DOI: 10.1002/hrm.22066

ORIGINAL ARTICLE

WILEY

Does women's board representation affect non-managerial gender inequality?

Pallab Kumar Biswas[1] | Helen Roberts[1] | Kevin Stainback[2]

[1]Department of Accountancy and Finance, University of Otago, Dunedin, New Zealand

[2]Department of Sociology, Purdue University, West Lafayette, Indiana

Correspondence
Pallab Kumar Biswas, Department of Accountancy and Finance, University of Otago, PO Box 56, 9054 Dunedin, New Zealand.
Email: pallab.biswas@otago.ac.nz

Abstract

Research examining gender and corporate boards has explored how women's representation impacts firm strategy and policy, particularly around corporate social responsibility (CSR) issues related to communities and other relevant stakeholders, the environment, and diversity and equity initiatives. However, fewer studies have examined how women's representation on boards affects gender inequality in firms. The studies that have been conducted generally focus on gender board diversity and the appointment of women executives. Yet, prior research has not sufficiently examined women's board representation and gender equality below executive level. Does women's representation have broader effects on gender equity beyond top leadership? And if so, is there a critical mass effect? In this article, we examine the relationship between women's board representation and non-managerial gender segregation. Gender segregation is an ideal measure of gender equality given that it captures the evenness of the distribution of women and men across jobs within workplaces and its well-known relationship to gender disparities in earnings and other job rewards. Drawing on Australian organization data (2014–2019) we find that the contemporaneous relationship between women's board representation and gender segregation is nonsignificant, but becomes significant and increases in magnitude with 1, 2, and 3-year lags. Our critical mass analysis suggests that having one woman on a board may not be enough to promote change but rather two or more women directors, or holding 20% or more board seats, appears to be more effective in reducing gender segregation. These findings demonstrate that the appointment of more women to corporate boards has broader effects on workplace gender equity beyond top leadership teams.

KEYWORDS
female leaders, female senior managers, gender segregation board gender diversity

JEL CLASSIFICATION
G30; J31; J33

1 | INTRODUCTION

Women continue to be underrepresented on corporate boards in countries around the globe. Many governments, in an effort to promote gender equality, have implemented gender quotas for corporate boards, some unregulated, some compulsory. Norway passed the earliest legislation in 2003[1] and many countries followed suit.[2] As a result, women's board representation has increased in recent decades.

However, while corporate governance scholarship examining board gender diversity and organizational outcomes has expanded dramatically in recent decades, a recent review of the literature concludes that it "largely ignores the effect of board gender composition on gender equality within firms" (Kirsch, 2018, p. 347). This leads us to ask, does women's representation on boards affect gender inequality within organizations?

Gould, Kulik, and Sardeshmukh (2018a) provide one of the few studies specifically examining the effects of women directors on gender inequality—a process they call the trickle-down effect. In contrast to bottom-up approaches, which seek to identify the factors that promote women into senior leadership, this perspective emphasizes a top-down process—one in which women on boards promote gender representation below board level. Specifically, Gould and colleagues argue that women's representation at a senior level will affect women's representation at the level immediately below and will eventually "trickle-down" organizational structures. Several studies support this assertion showing that women's board representation is associated with women's appointment to CEO and executive positions (e.g., Cook & Glass, 2014, 2015; Gould et al., 2018a).

Following Kirsch's (2018) call for more research on board composition and gender inequality within organizations, we extend the literature to examine whether women's board representation has a broader impact on not just increasing women's representation among CEO and executives, as suggested by the trickle-down perspective, but whether women's board representation affects gender inequality at lower levels of organizations as well. Although ingroup preference may impact some increase in women's representation among executive positions (women helping women), there are additional factors that may shape the relationship between women's board representation and gender inequality beyond the corporate suite. Boards are explicitly involved in strategic decision-making in firms and establishing policy and practice (Finkelstein, Hambrick, & Cannella, 2009; Westphal & Zajac, 1995), particularly around corporate social responsibility (CSR) issues (Hung, 2011). Prior research demonstrates that women's representation on boards is associated with greater CSR engagement on environmental, community, and diversity and equity initiatives (e.g., Dobbin, Kim, & Kalev, 2011; Glass & Cook, 2016, 2018; Glass, Cook, & Ingersoll, 2016; Post, Rahman, & McQuillen, 2015). Hence, women's board representation is likely to have an impact, not only on increasing *women's representation* at higher levels where they have been underrepresented, but also by addressing *gender inequality* (e.g., segregation, wages, hiring) within organizations through equity and diversity policy and practice.

We extend the research on the relationship between women's board representation and gender inequality using Australian workplace panel data (2014–2019) and by examining non-managerial gender segregation as a key gender inequality outcome. Segregation is a global indicator of gender inequality in firms and has been shown to be the primary source of the gender wage gap (Petersen & Morgan, 1995) and limited opportunities for women's career advancement (Maume Jr, 1999). Past research interested in explaining women's representation in executive and managerial positions often use representation measures as their outcomes (e.g., percent women directors, percent women managers). Such a measure is appropriate when researchers are interested in determining whether women are making gains in a hierarchical sense, such as access to managerial or executive positions from which they have historically lacked access. However, in this article, we are interested in whether women's representation on boards has an impact on gender equality among non-managerial workers. The non-managerial positions we examine are not clearly ranked hierarchically. Historically, some have been dominated by women and others by men. A measure of gender segregation provides a more general measure of the gender distribution of all non-managerial workers across multiple occupational locations in an organization simultaneously. Importantly, we measure segregation with the index of dissimilarity (Duncan & Duncan, 1955), which captures the distribution of women and men across occupations net of their raw numeric representation in a given organization. If women's board representation significantly reduces gender segregation, it would provide further evidence for the importance of women on boards for not only improving women's representation among top positions but also reducing gender inequality throughout organizations.

Australia provides a particularly interesting case due to its "soft" law, which established that women comprise at least 30% of public firms' corporate boards. Some research has suggested that laws without regulation are unlikely to be effective in bringing about equal opportunity (Edelman, 2016). Australia, however, has been able to increase gender diversity on corporate boards without legal quotas. Australia provides an interesting contrast against the findings in Norway (Bertrand, Black, Jensen, & Lleras-Muney, 2014). Firms were able to achieve a critical mass of representation in both contexts, but the conditions under which representation came about were very different; voluntary goals of 30% representation in Australia and a 40% requirement in Norway.[3]

Our research contributes to an expanding body of research examining women's board representation and gender equality in organizations. We find that women's board representation has a small negative relationship with gender segregation. In addition, we report that a critical mass of women on boards is needed for effective change. Specifically, we find that women's board representation needs to reach about two positions, or 20%, to be effective. The remainder of this article is organized as follows. Section 2 examines the existing literature, theoretical expectations, and hypotheses. Section 3 describes our sample selection, variable construction, and methodology. The empirical results are presented in Section 4. Section 5 presents the theoretical and practical implications of our findings as well as limitations and areas for future research. Section 6 summarizes the results and concludes.

2 | PRIOR RESEARCH AND THEORETICAL EXPECTATIONS

2.1 | Women directors and gender inequality

Gould et al. (2018a); Gould, Kulik, and Sardeshmukh (2018b) conceptualize the "trickle-down" effect as the process by which women in

senior leadership positions influence gender equality below. They suggest that "appointing women at a senior level may be the lever needed to increase female appointments at the level of management immediately below, which in turn will improve gender diversity throughout the organization" (Gould et al., 2018a, p. 932). Trickle-down is an apt description; the ability for women in corporate governance to affect gender equality in organizations, especially at lower levels, should not be immediate. It will take time, particularly since the theorized effect is a slow, gradual effect working down the organizational hierarchy. Therefore, gender quotas on boards in the Australian context are likely to have unanticipated, yet beneficial, effects for women below board level. Beyond women's representation having beneficial effects on levels immediately below board level as theorized by the trick-down perspective, this article examines the potential broader impacts of women's board representation on gender equality throughout organizations, specifically focusing on non-managerial gender segregation.

Although we cannot observe the specific mechanisms linking women's board representation and workplace gender segregation in our analysis, there are several reasons why increasing women's representation on boards may directly and indirectly reduce workplace gender segregation: (a) women directors are more likely to advocate for gender diversity broadly, both directly and indirectly, particularly advancing opportunities for women in top management, (b) women directors are more likely to propose and implement diversity and equal opportunity policies broadly promoting gender equity, not simply advancing women, and (c) women directors presence is likely to change the organizational culture regarding women's opportunities and abilities. We discuss each of these potential mechanisms in turn.

First, to directly affect change, women in leadership positions must have the desire and ability to work in the interests of and advocate for women (Cohen & Huffman, 2007; Gould et al., 2018a; Huffman, 2013; Stainback, 2017). Konrad, Kramer, and Erkut (2008) found that practically all of the women directors they interviewed reported advocating for women, directly or indirectly, in their organizations (e.g., mentoring, speaking to women's groups, "asking for diversity reports", producing diversity content). Many women they interviewed reported that they felt a "responsibility" to do this work. A recent study of interviews with German directors found similar results. "Many female supervisory board members were intent on sensitizing the supervisory board to the issue of equality, on initiating debates, and on putting gender equality issues on the agenda and pushing them forward" (Kirsch & Wrohlich, 2020, p. 46). These studies indicate that women directly advocate for women's representation in executive positions,[4] but they also advocate for women further down the organizational hierarchy by not only advocating for women, but also communicating the broader desire for greater *gender equality*.

A second way that women directors may affect women's opportunities below board level, which may affect gender segregation, comes in the form of equity policy adoption. Research has shown that women leaders tend to take a stronger position on social, environmental, and human resource issues than men (e.g., Glass et al., 2016; Glass & Cook, 2018; Kirsch, 2018; Konrad et al., 2008; Post et al., 2015). With regards to specific policies, prior research shows that women leaders are more likely to adopt and implement diversity and family-friendly policies (Dobbin et al., 2011; Glass & Cook, 2016, 2018; Ingram & Simons, 1995). Other research finds a positive mutually reconstitutive relationship between board diversity, defined more generally, and the adoption of diversity practices (Srikant, Pichler, & Shafiq, 2020). Gender equity policies are not merely about increasing women's representation, although they sometimes are, they are also about ensuing equity and fairness in the allocation of jobs and compensation. Such policies are likely to reduce the causal influence of gender in shaping the allocation of workers to jobs and therefore work against gender segregation.

Finally, having women visible in the organizational power structure may reduce the causal effects of gendered stereotypes throughout the organization (Konrad et al., 2008). For example, Ely (1995) found that women's representation among top leadership had significant effects on professional women's perceptions of opportunities as well as how women were evaluated within organizations; "with no or few women in positions of power, sex may persist as a salient category with negative consequences for women lower down in the organization" (Ely, 1995, p. 590). Hence, having women at the top of organizational power structure may benefit women workers in terms of self-assessed opportunities as well as how their performance is evaluated and rewarded. In effect, having more women on boards may change the culture and affect gender equality indirectly.

