses (quasi-)experimental methods that reflect more realistic means to establish causality and resolve endogeneity concerns (Angrist & Pischke, 2009; Antonakis, Bendahan, Jacquart, & Lalive, 2010). As Yang and colleagues (2019) illustrate, such methods require a treatment group to be causally affected by exogenous variation (but not a comparable control group), to resolve endogeneity issues and establish causal effects.

Finally, as a result of focusing on women on boards, we were unable to investigate if the representation of women on boards is associated with disclosures focusing on gender diversity across the firm, or at specific levels of management (e.g., middle management). Prior research has directed scholarly attention towards the content of gender diversity disclosures focused on the firm as a whole (e.g., Jonsen, et al., 2019; Pasztor, 2019; Singh & Point, 2006). We focused specifically on disclosures on board gender diversity, as these disclosures were clearly defined in the UK's corporate governance code and required by the UK's 'comply or explain' approach to board gender diversity.

3.6.3. Conclusion

Our aim in this study was to explore the relationship between women's presence at board level and the disclosure of information on board gender diversity. Specifically, our findings show that the presence of women at board level increases the likelihood of a firm disclosing information on board gender diversity. Also, through applying critical mass and tokenism theories, we find evidence to suggest that disclosure is most likely to occur when there is a critical mass (i.e., three or more) women at board level. Thus, in a national context where a 'comply or explain' approach has been enforced, the representation of women

at board level is positively linked to the disclosure of information on board gender diversity.

Chapter 4

4. Topic Modelling: A Method for Analysing Corporate Gender Diversity Statements.

4.1. Abstract

Many large organisations are increasingly disclosing gender diversity statements within annual reports and company websites. Such disclosures are used by organisations to publicly signal opinions, practices, and progress regarding gender in the workplace. Scholars have long recognised the usefulness of gender diversity statements, but the costs associated with manually analysing large collections of text documents have constrained research in this area. Thus, this chapter proposes the use of topic modelling, a specialised machine learning technique, as a method for automatically investigating the content within large volumes of gender diversity statements. In particular, the chapter provides a step-by-step guide outlining each stage of the topic modelling process, along with the application of a relevant example analysing the diversity statements of large American organisations. Opportunities and limitations for the use of topic modelling as a research method are discussed.

Key Words: topic modelling, machine learning, gender, annual reports, diversity reporting, diversity statements

4.2. Introduction

In recent years, corporate disclosures have become more engaged with the issue of gender diversity, with many large organisations reporting text-based disclosures that outline opinions, practices, and progress regarding gender diversity within the workplace (Financial Reporting Council, 2018). Text-based disclosures on gender diversity, referred to as ‘gender diversity statements,’ are often subsumed within corporate documents, such as annual reports, and offer an intriguing window that allow researchers to observe how gender diversity is defined, valued, and managed by organisations across the business world. For this reason, gender diversity statements reflect a vast corpus of rich text-based data that warrants the attention of management scholars.

Traditionally, the analysis of gender diversity disclosures has promoted the use of qualitative methods, such as manual qualitative content analysis (e.g., Singh & Point, 2006). However, based on current reporting practices across Europe (Windscheid et al., 2017), the ever-increasing number of gender diversity statements has the potential to exceed the capabilities of manual coders. Accordingly, researchers need to embrace methodological advances from the area of computational text mining, where computer scientists have developed machine learning techniques capable of analysing large quantities of text documents.

This chapter, therefore, outlines how researchers can use automated machine learning techniques to study gender diversity disclosures within corporate documents. In particular, its aim is to provide a methodological framework that allows the naïve researcher to understand and apply such techniques – namely, topic modelling. The rest of the chapter includes: a brief review of existing

literature on gender diversity statements; an overview of topic modelling; and a user-friendly ‘step-by-step’ guide which covers each stage of the topic modelling process, along with a relevant example. Finally, the chapter will consider the limitations of this approach, and future opportunities.

4.2.1. Gender diversity statements

The concept of gender is widely considered to reflect the social and cultural perceptions of what it means to be either ‘a man’ or ‘a woman’ in modern society. Perceptions of gender are constructed and communicated through the promotion of gender specific roles by significant social influencers (West & Zimmerman, 1987). In the business world, leadership and management positions are roles typically associated with men, such that many perceive the attributes of a ‘typical manager’ as similar to the attributes of a ‘typical man’ and dissimilar to a ‘typical woman’ (Schein, 1973). Hence organisations can be viewed as inherently gendered, reflecting environments where women are underrepresented in positions of power and authority (Vinnicombe et al., 2018). Corporate gender disclosures serve as important linguistic and visual frameworks that allow organisations to construct, communicate and manage perceptions of gender within their operating environments (Grosser & Moon, 2008). Therefore, regardless of intent, organisations that publicly disclose information on gender could shape perceptions of what it means to be ‘a man’ or ‘a woman’ within the workplace, and, as a result, such disclosures could alter perceptions of gender across wider society.

Tinker and Neimark (1987) were amongst the first scholars to investigate how gender is portrayed within corporate disclosures. Using a longitudinal content analysis, they studied how women were represented within the annual reports of

a large American corporation. Overall, from 1917 to 1976, annual reports communicated and perpetuated patriarchal beliefs regarding women's minority status, playing a vital role in the social production of gender. Gender related discourse within annual reports served as "ideological weapons in manipulating the social imagination about women" (Tinker & Neimark, 1987, p.86). Building upon this, research noted how textual (e.g., Adams & Harte, 1998; Helms Mills, 2005) and visual (e.g., Anderson & Imperia, 1992; Benschop & Meihuizen, 2002) components of annual reports reinforce traditional gender-role stereotypes, depicting occupational environments as masculine, male dominated spheres.

Recent literature continues to explore how gender is portrayed within corporate disclosures. Changes to the UK corporate governance code in 2010, 2012, and 2014 led to the disclosure of gender diversity statements becoming common practice within annual reports and websites of large organisations (Financial Reporting Council, 2018). A growing number of studies have used gender diversity statements as a tool for exploring how organisations construct and communicate the issue of gender within the workplace. Using qualitative content analysis methods, research reveals that organisations often present gender as a concept that helps generate a competitive business advantage (Jonsen et al., 2019; Pasztor, 2019; Singh & Point, 2006). However, this approach is often found to be nothing more than window-dressing, as many organisations use disclosures to declare gender diversity management efforts as successful, despite women remaining heavily underrepresented in the workplace (Windscheid et al., 2017).

Although research analysing text, images and diversity statements has done much to explain how organisations communicate and construct perceptions of gender within the workplace, this body of literature is not without its limitations.

To date, research analysing gender disclosures has exclusively relied upon traditional qualitative methods of analysis. Such methods have received criticism for the high human effort required to code text documents, which often restricts studies to the use of small sample sizes (Jung et al., 2009). As more and more texts on gender diversity are published, researchers could become increasingly constrained by the use of such methods and the human processing power required to read and code large volumes of text documents.

To illustrate this problem, in the context of the United Kingdom and Germany, large publicly listed organisations are required to report statements on gender diversity for upper management and board level positions (Financial Reporting Council, 2018; Windscheid et al., 2017). Thus, across European countries, a potential sample of gender diversity statements could reflect a dataset containing thousands of text-based documents. Therefore, a new methodology is required that allows researchers to analyse large corpuses of gender diversity statements.

In recent years, machine learning researchers have developed a suite of algorithms that allow researchers to inductively analyse large amounts of qualitative data. We propose the use of such algorithms, specifically topic modelling, for the future analysis of gender diversity statements.

4.2.2. Topic modelling: An overview

Probabilistic topic modelling can be conceptualised as machine learning algorithms that aim to discover and identify themes embedded within large archives of text documents. The themes, known as ‘topics’, emerge from data rather than being predetermined by a researcher. Therefore, for researchers, topic modelling can be viewed as an automated inductive method for analysing

large qualitative datasets in an objective, fast, and replicable manner (Doldor et al., 2019; Székely & vom Brocke, 2017).

In practice, topic modelling algorithms create a set of topics (i.e., multinomial distributions over words) and assume each document within a dataset can be described using a mixture of these topics (Blei, 2012). Such algorithms, rather than focusing on semantics and grammar, are built upon the assumption that meaning is grounded in the co-occurrence of words rather than residing within the meaning of individual words. For example, certain co-occurring words (e.g., women; female; chairman; male; men) can be interpreted to reveal the meaning of a common topic (e.g., 'gender') within a dataset. Furthermore, using this example, it is clear to see that a common topic (e.g., 'gender') will account for a higher proportion of words within some documents (e.g., 'gender diversity statements') relative to others (e.g., 'environmental disclosures'). A topic model, therefore, uses word co-occurrence to enable researchers to automatically organise and summarise text documents at a scale that would be impossible by human annotation.

Latent Dirichlet Allocation (LDA; Blei et al., 2003) is the simplest and most popular topic modelling technique used by researchers. Without exploring the complex mathematics that underpin this algorithm, (for a detailed description, see, Blei et al., 2003; Blei, 2012) LDA can be broadly understood using two principles:

Principle one, each document in a dataset contains a distribution of topics.

A document consists of multiple topics of different probability distributions, and these probabilities reflect the number of words within a document that have been assigned to each topic. Ultimately, every word within a document is assigned to

a topic. For example, an LDA model using two topics could be interpreted as "Document 1 contains 70% of Topic A and 30% of Topic B, Document 2 contains 50% of Topic A and 50% of Topic B, and so on." This is the defining characteristic of LDA, all documents within a dataset share the same topics, but each document exhibits topics in different proportions.

Principle two, each topic contains a distribution of words.

A topic is essentially a list of all words ordered by their probability of co-occurrence. For example, a two-topic model could be interpreted as "Topic A – labelled '*gender*' – contains words like *female*, *male* and *women*; whereas Topic B – labelled '*environment*' – contains words like *ocean*, *pollution*, and *atmosphere*." Importantly, LDA also allows words to "overlap" between topics. Using the example above, the word *diversity*, could apply to both the topics of 'gender' and 'environment'.

Taken together, these principles represent the two types of statistical output produced by LDA, a 'per-document topic distribution' and a 'per-topic word distribution'. The per-document topic distribution, building upon principle one, is a matrix where each row is a document, each column is a topic, and each cell within the matrix is a probability reflecting the occurrence of a topic within a document – the total probability of topics contributing to one row (i.e., a document) always sums to 100%. Likewise, the per-topic word distribution, building upon principle two, is a matrix where each row is a word, each column is a topic, and each cell within the matrix is a probability reflecting the occurrence of a word within a topic – the total probability of words contributing to a column (i.e., a topic) always sums to 100%. Taken together, these two matrices contain the output of

an LDA model, providing a quantitative summary of the content within a large dataset of text documents.

