NBER WORKING PAPER SERIES

CRACKS IN THE GLASS CEILING AND GENDER EQUALITY: DO EXPORTS SHATTER THE GLASS CEILING?

Bruno César Araújo
Lourenço S. Paz
James E. West

Working Paper 33260
http://www.nber.org/papers/w33260

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 2024

Thanks to C. Featherstone, V. Pham, M. Richards, seminar participants, and our colleagues at Baylor University. No funding to disclose. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

Cracks in the Glass Ceiling and Gender Equality: Do Exports Shatter the Glass Ceiling?
Bruno César Araújo, Lourenço S. Paz, and James E. West
NBER Working Paper No. 33260
December 2024
JEL No. F12, J16, J31

ABSTRACT

We use Brazilian administrative employer-employee matched data of worker demographics, industry of affiliation, occupation, and wages to examine whether females in managerial and executive positions (cracks in the glass ceiling) lead to more gender-equal workplace outcomes. In response to the large and unanticipated 1999 Brazilian Real exchange rate devaluation, the gender wage gap widened across all firms. The contrast between female and male-led firms was large and highly significant regarding managerial and supervisory employees. Both the gender wage gap and the proportion of female employees grew more in female-led firms than in male-led firms, consistent with the predictions of our monopsony model of firm behavior. We conclude that exports further crack the glass ceiling but do not necessarily improve the gender wage gap.

Bruno César Araújo
Instituto de Pesquisa Econômica Aplicada – IPEA
Setor de Edifícios Públicos Sul SEPS) 702/902
Ipea/Iphan, BL C Torre B - Asa Sul
Brasília, Brazil 70390-025
bruno.araujo@ipea.gov.br

Lourenço S. Paz
Baylor University
One Bear Place #98003
Waco, TX 76798
lourenco_paz@baylor.edu

James E. West
Department of Economics
Baylor University
One Bear Place #98003
Waco, TX 76798
and NBER
j_west@baylor.edu

1 Introduction

The glass ceiling, an invisible barrier that prevents females from joining corporate leadership or the C-suite,[1] has been viewed as a significant obstacle to addressing gender inequality in the workplace. There is a growing female presence in corporate boards of directors and the corporate C-suite, which we interpret as cracks in the glass ceiling. Many observers suggest that this will be a fundamental step towards gender equality, as a larger female presence in management will cause women to act as "agents of change" and redress the past inequities experienced by female employees, particularly female representation and the gender wage gap (Cohen and Huffman, 2007).

Do females in the C-suite merely stand up for themselves, or do they stand up for others? Recent empirical literature has drawn attention to interesting—albeit sometimes conflicting—evidence of female-led firms exhibiting a narrower gender wage gap and a higher proportion of female employment (Flabbi, Macis, Moro and Schivardi, 2019; Bertrand, Black, Jensen and Lleras-Muney, 2019; Kunze and Miller, 2017).[2] Understanding the extent to which cracks in the glass ceiling promote workplace gender equality requires estimating the causal impact of female leadership on gender-based outcomes within firms, including the male-female wage gap and the percentage of female employees.

We build upon the literature using monopsony power to explain gender inequality in the labor market (Manning, 2011; Manning, 2021) by adapting a theoretical framework based upon Card, Cardoso, Heining and Kline (2018). Search costs and the heterogeneous valuation of non-wage amenities by gender allow profit-maximizing firms with monopsony power to offer wages that exceed those of the perfectly competitive sector and are unequal by gender. Corradini, Lagos and Sharma (2022) provide direct evidence that female workers value non-

[1] Corporate leadership positions containing the word "chief," such as Chief Executive Officer, Chief Operating Officer, Chief Financial Officer, etc.

[2] See also Cardoso and Winter-Ebmer (2010), Hensvik (2014), Hirsch (2013), Pitts, Orozco-Aleman and Rezek (2014), and Stojmenovska (2019).

pecuniary amenities more than male workers in Brazil. This gender-based heterogeneous valuation of amenities implies a lower female wage elasticity of labor supply relative to male workers, as found in both the U.S. (Ransom and Oaxaca, 2010; Webber, 2015) and Brazil (Vick, 2017). Our theoretical model predicts that more productive (and therefore larger) firms or firms that offer a high level of amenities (e.g., female leadership) will exhibit more unequal wages yet employ a higher share of female workers. A positive demand shock — such as an exchange rate devaluation-induced export shock — will both cause female employment to increase and further widen the gender wage gap across all firms. Larger firms that benefit more from the shock will experience greater effects. Female-led firms, which provide additional amenities, will experience even larger effects.