Tate and Yang (2015), for example, find that women earn 5% less than comparable men after experiencing job displacement, however, the gender wage gap is half as large in firms with women in top management. Interestingly, in large multi-divisional firms, where presumably women in top management would be too organizationally distant to directly affect hiring and wage setting at lower levels, women's representation in top management exerted a significant effect irrespective of the gender of the hiring manager. They reason that this is because of "changes in culture as a mechanism instead of differences in the local interactions between female employees and female leaders, including initial wage negotiations" (Tate & Yang, 2015, p. 79). This study highlights how visible representation of women in leadership may also affect personnel decisions regarding hiring, assigning jobs, and promotions—irrespective of the gender of the decisionmaker. Although Tate and Yang (2015) focus on a different indicator of gender equality (wages), we suspect a similar effect for gender segregation.

Although research on women's board representation and gender inequality is limited (Kirsch, 2018), most prior studies have examined how women's board representation affects women's representation at the executive level. Few studies have examined how women's board presence influences gender equality at lower organizational levels. We know of only one study that suggests that women's representation at the board level may influence gender segregation at lower levels. Stainback, Kleiner, and Skaggs (2016) utilize a multi-level sample of nearly 6,000 U.S. organizations (specific workplace locations) nested in 89 Fortune 1,000 firms. They found that women's board representation was associated with less gender segregation

throughout firms. This finding is consistent with Tate and Yang's (2015) finding, which suggests that the influence of women board members may extend beyond more proximate organizational contexts. However, the Stainback et al. (2016) study is limited due to its reliance on cross-sectional data. We expect that women's representation on boards will lead to a slow and gradual process of change over time. This "gradual process of change" refers to the idea that women board members should not lead to an instantaneous change in workplace gender segregation. There is a lag expectation because of the necessary labor turnover, hiring, and promotion of individuals to change segregation.

Hypothesis 1. *The percentage of women on corporate boards is negatively associated with gender segregation.*

Hypothesis 2. *The relationship between the percentage of women on corporate boards and gender segregation should strengthen with lags.*

2.2 | Numbers and representation: Is there a critical mass effect?

Kanter's (1977a) classic study, *Men and Women of the Corporation*, highlighted the difficulties women face when integrating into male-dominated jobs, particularly in the upper echelons of organizations. Because men occupied the vast majority of managerial positions, ingroup preferencing, in terms of perceived similarity, liking (Byrne, 1971), and association (Blau, 1977; Kanter, 1977a, 1977b), tended to reproduce male-dominated managerial structures. She noted that when women gain token access to managerial jobs, their representation generates a unique set of problems (visibility, polarization, and role entrapment), as well as typical token responses. She provided evidence that these responses tend to reproduce rather than challenge the status quo.

Kanter (1977a, 1977b) found that because of women's high token visibility, every action was subject to scrutiny by co-workers. Women were expected to represent all women and were informed that their performance would affect opportunities for other women in the future. A common token response to hyper-visibility was to seek social invisibility (e.g., not speaking up in meetings, work from home, avoid social events). Kanter (1977b, p. 908) also noted that women would seek to avoid the negative effects of "exaggerated" gender differences by either becoming isolated or "they can try to become insiders, proving their loyalty by defining themselves as exceptions and turning against their own social category." Some have identified this latter idea as the "queen bee syndrome" (Staines, Tavris, & Jayaratne, 1974), suggesting that women cannot work with other women; however, Kanter (1977a, 1977b) suggests that this is not related to gender essentialism, but rather it is the structural manifestation of tokenism.

Kanter's (1977a, 1977b) theory of tokens posits that women in top management will only affect gender equality in lower levels of organizations if they gain a critical mass of managerial positions; allowing them to overcome tokenization and act to advance gender equity. She suggested that having two women, or as much as 20% representation, may not be enough to overcome tokenism. Konrad et al. (2008), drawing on this work, suggest that women may need three or more board positions to be effective. In a similar vein, Kristie (2011, p. 22) notes that "one woman on the board is a token, two is a presence, and three is a voice." A single woman board member will have difficulty advocating for women since they are subjected to token pressures. Konrad et al. (2008) note that things generally improve with two women on the board. However, women may still face some obstacles in advocating for gender diversity and equity (e.g., the two women may seek to avoid being seen as "co-conspirators"). Finally, they suggest that three or more women is a critical mass that eliminates many of the token pressures (e.g., women are routinely in discussions and are a part of daily interactions). Konrad et al. (2008) in-depth interviews with women board members confirm these assumptions. The existing literature is generally consistent with the notion that relative numbers do matter when examining the effect of board gender diversity on different firm-level outcomes, such as performance (Joecks, Pull, & Vetter, 2013; Liu, Wei, & Xie, 2014; Torchia, Calabrò, & Huse, 2011), CSR disclosure (Ben-Amar, Chang, & McIlkenny, 2017; Jia & Zhang, 2013), environmental performance (Liu, 2018; Post, Rahman, & Rubow, 2011), earnings quality (Srinidhi, Gul, & Tsui, 2011; Strydom, Au Yong, & Rankin, 2017) and informativeness of stock price (Gul, Srinidhi, & Ng, 2011).[5] However, there is no consensus as to what constitutes a critical mass in relative and absolute terms, although 30% is often used as the magic number (Dahlerup, 1988).

Increasing women's access to board positions will likely reduce tokenization for women directors and increase their ability to create organizational change that may promote gender equality. Therefore, board gender quotas not only encourage firms to provide more gender equality, but also provide the opportunity for a critical mass of women to avoid the performance pressures, isolation, and controlling stereotypes that emerge from token experiences. This discussion suggests that women's board representation may need to reach a critical mass before influencing gender equality in organizations. In the analyses that follow, we examine for critical mass using three nonlinear conceptualizations of women's representation. Drawing on the prior research, we expect the following.

Hypothesis 3. *The association between the percentage of women on corporate boards and gender segregation is nonlinear. Women's board representation needs to reach a critical mass of 2–3 positions (or 20% or more) before they can meaningfully impact gender segregation.*

2.3 | Other organizational factors influencing gender segregation

Although our focus is on women directors, women in other leadership positions are also likely to affect gender segregation in organizations.

Despite the dearth of studies using board-level data, there is a sizable literature examining the effect of women in managerial positions, broadly defined (e.g., workplace managers, supervisors), on gender segregation (for reviews see Huffman, 2013; Stainback, 2017). In an early study, Baron, Mittman, and Newman (1991) examined a sample of public-sector California state agencies and found that women's managerial representation reduced gender segregation over time. Huffman, Cohen, and Pearlman (2010) find that women's managerial representation is associated with declining gender segregation in the U.S. private sector from 1975 to 2005. Research on the gender composition of university administration and gender segregation provides similar results in the education sector (Kulis, 1997; Pfeffer, Davis-Blake, & Julius, 1995). We account for women in CEO and managerial positions in our analyses to conservatively isolate the relationship between women's representation on corporate boards on gender segregation.

A second important factor in explaining gender segregation is the role of industry. Industries are one of the key institutional environments in which organizations exist (DiMaggio & Powell, 1983). Organizations, like people, are other regarding. They look to their industrial environments as sources of information to reduce uncertainty. As such organizations develop routines, practices, and operating procedures similar to organizations within their industries. DiMaggio and Powell (1983) describe this homogeneity in industries as institutional isomorphism. Tomaskovic-Devey et al. (2006) found that about one-third of the observed reduction in gender segregation in the U.S. between 1966 and 2000 could be attributed to the growth of industrial sectors with less segregation, such as the service sectors, compared to those with high segregation, such as mining. McTague, Stainback, and Tomaskovic-Devey (2009) examined post-Civil Rights Act changes on U.S. firms and found that gender segregation levels become more similar within industries over time, suggesting isomorphism. Hence, a large portion of gender segregation is linked to the industrial context in which firms are embedded. We account for this source of variation in our estimation.

3 | METHOD

3.1 | Data

We utilize the Australian Workplace Gender Equality Agency (WGEA) public data from 2014 to 2019 to examine the relationship between women's board representation and non-managerial gender segregation. The 2012 WGEA requires all nonpublic sector employers with at least 100 employees to submit an annual report to the WGEA between 1 April and 31 May each year for the preceding 12-month period (1 April–31 March each year). Entities that are part of a corporate structure can either submit a standalone report or a combined report while other entities need to submit a standalone report.[6] Because the organizations in a combined report can change from year to year and an organization can change the reporting format from standalone to combined from 1 year to the next and vice-versa, we focus on the standalone reports.

The data contain employment counts of gender across five manager and eight non-manager occupation categories.[7] We started with 27,827 standalone and combined reports from 2014 to 2019. Our final sample consists of 17,344 standalone reports (4,389 unique employers) after excluding the combined reports and missing information on board-level variables. The industry and yearly distribution of the analytic sample is presented in Table 1.

Table 1 shows that yearly observations range between 1,981 and 3,227. Health care and social assistance industry have the most organization observations (17.08), followed by education and training (15.24), and manufacturing (11.99).

3.2 | Measurement of variables

3.2.1 | Dependent variable

Gender segregation

Non-managerial gender segregation is measured with the index of dissimilarity (Duncan & Duncan, 1955). This is the most commonly used segregation index in the workplace segregation literature (e.g., Huffman et al., 2010; Stainback & Tomaskovic-Devey, 2012). The measure is desirable in that it is able to differentiate the percentage of men and women in the workplace from how likely they are to work in the same occupations (jobs) in the same workplace. In other words, it measures the evenness of the distribution of men and women across a defined set of positions (McTague et al., 2009).

The index (D) is calculated as follows:

$$\left(\frac{1}{2}\sum_{i=1\ to\ 8}\left|\frac{m_i}{M}-\frac{w_i}{W}\right|\right)\times 100$$

where mi and wi are the number of men and women in the ith non-managerial occupation-workplace category and M and W represent the total non-managerial men and women in the workplace, respectively. The eight occupational gender distributions are summed within each workplace. The index takes values from 0 (complete integration) to 100 (total segregation). The index can be interpreted as the percentage of women or men that would have to change occupations to create a gender-integrated workforce (McTague et al., 2009).

3.2.2 | Key theoretical variable

Women's representation on corporate boards

We include a measure of the percentage of board positions held by women. Because the women's board representation on gender segregation effect should take time, we also estimate models with 1-, 2-, and 3-year lags.