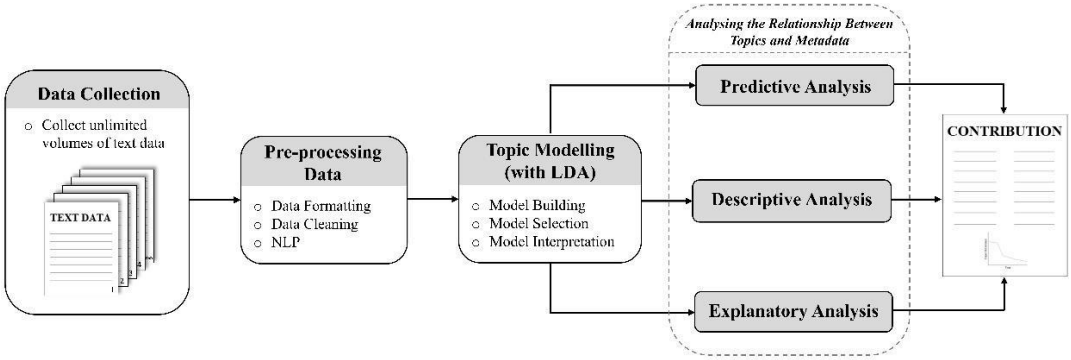
Using the extracted content from an LDA model, researchers can explore the qualitative content of topics emerging from the LDA analysis. This qualitative interpretation of results could be done by identifying key words that contribute to a topic, and, using a similar logic, a topic could be interpreted by viewing key documents that contain a high proportion of a specified topic. Once coded, topics can be combined with document-level metadata (i.e., information about each document), allowing researchers to analyse topics for descriptive, predictive, and explanatory purposes (Debortoli, et al., 2016). Thus, LDA can help provide new insights through the discovery of topics within large volumes of text data, and, when complimented with existing statistical methods, LDA output can also be used to explore the relationship between topics and document-level metadata.

Since LDA was first introduced by Blei and colleagues (2003), the standard LDA model has been subjected to a number of extensions. One large body of extensions imposes new structures on the topics (e.g., correlated topic models), whilst other extensions incorporate additional document-level data (e.g., time) into the LDA model (Nikolenko et al., 2017). LDA extensions may be of use to social scientists, as such extensions allow researchers to investigate the relationship between document metadata and content. For instance, in a recent paper in the field of leadership, researchers used Structural Topic Modelling (Roberts et al., 2014) to investigate how leader gender influenced the content of text-based departmental feedback (Doldor et al., 2019). Unfortunately, exploring LDA extensions further is beyond the scope of this chapter, any interested

readers are directed towards the work of Schmiedel, Müller and vom Brocke (2019), and Nikolenko, Koltcov and Koltsova (2017).

4.3. Topic modelling with LDA: A step-by-step guide

Figure 2. The topic-modelling process



The following aims to serve as an introductory tutorial and application of the method, covering each step of the topic modelling process. The cornerstone of a new project is the creation of the research question – a critical early signal that provides a point of direction for an imminent investigation. The example within this guide is embedded in the field of gender and corporate governance, exploring the research question: What are the key topics within a large corpus of web-based diversity statements?

4.3.1. Step 1: Data Collection

The data collection phase of a project requires researchers to identify and locate variables that could help answer the research question. LDA is no exception to this rule. However, there are some unique challenges researchers must overcome:

Sample Size. The sample of text documents must be large enough to ensure the LDA model produces meaningful and accurate results. What is deemed to be

an appropriate sample size is dependent upon the number of topics a researcher wishes to extract from the data. However, the number of topics used within an LDA model is determined by an iterative process during model construction (see, step 3). As a result, literature is yet to outline theoretically justified guidelines regarding a minimum sample for LDA modelling. Currently, it is accepted across literature that the accuracy and interpretability of results stabilise when a study uses a sample of 1000 text documents (Debortoli et al., 2016). Therefore, researchers should aim to collect a dataset that exceeds 1000 text documents.

Response Length. The number of words within each document must be long enough to ensure the LDA model produces accurate and meaningful results. Again, as of yet, there is no accepted single value for a minimum word count within a document. Extant research indicates that datasets should contain at least 100 words per document (Schmiedel et al., 2019).

Collecting Text Data. Since LDA models produce valid results when datasets are sufficiently large (i.e., $n > 1000$), many researchers collect text data from large publicly available data sources (e.g., websites and annual reports). As a result, researchers have developed automated methods (e.g., web-crawlers) to retrieve large quantities of text from websites (see, Debortoli et al., 2016) and PDF files from annual report archives (see, Székely & vom Brocke, 2017). Other methods of data collection could include data retrieved by the researcher themselves (e.g., interview transcripts, or online surveys). Ultimately, researchers should collect data in a way that best suits their research question.

Collecting Metadata. In addition to discovering topics, researchers often want to incorporate document-level metadata (e.g., document statistics) with topics for exploratory, explanatory, or predictive purposes (see, step 4). In practice,

researchers should have an advanced understanding of the phenomenon of interest and use this knowledge to identify and collect metadata relevant towards answering the research question.

Example Study

This example analysed the diversity statements of large US organisations. The data was manually downloaded from the websites of publicly listed companies. A sample of 500 diversity statements was collected, with an average document length of 281 words. No document level metadata was collected, as the study aimed to explore the content of diversity statements. The number of documents used within this example falls below the sample size recommended by literature (n > 1000). However, the goal of this example is to illustrate how topic modelling is generally used in a research project.

4.3.2. Step 2: Pre-processing Data

The data pre-processing stage of an LDA project reflects one of the most effortful steps of the research process (Kurgan & Musilek, 2006). Because text-based data is incredibly complex and unstructured, in almost all projects an extensive amount of data pre-processing is necessary before researchers can analyse data using a topic model, the data pre-processing steps are as follows:

Data Formatting. Most documents need to be formatted to allow the data to be processed by certain statistical programmes. This formatting depends upon the type of data collection method used by the researcher. For instance, data obtained by automated web-crawlers are typically stored within individual flat files. Other methods, such as online surveys, can automatically collapse text-based data and metadata into a single file. For the analysis process, as well as

pre-processing, data should be stored using a wide format, where each column represents a variable (e.g., id, text, and other items of metadata) and each row represents a single observation (e.g., id1, id2, id3, and so on), using a comma separated value file (i.e., .csv). Also, to ensure clarity and transparency, each stage of data pre-processing should be documented and saved, this will allow reviewers, as well as other interested parties, to see the original source of any new data created.

Data Cleaning. Data cleaning is a term used to describe the removal of 'noise' and duplicates within the dataset. Large text documents frequently contain duplicate documents (e.g., an individual may send the same email to multiple users) and contain high levels of "unclean" data (e.g., HTML and date tags might be left from automated web-crawlers). If left unattended, 'noise' and duplicates could lead LDA models to produce biased, incorrect results.

Natural Language Processing. Natural language processing (NLP), in its widest sense, concerns any use of computers in the manipulation of natural language. Unfortunately, there are no 'universal standards' for applying NLP to text documents. However, there are several commonly applied NLP strategies used by researchers to help remove 'noise' from documents and gradually transform unstructured qualitative datasets into numerical representations. The most commonly applied NLP strategies, along with recommendations for their application, are presented below:

Tokenisation. Tokenisation is the splitting of text documents into sentences and sentences into words. The process of tokenisation is mandatory for the extraction of topics using LDA models, as LDA topics derive from the co-occurrence of a collection of individual words (Jurafsky & Martin, 2009). This process requires an

important choice, researchers must choose how to split up strings of words. Simply treating text separated by white spaces as separate words, referred to as uni-grams (e.g., 'New,' 'York'), is often sufficient to explore meaning within textual data. However, this approach may be unpalatable as it essentially discards the order in which words occur within documents. If this is the case, researchers can retain some word order by including word pairs or triads, referred to as bi-grams or tri-grams, into the analysis (Miner et al., 2012). The use of bigrams, for example, would allow researchers to distinguish 'New York' from the adjective 'New' and the English city 'York'. The use of n-grams is still widely debated in literature. Some scholars argue that n-grams do little to enhance the performance of topic models (Hopkins & King, 2010; Manning et al., 2010; Schmiedel et al., 2019), whilst others recommend the use of n-grams as a tool for improving the coherence of extracted topics (Debortoli et al., 2016; Miner et al., 2012). In summary, researchers must tokenise text into uni-grams, whereas the use of bi-grams (or tri-grams) could be of use when humans are interpreting extracted topics.

Text Normalisation. Text normalisation typically includes the conversion of all characters into a lower-case format, punctuation removal, number removal, and stemming. Stemming removes the ends of words to reduce the total number of unique words within a dataset. For example, the Porter stemming algorithm (Porter, 1980), which is a widely used approach (Grimmer & Stewart, 2013), combines the words '*analysis*' and '*analysed*' into the single stem '*analys*'. Despite stemming being the most popular word shortening tool used amongst researchers, other methods such as lemmatisation – which combine words using a dictionary base – have been cited as better, less aggressive tools for simplifying

words (Lifchitz et al., 2009). The use of stemming and lemmatisation can add clarity to topic models, by reducing the scale of input data, but such algorithms have the added cost of removing important function words (e.g., nouns, verbs, adjectives) in a given context. Taken together, researchers are advised to convert characters to lower-case, remove punctuation, and remove numbers within the dataset – the use of lemmatisation and stemming is optional.

Word Removal. The removal of words is typically done by discarding stop words (i.e., words that serve as common grammatical functions), as well as removing very common and uncommon words. Many researchers remove stop words (e.g., 'the,' 'and,' 'of') from datasets as such words are common within natural language (Grimmer & Stewart, 2013). The inclusion of very common and uncommon words can bias the output of the LDA model. As a result, researchers also typically remove words which appear in less than 1% and more than 99% of the documents. This reduces the scale of input data.

TF-IDF Weighting. The term frequency by invers – document frequency (tf-idf) weighting is a numerical statistic that weights words by their importance within a dataset (Salton & McGill, 1983). The tf-idf weighting is an alternative method of representing data in topic models, and, in some cases, this could help produce more coherent results (Manning et al., 2010). However, as of yet, there is no single universally accepted optimal term-weighting (e.g., word count or tf-idf) for topic models. As a result, researchers are advised to use data weighted by word counts and tf-idf values in their analyses, comparing the coherence of the resulting outputs.

Example Study

To complete data pre-processing, this example used the statistical programming language R, and specifically utilised the *textmineR* package. The dataset was cleaned to remove as much noise as possible, this process included: (1) n-gram tokenising, splitting words into uni-grams (e.g., '*female*') and bi-grams (e.g., '*female_leaders*'); (2) removing stop words (e.g., '*and*,' '*the*'); (3) removing common and uncommon words; (4) removing numbers (e.g., '*2019*'); (5) removing punctuation; and (6) converting characters to lower case. After pre-processing, the dataset contained 500 documents with an average length of 163 words per document. After running preliminary LDA models, it was determined that models with the most coherent results used word count (rather than tf-idf) values.