To assess these predictions, we exploit the unexpected and large 1999 Brazilian real exchange devaluation as a positive export shock on Brazilian manufacturing firms and examine whether the response of female-led firms to this export-induced increase in labor demand differed relative to that of male-led firms. We believe our study is the first to take advantage of a plausibly exogenous macroeconomic shock to identify the effects of female leadership on labor market gender outcomes.

Brazil in the 1990s and 2000s has many advantages as a venue for our study. Besides being Latin America's largest economy and the most populous country, Brazil has a diversified manufacturing sector with significant gender inequality in labor market outcomes. Using data from the Brazilian 2000 census, Paz and Ssozi (2021) find a female employment share of 30 percent and a 40 percent male-female wage gap in manufacturing. However, these figures vary widely depending on the manufacturing industry. Madalozzo (2011) finds that Brazilian boards of directors sampled were more likely to choose a CEO that matched its gender profile, consistent with the existence of a glass ceiling. Of great importance, Brazil has very rich administrative employer-employee matched data that enable us to estimate the dynamics of various aspects of gender inequality that occurred in response to the unanticipated devaluation of the *Real*. And in the period studied here, government policies to promote gender equality were practically non-existent.

Our empirical work extends the methodology used by Verhoogen (2008) to study the relationship between productivity, product quality, and wages in Mexican manufacturing firms. Verhoogen's (2008) methodological innovation was his use of the 1994 devaluation of the Peso, which increased the competitiveness of Mexican-produced exports. The resulting difference-in-differences design allowed Verhoogen (2008) to estimate causal relationships between firm exports and wages. We extend this methodology to examine changes in the proportion of female employees and the male-female wage gap around the 1999 devaluation of the Brazilian *Real* separately for firms with male leadership and for firms with female leadership, and estimate triple differences.

Our analysis utilizes Brazilian administrative employer-employee-matched data from annual forms mandated by the Brazilian government. Our data includes worker demographics, the industry of affiliation, occupation, and wages. The richness of our data enables us to examine the proportion of female employees and the wage gap for five occupational groups: 1. Unskilled White Collar 2. Professional or Managerial 3. Skilled Blue-Collar 4. Technical or Supervisory (Skilled White Collar) 5. Unskilled Blue Collar. As in Verhoogen's (2008) study of Mexico, the unanticipated and massive devaluation of the local currency provides a plausibly exogenous positive shock to exporting firms. Tradable goods producers, such as manufacturing firms, must quickly hire additional labor to meet the growing demand for their products in export markets.

In response to the unanticipated export-enhancing shock, changes in the proportion of female employees are not significantly affected in firms with male leadership but increase in female-led firms. The male-female wage gap further widens in all firms regardless of the gender of firm leadership. Relative to male-led firms, additional increases in the wage gap by female-led firms are positive but imprecisely estimated. Disaggregated by occupational category, we find that the change in the percentage of females and the wage gap among Professional and Managerial, Skilled Blue-Collar, and Technical or Supervisory employees further increase in female-led firms. Relative to male-led firms, the increase is only significant for Professional or Managerial employees, which suggests that the 1999 devaluation further cracked the glass ceiling for some but not all females in the manufacturing sector in Brazil.

In the remainder of our paper, we review related literature, describe the Brazilian data, and develop a series of stylized facts to characterize the relationship between gender-based outcomes and firm size that we observe in the Brazilian labor market using summary statistics and descriptive analysis. We develop a theoretical model and an empirical strategy to estimate testable predictions from theory and stylized facts, discuss our empirical results, and conclude.

2 Literature Review

Opportunities are rare to directly measure firm-level responses to exogenous changes in the gender of firm leadership.[3] Scholars have used government mandates that increase gender equity in corporate leadership to estimate the effects of female leadership on corporate outcomes but have found little impact on gender equity below the executive level (Bertrand et al., 2019; Matsa and Miller, 2013).[4]

In 2003, Norwegian legislation mandated that the proportion of female members on corporate boards of directors remain between 40 and 60 percentage points. Several studies have made use of this legislation to estimate changes in gender-based outcomes as firms were required to increase the proportion of female directors sharply. Bertrand et al. (2019)

[3]See Baron, Ganglmair, Persico, Simcoe and Tarantino (2024) for a natural experiment that exploits random variation in the gender composition to the committee that nominates members to the Internet Engineering Task Force.