In subsequent analyses, we test for a critical mass effect by using three nonlinear transformations of board gender representation. First, we estimate models with a quadratic term. Second, we estimate

TABLE 1 Sample distribution

ANZSIC divisions	2014		2015		2016		2017		2018		2019		Total	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Accommodation and food services	90	5	169	6	201	7	178	6	176	6	194	6	1,008	6
Administrative and support services	83	4	148	5	160	5	157	5	160	5	170	5	878	5
Agriculture, forestry and fishing	12	1	22	1	23	1	23	1	25	1	23	1	128	1
Arts and recreation services	61	3	67	2	74	2	71	2	76	2	75	2	424	2
Construction	50	3	89	3	96	3	102	3	103	3	105	3	545	3
Education and training	380	19	439	15	445	15	458	15	453	15	469	15	2,644	15
Electricity, gas, water and waste services	18	1	25	1	27	1	25	1	26	1	28	1	149	1
Financial and insurance services	96	5	116	4	117	4	127	4	150	5	144	4	750	4
Health care and social assistance	393	20	481	17	527	17	524	17	509	16	529	16	2,963	17
Information media and telecommunications	35	2	63	2	75	2	80	3	80	3	89	3	422	2
Manufacturing	233	12	384	13	377	12	381	12	347	11	357	11	2,079	12
Mining	29	1	59	2	54	2	54	2	56	2	59	2	311	2
Other services	73	4	102	4	102	3	104	3	103	3	105	3	589	3
Professional, scientific, and technical services	159	8	244	8	259	9	293	9	297	10	336	10	1,588	9
Public administration and safety	5	0	9	0	14	0	10	0	13	0	19	1	70	0
Rental, hiring and real estate services	23	1	39	1	43	1	48	2	50	2	50	2	253	1
Retail trade	104	5	203	7	200	7	200	6	208	7	206	6	1,121	6
Transport, postal and warehousing	56	3	97	3	98	3	95	3	102	3	100	3	548	3
Wholesale trade	81	4	142	5	154	5	160	5	168	5	169	5	874	5
Total	1,981	100	2,898	100	3,046	100	3,090	100	3,102	100	3,227	100	17,344	100

numeric models where we create a set of indicator variables for one woman on board, two women on board, and three or more women on board. No women on board serves as the reference. Finally, we examine compositional thresholds drawing roughly on Kanter's (1977a) work.[8] We include indicator variables for women's representation on boards such as >0–20 (token female), >20–40 (tilted-male), >40–60 (gender balanced), >60–80 (tilted-female), and >80 (female dominant). The reference category is no women directors.

3.2.3 | Control variables

Women's CEO and managerial representation

Women's managerial representation is calculated at different levels of the organizational hierarchy from CEO to lower-level managers. Although most organizations report having one CEO, some organizations report having more than one. We created two indicator variables for women's CEO representation, the first is for organizations with a sole CEO who is a woman (Sole Woman CEO), the second is for organizations with more than one CEO and at least one woman CEO, which we label gender-mixed CEO. Sole men CEOs and organizations with multiple CEOs who are all men serve as the reference category.

As mentioned previously, employers provide information on five standardized managerial categories: CEO, Key Management Personnel (KMP), other executives/general managers, senior managers, and other managers. Using these categories, we calculated two variables: the fraction of top-ranking managers where top-ranking managers include KMP, general managers, and senior managers, and the percentage of low-ranking managers where we define low-ranking managers as other managers. We estimate both linear percent and the quadratic function of high and low managers in our models based on the nonlinear relationships between workplace women managers and gender segregation identified in prior research (e.g., Huffman et al., 2010; Stainback et al., 2016; Stainback & Kwon, 2012).

Time

We include a linear time measure to capture the overall residual time trend in gender segregation. The time trend accounts for the normative time trend in gender segregation.

Occupational heterogeneity index

Measurement error in gender segregation will vary across organizations depending on how well the eight WGEA occupational categories match clusters of jobs within each workplace. The occupational distinctions will account for occupational segregation, but will underestimate within occupation gender segregation (e.g., job-level distinctions within occupations). Organizations in which workers are dispersed evenly across all eight non-managerial categories will tend to have higher observed segregation, while organizations with employment in one or only a few categories will tend to have lower measured segregation (see Huffman et al., 2010; Stainback & Tomaskovic-Devey, 2012), we account for this source of measurement error by controlling for occupational heterogeneity. The heterogeneity index is calculated as:

$$1 - \sum_{\text{i=1 to 8}}^{N} p_{\text{i}}^2$$

where p_i is the proportion of total employment in each of the eight non-managerial occupations. An organization with workers in a single occupation will have an index value of 0, while an organization where employment is evenly distributed across the eight occupational categories will have a value of 87.5.

Total employment

Research suggests that smaller organizations are likely to have higher segregation than larger ones for a variety of reasons. Researchers often refer to the fact that larger organizations, compared to smaller ones, are more likely to have formal human resource functions and to have implemented equal opportunity "best practices" (e.g., Kalev, Dobbin, & Kelly, 2006). It is also likely that smaller organizations are more susceptible to random segregation processes. We control for the natural logarithm of total employment.

Number of board of director positions

We account for the total number of board positions to account for any year-to-year fluctuations in women's percent of board positions that may be affected by changes in the total number of positions, especially on small boards. Due to the skewed distribution, we use the natural logarithm of board positions in our statistical models. All variable definitions are provided in Table 2.

TABLE 2 Variable definition

Variable	Definition
Gender segregation	Index of dissimilarity (D) $= \left(\frac{1}{2}\sum_{i=1\text{ to }8}\left\|\frac{m_i}{M}-\frac{w_i}{W}\right\|\right)\times 100$, where $\frac{m_i}{M}$ and $\frac{w_i}{W}$ are the proportion of men and women in each of the eight non-managerial occupation categories.
Board gender diversity	(Number of women directors ÷ Board size) × 100
Women low managers	(Number of women in *other manager* category ÷ Number of *other managers*) × 100
Women top managers	(Number of women top managers ÷ Number of top managers) × 100
Index of heterogeneity	$\left(1-\sum_{i=1}^{8}p_i^2\right)\times 100$, where p_i is the proportion of total employment in each of the eight non-managerial occupations squared and summed
Board size	Natural log of board size
Single woman CEO	Dummy variable that takes the value of 1 if a woman is the sole CEO in the firm and 0 otherwise
Mixed women CEO	Dummy variable that takes the value of 1 if both men and women occupy CEO positions in the firm, and 0 otherwise
Natural log of firm size	Natural log of number of employees in the firm
Board gender diversity target	Dummy variable that takes the value of 1 if the firm has either a gender balance board or set a target to increase female representation on the governing body, and 0 otherwise.

3.3 | Analytic technique

3.3.1 | Statistical models

We utilize random intercept models to estimate our data. These mixed effect models are well equipped to address the research questions at hand as they are ideal for analyzing panel data and allow us to model and observe variation associated with industry clustering in our data (annual firm observations, within firms, within industries). We considered fixed effects models; however, they are inappropriate for our data. Fixed effects are limited in their ability to estimate data with a small number of panels and in data where there is a limited amount of change (see Hill, Davis, Roos, & French, 2020 for review). Fixed effects coefficients are downwardly biased when there are few waves of data and statistical power is limited when change is small (Allison, 2009; Hill et al., 2020; Treiman, 2009). We have a relatively short time frame of just six waves of data (fewer with lags) across 5 years and a small amount of change in our variables. Segregation for the overall sample declines by less than 1% per year in our data. It takes time for women to be appointed and for changes in employment to occur. Change in gender segregation is relatively slow. Moreover, in 2019, our data indicate that 31.8% of firms still have no women on their boards.[9] Given the characteristics of the data at hand, and our interest in estimating industry variation, random intercept models are more appropriate. The basic random intercept model is given by Equation (1):

$$D_{tij} = \beta_{000} + \beta_1 \text{ Percent Female Directors}_{tij} + \sum_{k=2}^{11} \beta_{ktij} + v_{00j} + v_{0ij} + e_{tij} \quad (1)$$

where D_{tij} is the index of dissimilarity (segregation index) at time t, for organization i, in industry j. β_{000} is the grand mean, β_1 is our focal variable to be estimated, percent female directors, and $\sum_{k=2}^{11} \beta_{ktij}$ refer to additional time varying covariates to be estimated, such as our measures of women's representation among leadership positions, time, occupational heterogeneity index, total employment, and number of board positions. The model contains a random intercept for industry and organization. The variance is partitioned into three parts—two variance parameters and a residual. First, v_{00j} represents the deviation of industry-level segregation from the grand mean. The model estimates industry-specific segregation intercepts and then estimates the variation in segregation intercepts relative to the grand mean (between industry variation). The second variance parameter, v_{0ij} is the deviation of organizations from their industry-predicted segregation level (between organization variation). Finally, e_{tij} is the time specific deviation from an organization's predicted value (within organization residual).

3.3.2 | Estimation strategy

Our analysis takes place in four parts. First, we begin by providing descriptive statistics for our analytic sample, which provides information about change in our key variables as well as industrial variation. Second, we estimate a set of nested random intercept models. These models use a 1-year lag and allow us to observe a baseline estimate of a time trend and variation associated with industry and organization levels. We then add percent women directors followed by controls in subsequent models. These models allow us to examine Hypothesis 1.

Third, because the relationship between women's board representation and gender segregation is theorized to take time, we estimate additional models with different time lags to examine Hypothesis 2. We estimate models with no lag, 1-year, 2-year, and 3-year lags to see if there appears to be further evidence of a lagged effect. A strengthening relationship between women on boards with lags would provide support for the hypothesis.

Fourth, we examine a series of models with different nonlinear approaches to test for a critical mass effect (Hypothesis 3). We provide an abridged table summarizing the results from 12 models—three different nonlinear transformations (quadratic, numeric, and thresholds) by four lag periods (0–3 years).

Finally, the literature on board gender diversity has noted the endogeneity issues in all research seeking to examine board gender diversity and organizational outcomes (Adams, Hermalin, & Weisbach, 2010; Kirsch, 2018). We seek to contribute to the board gender diversity and equality literature while being aware of the inherent difficulties of the task. We provide some additional analysis and robustness checks to speak to endogeneity.

4 | RESULTS

4.1 | Sample descriptive statistics

The descriptive statistics for the WGEA sample are reported in Table 3. The sample consists of 17,322 firm-year observations for the period 2014–2019. The statistics reported in Table 3 show that nonmanagerial gender segregation has a mean of 32.3 and varies between 13.77 and 45.90 across the 25th to the 75th percentiles. Women's average director representation is 23.9 and ranges from firms with no women board members to 38.46 women board members at the 75th percentile. The average percentage of women top managers for the entire sample is 37.2 with a range from 16.7 to 54.7 from the 25th to the 75th percentiles. All other women managers have the highest mean with 39.1 and range from 10 to 63.49 between the 25th and 75th percentiles. Sole CEO women are 17 of the sample.

Table 4 reports the mean yearly distributions for the period of the study for the variables used in our statistical estimates. The results show that change across variables is small over the 5-year span across six waves of data.