4.3.3. Step 3: Data Analysis and Interpretation of Topics

The process of building, selecting and interpreting LDA models can be very challenging. The LDA algorithm is sensitive to changes in its parameters (i.e., number of topics; hyperparameters) and 'noise' within the input dataset, which, for example, could be introduced from the absence (or presence) of certain pre-processing methods. The journey towards achieving coherent and valid results, therefore, often reflects an iterative rather than linear process, key stages are outlined below:

Model Building. A crucial part of LDA model building concerns how many topics are to be extracted by the model (Blei et al., 2003; Boyd-Graber et al., 2014). If too many topics are chosen, the LDA algorithm will extract a number of topics that are barely distinguishable. On the other hand, if too few topics are

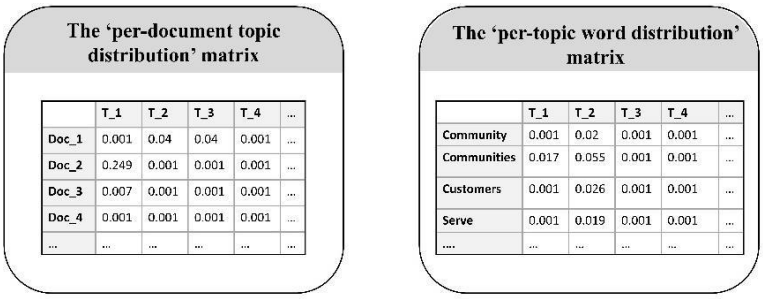
chosen, the LDA algorithm will be put under unnecessary constraint, reducing the overall exploratory power of the model. It is, therefore, common practice to vary the number of topics and evaluate the quality of the extracted outputs based upon the research question (Debortoli et al., 2016). In addition, a second part of LDA model building concerns the hyperparameters alpha (α = influences the distribution of topics across documents) and beta (β = influences the distribution of words across topics). Although the selection of hyperparameter distributions can be done using various approaches (see, Asuncion et al., 2009), it is common practice for researchers to use established standardised hyperparameter values (e.g., $\alpha = 0.1$, $\beta = 0.1$; or α and $\beta = 1$ divided by number of topics) (see, Debortoli et al., 2016; Nikolenko et al., 2017). Taken together, researchers are advised to test alternative models using between 10 and 100 topics (in steps of 10) using established hyperparameter values for all models.

Model Selection. Choosing the correct topic model is a difficult process. As of yet, there are no universal 'gold standards' for evaluating the results of LDA models. In response to such problems, computer scientists have developed tools for evaluating the quality of topic models, such as measures assessing 'semantic coherence'. Semantic coherence is a measure for analysing if common words in a given topic actually co-occur in a reference piece of the original dataset, reflecting a measure of construct validity (for more information, see, Lau et al., 2014). However, a common problem with such calculations is that models with the highest accuracy are not necessarily the models most well suited for human interpretation (Chang et al., 2009). Given that LDA models are often interpreted by humans, Boyd-Graber, Mimno and Newman (2014) provide two useful considerations for researchers during the model evaluation phase of a study: first,

are the extracted topics meaningful, interpretable, coherent, and useful?; and second, are the assignments of topics to documents meaningful, appropriate, and useful? Using these considerations, researchers can identify a model that contains coherent topics applicable to the research question. However, there are many threats that could interfere with researchers ability to evaluate models (for a guide on LDA model problems, diagnostics, and improvements, see, Boyd-Graber et al., 2014). Therefore, researchers should view LDA modelling as an iterative process in which problem solving (e.g., removing additional words; including n-grams; lemmatizing words) and the re-running of analyses is common practice.

Model Interpretation. Once a coherent topic model has been created, researchers must interpret the output of the model (see, Figure 2). When interpreting the meaning of a topic, a researcher is advised to look at the words with the highest probability of occurrence within a given topic (using the output within 'the per-topic word distribution' matrix), as well as documents that contain a high proportion of a given topic (using the output of 'the per-document topic distribution' matrix). Often, as is the case with traditional qualitative methods, researchers use the LDA output to assign descriptive labels that best represent the meaning of topics. To ensure this process is reliable, the interpretation and labelling of topics should be completed by at least two coders, with inter-rater reliability reported.

Figure 3. Probabilistic output from the example study LDA model.



Example Study

Using the *textmineR* package, this example tested alternative models ranging between 10 and 100 topics (in steps of 10). The cohesiveness of each LDA output was evaluated to determine the best model. It was determined that the best model contained 30 topics, as larger topic models (40-100 topics) produced results with an increasing number of duplicate topics, and smaller topic models (10-20 topics) failed to produce clearly distinguishable topics. To further establish the best model, additional models were tested ranging between 25 and 35 topics (in steps of 2). Ultimately, a model containing 25 topics was identified as the best model this model was coherent and produced clearly distinguishable topics.

For the labelling of topics (see, Table 9), the coders interpreted the output of the topic model, using the weightings of the most important words per topic (i.e., per-topic word distributions) and the most important documents per topic (i.e., per-document topic distributions). Each topic was coded by examining the top five words associated with the topic, along with the diversity statements most strongly associated with a given topic. For example, the words associated with Topic 6 included *president*, *chief*, *officer*, *executive*, and *vice_president*, and, in addition, the diversity statements most closely associated with this topic included

commitments and comments on diversity from members of senior leadership. Thus, Topic 6 was labelled '*executive intervention'*.

Overall, twenty-three topics were considered relevant to answering the research question, the coders discarded two topics that were not relevant. Discarded topics, for example, referred to structural components of the diversity statements that directed website users to '*click*' or '*read*' other resources listed on the corporate website. Following on from the identification of relevant topics, this example went on to use a descriptive analysis of topics to answer the research question.

Table 9. Example of Topic Labelling Process

Topic ID	Top Words	Example Text	Topic Label
T_25	network, employee, networks, employee_network	"Black Employee Networks (BEN) mission is to recruit, retain, and empower Black employees"	Diversity Networks
T_13	pay, equity, gender, pay_equity, equal	"We review our pay practices each year for any potential unexplained differences in pay by gender or race. To this end, [Company A] has internal processes, analyses and monitoring in place to assist in identifying and addressing any gender, or race, pay gap issue"	Pay Gap
T_17	top, companies, women, named, magazine, logo	"[Company B] Incorporated has been named one of the best places to work by the American Association of People with Disabilities and Disability"	Signalling Awards

4.3.4. Step 4: Analysing the Relationship Between Topics and Metadata

The analysis of the relationship between topics and metadata is dependent upon the research question. Prior to analysing data, researchers should have a comprehensive understanding of literature relating to extracted topics and the phenomenon of interest. Such an understanding will facilitate the development of meaningful hypotheses about potential relationships within the dataset. It is beyond the scope of the present chapter to outline all methods for analysing LDA output, therefore three common approaches for analysing LDA data are presented below:

Descriptive Modelling. Descriptive modelling is aimed at summarising and representing the LDA output in a concise manner. Crucially, this form of modelling is useful for exploratory purposes when reliance upon a causal theory is absent from the research question. For some researchers, the reporting of discovered topics within a given collection of text documents could be the sole objective of a research study – as is the case with our example. Alternatively, a researcher could perform more sophisticated descriptive analyses by aggregating topics based upon different aspects of document metadata (i.e., information about each document). Because all discovered topics are numeric datapoints standardised as a probability, researchers can easily compare topics across document subgroups and track the evolution of topics over time. Székely and vom Brocke (2017), for example, explored how the prevalence of certain topics within corporate sustainability reports changed over a fifteen-year period, a notable finding highlighted how the topic of ‘economic sustainability’ increased in prevalence after the global financial crisis of 2008.

Explanatory Modelling. Explanatory models are typically used to test causal hypotheses, in such models variables *x* (e.g., topics) are assumed to cause an effect on variable *y* (document metadata – e.g., number of women in leadership positions). Researchers who aim to test an explanatory research question, using methods such as linear regression, tend to use LDA models with fewer topics (e.g., 10-50 topics) in order to present results in a full and coherent manner (see, Debortoli et al., 2016). Since standard forms of regression are not well suited for the analysis of datasets with high dimensionality (i.e., large numbers of variables), researchers performing explanatory models are advised to use appropriate statistical methods. For example, statistical methods appropriate for modelling LDA data with high dimensionality include Ridge and LASSO regression (for an illustration, see, Yoon et al., 2016).

Predictive Modelling. Predictive models use data mining algorithms for the purpose of predicting or classifying new observations of data. In such models, an algorithm is 'trained' on a subsample of the dataset, with the aim of accurately predicting the variable *y* (e.g., author gender = male or female) for a test dataset using observations of a given set of *x* variables (e.g., topics). For example, a common application of predictive modelling is email spam detection, where linguistic components of spam emails are used to 'train' an algorithm to classify future emails as either 'spam' or 'not-spam'. However, these models may be of little use for social scientists, as predictive models reflect a complex 'black box' technique that simply provides a score of classification accuracy, and, as a result, such methods give researchers little information for descriptive and exploratory purposes (see, Martens & Provost, 2014).

Example Study

This example sought to explore the key topics embedded within web-based diversity statements. Using a descriptive analysis, where topics were interpreted by researchers, LDA modelling revealed that diversity statements communicated a wide range of discourse on diversity. They include, for example, topics associated with an organisation's activities directed towards external stakeholders (topics: '*corporate citizenship activities*,' '*customer diversity*,' '*supplier diversity*') and employees (topics: '*external diversity associations*,' '*diversity programs*,' '*executive intervention*,' '*gender related policies*,' '*diversity networks*,' '*equal opportunity policies*'). Furthermore, other topics were associated with diversity being part of the 'identity' of an organisation (topics: '*culture of diversity*,' '*valuing diversity*,' '*supporting diversity*,' '*diverse working environment*'). The remaining topics referred to anti-discrimination legislation (topics: '*equal rights*,' '*pay gap*,' '*protected characteristics*'), diversity management (topics: '*diverse perspectives*,' '*reflecting customers*,' '*developing talent*,' '*diversity monitoring*'), and the promotion of diversity related achievements (topic: '*signalling awards*'). Taken together, these findings reflect the key topics discussed within the web-based diversity statements of large US organisations.

Overall, this short example demonstrates how topic modelling can be used as an inductive, automated method for extracting meaningful topics from a large collection of diversity statements (our sample was relatively small, n=500, but we could use this on, for example, all 2,800 companies listed on the UK stock exchange). This example, along with the step-by-step guide, outlines each stage of the topic modelling process, illustrating how researchers can use this

methodology as a tool for investigating corporate diversity disclosures, such as gender diversity statements.

4.4. Discussion

4.4.1. Opportunities for Topic Modelling

Compared to established methods used by literature investigating gender diversity statements, topic modelling brings a number of important advantages and opportunities.

The use of topic modelling allows researchers to analyse large quantities of gender diversity statements, without sacrificing the in-depth qualitative insights embedded within the textual data. Topic models combine the rich inductive insights gained from traditional qualitative content analysis with the benefits of examining data on a large scale.