[4]An additional study of the effects of exogenous policy changes on firm outcomes is Huber, Lindenthal and Waldinger (2019), who estimates reductions in the stock price, dividends, and return on assets in firms that were forced to dismiss Jewish managers in Nazi Germany. Yet, there is no gender dimension to this study.

document that the gender gap in earnings among board members declined dramatically. Nonetheless, these benefits did not extend to other female employees of firms affected by the legislation. In contrast, Kunze and Miller (2017) find that increased female corporate leadership benefits women lower in the corporate hierarchy. Finally, Matsa and Miller (2013) observe that compared to firms unaffected by the legislation, Norwegian firms with mandated increased female directors implement fewer workforce reductions, which increase relative labor costs and employment levels and reduce short-term profits. Matsa and Miller (2013) attribute these outcomes to hiring like-minded executives. Similarly, Maida and Weber (2019) study the 2011 Italian law mandating step-wise increases in female membership of corporate boards and find only moderate and imprecisely estimated spillover effects.

Absent an exogenous change in the gender of firm leadership, an important aspect of studies that examine the effects of the gender of firm leadership is the role of the organizational climate on both the gender of firm leadership and gender-based labor market outcomes. A "female-friendly" climate may cause a firm to have female leadership, more equal wages, and greater workforce balance. Beyond issues of causality, it is challenging to construct objective measurements of firm climate.

An additional strand of related literature examines the extent and costs of discrimination in firm responses to economic shocks. Black and Strahan (2001) examine changes in rent-sharing with female versus male employees as states legalized interstate branch banking in the late 1970s and 80s. They find a much larger reduction in male employee salaries than female employee salaries after deregulation. Black and Brainerd (2004) find that globalization before the early 1990s in manufacturing industries modestly decreased the relative wages of less-skilled workers but also appeared to benefit women by increasing their share in employment. None of these studies have examined the differential response of female-led and male-led firms.

3 Data and Stylized Facts

The data used in this study comprise two firm-level confidential administrative databases covering 1995-2004, which were merged by firm tax identification codes. The first dataset contains administrative records of firm-level export operations provided by the *Secretaria de Comércio Exterior* (Secretary of Foreign Trade) of the *Ministério do Desenvolvimento, Indústria e Comércio Exterior* (Ministry of Development, Industry and Foreign Trade). This dataset contains information about each firm-level export transaction, including the product code, value, and destination country of each exported good. The second administrative dataset is the RAIS (*Relação Anual de Informações Sociais*) from the *Ministério do Trabalho e Emprego* (Ministry of Labor and Employment). The RAIS form contains each firm's tax identification code and each employee's identification number, gender, age, level of educational attainment, and occupation. Every firm is required by law to annually fill out and file this RAIS form disclosing the labor contracts for all of its employees, even if the duration of employment were as brief as a single day. A firm with no employees must still file an RAIS form stating it has no employees. These characteristics make the RAIS dataset effectively cover all formal employment except self-employed and informal workers.[5]

We consider a worker employed at a specific firm during a given year if she (or he) worked for at least one day in December of that year.[6] We retain only firms with at least 20 employees. Additionally, we restrict the scope of our data to manufacturing firms (CNAE-Brazilian Industry Classification version 1.0 codes ranging from 15 to 37) as they produce tradable goods that can be exported (Black and Brainerd, 2004; Tsou and Yang, 2019). These firms are more likely to be directly affected by a large currency devaluation, the quasi-exogenous source of variation exploited by our empirical strategy.

[5]The use of informal workers in exporting firms is highly unlikely, as most informal jobs are created by firms typically employing less than 30 employees. For a detailed study of informal workers in Brazil, see Paz (2014).

[6]For further detail on data sources and the construction of our data set, see Appendix A.1.

At the employee level, we dropped from the sample workers younger than 15 years of age or older than 65 years of age. Worker records with missing observable characteristics and wages are also excluded. The characteristic with the highest proportion of missing values is occupation, with approximately 1.5% of the employee records missing. These missing observations exhibit no discernible pattern in industry, year, worker characteristics, or firm size. Our balanced panel contains 60,095 firms that employed, on average, three million workers annually.