We also present two ways of looking at the managerial variables, the non-managerial variables, and the constitutive parts of the segregation index in the bottom portions of the table. First, we provide the distribution of *all managerial women* (totaling 100% of women managers within each workplace) and do the same for men. We also do this for all *non-managerial* positions separately for women and men as well (this includes occupations from professional to other). For instance, under the female % across occupations, the first five are managerial occupations and total 100% (CEO to Other managers). This is this distribution of all managerial women across managerial positions. Of women in managerial jobs in 2014, in the average workplace, nearly half (48.96%) are in "other managerial" positions and only 2% of women in managerial positions are CEOs. Among men in managerial positions, their distribution is somewhat different, with fewer in "other managerial" positions and more in the top three managerial occupations relative to women's distributions.

For the managerial distinctions, there does not appear to be much resorting over time, at least in the aggregate, of women across these positions. Among non-managerial positions, the categories that contribute to our gender segregation variable, there is some resorting in the aggregate. Over time women are less likely to be in clerical and administrative and "other non-managerial occupations" and more likely to be in professional, sales, and laborer positions.

Second, we report women's share of these (a) managerial positions and (b) non-managerial positions. This is a relative measure, in that men's share is simply the inverse of women's percentage. Hence, we simply report women's percentage in occupations. For example, in 2014, women's share of clerical and administrative occupations in the average workplace was 82.2% (men about 17.8%). This measure demonstrates where, *in the aggregate*, women's representation is increasing and declining. This indicates representation relative to men in the aggregate for the average workplace. Women's gains, by definition, mean men's losses and vice versa. Women's share has fallen in

TABLE 3 Descriptive statistics for all years

Variable	*N*	Mean	*SD*	P25	P50	P75
Gender segregation	17,322	32.315	23.725	13.770	27.173	45.902
Board gender diversity	17,322	23.904	21.879	0.000	22.222	38.462
Women top managers	17,322	37.214	25.623	16.667	33.333	54.717
Women low managers	17,322	39.144	31.095	10.000	37.500	63.492
Single woman CEO	17,322	0.171	0.377			
Mixed women CEO	17,322	0.017	0.131			
Index of heterogeneity	17,322	46.513	21.399	31.515	50.669	63.740
Natural log of firm size	17,322	5.640	1.010	4.984	5.460	6.125
Number of board members	17,322	7.098	5.170	4.000	7.000	9.000
Natural log of board size	17,322	1.766	0.664	1.386	1.946	2.197
Board gender diversity target	17,322	0.158	0.365			

Note: P25, P50, and P75 refer to the 25th, 50th, and 75th percentiles in the data.

community and personal services, clerical and administrative, and "other occupations" and slight gains in laborer positions. We should, however, be cautious about this aggregate data. The statistical estimates in our models are preferred since we can control for important factors and estimate within workplace relationships.

Time series of the segregation and women's representation in leadership positions is shown in Figure 1. The figure provides a visual depiction of the modest increase in the percentage of women directors and women CEOs and the percentage of women in high and low managerial positions together with a decline in gender segregation. For illustrative purposes, we provide the segregation trend estimate adjusted to approximate a more realistic level of actual workplace segregation.[10] Once accounting for measurement error associated with the WGEA occupational categories, the estimated segregation level is about 20 points higher and more consistent with workplace level estimates of gender segregation (e.g., Stainback & Tomaskovic-Devey, 2012; Tomaskovic-Devey et al., 2006). This adjusted segregation estimate suggests that by 2019, in the average workplace, approximately half of women (or men) would need to change jobs to create a gender-balanced workforce in Australia.

We provide descriptive trends in gender segregation by industry in Figure 2. As should be expected, these trends show remarkable between industry variation in gender segregation and provide further evidence for our use of random intercept models.

Table 5 presents the correlation coefficients for all variables used in our analysis. The correlation between the index of dissimilarity and each of the independent variables is statistically significant at the 0.1 level.

4.2 | Is there a relationship between women's board representation and gender segregation?

We estimate the effect of percent women on boards on non-managerial gender segregation in Table 6. The mixed-effect models include a random intercept for industry and organization where yearly observations are nested in firms, which are nested in industries. All time-varying covariates in the model are lagged 1-year, with the exception of occupational heterogeneity.

Model 1 provides a baseline for our variance parameters and only includes time in the model. The variance statistics are reported as the estimated variance between unit (industry, organization) standard deviations and are therefore in units of the dependent variable: non-managerial segregation.

The variance components are the unexplained components associated with each cluster. If covariates added to the model reduce these components, it simply means that those factors are explaining some of the variation that exists at the level of industries and/or organizations. Hence, we will be able to see the extent to which differences in the represented levels of women in leadership positions explain variation at the industry and organization levels.

While the variance parameters indicate the average differences between units, the intraclass correlations (ICC) describe how similar observations are within clusters. The model shows that industry and firm, as clusters, account for a significant amount of variation in non-managerial segregation. The ICC indicates that firms within the same industry are moderately similar to one another with a value of 0.337. A value of 1 would indicate that firms within industries are identical. The ICC for organization is very high at 0.917, as is expected. This means that within organization observations are highly correlated.

The time trend represents the average annual change in non-managerial segregation over the period under study. The average change is a little over half a segregation point (−0.605) decline annually.

Model 2 provides the baseline estimate of women's board representation on non-managerial gender segregation net of basic controls. The effect of women's board representation is associated with a small, statistically significant decline in non-managerial gender segregation (−0.022). In economic terms, it means that other things being equal, a one standard deviation increase in female board representation is associated with a 0.015 $\left(0.022 \times \frac{21.879}{32.315}\right)$ percentage point decrease in gender segregation at the mean.[11] The magnitude of this effect is consistent with previous conceptualizations of women on boards having a "trickle-down" effect.

TABLE 4 Mean yearly distribution

	2014	2015	2016	2017	2018	2019		
Observations	1,970	2,892	3,045	3,087	3,102	3,226	2019–2014	*t*-stat
Gender segregation	33.315	34.235	32.744	32.286	31.464	30.427	−2.890	−4.36***
Board gender diversity	22.474	21.817	22.969	23.977	25.420	26.003	3.530	5.71***
Women top managers	36.556	35.939	37.197	37.218	37.761	38.246	1.690	2.31**
Women low managers	38.992	37.992	38.645	38.909	39.879	40.256	1.260	1.42
Index of heterogeneity	47.652	47.265	46.384	46.51	46.200	45.572	−2.080	−3.42***
Single woman CEO	0.165	0.153	0.164	0.172	0.179	0.190	0.030	2.30**
Mixed women CEO	0.018	0.018	0.018	0.016	0.019	0.015	−0.003	−0.77
Natural log of firm size	5.677	5.596	5.616	5.635	5.664	5.663	−0.150	−0.50
Natural log of board size	1.930	1.732	1.737	1.751	1.751	1.755	−1.820	−9.86***
Board gender diversity target	0.182	0.299	0.266	0.072	0.077	0.076	−0.106	−11.75***
Female % (across occupations)								
CEO	2.48	2.20	2.27	2.18	2.33	2.47	−0.109	−0.04
Key management personnel	13.29	13.42	13.06	13.10	12.65	12.37	−0.924	−1.56
General manages	9.92	10.44	10.17	10.35	10.15	10.22	0.301	0.57
Senior managers	25.35	25.34	25.27	24.90	25.23	25.29	−0.059	0.08
Other managers	48.96	48.61	49.23	49.48	49.64	49.65	0.694	0.77
Professionals	27.93	26.42	27.16	28.28	29.50	30.43	2.495	3.04***
Technicians and trade	3.20	3.50	3.31	3.43	3.43	3.55	0.355	1.28
Community and personal service	18.26	18.28	19.28	19.19	18.77	19.12	0.858	0.96
Clerical and administrative	28.22	29.11	28.18	27.79	27.41	26.56	−1.655	−2.36**
Sales	9.43	11.94	11.59	11.47	11.57	10.93	1.502	2.40**
Machinery operators and drivers	2.39	2.74	2.55	2.48	2.31	2.22	−0.168	−0.62
Labourers	3.96	6.40	6.95	6.41	6.24	6.34	2.383	5.09***
Others	6.62	1.60	0.97	0.95	0.78	0.85	−5.771	−17.79***
Male % (across occupations)								
CEO	8.116	7.842	7.996	8.418	8.339	8.072	−0.044	0.10
Key management personnel	16.033	15.937	15.559	14.820	14.767	14.324	−1.709	3.35***
General manages	12.019	11.673	11.401	11.395	11.116	11.163	−0.856	−1.84*
Senior managers	25.559	25.437	25.105	24.744	24.968	25.151	−0.407	0.66
Other managers	38.273	39.111	39.939	40.624	40.810	41.289	3.016	3.97***
Professionals	31.519	29.511	30.185	31.132	32.484	33.116	1.596	1.70*
Technicians and trade	13.445	14.639	14.038	13.895	13.917	13.998	0.553	0.90
Community and personal service	16.182	16.514	17.519	17.426	16.977	17.456	1.274	1.47
Clerical and administrative	7.084	7.680	7.552	7.625	7.729	7.655	0.571	1.50
Sales	8.405	10.643	10.277	10.389	10.350	9.929	1.525	2.66***
Machinery operators and drivers	6.725	7.726	7.356	7.139	6.762	6.410	−0.315	0.65
Labourers	8.380	10.962	11.561	10.997	10.693	10.417	2.037	3.65***
Others	8.259	2.325	1.512	1.398	1.089	1.018	−7.252	−19.56***
Female % (within occupations)								
CEO	17.485	16.252	17.322	18.001	18.998	19.899	2.415	2.18**
Key management personnel	25.047	24.758	25.556	26.705	26.588	26.632	1.584	1.87*
General manages	20.851	20.563	21.198	20.782	21.789	22.169	1.318	1.52
Senior managers	31.497	31.082	32.448	32.386	33.183	33.801	2.304	2.65***
Other managers	38.992	37.992	38.645	38.909	39.879	40.256	1.264	1.42
Professionals	46.873	45.004	45.057	46.149	45.817	46.418	−0.456	−0.52

TABLE 4 (Continued)

	2014	2015	2016	2017	2018	2019		
Observations	**1,970**	**2,892**	**3,045**	**3,087**	**3,102**	**3,226**	**2019–2014**	***t*-stat**
Technicians and trade	10.155	9.985	10.192	10.606	9.897	10.326	0.171	0.29
Community and personal service	30.675	27.908	28.836	29.113	28.572	28.580	−2.095	−1.91*
Clerical and administrative	82.207	80.236	79.446	79.482	79.449	78.910	−3.296	−5.25***
Sales	25.100	27.588	26.581	26.170	25.983	25.149	0.049	0.05
Machinery operators and drivers	3.291	3.475	3.523	3.144	3.125	3.000	−0.291	−0.94
Labourers	9.298	11.066	11.513	11.126	10.987	11.103	1.805	2.89***
Others	18.970	12.140	8.976	8.737	8.022	8.151	−10.819	−14.11***

Note: ***$p < .01$, **$p < .05$, *$p < .10$.