Furthermore, topic modelling also complements existing statistical methods of analysis, to gain new insights from gender diversity statements. To date, the main focus of research in the field has been the inductive analysis of content within gender diversity statements. As a consequence, a wealth of explanatory questions remain unanswered regarding the relationship between what organisations disclose and actual practice towards promoting gender equality. For instance, two qualitative studies, separated by fifteen years, both highlighted the need for research to investigate how gender diversity statements are related to organisational outcomes in the workplace, such as the representation of women in senior positions, career aspirations of young women, or financial performance measures (Point & Singh, 2003; Windscheid et al., 2017). Future research can use predictive modelling techniques – such as linear regression –

to explore the relationships between corporate disclosure (e.g., topics) and practice (e.g., company metadata). Therefore, the use of topic models alongside existing statistical methods can produce new insights, by investigating whether companies, shareholders or prospective employees act upon the policies and values promoted within gender diversity statements.

Another key advantage of topic modelling concerns the scope and range of data that can be analysed by researchers. As of yet, research analysing corporate disclosures on gender has fallen into three main categories, work analysing pictures, texts, and gender diversity statements published within annual reports and websites. However, given that topic models are suited for the analysis of any 'naturally occurring' data (Müller et al., 2016), the scope of research could extend to different forms of textual data published by organisations on the issue of gender, for example, posts on social media or the discussion of gender at annual general meetings. Topic modelling, therefore, grants researchers the ability to analyse new, previously unexplored sources of data. Future research can build upon the points discussed to develop a more detailed, advanced understanding of gender diversity statements.

4.4.2. Limitations of Topic Modelling

Despite being referred to as an automated technique, topic modelling is a method still heavily influenced by the input of human researchers. The complex mathematical algorithms support, rather than substitute, the human researchers who use this methodology. Researchers must make a number of important decisions throughout the course of a topic modelling research project, e.g., ranging from the selection of an appropriate sample size for the study, to choosing the most coherent model. Therefore, topic modelling does not eliminate the risk

of researcher bias influencing extracted results. Ultimately, topic modelling should not be viewed by researchers as a method that immediately produces objective interpretable content from a collection of documents, but instead as a tool that makes large collections of data more manageable for human coders.

A second limitation concerns the complexity associated with applying the method. The process of going from a set of raw text-based data to an effective topic model may be extremely challenging for new users. Rather than reflecting a linear process where researchers can complete the analysis at a 'touch of a button', topic modelling instead reflects an iterative process where researchers often repeatedly pre-process and analyse data prior to obtaining useful results. In time, however, this process may become more seamless as tool builders develop programmes capable of reducing the need for human input.

Topic models also create problems for researchers by creating meaningless topics. Because topic models create topics based upon word co-occurrence, it is likely that the topic modelling algorithm extracts topics that are not relevant to the phenomenon of interest. Researchers must determine the extent to which extracted topics relate to the research question, omitting irrelevant topics from the main analysis. Ethical implications of this include the importance of following common standards of ethical practice when using topic modelling, e.g., using multiple coders to interpret and code discovered topics.

4.4.3. Conclusion

The purpose of this chapter was to provide a methodological framework that allows researchers to interpret and use topic models for the analysis of large corpuses of gender diversity statements. Although the advantages of the proposed method are numerous relative to existing methods employed within the

field, researchers should be wary of the limitations and challenges associated with any project that uses topic modelling. In summary, the use of topic modelling, along with complementary statistical methods, allows future research to explore and study gender diversity statements in a way that can help provide new insights and advance theory on the ways in which organisations communicate and construct gender within corporate disclosures.

Chapter 5

5. Conclusion

5.1. Introduction

This thesis investigates the extended impact of soft law regulation on board gender diversity. Specifically, two research questions led to the empirical investigation of: how is the gender-based trickle-down effect between the corporate board and senior management team influenced by unexpected introduction of soft law regulation on board gender diversity? And second, what is the relationship between women on boards and the disclosure of information on board gender diversity? The thesis also had the objective of presenting a new methodology to outline how researchers can use automated topic modelling techniques to study gender diversity disclosures within corporate documents.

The empirical context of this thesis is on a single country where soft law regulation was implemented, such as the UK. Like much research on women on boards (see, Kirsch 2018), the three papers use quantitative methods and secondary data that was either hand collected from firm annual reports, or alternatively, data was downloaded from large online databases on board member characteristics (e.g., BoardEx) and firm characteristics (e.g., FAME). The exploration of research questions – presented in Chapter 2 and 3 – was done using an event study design and instrumental regression analysis techniques, these methods were used to limit problems associated with endogeneity (Antonakis et al., 2010) which has been noted by prior literature as a key problem in research exploring women on boards (Adams, 2016; Adams & Ferreira, 2009). Furthermore, Chapter 4 addresses the research objective of presenting a new

methodology to illustrate how natural language processing and topic modelling techniques can be used for analysing board gender diversity disclosures.

This thesis builds upon corporate governance research on board gender composition and corporate disclosure, and more specifically, contributes towards the following four key streams of research:

• *Stream 1*: Literature on the trickle-down effect of women in board level positions. A body of research has examined the relationship between the presence of women at board level and the representation of women in lower levels of management within the firm (e.g., Bilimoria, 2006, Gould et al., 2018, Skaggs et al., 2012). This stream of research has also identified that the trickle-down effect is influenced by critical mass at board level (Biswas, Chapple, Roberts, & Stainback, 2021), board independence (Biswas, Roberts, & Stainback, 2021), industry gender composition (Ali et al., 2021), and changes in reporting requirements (Gould et al., 2018). This thesis contributes to this area of literature by leveraging an exogenous shock to explore how the trickle-down effect is influenced by the introduction of soft law regulation.

• *Stream 2*: Research has previously studied the effect of regulation introduced to increase the representation of women at board level. This stream of research has previously focused on the impact regulation has on firm financial outcomes (e.g., Ahern & Dittmar, 2012; Eckbo et al., 2018; Matsa & Miller, 2013; Olsen, Schøne, & Verner; 2013) and labour market outcomes for women who occupy mandated board level positions (e.g., Mateos de Cabo et al., 2019; Seierstad & Opsahl, 2011; Sojo et al., 2016). This thesis extends this area of research by exploring alternative outcomes associated with the introduction of regulation, which is particularly pertinent to research and practice as regulation is often

introduced by national governments with the explicit assumption that the effect of regulation will “cascade out into senior leadership roles” and improve reporting on board gender diversity (Department for Business, Innovation & Skills, 2015, p.18; Financial Reporting Council, 2012).

• *Stream 3*: Literature on the relationship between women on boards and CSR disclosure. Prior research has found a positive relationship between the presence of women at board level and the disclosure of information on CSR related issues, such as carbon emissions (Ben-Amar, Chang, & McIlkenny, 2017); corporate risk (Seebeck & Vetter, 2021); cybersecurity risk (Radu & Smaili, 2022); and financial reporting (Wahid, 2019). This thesis reveals that the aforementioned positive relationship is also observed when exploring women on boards and the disclosure of information on board gender diversity, providing further evidence that the presence of women on boards can help to reduce information asymmetries – in this case, women on boards increase the likelihood of disclosures on board gender diversity.

• *Stream 4*: Literature in the field of corporate communication has analysed the qualitative themes within gender diversity disclosures. Prior research has analysed the themes within gender diversity disclosures, often finding the most prevalent theme frames gender diversity as something that can be utilised and managed to produce meaningful business-related benefits (e.g., Gurrier & Wilson, 2011; Point & Singh, 2003). This thesis advances research in this field by leveraging technological and methodological advances in natural language processing to provide a methodology to assist researchers wanting to inductively analyse large volumes of gender diversity disclosures using automated topic modelling techniques.

The next section of the conclusion discusses the findings of the thesis. The third section describes the contributions of this thesis, providing an overview of empirical and theoretical contributions, as well as discussing implications for policy and practice. The fourth section considers limitations and future directions for research. Finally, concluding remarks are provided.

5.2. Discussion of Findings

This section will provide a summary of the key findings relating to the research questions and objectives for this thesis.

5.2.1. Research Question: how is the gender-based trickle-down effect between the corporate board and senior management team influenced by unexpected soft law regulation on board gender diversity?

To explore this research question, data was collected on firms listed on the UK FTSE 350 index from 2007 to 2018. During this period, specifically in 2011, the UK government abruptly implemented soft law regulation in which eleven recommendations were proposed to increase women's representation on the boards of FTSE 350 listed firms (Department for Business, Innovation & Skills, 2011), the most critical recommendation was for firms to meet the voluntary target of having twenty-five percent of board positions held by women. The introduction of soft law regulation was therefore considered an exogenous shock, an unprecedented and unexpected event, in which corporate boards were abruptly confronted with new external soft law regulatory recommendations regarding the representation of women at board level (Doldor, Sealy, & Vinnicombe, 2016).

The immediate introduction of the UK soft law regulation made it possible to investigate the variation in the trickle-down effect before and after regulation was announced in 2011. Descriptive statistics revealed that the soft law regulation was

effective in increasing the representation of women at board level, with a dramatic increase of 15.76% in the proportion of women at board level being observed in the post-regulation time period (2011 to 2018) – this was a much higher than the modest increase of 0.98% observed during the pre-regulation time period (2007 to 2010). These descriptive results are aligned with prior research suggesting soft law regulation on board gender diversity is an effective tool for increasing female participation at board level (Sarabi & Smith, 2021; Oldford, 2022).

However, unlike the change in the percentage of women at board level, the increase in the percentage of women in senior management positions was relatively modest in both the pre-regulation (0.71%) and post-regulation (4.17%) time periods. When observing and comparing the representation of women in board and senior management positions in the pre-regulation time period, the (modest) percentage changes between 2007 and 2010 for women at board level (0.98%) and senior management (0.71%) roughly coincided, suggesting that they were correlated before the regulation was introduced – suggesting the presence of a trickle-down effect. When soft law regulation was introduced, the increase in the percentage of women in senior management (4.17%) did not increase at the same pace as the increase of female representation at board level (15.76%) – suggesting that regulation weakens the trickle-down effect.

To econometrically test the assumption that the trickle-down effect is weakened by the introduction of soft law regulation OLS regressions were used. The findings repeatedly revealed that in the pre-regulation period the representation of women at board level trickled-down and was positively related to the representation of women in senior management positions. However, the

introduction of regulation on board gender composition led to a substantial weakening of that relationship.

Contrary to literature indicating that regulation could strengthen the trickle-down effect (e.g., Matsa & Miller, 2011), the observed findings suggest that whilst firms engage in the pursuit of meeting regulatory requirements on board gender diversity, the introduction of regulation does not guarantee an improvement in gender diversity at board level will extend to senior management positions. This result is consistent with past literature which had also found the trickle-down effect is weakened by changes in reporting requirements in Australia (Gould et al., 2018), and is aligned with results suggesting that mandated women at board level is not associated with the representation of women within Norwegian firms (Bertrand et al., 2019).

5.2.2. Research Question: what is the relationship between women on boards and the disclosure of information on board gender diversity?