The wage variable is the natural logarithm of the hourly wage. Within firms, we group employees into broad categories based on skill level. We define a skilled worker as an employee who has graduated from high school. We further disaggregate employees by firm into the following classification of occupations: Professional and Managerial, Skilled White-Collar, Unskilled White-Collar, Skilled Blue-Collar, and Unskilled Blue-Collar (Helpman, Itskhoki, Muendler and Redding, 2017). Even though these categories are broad, this classification is not significantly affected by misclassification problems present in highly disaggregated occupational data (Kambourov and Manovskii, 2009). Another benefit of Helpman et al.'s (2017) classification system is the direct comparability of our results with other scholarly studies.

To classify the gender of firm leadership, we define a firm as having female leadership if females are employed as either managers or directors (equivalent to C-suite positions in the USA) in at least one of the years between 1995 and 2004. The occupation codes for these positions are listed in Appendix Table A.1. We define a firm as having male leadership if, between 1995 and 2004, females were never employed as either managers or directors. Even though a firm may employ a female in a leadership position only in 2004, we still classify this firm as female-led for the duration of our study. This is because hiring a female leader indicates an environment more amenable to female workers, which likely existed before hiring the female leader. Most importantly, it is unobservable to the researcher whether this firm had not previously hired a female leader due to search and matching frictions. Using this criterion, the sample has 49,803 female-led firms that, as a group, employed an average of 1,225,842 workers per year and 10,292 male-led firms that, as a group, employed an average of 1,813,944 workers per year.

Table 1 presents the firm-level descriptive statistics for all firms and the subsamples of female-led and male-led firms for 1995 and 2004. Columns 4 and 8 report a difference of means t test between female- and male-led firms. Relative to female-led firms, male-led firms have dramatically more employees and are more export-intensive. Female-led firms have a much smaller proportion of employees with college degrees and a smaller proportion of skilled workers. The remainder of Table 1 reports the proportion of female employees by selected worker attributes and occupations. Male-led firms employ a larger share of female workers in four occupational categories: Unskilled White-Collar (1995 only), Professional or Managerial, Skilled Blue-Collar, and Unskilled Blue-Collar. Female-led firms employ a significantly smaller proportion of female employees than male-led firms by college degree status and skill level. Next, we describe our construction of the other outcome of interest: the gender-based wage gap.

3.1 Male-Female Wage Gap

To construct the male-female wage gap, we follow Berik, Rodgers and Zveglich (2004). We first estimate a Mincer-type wage equation using data from male employees separately for each year of the data sample.

$$w_{ijt} = \theta_0 + \mathbf{x'_{it}}\gamma_\mathbf{t} + \epsilon_{ijt} \tag{1}$$

where w_{ijt} is the logarithm of the hourly wage received by worker i employed by firm j in year t, θ_0 is a constant, $\mathbf{x_{it}}$ is a vector of the worker's observable characteristics (age, age squared, years of education, college degree indicator, tenure at firm j, and state of residence fixed effects), and a stochastic disturbance term, ϵ_{ijt}.[7] The estimated coefficients of regressions based on Equation (1) are reported in Appendix Table A.2. We find evidence that the hourly wage is increasing in the worker's age at a decreasing rate and increasing in years of tenure. Each year of additional schooling has around a seven percent annual rate of return. Workers with a college degree earn 70% higher hourly wages. These estimates are comparable to those from the extant literature.

Using the estimated coefficients from Equation (1), we calculate the firm- and occupation–firm-level average male-female wage gap. For both male and female workers, we compute predictions of the worker's return to her observable characteristics component, $\widehat{s}_{it} \equiv \mathbf{x'_{it}}\widehat{\gamma}_{\mathbf{t}}$. Equation (2) illustrates the firm-level male-female wage gap as the difference between the average residual wage of male and female employees for each firm and year. $N^{♂}_{jt}$ is the number of male employees of firm j in year t. This difference in residuals captures the potential effect of discrimination on the returns of both observable and unobservable worker characteristics:

$$(\widehat{w^{♂} - w^{♀}})_{jt} \equiv \frac{1}{N^{♂}_{jt}} \sum_{k=1}^{N^{♂}_{jt}} (w_{ijt} - \widehat{s}_{kjt}) - \frac{1}{N^{♀}_{jt}} \sum_{k=1}^{N^{♀}_{jt}} (w_{ijt} - \widehat{s}_{kjt}) \tag{2}$$

In addition to the average male-female wage gap, we compute the difference in the standard deviation, the difference between male and female residuals at the 10^{th}, 50^{th}, and 90^{th} percentile. We compute the occupation-firm wage gap as the difference between the average residuals of male and female workers for each occupation-firm unit. We also calculate the firm-level wage gap for workers with and without college degrees and for skilled and unskilled workers. These measurements of the wage gap are only defined for firms with male and female employees in the category, which results in a smaller number of wage gap estimates for some categories.