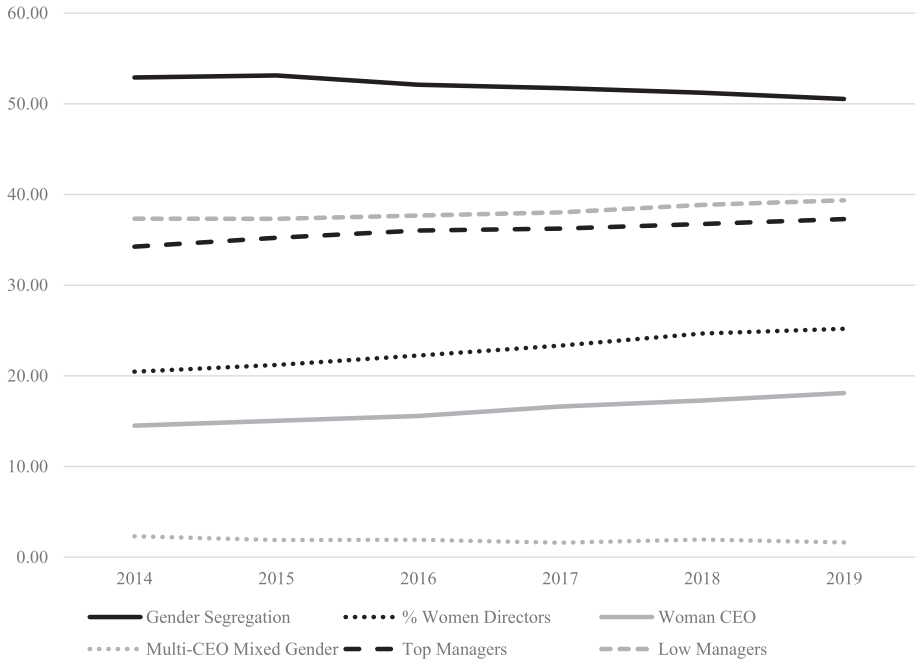

FIGURE 1 Time trends in segregation and women's representation in leadership positions, 2014–2019. Estimates derived from linear models with time indicator variables only. The intercept for segregation is based on the adjusted segregation intercept

The control variables also exert a significant influence on non-managerial segregation. We also estimated a model with women's board representation and without the additional controls (not reported). The changes in the variance components at the industry and organization levels are driven entirely by the control variables. Specifically, it is the index of occupational heterogeneity that is the factor driving this explained variation.

This is not unexpected since the occupational heterogeneity index was included to account for measurement error between the eight non-managerial occupational distinctions used in the survey and actual divisions of labor in organizations (e.g., jobs, job titles). Therefore, it makes sense that it would explain some of the organization-level variation. Observed segregation is, on average, higher in organizations where workers are more evenly distributed across all eight occupations compared to organizations where workers are only observed in a few. It also makes sense that this measure would reduce the industry variance component. Organizations producing similar goods and services are likely to use similar divisions of labor and therefore measurement error will also be correlated with industry.

Model 3 estimates the effect of women's board representation net of women's representation in CEO positions. The magnitude of the effect of women on boards is largely unchanged and the women CEO coefficients fail to reach statistical significance.[12]

Model 4 estimates the effect of women on boards on non-managerial segregation net of women in upper and lower managerial positions. Similar to the previous model, the substantive change in the magnitude of the coefficient is unremarkable. The model does reveal that women in the managerial ranks below CEO level exert a significant effect on reducing segregation. These are small, yet notable effects. This indicates that women managers closer to the location where women work and are likely to be in charge of the day-to-day personnel decisions (e.g., hiring, promotion) do appear to reduce gender segregation among non-managerial workers.

Finally, we provide a full estimate of women's representation across leadership ranks in Model 5. The estimates remain relatively

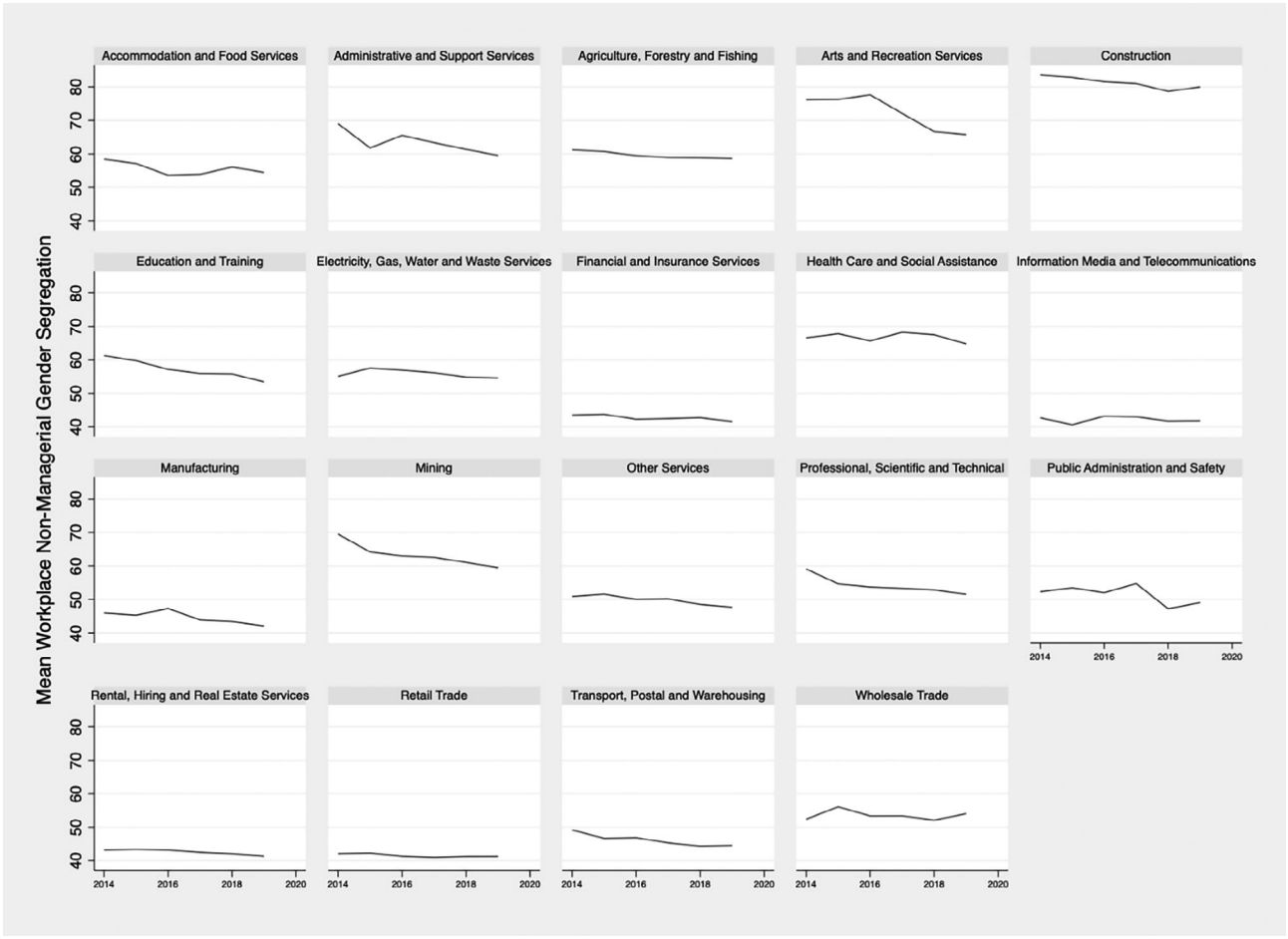

FIGURE 2 Gender workplace segregation in Australian organizations, by industry. These descriptive trends in non-managerial gender segregation adjust for measurement error associated with the eight non-managerial occupational categories

TABLE 5 Correlation matrix

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
[1] Gender segregation	1.00									
[2] Board gender diversity	−0.26***	1.00								
[3] Women top managers	−0.35***	0.45***	1.00							
[4] Women low managers	−0.28***	0.27***	0.42***	1.00						
[5] Natural log of board size	−0.17***	0.31***	0.23***	0.16***	1.00					
[6] Single woman CEO	−0.16***	0.38***	0.35***	0.19***	0.14***	1.00				
[7] Mixed women CEO	−0.03***	0.10***	0.04***	0.01	−0.02**	−0.06***	1.00			
[8] Index of heterogeneity	0.50***	−0.07***	−0.18***	−0.13***	0.06***	−0.07***	−0.02*	1.00		
[9] Natural log of firm size	−0.22***	0.07***	0.05***	0.13***	0.13***	−0.01	0.01	−0.09***	1.00	
[10] Board gender diversity target	−0.09***	0.24***	0.14***	0.09***	0.14***	0.10***	0.03***	−0.01	0.04***	1.00

Note: Gender segregation refers to non-managerial gender segregation measured with the Index of dissimilarity (*D*). ***$p < .001$, **$p < .01$, *$p < .05$.

stable compared to previous models. Women's board representation is associated with very small, "trickle-down" like effect on reducing gender workplace segregation (−0.019) and women in managerial positions below CEO level appears to also significantly reduce segregation. Women in CEO positions are not associated with non-managerial segregation with a 1-year lag. We explore different lags in the next set of analyses. Although it is beyond the scope of our study to examine the trickle-down effect to managers, if the entire effect of

TABLE 6 Random intercept estimates of gender composition of corporate boards and gender segregation

Variables	Model 1		Model 2		Model 3		Model 4		Model 5	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Board of Directors										
Of board positions held by women			−0.022**	0.007	−0.021**	0.007	−0.020**	0.007	−0.019**	0.007
CEO										
Sole CEO position, held by woman					−0.470	0.390			−0.494	0.390
Multiple CEO positions, at least one woman					−0.587	0.752			−0.782	0.753
Managerial positions										
Women high managerial positions							−0.129***	0.017	−0.129***	0.017
Women high managerial positions sq.							0.001***	0.000	0.001***	0.000
Women low managerial positions							−0.064***	0.012	−0.064***	0.012
Women low managerial positions sq.							0.001***	0.000	0.001***	0.000
Controls										
Time	−0.605***	0.053	−0.456***	0.051	−0.454***	0.051	−0.420***	0.051	−0.418***	0.051
Occupational heterogeneity (non-managers)			0.413***	0.009	0.413***	0.009	0.415***	0.009	0.415***	0.009
Total employees (ln)			−2.499***	0.224	−2.509***	0.225	−2.298***	0.224	−2.307***	0.224
# Board of Director Positions (ln)			−0.681**	0.246	−0.687**	0.246	−0.608**	0.246	−0.614**	0.246
Intercept	38.006***	3.332	34.116***	2.953	34.218***	2.950	35.615***	2.853	35.733***	2.850
Variance statistics/RE parameters										
Industry	14.346	2.382	11.252	1.871	11.233	1.868	10.737	1.790	10.713	1.786
Organization	18.801	0.231	16.370	0.205	16.360	0.205	16.091	0.204	16.080	0.204
Residual	7.128	0.054	6.689	0.051	6.690	0.051	6.703	0.052	6.704	0.052
Intraclass correlation (ICC)										
Industry	0.337	0.074	0.288	0.068	0.288	0.068	0.275	0.067	0.274	0.066
Organization	0.917	0.009	0.898	0.010	0.898	0.010	0.893	0.010	0.893	0.010
BIC	95,335		93,267		93,284		93,220		93,237	

Note: All variables lagged 1 year, except time and the occupational heterogeneity index. ***$p < .001$, **$p < .01$, *$p < .05$. $N = 12{,}378$ observations, 3,752 organizations, and 19 Industries.