This research question was investigated using the national context of the UK FTSE 350 Index from 2012 to 2016. At the start of this time period, to enhance its soft law regulation on board gender diversity, the UK Government introduced a ‘comply or explain’ principle within the UK corporate governance code, this change in the code required firms to disclose information on board gender diversity within their annual report (see, Financial Reporting Council, 2012). As a consequence, from 2012, large UK listed firms not only faced pressure to meet the soft law voluntary target of achieving twenty-five percent women at board level, but they also were required to disclose information on board gender diversity.

Descriptive results reveal that the introduction of a ‘comply or explain’ principle was successful in encouraging FTSE 350 listed firms to provide a disclosure on board gender diversity, with the number of firms complying with disclosure rules on gender diversity increasing from 77% (2012) to 90% (2016). The ‘comply or explain’ principle had the anticipated impact of encouraging firms to disclose information on board gender diversity within their annual reports, this finding is consistent with research that has shown corporate governance codes are effective tools for spreading good governance practices and coercing companies into complying and internalising their demands (e.g., Aguilera & Cuervo-Cazurra 2004, 2009).

That said, however, the relationship between women’s presence at board level and the disclosure of information on board gender diversity remained to be tested – this was done using instrumental variable regressions. Overall, the results suggest that the representation of women in the boardroom is positively related to the disclosure of information on board gender diversity. Furthermore, we find that this positive effect is most prominent when there is a critical mass of three or more women at board level. To establish the robustness of the positive link between women on boards and board gender diversity disclosure, a series of additional analyses were conducted using different variable specifications. It was found that the percentage of women at board level was also positively related to: the total number of words in a disclosure; whether the disclosure contains a policy; and the use of feminine words in a disclosure. The results were also robust to the use of a different variable description for the representation of women at board level – consistent results were used when analyses were repeated using the total number of women at board level, the percentage of women in executive

director positions, and the percentage of women in non-executive director positions.

These results suggest a ‘comply or explain’ principle on board gender diversity, which encourages firms to disclose information on board gender diversity, is likely to lead firms to engage in transparent disclosure where the representation of women at board level is positively related to the disclosure of information on board gender diversity.

5.2.3. Research Objective: to outline how researchers can use automated machine learning techniques to study gender diversity disclosures within corporate documents.

Across the globe, the disclosure of information on the issue of gender diversity has become a requirement of many national corporate governance codes. Scholars have long recognised the usefulness of gender diversity statements (Point & Singh, 2003; Singh & Point, 2006), but the costs associated with manually analysing the qualitative themes across large collections of text documents means much more remains to be explored in this area of research. Thus, this thesis proposed that scholars in this field use topic modelling, a specialised machine learning technique, as a method for automatically investigating the content within large volumes of gender diversity statements.

Alongside a discussion of the proposed methodology, a step-by-step ‘example study’ illustration of the topic modelling process was also provided. The example study sought to answer the following research question: What are the key topics within a large corpus of web-based diversity statements?

Data was collected by manually downloading diversity statements from the corporate websites of 500 firms listed on the US Standard & Poor’s (S&P) 1500

Index. The average length of the diversity statements was 281 words. Initially, the data was processed using data cleaning methods and natural language processing. Then the data was analysed using the simplest and most popular topic modelling technique, Latent Dirichlet Allocation (LDA; Blei et al., 2003).

The results of the exploratory analysis revealed that a model containing 25 topics was identified as the best model, this model was coherent and produced clearly distinguishable topics. The results of the analysis revealed that prominent topics within diversity statements related to: 1) corporate citizenship activities; 2) customer diversity; 3) supplier diversity; 4) external diversity associations; 5) diversity programs; 6) executive intervention; 7) gender related policies; 8) diversity networks; 9) equal opportunity; 10) policies; 11) culture of diversity; 12) valuing diversity; 13) supporting diversity; 14) diverse working environment; 15) equal rights; 16) pay gap; 17) protected characteristics; 18) diverse perspectives; 19) reflecting customers; 20) developing talent; 21) diversity monitoring; and 22) signalling awards[21]. Taken together, these findings reflect the key topics discussed within the web-based diversity statements of large US organisations.

Alongside this example study, a step-by-step guide – outlining published work on each stage of the topic modelling process – was presented to researchers so they can use this methodology as a tool for investigating corporate diversity disclosures.

[21] Some topics were discarded as they referred to structural components of the diversity statements that directed website users to ‘click’ or ‘read’ other resources listed on the corporate website.

5.3. Discussion of Contributions

5.3.1. Empirical contributions

First, this thesis adds to an emerging body of empirical research exploring soft law regulation on board gender diversity (e.g., Allemand et al., 2022; Conde-Ruiz et al., 2019; Gregorič, et al., 2017; Humbert et al., 2019; Kang et al., 2023; Martínez-García et al., 2022; Mateos de Cabo et al., 2022; Mateos de Cabo et al., 2019; Mensi-Klarbach & Seierstad, 2020; Oldford, 2022; Sarabi & Smith, 2021). Recent research in the field has commented on the extent to which soft law regulation is effective towards promoting the representation of women at board level (Conde-Ruiz et al., 2019; Oldford, 2022) and has pointed out factors influencing the effectiveness of regulation – such as firm contracts with public institutions (Mateos de Cabo et al., 2019), firm ownership (Martínez-García et al., 2022), and the method through which regulation is introduced (Kang et al., 2023). Outside of discussing the effectiveness of soft law regulation (e.g., Conde-Ruiz, Garcia, & Yañez, 2019; Kassam, 2023; Mateos de Cabo et al., 2019; Oldford, 2022; Sarabi & Smith, 2021) only a limited number of studies have investigated the extended impact of soft law regulation beyond the mere representation of women at board level (e.g., Allemand et al., 2022; Mateos de Cabo et al., 2022), and as a consequence, it has been stated that research in this area is in its "infancy stage" (Hughes et al., 2017, p.346). Although studies on hard law regulation have considered its impact on firm financial outcomes (e.g., Yang et al., 2019) and female labour market outcomes (e.g., Bertrand et al., 2019), much more remains to be understood regarding the extended impact of regulation on board gender diversity, especially on the extent to which regulation influences the relationship between women on boards and the representation of women in lower

levels of management – referred to as the trickle-down effect. This thesis addressed this gap in the literature, through empirically testing the impact of regulation on the trickle-down effect. This empirical contribution to literature provides evidence to suggest regulation on board gender diversity has a negative impact on the relationship between women on boards and women in senior management, and thus, contributes towards knowledge on empirical outcomes associated with regulation on board gender diversity.

A second empirical contribution advances research by exploring the impact of an exogenous shock on the trickle-down effect (e.g., Ali et al., 2021, Bilimoria, 2006, Biswas; Chapple., Roberts, & Stainback; 2021, Biswas, Roberts, & Stainback, 2021; Gould et al., 2018, Matsa & Miller, 2011, Skaggs et al., 2012). Whilst research has documented women's representation at board level leads to an increase women's representation in lower levels of management (Bilimoria, 2006; Bilimoria, 2006; Bozhinov et al., 2021; Matsa & Miller, 2011; Skaggs et al., 2012), only a small amount of scholarly attention has been dedicated towards exploring factors that influence the strength of the trickle-down effect – with the trickle-down effect being influenced by critical mass at board level (Biswas, Chapple, Roberts, & Stainback, 2021), board independence (Biswas, Roberts, Stainback, 2021), and gender diversity across industry sectors (Ali et al., 2021). An empirical contribution in this field of research is provided in this thesis by exploring how the trickle-down effect is influenced by an exogenous shock of regulation in the UK. Exploring the impact of an exogenous shock reflects a key empirical contribution to this area of research, particularly given the existing literature on trickle-down effects has largely neglected to explore how external events can influence the trickle-down effect.

This thesis also makes an empirical contribution towards CSR literature through exploring the link between women on boards and disclosure on board gender diversity. Research has mostly uncovered a positive link between women on boards and CSR activities, such activities include firm performance on dimensions relating to: community, corporate governance, diversity, employee relations, environment, human rights, and product related social issues (e.g., Bear, Rahman, & Post, 2010; Boulouta, 2013; Byron & Post, 2016; Glass, Cook, & Ingersoll, 2016; Post, Rahman, & McQuillen, 2014). This body of research has also expanded towards exploring the positive link between women on boards and disclosures in corporate reports (e.g., Arayssi, Dah, & Jizi, 2016; Ben-Amar, Chang, & McIlkenny, 2017; Frias-Aceituno, Rodriguez-Ariza & Garcia-Sanchez, 2013; Hoang, Abeysekera, & Ma, 2018; Rao & Tilt, 2016). Although this research has done much to advance knowledge on the link between women on boards and improved firm disclosure, it has been noted by prior literature that much more remains to be explored regarding the link between women's representation in the firm and disclosures on gender diversity (Point & Singh, 2003; Windscheid et al., 2018). Therefore, in the third chapter of this thesis, an empirical contribution was provided by exploring the link between women on boards and the disclosure of information on board gender diversity. This contribution provides evidence of a positive link between women on boards and disclosures on gender diversity, thus, contributing to research investigating the relationship between women on boards and CSR reporting.

Another empirical contribution is also provided to research in the field of corporate communications on gender diversity (e.g., Gurrier & Wilson, 2011; Jonsen et al., 2019; Pasztor, 2019; Point & Singh, 2003). Researchers in this field

are quite familiar with qualitative text analysis as a method for inductive inquiry. Qualitative approaches, such as grounded theory or content analysis, have proven to be extremely useful for inductively generating a coherent and comprehensive understanding of themes within gender diversity disclosures (e.g., Point & Singh, 2003). However, such approaches are resource intensive and do not scale well, which also restricts studies to the use of small sample sizes (Jung et al., 2009). As a consequence, in line with advances in computational power, efficiency, and tools for mining large amounts of unstructured text data (Campion & Campion, 2020), this thesis proposed a methodology for automatically investigating the content within large volumes of gender diversity statements using topic modelling – along with the application of a relevant example study analysing the diversity statements of large US listed firms. This provides future corporate communication researchers with a methodological framework that allows them to interpret and use topic models for the analysis of large corpuses of gender diversity statements. This empirical contribution will provide researchers with the ability to conduct more sophisticated statistical analysis of themes within corporate communications on gender diversity, thus, contributing towards knowledge on gender diversity disclosures.

The final empirical contributions relate to the methodology used by research exploring the impact of regulation on board gender composition. First, much of the prior research on regulation has focused on the Norwegian quota (e.g., Ahern & Dittmar, 2012; Bertrand et al., 2019; Seierstad & Opsahl, 2011). Whilst this body of research has done much to advance knowledge on the impact of regulation, recent research in the field of regulation has focused on national contexts beyond the focal Norwegian quota – exploring the impact of quotas introduced in France

(e.g., Nekhili, et al., 2019), Spain (e.g., Mateos de Cabo et al., 2022), and Italy (Ferrari et al., 2022). Thus, rather than focusing on the notable Norwegian case, this thesis presents the UK soft law regulation (introduced in 2011) as a contrasting empirical context for future research.