Table 2 reports summary statistics for the male-female wage gap by occupational, skill,

[7] We do not include any controls for the worker's occupation or firm characteristics because the job held and its characteristics may be themselves the result of gender discrimination.

and education categories. Relative to male-led firms, the wage gap is larger in female-led firms for Unskilled White-Collar employees and Professional or Managerial employees. It is also smaller in female-led firms for Skilled Blue-Collar employees and Technical or Supervisory employees. When dividing employees by education level, we find that employees with college degrees experience a higher wage gap in female-led firms. Employees without college degrees exhibited a lower wage gap in female-led firms than in male-led firms in 1995 but a higher gap in 2004. Unskilled employees experience a smaller wage gap in female-led firms, while the wage gap for skilled workers in male-led firms was larger in 1995 and smaller in 2004 than that of female-led firms. The final row of Table 2 shows that male workers earned, on average, approximately 25 percent more than female workers. Female-led firms exhibited a narrower wage gap than male-led firms in 1995, which was reversed in 2004. Additionally, our data indicate that relative to male-led firms, female-led firms displayed a narrower wage gap for low-earnings workers (10^{th} percentile) and a wider gap for high-earners (90^{th} percentile).

3.2 Firm-size and Gender Outcomes Stylized Facts

The empirical literature contains several studies in which male-led and female-led firms diverge regarding gender-based outcomes such as female share and gender wage gap. Interestingly, no clear pattern emerges – female-led firms exhibit a wider wage gap in some studies and a narrower gap in others. While these studies differ in methodology and sample characteristics, none account for firm heterogeneity, especially in firm size as measured by the number of employees. Evidence shows that firm size is related to firm-level employment composition outcomes such as skills in both Mexico (Verhoogen, 2008) and Brazil (Araújo and Paz, 2014). However, a relationship between firm size and gender-related labor outcomes has yet to be explored. Heterogeneity in the employment level of female-led and male-led firms (Table 1, Row 1) could contribute to these divergent results. Suppose that female-led firms employ a larger share of female workers than male-led firms for firms of the same size.

But if male-led firms are, on average, larger than female-led firms, then it is possible to observe male-led firms employing a larger share of female employees. With this in mind, we proceed with an examination of firm size and gender outcomes using a cross-section linear regression of gender labor outcomes on firm size with industry and state fixed effects (Verhoogen, 2008).[8] Table 3 reports the coefficients of these regressions using data for 1995 and 2000. The first row of Table 3 shows a positive and statistically significant estimated coefficient of the firm size for the share of female workers in the all-firm sample similar to results found in U.S. data (Carrington and Troske, 1998).[9] We present this result as the first stylized fact.

Stylized Fact 1. *The share of female workers is positively related to the overall employment level of the firm.*

We split our sample by the gender of firm leadership. Female-led firms exhibit a positive correlation between firm size and female share; however, male-led firms exhibit a negative and significant correlation. We state these findings as the next stylized fact.

Stylized Fact 2. *The female share is larger in female-led firms than in male-led firms of similar size.*

Disaggregating by educational and skill categories, the female share among skilled and college degree holders is also increasing in firm size. Male-led firms exhibit a larger coefficient for the female share among college workers than female-led firms. While the coefficient for non-college workers and unskilled workers are positive for female-led firms, they are negative for male-led firms. For skilled workers, female-led firms show a positive coefficient. In contrast, male-led firms exhibited a positive and much smaller coefficient for 1995 and a negative

[8] Originally, Verhoogen's (2008) approach is motivated by a firm-level productivity heterogeneity model that in equilibrium exhibits firm output, employment, and exports increasing in firm productivity. Since productivity is not observable—or the data needed to estimate is unavailable—firm size is proxied by the natural logarithm of firm-level employment, as in Araújo and Paz (2014) and others.