TABLE 7 Lagged random intercept estimates of gender composition of corporate boards and gender segregation

Variables	No lag		1-year lag		2-year lag		3-year lag	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Board of Directors								
Of board positions held by women	−0.012	0.006	−0.019**	0.007	−0.030***	0.008	−0.043***	0.010
CEO								
Sole CEO position, held by woman	0.119	0.335	−0.494	0.390	−0.905	0.466	−0.605	0.587
Multiple CEO positions, at least one woman	−0.286	0.677	−0.782	0.753	−2.405**	0.863	−1.296	1.031
Managerial positions								
Women high managerial positions	−0.146***	0.014	−0.129***	0.017	−0.145***	0.020	−0.120***	0.023
Women high managerial positions sq.	0.001***	0.000	0.001***	0.000	0.001***	0.000	0.001***	0.000
Women low managerial positions	−0.056***	0.010	−0.064***	0.012	−0.054***	0.014	−0.079***	0.017
Women low managerial positions sq.	0.001***	0.000	0.001***	0.000	0.001***	0.000	0.001***	0.000
Controls								
Time	−0.340***	0.039	−0.418***	0.051	−0.368***	0.071	−0.492***	0.107
Occupational heterogeneity (non-managers)	0.430***	0.007	0.415***	0.009	0.410***	0.011	0.420***	0.013
Total employees (ln)	−3.654***	0.195	−2.307***	0.224	−2.665***	0.259	−2.637***	0.296
# Board of Director Positions (ln)	−0.334	0.211	−0.614**	0.246	−0.048	0.287	−0.549	0.361
Intercept	42.226***	2.744	35.733***	2.850	37.075***	2.901	37.819***	3.034
Variance statistics/ random effects								
Industry	10.673	1.772	10.713	1.786	10.282	1.729	10.020	1.704
Organization	15.922	0.186	16.080	0.204	15.812	0.221	15.502	15.047
Residual	7.403	0.046	6.704	0.052	6.111	0.059	5.636	5.494
BIC	131,022		93,237		63,979		43,347	
N	17,322		12,378		8,513		5,693	

Note: Model 2, is from previous table. All variables lagged as indicated, except time, and the occupational heterogeneity index. ***$p < .001$, **$p < .01$, *$p < .05$, +$p < .10$.

women board members operated through the appointment of women managers, then we would expect to see the magnitude of the percent women directors coefficient decline with the inclusion of managerial variables; however, the relationship does not appear to be influenced by the inclusion of women in management variables.

Comparing the change in variance components from Model 2 to Model 5 suggests that only a small amount of the initial variation in Model 2 is explained by the women in leadership variables. Given the small effect sizes, this is unsurprising; however, it does suggest that significant unexplained variation in non-managerial gender segregation continues to exist at both the industry and organization levels. These findings provide support for Hypothesis 1. There appears to be a small, yet significant effect.

4.3 | Further analysis of the women on boards and gender inequality relationship

Theoretically, it is presumed that women in top leadership, such as board positions, would lead to less gender inequity in organizations.

TABLE 8 Board gender diversity and non-managerial gender segregation: is there a critical mass effect?

	No lag		1-year lag		2-year lag		3-year lag	
Variables	**Coefficient**	**Standard error**	**Coefficient**	**Standard error**	**Coefficient**	**Standard error**	**Coefficient**	**Standard error**
Quadratic models								
Board of Director Positions Held by women	−0.019	0.014	−0.033*	0.016	−0.053**	0.019	−0.063**	0.024
Board of Director Positions Held by Women^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Numeric models								
No women directors (reference)								
One Woman Director [1]	−0.246	0.273	−0.570+	0.313	−0.606	0.370	−0.990*	0.475
Two Women Directors [2]	−0.619+	0.344	−1.344***	0.397	−1.518***	0.467	−1.618**	0.591
Three or more Women Directors [3]	−0.926*	0.389	−1.395**	0.445	−2.008***	0.519	−2.377*	0.653
Difference between numeric categories								
[2]–[1]	−0.374	0.272	−0.774*	0.017	−0.912*	0.380	−0.501	0.455
[3]–[2]	−0.306	0.272	−0.051	0.303	−0.490	0.353	−0.732+	0.426
Threshold models								
No women directors (reference)								
>0–20 women directors (token) [1]	0.034	0.311	−0.346	0.355	−0.449	0.419	−1.139*	0.521
>20–40 women directors (tilted-male) [2]	−0.401	0.308	−1.089**	0.358	−1.391***	0.420	−1.754***	0.528
>40–60 women directors (balanced) [3]	−0.506	0.363	−0.658	0.420	−1.701***	0.494	−2.023***	0.619
>60–80 women directors (tilted-female) [4]	−0.606	0.536	−1.076+	0.605	−2.232**	0.706	−1.443	0.883
>80 women directors (female dominant) [5]	−1.385	0.892	−2.460*	1.075	−2.604*	1.232	−4.071**	1.526
Difference between threshold categories								
[2–1]	−0.435+	0.250	−0.744**	0.284	−0.942**	0.330	−0.615	0.409
[3–2]	−0.106	0.256	0.431	0.290	−0.310	0.349	−0.270	0.429
[4–3]	−0.100	0.450	−0.417	0.498	−0.531	0.589	0.581	0.749
[5–4]	−0.778	0.883	−1.385	1.049	−0.372	1.199	−2.628+	1.524
N	17,322		12,378		8,513		5,693	

Note: Random intercept mdel estimates from 12 models. All models include CEO, Managerial Positions, and Control variables found in previous models. Full model results available from authors. ***$p < .001$, **$p < .01$, *$p < .05$, +$p < .10$.

However, the processes that are likely to influence change are gradual and should exert small cumulative effects over time. Gender segregation is often slow to change. This is because of longstanding gendered stereotypes about gender-appropriate work coupled with the fact that an organization can only change when people are hired, fired, or promoted. As such, we would need a longer time horizon to allow for change to occur to fully see if the presumed cumulative effects of women in power reduce segregation.

In Table 7, we seek to provide some preliminary evidence for whether or not women's representation on boards matter for reducing segregation below CEO level. We present the full models from Table 2 with time lags ranging from 0 to 3 years to see if there is evidence of a cumulative women in power effect.

Model 1 provides no lag between the independent and dependent variables. A significant relationship between women on boards and non-managerial segregation would suggest that these factors change contemporaneously. For example, if a firm was committed to increasing women in leadership roles and addressing gender equality in employment, it could be the case that the relationship between women's board representation and gender segregation is spurious.

This is precisely why we estimated our previous models in Table 5 with 1-year lags. This does not rule out endogeneity concerns, but certainly establishes a temporal dimension. Theoretically, we would expect women director's ability to create change for women below CEO level to be slow and gradual.

The relationship between women on boards and non-managerial segregation is not statistically significant by traditional standards in Model 1 (no lag—contemporaneous effect). Model 2 presents the model with 1-year lags and is simply the full model reported in Table 2. Models 3 and 4 provide estimates for 2-year and 3-year lags.

The pattern provides some preliminary evidence of a cumulative and gradual effect of women directors over time. The effect is still relatively small. However, it appears to grow with each year lag. While the effect is small, the magnitude of the 3-year lag is about twice that of the 1-year lag. It is important that we remind the reader that we are observing organizations over a relatively small timeframe 2014–2019 and that observing significant changes in segregation requires longer time frames given that it is a process that involves changes in hiring, firing, turnover, job reassignment, and promotion over time. It is worth noting that these effects are net of the normative time trend. On average, gender segregation is declining across organizations as indicated by the time coefficient, however, segregation is declining slightly faster in firms with a larger percentage of women directors.

While women's representation in CEO and managerial positions are control variables in this study, there are a few noteworthy findings. First, in contrast to the 1-year lag models, there is some evidence that women's representation in CEO positions is associated with less gender segregation in the 2-year lag models. The lagged models also show that women in upper and lower managerial jobs below CEO level exert a significant and relatively stable effect on reducing gender segregation. This suggests that the influence of women managers who are most directly involved in the day-to-day personnel decisions are likely to have a direct and significant effect. This may suggest that the women director effect is slower and more gradual while the manager effects take a more immediate effect.

4.4 | Is there a critical mass effect?

Prior research suggests that women directors may need a critical mass to be effective in advocating for women; therefore, the relationship between board gender diversity and non-managerial gender-segregation may be nonlinear. When women occupy only one or a few board positions they may lack the ability to advocate for women in the firm. Kanter (1977a, 1977b) early work on the tokenization of women managers illustrates this point. More recent work by Konrad et al. (2008) suggests that token women may be unable to be effective, but that at least two women may be required and three would likely reduce the negative effects of tokenization. They conclude that three women or more are required to fully reduce the effects of tokenism. We examine three different conceptualizations of nonlinear effects in Table 8. First, we estimate models with a quadratic term for women directors. Next, we estimate models with indicators for number of women on boards such as 1, 2, and 3 or more (all-male board is the reference). Finally, we roughly draw on Kanter's (1977a) conceptualization and create indicators for thresholds (token, tilted male, gender balanced, tilted female, and female dominant) with no women directors serving as the reference. For each version, we estimate 0-, 1-, 2-, and 3-year lags.

For the quadratic models, we find the same pattern we have previously observed. The linear effect of percent women is not significant in the non-lagged model. It becomes significant and slightly grows in magnitude with each lag. The quadratic term, however, fails to reach statistical significance in any of the models. These models fail to provide support for Hypothesis 3, which suggested that the effect of women directors is nonlinear.