Second, prior research on the impact of regulation often uses difference-in-difference techniques (e.g., Yang et al., 2019) or instrumental variable regressions (e.g., Ahern & Dittmar, 2012) in their analyses to mitigate against issues associated with endogeneity (Adams, 2016; Antonakis et al., 2010). Whilst these methods are effective tools for addressing endogeneity, these analytical techniques may not be appropriate in certain contexts. For instance, when conducting an instrumental variable regression, the identification of a suitable instrument can be very challenging (Adams & Ferreira, 2009) – especially when exploring board gender diversity. Also, due to data limitations, researchers may not be able to use a difference-in-difference approach to establish causal results. Thus, when difference-indifference or instrumental variable approaches cannot be used, this thesis presents an event study design using OLS regressions to investigate impact of regulation at the national level by modelling the following equation:

$$DV_{it} = \beta 1 IV_{it} + \beta 2 Regulation_t + \beta 3 IV_{it} \times Regulation_t + \alpha_i + \varepsilon_{it}$$

where $_i$ indexes firms and $_t$ indexes time. DV_{it} is the measure of the dependent variable firm $_i$ at time $_t$, IV_{it} is the independent variable for firm $_i$ in year $_t$, $Regulation_t$ is a dummy for the years before and after the introduction of regulation. To test the relationship between the independent variable and the dependent variable before the introduction of regulation, one should examine the sign and significance of $\beta_1 IV_{it}$. To test a change the in relationship after the

introduction of regulation, one should examine the sign and significance of $\beta_3 IV_{it} \times Regulation_t$. Also, it is important to hold constant firm fixed effects (α_i) to account for unobserved heterogeneity related to differences between firms. Finally, ε_{it} is the error term.

5.3.2. Theoretical contributions

With respect to theory, prior literature exploring the trickle-down effect draws from a wide variety of established theoretical frameworks on in-group preference, such as similarity-attraction paradigm (Byrne, 1971), social identity theory (Tajfel & Turner, 1979), homosocial reproduction (Kanter, 1977), and homophily (Ibarra, 1993), to argue that women in senior leadership positions can promote the representation of other women within the firm. These theoretical perspectives could lead scholars to assume that regulation to increase women's presence on corporate boards should strengthen the trickle-down effect, as previously argued by Matsa and Miller (2011). However, institutional literature suggests that regulation could lead to decoupling practices (Terjesen et al., 2015), implying that "organizations under pressure to adopt particular structures or procedures may opt to respond in a ceremonial manner, making changes in their formal structures to signal conformity but then buffering internal units, allowing them to operate independent of these pressures" (Scott, 2008, p. 171). Thus, literature from an institutional perspective suggest that the introduction of regulation could lead to a weakening of the trickle-down effect, as firms are more likely to engage in decoupling (otherwise referred to as ceremonial conformity or 'window dressing'). The findings of this thesis do not support the theoretical view that regulation, using quotas or targets, will strengthen the relationship between the representation of women at board and senior management levels, which has been suggested by

theory used by prior literature on the trickle-down effect (e.g., Biswas, Chapple, Roberts, & Stainback, 2021). Instead, this thesis argues the introduction of regulation on board gender diversity could lead to decoupling practices that weaken the trickle-down effect, where a firm complies with regulation on board gender diversity to gain recognition and praise, when in fact below board level they do not fully endorse or internalize these efforts.

This thesis also provides robust evidence for a positive relationship between the representation of women on boards and disclosures on board gender diversity. Evidence suggests that women need to reach a critical mass (when three of more women serve on the board) before the positive impact takes effect. Overall, our findings support the theoretical assumption that gender diversity at board level promotes the disclosure of information through improved board group dynamics (e.g., Anderson et al., 2011; Bilimoria & Wheeler, 2000; Bilimoria, 2000; Daily & Dalton 2003; Zelechowski & Bilimoria, 2004). As the disclosure of information on board gender diversity is driven by compliance with soft law corporate governance codes, our findings indicate that the presence of women on boards can help to increase the transparency of disclosure, which in turn lowers information asymmetries.

Finally, this thesis contributes to theory on gender diversity disclosures. Through the use of topic modelling, this thesis presents a methodological approach to researchers in the field of corporate communications, which allows them to inductively generate topics from a body of text without making prior assumptions about the findings (Roberts et al., 2014). To date, theory used when analysing the content of gender diversity disclosures draws heavily from the diversity management perspective (e.g., Gurrier & Wilson, 2011; Jonsen et al.,

2019; Pasztor, 2019; Uysal, 2013), and to a lesser degree, from institutional (e.g., Ghauri et al., 2021; Manoharan, Madera, & Sigal, 2021), Marxist (e.g., Hossain, Ahmad, & Siraj, 2016; Tinker & Neimark, 1987), impression management (e.g., Hossain et al., 2021; Long, Doerer, & Stewart, 2015), and feminist theories (e.g., Adams & Harte, 1998). Therefore, the topic modelling approach presented in this thesis can help future research to inductively discover new theoretical constructs, or alternatively, explore how language within diversity disclosures is related to existing theoretical constructs. When topic models are applied to gender diversity disclosures – i.e., written text – topic modelling provides a window into how firms construct, communicate, and manage perceptions of gender within their operating environment. Ultimately, this thesis helps to advance the development of theory on board gender disclosures through the use of topic modelling techniques.

5.3.3. Implications for Policy and Practice

The findings of this thesis have several implications for policy and practice. First, the introduction of regulation weakens the trickle-down effect between women on board and women in senior management. This thesis is the first evidence showing that the exogenous shock of regulation weakens the trickle-down effect. In essence, the representation of women at board and senior management team positions are no longer as strongly correlated after regulation was implemented. With respect to implications for practitioners, our results suggest that when women's representation on a firm's board is regulated, either with soft law or hard law, the representation of women on boards could reflect a less accurate measure of a firm's actual orientation towards the promotion of gender diversity within the workplace. To address this issue, practitioners (e.g.,

investors, shareholders, policy makers, or other stakeholders) should consider using alternative proxies as a measure of a firm's orientation towards promoting gender equality, such as the representation on women in lower (non-regulated) senior management positions. Furthermore, policymakers could help resolve the disconnect between women's representation between the corporate board and senior management team in the post-regulation era by increasing the relevance of regulation for management teams located below board level. For instance, this could be achieved through setting soft law or hard law regulation on the representation of women in the senior leadership positions below board level (also suggested by Klettner, Clarke, & Boersma, 2016) – which subsequently became the case in the UK, with the Hampton Alexander Review extending voluntary targets at board level to the direct reports of the executive committee and also requested that firms "set their own targets for gender diversity in senior management" (Department for Business, Energy & Industrial Strategy, 2016, p. 21)

A second contribution relevant to practice relates to our findings on the relationship between women on boards and the disclosure of information on board gender diversity. Past literature has proposed that a 'comply or explain' approach could lead to decoupling practices where a firm makes efforts towards externally endorsing board gender diversity when in fact, they do not fully internalise the practice of improving board gender diversity (Terjesen et al., 2015). This presents a problem for many nations around the globe (e.g., Canada, Australia, United States) who have introduced 'comply or explain' principles that require a firm to publish transparent information on board gender diversity. The results in this thesis show that the 'comply or explain' principle in the UK

governance code is associated with transparent disclosures, where women's presence at board level is positively related to disclosures on board gender diversity. We therefore provide evidence advocating the use of 'comply or explain' principles for improving board gender diversity. Also, with a focus on practitioners, our results confirm that board gender diversity disclosures in annual reports are positively related to the representation of women at board level, and as a consequence, these disclosures are likely to reflect a transparent reflection of a firm's effort towards promoting gender equality in the boardroom.

This thesis also has broader implications for all directors (men and women) who occupy board level positions that are influenced by regulation on board gender diversity. It is important that those who hold focal board level positions ensure that gender diversity is a priority at all levels of the corporate hierarchy, not just at board level. Thus, directors should ensure that equal attention is given towards promoting human resource policies designed to improve gender diversity within the firm, in addition to responding to national regulatory initiatives to increase the representation of women at board level. Whilst regulation has done much to improve the representation of women in regulated board level positions (e.g., Ferrari et al., 2022; Oldford, 2022; Sarabi & Smith, 2021; Wang & Kelan, 2013), it is possible that a 'glass ceiling' could still exist where barriers are present in the workplace that prevent the progression of women up the corporate hierarchy (Morisson, et al., 1987). This issue could be mitigated against by ensuring the board, in addition to complying with regulations on board gender diversity, directs board-level attention towards addressing gender (in)equality at lower levels of management within the firm. This does not necessarily require the use of targets or quotas (often used at board level) in lower levels of management

per se, alternative policy interventions could be introduced within the firm to ensure progress towards improving gender diversity across the firm – for instance, ensuring the firm engages key power holders, such as the CEO, with the delivery of policies and objectives to improve gender diversity within the firm (Benschop & Van de Brink, 2014). This approach could have broader benefits for firms facing pressure to increase the representation of women at board level, as improving gender diversity throughout the firm could mitigate against criticisms of "window dressing" from external stakeholders.

Finally, this thesis has implications for non-listed firms. It is clear to see that regulation introduced to improve the representation of women at board level has expanded over time. For instance, the UK soft law regulatory target was initially introduced for FTSE 100 firms (Department for Business, Innovation & Skills, 2011), in the time since the target was introduced it has expanded to FTSE 350 firms (Sealy, et al., 2011), executive committees and direct reports (Department for Business, Energy & Industrial Strategy, 2016), and most recently the 50 largest private firms in the UK have been monitored based upon their progress towards improving board gender diversity (FTSE Women Leaders, 2023). Thus, large private firms now face greater pressure to comply with norms and expectations regarding the representation of women at board level, and as a consequence, they too should act on the findings of this thesis to ensure they are seen as progressive and acting in accordance with best practice governance.

5.4 Limitations and Future Directions

5.4.1 Research Limitations

The analyses in this thesis focused on a very specific national context. It therefore remains unclear if our results are generalisable to other national

contexts, such as Italy, Germany, or India, where mandatory regulation has been implemented with non-compliance leading to penalties or sanctions (Terjesen et al., 2015). This issue is not limited to this thesis, literature on women on boards has often focused analyses on a single country (Kirsch, 2018; Terjesen, Sealy, & Singh, 2009). The tendency to focus on one single country impedes cross-country comparisons, which is of importance when considering that efforts towards addressing gender diversity at board level may differ from nation-to-nation depending on differences in public policies, institutional forces; and cultural, social, or political histories (Grosvold & Brammer, 2011; Terjesen et al., 2015; Terjesen & Singh, 2008; Seierstad et al., 2017; Verloo & Lombardo, 2007). Therefore, there is reason to assume that results could differ between countries. Second, due to constraints accessing data on boards, this thesis relied upon the use of secondary data collected from databases and annual reports. Whilst the use of secondary data is commonplace when studying corporate boards (see, Kirsch, 2018), it is important to acknowledge calls for research to move beyond the use of secondary data as proxies for actual board level decision making (Terjesen & Sealy, 2016). Although it is difficult for researchers to access boardrooms (Feldman, Bell, & Berger, 2004), it is important to consider limitations of exclusively using secondary data – rather than using in-depth qualitative studies that offer a deeper insight into board processes.