[9] The estimated coefficients for the regressions using data for the remaining years have the same sign and statistical significance, albeit there is some variation in their magnitude.

coefficient for 2000.[10] The remaining rows of Table 3 report cross-sectional regressions of several male-female wage gap measurements on firm size. In the sixth row of Table 3, the estimated coefficient for firm size is positive and statistically significant for the average wage gap. This motivates the following stylized fact.

Stylized Fact 3. *The male-female wage gap is positively related to the overall employment level of the firm.*

Next, we contrast the magnitudes of the estimated effect of firm size on the wage gap by the gender of firm leadership. The estimated effects are positive and significant for each category of education and skill level for firms contained in Columns 7 through 10. When disaggregated by the gender of firm leadership, in Columns 2, 3, 5, and 6, the estimated coefficients for female-led firms are larger than that for male-led firms in almost all cases. This leads to the following stylized fact.

Stylized Fact 4. *The male-female wage gap is wider in female-led firms than male-led firms of similar size.*

Table 4 presents cross-section estimates for the five broad occupational groups. The female share is increasing in the firm size for each occupational group. It is greater in female-led firms, except for Unskilled Blue-Collar employees, where the coefficients for female- and male-led firms do not significantly differ. Turning to the male-female wage gap by occupational group, the estimated coefficients of firm size are positive, indicating a wider wage gap in larger firms, as in Stylized Fact 3. Interestingly, the estimated coefficients for female-led firms exceed those of male-led firms, consistent with Stylized Fact 4.

For most outcomes, the estimated coefficient using 1995 data (pre-devaluation) differs significantly from estimates using 2000 data (post-devaluation). These estimates should be interpreted as simple correlations only. The following section develops a theoretical model of

[10]This is the only outcome in Table 3 that exhibits alternating signs by year.

third-degree monopsonistic firms that replicates these stylized facts and justifies the empirical strategy used to estimate the causal effects of an unanticipated export shock on gendered labor outcomes of male- and female-led firms.

4 Theoretical Model

Analysis of labor markets frequently assumes many elements of the perfectly competitive model: homogeneity of both workers and jobs and many workers available to fill an individual job at the prevailing wage. If justified, individual firms have limited ability to deviate from local prevailing wages unless economic rent is present. Yet, much evidence exists that labor markets are less than perfectly competitive, such as firm-level wage premiums in Brazil (Krishna, Poole and Senses, 2012; Araújo and Paz, 2014) and in Italy (Macis and Schivardi, 2016). Such deviations from a competitive market wage may come from unionization, worker accumulation of firm-specific human capital, worker heterogeneity, and monopsonistic labor markets. Monopsony power can result from the disparate valuation of non-wage amenities, such as commuting time and work schedule flexibility to accommodate family needs. Under the assumption that both search costs for workers and recruitment costs for firms exist in the presence of heterogeneity, firms can exploit idiosyncratic tastes for non-wage amenities to exercise monopsony power.[11] Recent studies find evidence of monopsony power in Brazilian labor markets (Vick, 2017; Corradini et al., 2022; Sharma, 2023).[12] In light of these findings, we adapt the monopsonistic labor market framework of Card et al. (2018) to worker gender to provide theoretical motivation for the stylized facts presented earlier and frame our analysis of the effects of an export shock.

[11] See Manning (2011), Manning (2021), and Ashenfelter, Card, Farber and Ransom (2021) for a review of monopsonistic labor markets.

[12] See Berger, Herkenhoff and Mongey (2019) for evidence of monopsonistic labor markets in the U.S. and Hirsch, Jahn and Schnabel (2018) for Germany.

4.1 Labor supply

For each worker i in gender $g \in \{♀, ♂\}$, let the indirect utility of working at firm $j \in \{1..J\}$ be

$$U_{ijg} = \beta_g \ln(w_{jg} - b) + v_g(a_j) + \upsilon_{ijg} \tag{3}$$

where w_{jg} is the wage paid by firm i to workers of gender g, b is the wage available to the worker in their best alternative employment, $v_g(a_j)$ is the value to employees of non-wage amenities, including benefits, work schedule flexibility, and the gender of the firm leadership. We assume that amenities are a within-firm club good with a common valuation across all employees of the same gender within each firm. υ_{ijg} is the idiosyncratic preferences of worker i for working at firm j, such as commuting time. In line with the findings of Vick (2017) for the Brazilian labor market, we further assume that male employees place a higher value on relative wages than do females, expressed in the notation of our model as $\beta_{♂} > \beta_{♀}$.[13] Female employees place a higher value on amenities than do male employees, $v_{♀}(a_j) > v_{♂}(a_j)$, as found by Corradini et al. (2022). For ease of analysis, we normalize the values placed on amenities so that $v_{♂}(a_j) = 0$ and $v_{♀}(a_j)$ represents the additional value placed on amenities by female employees relative to male employees.