The numeric models, which are conceptually closest to Konrad et al.'s (2008) critical mass research, provide some evidence of a nonlinear pattern. Comparing firms with one woman director to no women directors across the lagged models, firms with one woman director do not differ from firms with no women. This is consistent with Konrad et al. (2008) and Kanter (1977b) suggesting that it would be difficult for one woman on the board to advocate for other women in the firm. However, after 3 years, this effect is significant (-0.99, $p < .05$). Interestingly, we do not find a significant difference between firms having two women on the board and 3 or more. The key distinction seems to be 2 or more. However, in the 3-year lag models, the difference between having 2 women and 3 women on boards becomes marginally significant ($p < .10$). This provides partial support for Hypothesis 3, but the pattern is not conclusive. It appears that token women may have difficulty in advocating for change, at least initially. Having 2 or more women on boards seems to be the nonlinear threshold in these models, although there is some evidence that having three or more is more beneficial in the 3-year lag models.

Following Kanter (1977b), we also examine threshold effects. The findings are similar to the previous models. Women's token board representation measured as a percentage range (>0–20) is not associated with reduced segregation compared to firms with no women on boards. Similar to the previous models, this changes in the 3-year lag model and becomes significant. The general pattern suggests that women need to make up 20 or more to be effective for periods of 2 or more years.

4.5 | Endogeneity concerns and robustness checks

Although we argue that board gender diversity may lead firms to have lower non-managerial gender segregation, causality may actually flow in the opposite direction. Besides, as Farrell & Hersch (2005) argue, a dearth of qualified women directors offers them the flexibility of self-selection or to serve on the boards of higher gender-segregated firms. Further, firms may also voluntarily choose to appoint women directors. Endogeneity concerns, such as these, in women on board research are ubiquitous and well known (Adams et al., 2010; Kirsch, 2018). We provide some additional analyses to address endogeneity concerns.

TABLE 9 Tests of endogeneity

	Heckman's 2-stage model		2-SLS	
	Selection model	Main model	First stage	Second stage
	Board diversity	Gender segregation	Women on boards	Gender segregation
Board of Directors Gender Diversity Target$_{t-1}$	0.759*** (11.03)		9.715*** (16.78)	
Board of Director Positions Held by women		−0.062*** (−4.40)		
Women on boards predicted				−0.204*** (−3.88)
Women high managerial positions	0.011*** (8.68)	−0.082*** (−5.01)	0.184*** (12.38)	−0.054** (−2.86)
Women low managerial positions	0.001* (1.72)	−0.046*** (−4.74)	0.027** (2.71)	−0.042*** (−4.31)
# Board of Director Positions (ln)	1.562*** (31.39)	−1.402 (−1.45)	4.899*** (9.12)	−0.780 (−1.34)
Sole CEO position, held by woman	0.456*** (5.82)	−0.755 (−1.19)	11.340*** (12.93)	0.912 (1.04)
Multiple CEO positions, at least one woman	0.516*** (3.45)	−2.315 (−1.51)	15.215*** (6.93)	−0.060 (−0.04)
Total employment(ln)	0.021 (0.83)	−3.592*** (−12.94)	0.366 (1.49)	−3.526*** (−12.55)
Inverse Mills ratio		0.141 (0.13)		
Occupational heterogeneity (non-managers)		0.435*** (26.91)	−0.007 (−0.49)	0.435*** (26.91)
Intercept	−2.627*** (−11.32)	42.783*** (10.80)	10.229*** (4.17)	44.420*** (14.55)
Year controls	Yes	Yes		
Industry controls	Yes	Yes		
Pseudo/adjusted R-squared	0.437	0.476		0.464
Wald chi-squared/*F*-statistic	1760.93	152.916		151.455
Under identification test			245.734***	
Weak identification test			513.35***	
Partial F-stat			281.473***	
Observations	12,388	12,388	12,388	12,388

Note: Standard errors clustered at the firm level. *t*-statistics are in parenthesis. ***$p < .001$, **$p < .01$, *$p < .05$.

We address the potential self-selection and reverse causality issue by using the Heckman (1979) two-stage model and a two-stage least squares (2-SLS) instrumental variables (IV) approach. Under the 2-SLS IV approach, we estimate the determinants of board gender diversity in the first stage, and then in the second stage, we estimate non-managerial gender segregation. For both of these approaches, we need to identify one or more unique IVs that are related to board gender diversity but are not relevant to non-managerial gender segregation. In other words, an instrument needs to satisfy two conditions: the relevance criteria and the exclusion restriction (Larcker & Rusticus, 2010). In our case, the former requires an instrument to be correlated with the endogenous variable, namely the proportion of women on the board. The latter requires the instrument to be uncorrelated with the non-managerial gender segregation equation error, which is a difficult criterion to satisfy as it cannot be empirically "proven", but instead requires some articulated justification for why the instrument is independent of the non-managerial gender segregation equation error term. Although the use of industry level variables such as industry mean of the percentage of women directors is quite common in the extant literature (e.g., Hasan & Cheung, 2018; Usman, Zhang, Farooq, Makki, & Dong, 2018), such an instrument is unlikely to be relevant in the context of this study. This is because the key dependent variable (non-managerial gender segregation) and key explanatory variable (percentage of women directors) could be a function of the nature of the industry and hence they are likely to be correlated.[13]

We therefore used a policy-level variable to act as the instrument for board gender diversity. In the annual questionnaire survey, respondents must answer the following question[14]: *Has a target been set to increase the representation of women on its governing body?* The answers could be either yes or no. If the answer is "no", the respondent has the option to specify why a target has not been set and the options include (a) governing body/board has gender balance; (b) currently under development; (c) insufficient resources/expertise; (d) do not have control over governing body/board appointments; (e) not a priority; and (f) other reasons. Using the responses to this question, we have created a dummy variable taking the value of 1 if the firm has either a gender-balanced board or set a target to increase women's representation on the governing body, and 0 otherwise.[15] Because the question is directly related to the board gender diversity, it is unlikely that it is directly associated with non-managerial gender segregation at the firm-level. However, firms having a gender-diverse board or with a target to increase female board representation in year t are more likely to have higher board gender diversity compared to other firms in year $t + 1$. Thus, the exclusion and relevance criteria for the instrumental variable are being reasonably met.

In the first stage of the Heckman two-stage model, we analyze the decision to have a gender-diverse board. The dependent variable is a dummy variable indicating the presence of at least one woman director. We include 1-year lag of the policy-level indicator variable as an independent variable in the first stage Heckman model along with other firm-level determinants of board gender diversity, namely board size, percentage of women in the top and low manager level, firm size, and a dummy variable indicating whether the firm has a woman CEO. Year and industry controls are also included in the regression model. The results are presented in Table 9.

The results of the selection model are presented in Column 1 of Table 9. The results show that with the exception of firm size, all variables positively influence a firm's decision to have a gender-diverse board. To control for self-selection bias, we estimate the second-stage regressions with the inverse Mills ratio, a variable designed to reflect all unmeasured characteristics related to female director choice, as an additional independent variable in the segregation model. The results in Table 9 show that the coefficient for inverse Mills ratio is positive and statistically insignificant. Nevertheless, percentage of women directors still exhibits a negative association with non-managerial gender segregation after controlling for self-selection bias.

For the 2-SLS, we use the same instrument as in the first-stage of Heckman-two stage estimation. The first stage results suggest that the instrument and board gender diversity are significantly ($\beta = 9.715$, $p < .001$) correlated. The instrument also passes the relevance criteria as the partial *F*-statistic is 281.473 and is significant at the 1 level. In the second stage, the predicted value of percent women board of directors and other control variables are used to re-estimate our baseline regression. The second-stage regression results are presented in Column 4 of Table 9. The results confirm our previous finding of a negative relationship between board gender diversity and non-managerial gender-segregation.

5 | DISCUSSION

Prior literature suggests that having a larger share of women on corporate boards promotes gender equality in positions just below board level (e.g., Bilimoria, 2006; Cook & Glass, 2014, 2015; Gould et al., 2018a). This process by which women's representation gradually increases gender workplace equality has been referred to as the "trickle-down effect" (Gould et al., 2018a). The main objective of our study was to investigate if board gender diversity promotes gender equality throughout organizations beyond the top management team. We incorporate a measure of non-managerial segregation, the index of dissimilarity, as a workplace-level indicator of gender equality across a diverse range of occupational distinctions. The index is an ideal measure as it accounts for several nonhierarchically ranked occupations simultaneously, meaning it is a general measure of workplace gender equality.

Additionally, we were also interested in examining if there is evidence of a critical mass effect. Theoretically, researchers have suggested that one or a few women directors may not be enough to promote gender equality or to exert influence in the boardroom (Kanter, 1977a; Konrad et al., 2008; Kristie, 2011). Therefore, we examine several different conceptualizations of critical mass in our analyses.

Using 6 years of Australian organizational panel data we examine the relationship between women's board representation and non-managerial gender segregation. Our robust empirical analysis investigates how women on boards influence gender equality in Australian organizations. The contribution of this work is considerable because segregation is a primary source of the gender wage gap and it limits opportunities for women's advancement (e.g., Maume Jr, 1999; Petersen & Morgan, 1995). We report that women's board representation is associated with significantly less gender segregation net of women's representation in other leadership positions (e.g., CEO, managerial). Our critical mass analysis examining several measures across 0-, 1-, 2-, and 3-year lags suggest that women's representation needs to reach beyond token levels (2 or more or greater than 20%, depending on the measure examined), to effectively promote gender equality beyond top management. These findings provide further evidence for the importance of diversifying boards.

5.1 | Theoretical implications

Our study makes two distinct theoretical contributions. The trickle-down effect has focused on the relationship between women's board representation and women's representation in top management (e.g., CEO, executives). The initial theoretical idea speculated that the likely mechanisms shaping the relationship between women directors and women in top management included women directors directly advocating for women and the presence of women directors created an environment in which women believed they had opportunities for advancement.

Drawing from prior research we extend the discussion about how women directors can influence gender segregation among non-managers who may be proximally distant from women directors. We identify three likely mechanisms for how women's board representation may directly and indirectly reduce workplace gender segregation: (a) women directors are more likely to directly and indirectly advocate for gender diversity (e.g., mentoring, "asking for diversity reports", producing diversity content (Konrad et al., 2008), (b) women directors are more likely to propose and implement diversity and equal opportunity policies and practices, not simply for women, but for gender equity (Glass & Cook, 2016, 2018), and (c) women directors presence is likely to change the organizational culture regarding women's opportunities and abilities (Ely, 1995; Tate & Yang, 2015). Our analysis provides evidence of a slow and gradual process working down the organizational hierarchy. The theoretical implications are that the women on boards effect is broader than initially theorized in the trickle-down perspective.

We also test for a critical mass effect. Kanter's (1977a) theory of tokenization suggested that women's token representation is unlikely to be effective in influencing decision making in these group settings.