Finally, the analyses used in this thesis do not completely solve endogeneity issues associated with our independent variable, the representation of women on boards. Even though there might be reasons to believe the analytical approaches used, namely leveraging the exogenous shock of regulation and the use of instrumental variable regressions, suffer less from issues associated with

endogeneity (Bun & Harrison, 2019), it is important to express caution regarding the causal interpretation of the results presented. To adequately address the issue of endogeneity, it is recommended that research in this area employs additional (quasi-) exogenous methods (see, Antonakis et al., 2010; Matsa & Miller, 2013; Yang et al., 2019) such that only a treatment group is causally affected by the exogenous variation (but not a comparable control group), to resolve endogeneity issues and establish causal effects.

5.4.2. Future Directions for research

At present, there is little understanding of the impact of regulation on board gender composition on the trickle-down effect in other national contexts where regulation has been introduced. As revealed in this thesis, the introduction of soft law regulation in the UK weakened the trickle-down effect. To date, literature on the trickle-down effect has focused on a single national context. Consequently, it remains unclear what the impact of regulation is in other national environments where the context surrounding the introduction of regulation differs from country to country – such as female labour market provisions, political ideologies, and policy initiatives for gender equality (Terjesen et al., 2015). Furthermore, the impact of regulation on the trickle-down effect could be influenced by the various national approaches to regulating women on boards, which often vary depending on the use of: hard law or soft law; targets or quotas; compliance dates; and scope (see, Kang et al., 2023). Therefore, in line with calls for further use of cross-national comparative studies (Terjesen & Sealy, 2016; Kirsch, 2018), future research could conduct a cross-country analysis on the impact of different types of national regulations on the trickle-down effect, whilst also considering the national institutional context in which the regulation is embedded.

In addition to introducing regulation on women on boards, governments have also shown increased attention towards legislating other forms of diversity at board level. For instance, in 2017, the UK government put in place soft law regulation requiring that firms listed on the FTSE 350 Index should have at least one director of colour by 2024 (Department for Business, Energy & Industrial Strategy, 2017). Similar targets have also been introduced in Canada, where firms have been pressured to have both gender parity on boards whilst also having at least thirty percent of board positions held by other equity-deserving groups (Institute of Corporate Directors and TMX Group, 2022). The introduction of additional regulation on board diversity could reflect a fruitful area for future investigation. First, through treating the introduction of additional diversity regulation as an exogenous shock, it would be possible to explore the impact new regulation has on a firms progress towards maintaining (or achieving) older regulatory recommendations regarding the representation of women at board level. For example, using Ocasio's (1998) attention-based view as a theoretical framework, it could be argued that the introduction of regulation on racial diversity could divert attentional resources of the board away from making progress on improving the representation of women at board level, thus weakening progress towards achieving regulatory targets on board gender composition. Second, building upon literature arguing women's presence at board level is positively associated with ethnical and social compliance by the firm (e.g., Byron & Post, 2016; Isidro & Sobral, 2015), future research could explore the relationship between the presence of women at board level and compliance with new regulatory demands regarding other forms of diversity at board level. Thus, moving beyond regulation on board gender composition, corporate governance

research could explore the impact of alternative forms of regulation introduced to improve diversity at board level.

Much more remains to be explored concerning the link between women on boards and disclosure on board gender diversity. Whilst this thesis explores the relationship between women on boards and disclosure using traditional regression analysis techniques, future research could explore this relationship using more advanced topic modelling methods. In particular, to propel scholarship in this area, future research could make use of structural topic modelling (STM), an unsupervised machine learning approach to extract topics from textual data (Roberts et al., 2019). Structural topic models take traditional topic modelling – presented in Chapter 4 of this thesis – one-step further by incorporating document metadata into the model building procedure. Future research could include metadata (such as CEO gender, board gender diversity, or the achievement of targets on gender diversity) and the inclusion of this additional data allows researchers to explore relationships between metadata and topics (see, Tonidandel et al., 2022). The incorporation of topic modelling techniques, such as LDA or STM, reflects an important area for future research on corporate disclosures on board gender diversity.

Also, drawing from literature in economics, it has been proposed that greater gender diversity could be achieved when appointment decisions are made simultaneously rather than sequentially (Bohnet, 2016). This is due to a phenomenon known as the diversification bias (Read & Loewenstein, 1995), which, put simply, argues that variety is more likely to emerge when people make multiple decisions simultaneously rather than sequentially. At present, it remains unexplored if the simultaneous (rather than sequential) appointment of directors

is associated with the increased likelihood of appointing women at board level. Future research could therefore explore if the diversification bias extends to the appointment of women to board level positions.

Finally, whilst this thesis explored the relationship between women on boards and board gender diversity disclosures, it remains unknown whether disclosure is related to the representation of women in lower levels of management within the firm. As this thesis has revealed, there is evidence to suggest that the introduction of regulation on board gender diversity has led to a disconnect between the board and senior management team. It could, therefore, be argued that disclosures on board gender diversity in a regulated environment – such as the UK – are not related to the representation of women in senior management. This would be aligned with the perspective that regulation on board gender diversity could lead the board to become decoupled from the representation of women within the firm (Terjesen et al., 2015). Future research could explore the link between board gender diversity disclosures and the representation of women within the firm.

5.6. Concluding remarks

This thesis investigates the effect of external regulation on board gender diversity. More specifically, in Chapter 2 evidence is found that suggests the introduction of soft law regulation in the UK weakened the trickle-down effect between women at board level and the representation of women in senior management. In general, this item of research adds to literature on women on boards by integrating trickle-down effect and regulation literatures. The findings have important policy implications, as regulators have explicitly assumed regulation on board gender diversity will strengthen the link between women on

boards and gender diversity in lower levels of management (e.g., Department for Business, Innovation & Skills, 2015). When compared against established literature on regulation, such as the work of Ahern and Dittmar (2012), the findings of Chapter 2 appear to confirm the assumption that regulation on board gender diversity can have unintended negative implications.

Secondly, this thesis – in Chapter 3 – provides novel empirical evidence on the relationship between women on boards and firm disclosure on board gender diversity. By applying an instrumental variable approach, it is documented that the presence of women on boards is positively related to disclosure on board gender diversity. Whilst prior literature has recognised the risks associated with mandatory disclosures on board gender diversity, namely associated with 'window-dressing' or 'decoupling' (Terjesen et al., 2015), this thesis shows a robust relationship between women's presence at board level and the likelihood of disclosure on board gender diversity.

Finally, this thesis contributes to the existing body of literature investigating the qualitative content of gender diversity disclosures (e.g., Point & Singh, 2003). This thesis – in Chapter 4 – presents a new tool to the field, that allows scholars to conduct automated topic modelling of gender diversity statements published in annual reports or company websites. Aside from helping scholars automatically analyse gender diversity disclosures, this thesis also acts as a foundation on which scholars can perform sophisticated analyses of gender diversity disclosures in the future.

6. Appendices

Figure A1.

The number of firms with women representing twenty-five percent of board level positions

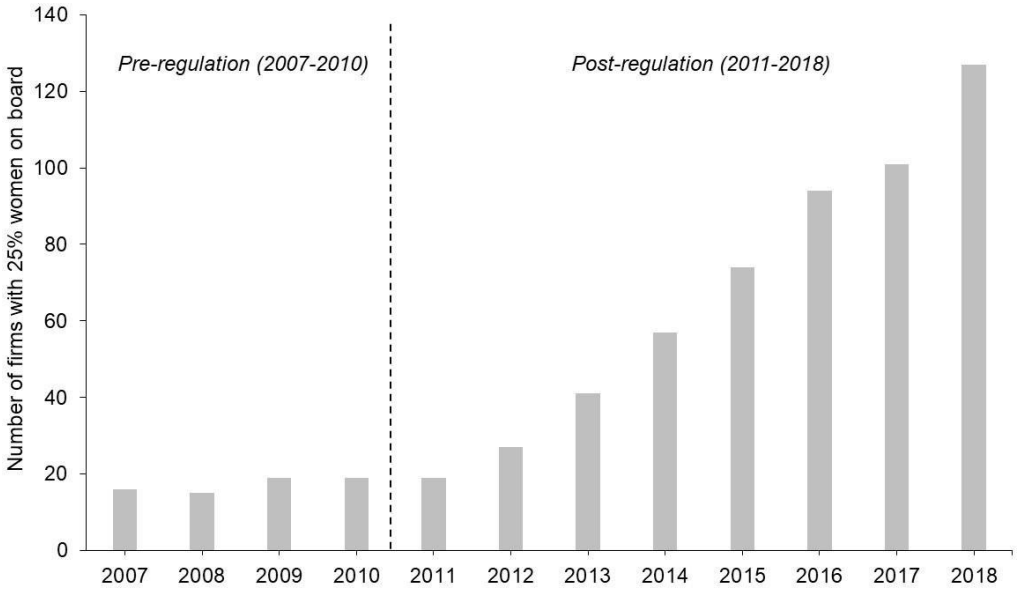


Table A1.
Examples of most frequent senior management roles.

Senior Management Role	Frequency of Occurrence (n)
Senior Vice President	66
Vice President	60
Executive Vice President	44
General Council	37
Group Director	35
Division Chief	29
Chief Information Director	26
Investor Relations Director	23
Regional Director	15
Chief Technology Director	14
Corporate Development Director	14
Chief Marketing Director	11
Division Executive	11
Marketing Officer	11

Note: This table presents examples of the most frequent senior manager roles retrieved from the BoardEx database. A total of 1359 unique senior manager roles were identified across all firms.

Table A2.
Descriptive statistics and correlations.

	Mean	SD	1	2	3	4	5	6	7
1. Women Snr. Mgmt.	20.234	16.610	–						
2. Women on Board	15.409	11.491	0.117**	–					
3. Regulation	0.666	0.471	0.086**	0.413**	–				
4. Board Size	9.912	2.914	0.136**	0.162**	0.008	–			
5. Senior Management Size	14.608	13.820	0.094**	0.280**	0.161**	0.530**	–		
6. Board Independence	0.700	0.147	-0.092*	-0.211**	0.191**	-0.203**	0.059**	–	
7. Firm Size	3.355	1.425	0.119**	0.131**	0.036*	0.512**	0.428**	-0.410**	–

Note: † p<0.1, * p<0.05, ** p<0.01.

Table A3.
OLS regressions with women in senior management (%) as the dependent variable by year.