The probability that worker i is employed at firm j follows a multinomial logit specification (McFadden, 1973). Assuming a large number of firms J, the exponential approximation of the probability that a worker of gender g is employed at firm j is

$$p_{jg} = \gamma_g \exp(\beta_g \ln(w_{jg} - b) + v_g(a_j)) \tag{4}$$

where γ_g is a parameter shared by all firms. The approximate firm-level labor supply for

[13]For instance, Webber (2016) used U.S. LEHD data and found an elasticity of 0.94 for females and 1.09 for males.

workers of each gender are

$$\ln\left(S_{j\female}(w_{j\female},a_j)\right) = \ln\left(\mathbb{S}^{\female}\gamma_{\female}\right) + \beta_{\female}\ln\left(w_{j\female}-b\right) + v_{\female}(a_j) \tag{5}$$

$$\ln\left(S_{j\male}(w_{j\male},a_j)\right) = \ln\left(\mathbb{S}^{\male}\gamma_{\male}\right) + \beta_{\male}\ln\left(w_{j\male}-b\right) + v_{\male}(a_j) \tag{6}$$

where $\mathbb{S}^{\female}$ and $\mathbb{S}^{\male}$ are the total number of available workers by gender in the labor market and $\gamma_{\female}$ and $\gamma_{\male}$ are constants common to all firms.

Using Equations (5) and (6), the firm-level elasticity of labor supply by gender is

$$\epsilon_{jg} = \frac{\beta_g w_{jg}}{w_{jg}-b} \tag{7}$$

A convenient measurement of the gender balance in firm j is the difference of Equations (5) and (6)

$$\ln\left(\frac{S_{j\female}(\cdot)}{S_{j\male}(\cdot)}\right) = \ln\left(\frac{\mathbb{S}^{\female}\gamma_{\female}}{\mathbb{S}^{\male}\gamma_{\male}}\right) + \beta_{\female}\ln\left(w_{j\female}-b\right) - \beta_{\male}\ln\left(w_{j\male}-b\right) + v_{\female}(a_j) \tag{8}$$

where by assumption $v_{\male}(a_j)=0$. Each firm's gender balance is a function of the balance of the labor pool, wages offered by the firm, and the value workers place on non-wage amenities.

4.2 Monopsonistic firm

Each firm is a third-degree monopsonist, and labor by gender is assumed to be perfect substitutes. In a perfectly competitive labor market, an infinitely elastic labor supply forces firms to set wages to the marginal revenue product of labor. Deviations from a perfectly elastic labor supply allow firms to exploit labor, paying less than the marginal revenue product. Following Pigou (1924), let firm j's ability to "exploit" its workers, i.e., depress wages of workers below their marginal revenue product of labor, be

$$E_{jg} = \frac{1}{\epsilon_{jg}} \tag{9}$$

Let firm j have the production function

$$Y_j = f\left(S_{j♀}, S_{j♂}, T_j\right) \tag{10}$$

where T_j is a firm-specific productivity parameter and $f(\cdot)$ is a continuous production function twice differentiable in all parameters. To ensure a solution to the profit maximization problem of the monopsonist exists, let output increase in technology at a decreasing rate with positive marginal products of labor. It is also necessary that either $\partial^2 f\left(S_{j♀}, S_{j♂}, T_j\right)/\partial S_{j♀}^2 < 0$ and $\partial^2 f\left(S_{j♀}, S_{j♂}, T_j\right)/\partial S_{j♂}^2 < 0$ or some degree of product differentiation and market power to ensure the MRPL curve is downward sloping.[14] Given technology, firms choose wages and amenity levels to maximize profit

$$\max_{w_{j♀}\ w_{j♂}} Pf\left(S_{j♀}, S_{j♂}, T_j\right) - w_{j♀} \cdot S_{j♀}(w_{j♀}, a_j) - w_{j♂} \cdot S_{j♂}(w_{j♂}, a_j) - c(a_j)$$

subject to a constraint on the minimum level of amenities and firm technology. The first order condition for wages is

$$\frac{\partial \pi}{\partial w_{jg}} = MRPL_{jg}\frac{\partial S_{jg}}{\partial w_{jg}} - S_{jg} - w_{jg}\frac{\partial S_{jg}}{\partial w_{jg}} = 0 \tag{11}$$

for $g \in \{♀, ♂\}$.