She argued that women in top management will only affect gender equality if they gain a critical mass of managerial positions, which would allow them to overcome tokenization and act to advance gender equity. She suggested that having 2 women, or as much as 20% representation, may not be enough to overcome tokenism. Other researchers drawing on Kanter's work, suggest that things generally improve with two women on the board, however, women may need three or more board positions to be effective (Konrad et al., 2008; Kristie, 2011). For example, Kristie (2011, p. 22) noted that "one woman on the board is a token, two is a presence, and three is a voice." A single woman board member will have difficulty advocating for women since they are subjected to token pressures (visibility, polarization, and role entrapment). We estimate a series of models with different conceptualizations and, consistent with Kanter's expectations, find that women's representation needs to exceed about 2 board positions or 20% to be effective in reducing gender segregation.

5.2 | Practical implications

Our findings have several practical implications. First, as it relates to our central research aims, the baseline results show that non-managerial gender segregation decreases with women's board representation. Promoting women directors supports small effects that decrease gender workplace segregation. On average, women's representation needs to exceed about 20% of the board seats to combat gender workplace segregation.

Second, applying a consistent adjusted segregation estimate to the WGEA sample used in this study, we report clear evidence of gender segregation in Australian workplaces. Specifically, the findings show that by 2019 approximately half of women (or men) would need to change jobs in order to create a gender-balanced workplaces. The finding points to the need for the WGEA to continue to promote workplace gender equality. These findings also suggest that human resource managers focus not only on the percentage of women and men workers, but also on how segregated those workers are from one another in the workplace.

Third, gender segregation varies considerably by industry. Organizations should monitor and assess absolute changes in gender diversity regularly (boards, managers, and workers). Part of this assessment should entail benchmarking to industry averages to gauge relative progress. However, organizations that wish to realize the benefits of gender diversity should strive to be industry leaders in this area. Initiating workplace practices that encourage women to apply for promotion across all levels of an organization will provide opportunities to reduce gender underrepresentation. These could include explicit support for women's career advancement that enhances internal career opportunities, the introduction of equal opportunity management practices, and enabling senior women's support for other women's careers.

Fourth, managerial ranks below CEO exert a significant effect on reducing segregation and there is some evidence that women CEOs may also be important in advancing gender equity at work. While we controlled for the influence of women in these positions, the results indicate that employing more women in upper and lower managerial jobs below CEO level can significantly reduce workplace segregation. In particular, increasing the number of women managers in areas of the organization where women work and execute day-to-day personnel decisions (such as hiring and promotion) may be particularly effective in reducing non-managerial gender segregation.

Our results are also a reminder to firms of the need to adopt policies to address longstanding gendered stereotypes concerning gender appropriate work. These need to be facilitated when appointments change following hiring, firing, and promotion decisions. Nominating more women to stand for board positions will also lead to reductions in non-managerial segregation over time. However, it is important to note that the effect is relatively small and should be one of many strategies organizations implement to increase gender workplace equity.

5.3 | Limitations and opportunities for future research

This study focussed specifically on whether women's board representation affects gender segregation of non-managerial workers. The results document empirical support for a slow and gradual effect associated with more women board members. The findings support further diversification of boards of directors across Australian organizations.

Despite our evidence of a beneficial relationship between women's board representation and reduced gender inequality, further research to investigate the specific processes linking board representation and segregation is required. In particular, qualitative studies that increase understanding around the factors that facilitate the ability of women in leadership roles to effect change to advocate for women and their interests, to implement policies aimed at ameliorating gender inequality, and changing the organizational culture are needed. This work can shed light on how women impact gender inequality in organizations and may also identify potential inhibitors to more gender diverse workplaces. Studies that can inform women about how to use their positions to promote greater gender diversity effectively across the hierarchical organizational structure will also enhance the literature.

Globally organizational gender diversity continues to receive significant attention as governments, equity groups, and other interested stakeholders look to address the lack of women in senior organizational roles. Academic researchers should also consider studies that address the effects of gender diversity on the organizational power structure.

6 | CONCLUSION

Using 6 years of Australian organizations panel data from 2014 to 2019, we investigate if women on boards are associated with gender workplace segregation. Using random intercept models to estimate

the effect of corporate board gender composition on gender segregation, we report that women's board representation significantly reduces workplace gender segregation. Our findings document a significant temporal effect on segregation change associated with board gender diversity and increasing benefits from reduced gender segregation within firms reported over 1-, 2-, and 3-year lags. Tests for a critical mass of female board members using numeric models show that segregation benefits exist when at least one woman is on the board and these increase with the presence of more women directors. Threshold models of female board representation also provide evidence of a critical mass effect.

Our study contributes to the research examining women's representation in leadership positions and highlights the critical role that women directors have in the promotion of greater gender workplace diversity. In particular, we report the need for a critical mass of women on the board for change in organization segregation to be impactful. Considering various levels of managerial positions held by women we document reductions in segregation with higher proportional representation of women throughout managerial appointments. Specifically, women holding positions ranging from key management, executives, senior managers to other managers, appear to reduce workplace gender segregation, and also support lower segregation levels. This benefit can be explained by the improved power balance that comes from having women in leadership at the top of the organizational ranks. Achieving a critical mass representation of women directors supports lower levels of segregation and current literature indicates that this can support changes in organizational culture and affecting gender equality directly. Opportunities for future research include work on better understanding how women on boards can promote organization diversity and how less segregated work environments benefit both women workers and the organization.

ACKNOWLEDGMENT

We would like to thank the team members at the WGEA for making the data available to us.

ENDNOTES

[1] The original mandate did not entail sanctions for non-compliance. After little change in the initial laws following the passage of the mandate, the law became compulsory in 2006.

[2] Some countries established a minimum of at least one woman on the boards of public companies, such as India, Pakistan, while others mandated women's representation between 30 and 40%, including France, Iceland, Italy, Belgium, Germany, Spain, Portugal, Austria, Netherlands, United Kingdom, and Australia.

[3] While our analysis centers on Australian organizations, it is worth noting that the trickle-down effect may vary depending on policy makers' approach to women's board representation. Research using Norwegian data, for example, shows no association between legal quotas mandating women's representation on corporate boards and women's representation at senior and lower managerial appointments (Bertrand et al., 2014).

[4] Recently, Gould et al. (2018a) find that women's representation on boards was significantly associated with women's executive representation among a sample of ASX-listed firms between 2003 and 2012. A similar trickle-down finding has also been observed in the Australian public sector (Gould et al., 2018b) as well as Brazilian public sector organizations (Arvate, Galilea, & Todescat, 2018).

[5] As an exception, Glass and Cook (2018) report that even a token representation of one or two women on the Fortune 500 boards is associated with improved CSR performance although the association is substantially higher for a critical mass of three or more women directors.

[6] Combined reports include organizations that belong to the same ANZSIC division and where the roles and responsibilities of managers are similar. Organizations with fewer than 80 employees have the option to be included in any other report from the group.

[7] Manager occupation categories include CEO, KMP, other executives/general managers, senior managers, and other managers. Non-manager occupation categories comprise of professionals, technicians and trade, community and personal service, clerical and administrative, sale, machinery operators and drivers, laborers, and other.

[8] We also estimated models coding with Kanter's specific numeric thresholds. This coding includes, >0–15% (token female), >15–40% (tilted-male), >40–60% (gender balanced), >60–85% (tilted-female), and >85% (female dominant). Substantive results are identical. We reported the categories we do because (a) adding a single woman may have a relatively large impact on board representation. For example, in percentage terms, a firm changing from no women to 1 woman on a 6-person board would change from 0% to 16.67% women. Also, Kanter suggested that "Two (or less than 20% in any particular situation) is not always a large enough number to overcome the problems of tokenism and develop supportive alliances, unless the tokens are highly identified with their own social category" (Kanter, 1977b, p. 987).

[9] We also estimated General Estimating Equations (GEE), another option for dealing with repeated observations. The magnitude of the women on board effect is slightly larger in the GEE model estimates compared to what we report, however, the substantive findings are identical.

[10] The adjusted segregation level is computed in two stages (also see Stainback & Tomaskovic-Devey, 2012). First a basic linear regression model is estimated with time, firm size, and occupational heterogeneity. The heterogeneity coefficient (0.4620578) is then used to adjust segregation at the organization-year level as follows: adjusted segregation = observed segregation + ((87.5 – observed occupational heterogeneity) * 0.4620578). Note that 87.5 is the theoretical maximum the heterogeneity index can have with eight categories.

[11] In more simplistic terms, the model predicts that a 10% increase in percentage of women directors is associated with about 1/5 of a point decline in segregation.

[12] An anonymous reviewer asked whether our results would change if women CEOs, who are also on boards, were removed from the numerator and denominator of the women on boards variable. Our focus is on women on boards and their ability to impact change net of any influence of women CEOs. To ensure the veracity of our findings, we re-estimated models dropping women's count from boards if they were CEOs. Untabulated results show that both CEO variables reach marginal significance ($.05 < p < .10$). The % women on boards coefficient remains consistent in models net of coding decisions (−.019 vs. −.017) Our manuscript is about women on boards; CEO composition is a control. The substantive finding is identical regardless of how we code the CEO gender composition variables.

[13] We thank an anonymous reviewer for raising the issue.

[14] Question number 2.1d.1 in the 2018–2019 survey.

[15] Results are qualitatively similar if the variable is coded as 0 for those firms who did not set a target to increase board gender diversity because they consider themselves having gender-diverse boards.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from https://www.wgea.gov.au/.

ORCID

Pallab Kumar Biswas https://orcid.org/0000-0003-3551-6368
Helen Roberts https://orcid.org/0000-0003-0763-8990
Kevin Stainback https://orcid.org/0000-0001-9358-9819

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AUTHOR BIOGRAPHIES

Pallab Kumar Biswas, PhD, is a Senior Lecturer of Accountancy & Finance at the University of Otago, New Zealand. He obtained his PhD in Accounting & Finance from the University of Western Australia, Australia (2013) and an MBA in Accounting from the University of Dhaka. His research interests include board diversity, corporate governance, private firms, audit committee, corporate social responsibility, and disclosures in annual reports.

Helen Roberts, PhD, studies the effect of board gender diversity on performance, risk, and capital decisions. Her research seeks to understand how more balanced workplaces and management teams can impact on firm value. She seeks to address inequity within organizations that discriminate and to investigate the benefits of workplace diversity. Dr Roberts is an Associate Professor in the Department of Accountancy and Finance at the University of Otago (NZ).

Kevin Stainback, PhD, is broadly interested in understanding and highlighting the role of organizations, as both actors and contexts, in the study of diversity and inequality at work. He has published on topics ranging from organizational response to equal opportunity laws to the effects of workplace discrimination on health and wellbeing. He is currently a Professor of Sociology at Purdue University (USA).

How to cite this article: Biswas, P. K., Roberts, H., & Stainback, K. (2021). Does women's board representation affect non-managerial gender inequality? *Human Resource Management*, *60*(4), 659–680. https://doi.org/10.1002/hrm.22066