	Pre-regulation (2007-2010)				*Post-regulation (2011-2018)*							
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Women on Board	0.373**	0.458**	0.372**	0.192	0.094	0.013	-0.090	-0.013	-0.052	0.056	-0.061	0.117
	(0.134)	(0.128)	(0.126)	(0.121)	(0.120)	(0.124)	(0.119)	(0.136)	(0.124)	(0.119)	(0.111)	(0.140)
Constant	14.907**	13.897**	15.085**	16.942**	18.187**	20.014**	21.914**	20.840**	22.249**	20.960**	24.270**	20.255**
	(1.739)	(1.574)	(1.648)	(1.788)	(1.885)	(2.321)	(2.453)	(2.850)	(2.809)	(2.897)	(2.958)	(3.850)
Observations	219	219	219	219	219	219	219	219	219	219	219	219
R-Squared	0.038	0.062	0.043	0.012	0.003	0.001	0.002	0.001	0.001	0.001	0.002	0.004
Adj. R-squared	0.034	0.058	0.038	0.007	-0.001	-0.004	-0.001	-0.004	-0.003	-0.003	-0.003	0.001

Note: This table presents OLS regressions on the representation of women in senior management for each year within our sample time-period. Robust standard errors are clustered by firm and reported in parentheses. † p<0.1, * p<0.05, ** p<0.01

Table A4.
Fixed effect Poisson regressions with the number of women in senior management as the dependent variable.

	Model 1	Model 2
Women on Board	0.113**	0.159**
	(0.035)	(0.031)
Regulation	0.393**	0.347**
	(0.088)	(0.057)
Regulation*Women on Board	-0.011	-0.106**
	(0.033)	(0.030)
Board Size		0.007
		(0.008)
Senior Management Size		0.023**
		(0.003)
Board Independence		0.457*
		(0.191)
Firm Size		-0.040
		(0.46)
Firm fixed effect	Yes	Yes
Number of firms	201	201
Observations	2412	2412
Wald test	145.010**	171.650**

Note: *n* = 201, 18 firms dropped because of all zero outcomes. This table presents Poisson regressions on the representation of women in senior management. Robust standard errors are reported in parentheses. † p<0.1, * p<0.05, ** p<0.01

Table A5.
Fixed effect regressions with women in senior management (%) as the dependent variable, controlling for revision of voluntary targets in 2016.

	Model 1	Model 2
Women on Board	0.225**	0.232**
	(0.087)	(0.087)
Regulation	3.560**	3.569**
	(1.302)	(1.534)
Regulation*Women on Board	-0.175*	-0.169*
	(0.081)	(0.081)
Board Size		0.243
		(0.219)
Senior Management Size		-0.029
		(0.219)
Board Independence		2,528
		(0.960)
Firm Size		-2.340*
		(0.960)
Post 2016 Dummy	2.008**	2.147**
	(0.751)	(0.753)
Constant	16.245**	20.123**
	(1.048)	(5.025)
Firm fixed effect	Yes	Yes
Number of firms	219	219
Observations	2628	2628
R-squared	0.036	0.042
Adj. R-squared	0.035	0.039

Note: This table presents OLS regressions on the representation of women in senior management. Robust standard errors are clustered by firm and reported in parentheses. † p<0.1, * p<0.05, ** p<0.01

Table A6.
Fixed effect regressions with women in senior management (%) as the dependent variable.

	Women in Senior Management
Women on Board	0.255**
	(0.085)
Regulation	3.342*
	(1.309)
Regulation*Women on Board	-0.149†
	(0.082)
Board Independence	2.831
	(4.522)
Firm Size	-2.078*
	(0.912)
Constant	20.940**
	(4.440)
Firm fixed effect	Yes
Number of firms	219
Observations	2628
R-squared	0.036
Adj. R-squared	0.034

Note: This table presents OLS regressions on the representation of women in senior management. Robust standard errors are clustered by firm and reported in parentheses. † p<0.1, * p<0.05, ** p<0.01

Table A7.
Descriptive statistics and correlations.

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1. Disclosure on Board Gender Diversity	0.866	0.340	–										
2. Women on Board (%)	16.617	10.545	0.100**	–									
3. Women on Board (Blau)	0.254	0.138	0.146**	0.972**	–								
4. CEO Duality	0.032	0.176	-0.069*	-0.120**	-0.130**	–							
5. CEO Nationality	0.634	0.488	0.047	-0.046	-0.018	-0.040	–						
6. CEO Gender	0.049	0.216	0.02	0.176**	0.164**	0.091*	0.073*	–					
7.Board Independence	0.71	0.14	0.003	0.152**	0.134**	-0.151**	-0.436**	-0.038	–				
8.Board Tenure	5.756	2.715	-0.124*	-0.179**	-0.186	0.350**	0.034	-0.008	-0.107**	–			
9. Tobin's Q	1.104	1.227	0.017	0.009	0.006	0.045	0.024	-0.016	-0.099**	0.083**	–		
10. Return on Assets	11.788	19.041	0.037	-0.016	-0.011	-0.001	0.072*	-0.012	-0.145**	0.061**	0.492**	–	
11. Return on Equity	19.537	62.268	-0.007	0.022	0.017	0.001	0.087**	-0.013	-0.091**	0.003**	0.156**	-0.016	–

Note: † p<0.1, * p<0.05, ** p<0.01.

Table A8.
Instrumental variable regressions with the count of women at board level as the dependent variable, and the disclosure on board gender diversity as the predictor variable.

	Model 8	
	1st stage Women on Board (%)	2nd stage Female References in Disclosure
Women on Board (count)		**0.124****
		(0.032)
Firm Size	0.350**	
	(0.031)	
CEO Duality	-0.171	-0.024
	(0.170)	(0.062)
CEO Nationality	0.016	0.054*
	(0.065)	(0.023)
CEO Gender	0.650**	-0.067
	(0.130)	(0.051)
Board Independence	0.053	0.061
	(0.223)	(0.085)
Board Tenure	-0.055**	-0.004
	(0.011)	(0.004)
Tobin's Q	-0.017	0.003
	(0.026)	(0.009)
Return on Assets	0.003*	0.001†
	(0.001)	(0.001)
Return on Equity	0.001*	-0.001
	(0.001)	(0.001)
Constant	-2.335**	0.684**
	(0.386)	(0.092)
Industry fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Number of firms	236	236
Observations	1180	1180
Adj. R-squared	0.250	
Wald test	$\chi^2 = 85.89$	
	Prob > $\chi^2 = 0.001$	

Note: This table presents instrumental effect regressions of board gender diversity disclosure and women on boards (count) and control variables. Robust standard errors are reported in parentheses. † p<0.1, * p<0.05, ** p<0.01

Table A9.
Instrumental variable regressions with critical mass and tokenism as the dependent variables, percentage of women executive directors (Women ED) and percentage of women non-executive directors (Women NED) are the predictor variables.

	Model 9		Model 10	
	1st stage Women on Board (%)	2nd stage Disclosure on Board Gender Diversity	1st stage Women on Board (Blau)	2nd stage Disclosure on Board Gender Diversity
Women ED		**0.034***		
		(0.013)		
Women NED				**0.027***
				(0.009)
Firm Size	1.281**		1.600**	
	(0.354)		(0.394)	
CEO Duality	-7.575**	0.211	-3.131	0.039
	(1.929)	(0.138)	(2.148)	(0.086)
CEO Nationality	-1.004	0.090*	0.564	0.040
	(0.735)	(0.039)	(0.819)	(0.030)
CEO Gender	49.702**	-1.676*	-8.294**	0.239†
	(1.470)	(0.661)	(1.638)	(0.100)
Board Independence	-12.463**	0.492*	-4.368	0.187
	(2.638)	(0.210)	(2.938)	(0.118)
Board Tenure	-0.105	-0.007	-0.749**	0.009
	(0.125)	(0.006)	(0.139)	(0.008)
Tobin's Q	0.825**	-0.026	0.064	-0.001
	(0.303)	(0.016)	(0.338)	(0.012)
Return on Assets	-0.002	0.001†	0.034	0.001
	(0.019)	(0.001)	(0.021)	(0.001)
Return on Equity	0.001	-0.001	0.010†	-0.001
	(0.005)	(0.001)	(0.005)	(0.001)
Constant	-2.224	0.469*	1.600**	0.303
	(4.376)	(0.187)	(0.394)	(0.209)
Industry fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Number of firms	236	236	236	236
Observations	1180	1180	1180	1180
Adj. R-squared	0.519		0.19	
Wald test	$\chi^2 = 39.14$ Prob > χ^2 = 0.013		$\chi^2 = 51.15$ Prob > χ^2 = 0.001	

Note: This table presents instrumental effect regressions of board gender diversity disclosure and percentage of women executive directors and percentage of women non-executive directors and control variables. Robust standard errors are reported in parentheses. † p<0.1, * p<0.05, ** p<0.01

Table A10.
OLS regressions with all-male board dummy variable as the dependent variable, and a board gender diversity disclosure as the predictor variable.

	Model 11	
	1st Stage All-Male Board	2nd Stage Disclosure on Board Gender Diversity
All-Male Board		**-0.683****
		(0.193)
Firm Size	-0.063**	
	(0.011)	
CEO Duality	0.116†	0.0336
	(0.060)	(0.071)
CEO Nationality	-0.057*	0.017
	(0.023)	(0.026)
CEO Gender	-0.189†	-0.098†
	(0.082)	(1.270)
Board Independence	-0.189*	-0.061
	(0.082)	(0.097)
Board Tenure	0.016**	0.001
	(0.003)	(0.005)
Tobin's Q	0.005	0.005
	(0.009)	(0.010)
Return on Assets	-0.001*	0.001
	(0.001)	(0.001)
Return on Equity	-0.002	-0.001
	(0.001)	(0.001)
Constant	0.063**	1.193**
	(0.011)	(0.138)
Industry Fixed effect	Yes	Yes
Year Fixed effect	Yes	Yes
Number of firms	236	236
Observations	1180	1180
Adj. R-squared	0.185	
Wald test	$\chi^2 = 74.53$	
	Prob > $\chi^2 = 0.001$	

Note: This table presents OLS regressions on the presence of an all-male board. Robust standard errors are reported in parentheses. † p<0.1, * p<0.05, ** p<0.01

Table A11.
OLS regressions with women on board (%) as the dependent variable, and a board gender diversity disclosure as the predictor variable.

	Model 12
Board Gender Diversity Disclosure	0.839
	(0.802)
CEO Duality	-3.102†
	(1.535)
CEO Nationality	-1.334*
	(0.105)
CEO Gender	7.927**
	(1.270)
Board Independence	5.930**
	(2.278)
Board Tenure	-0.672**
	(0.108)
Tobin's Q	0.115
	(0.258)
Return on Assets	0.016
	(0.016)
Return on Equity	0.006
	(0.004)
Constant	7.484**
	(2.357)
Industry Fixed effect	Yes
Year Fixed effect	Yes
Number of firms	236
Observations	1180
R-squared	0.231

Note: This table presents OLS regressions on the representation of women on boards. Robust standard errors are reported in parentheses. † p<0.1, * p<0.05, ** p<0.01

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