[14]The precise mechanism used to ensure a downward-sloping MRPL curve is inconsequential to the subsequent analysis.

The first-order conditions for wages by gender can be rearranged as

$$\begin{aligned} w_{jg}\left(1+E_{jg}\right) &= P\frac{\partial f\left(S_{j♀}, S_{j♂}, T_j\right)}{\partial S_{jg}} \\ MCL_{jg} &= MRPL_{jg}\left(S_{j♀}, S_{j♂}, T_j\right) \end{aligned} \tag{12}$$

Note that an important feature of this model is that wages are increasing in firm productivity, and by Equations (5) and (6), labor supply is increasing in wages. Together, firm-level employment (hereafter, firm size) is increasing in productivity, as in the theoretical model of Melitz (2003), and empirically in Mexico (Verhoogen, 2008) and in Brazil (De Negri, 2005). Equation (12) can be further rearranged to solve for wages by gender.

$$w_{jg} = \frac{MRPL_{jg}\left(S_{j♀}, S_{j♂}, T_j\right)}{1+E_{jg}} \tag{13}$$

Combining this expression with Equations (7) and (9), the optimal wage for firm j is expressed as a weighted average of the reference wage from the competitive sector and the marginal revenue product of labor.

$$w_{jg} = \frac{1}{1+\beta_g}b + \frac{\beta_g}{1+\beta_g}MRPL_g\left(S_{j♀}, S_{j♂}, T_j\right) \tag{14}$$

Firm-level wages are increasing in productivity, which implies a positive relationship between firm size and wages. This is consistent with findings in Mexico (Verhoogen, 2008) and Brazil (Araújo and Paz, 2014). The male-female wage inequality by firm is calculated from Equation (13).

$$\frac{w_{j♂}}{w_{j♀}} = \frac{MRPL_{j♂}(1+E_{j♀})}{MRPL_{j♀}(1+E_{j♂})} > 1 \tag{15}$$

By the previous equation, the gender wage gap can mathematically be positive either if male workers are more productive than female workers or if the ability of firms to depress female wages below their marginal revenue product exceeds that of male workers. Under our simplifying assumption that female and male labor are perfect substitutes, marginal revenue products by gender are equal, and we attribute the gender wage gap to differing monopsony power by gender.

4.3 Wage and employment determination

We illustrate in Figure 1 the process of wage determination under our assumption that labor by gender are perfect substitutes. Smaller firm-level wage elasticity of labor supply for female than male employees is reflected in both a steeper slope for female labor supply and a wider gap between labor supply and MCL relative to male employees.[15] Equating $MRPL$ to MCL by gender determines the number of employees by gender and their respective pay. The monopsonistic firm pays workers of each gender the reservation wage of the marginal worker. With $0 < \epsilon_{j♀} < \epsilon_{j♂}$, $w_{♂} > w_{♀}$ even under the assumption that marginal revenue products are equal. Panel (a) of Figure 1 illustrates the case of a high-amenity firm and Panel (b) a low-amenity firm. By Equation (8), the gap between the vertical intercepts of labor supply by gender is wider in high-amenity firms than in low-amenity firms. As detailed in the Math Appendix A.2, a higher amenity level reduces wages paid to female workers. This causes firms to substitute higher-wage male workers for female workers, increasing the female employment share. Even though this substitution lowers male wages and attenuates the decline of female wages, the comparative statics presented in Math Appendix A.2 indicate that the gender wage gap widens.

In this model, costless amenities are supplied via the gender of the firm leadership, which we assume is considered an amenity only by female workers.[16] One possible justification could

[15] Recent empirical estimates of the firm-level wage elasticity of labor supply for male and female workers find lower elasticities for female than male workers using Norwegian data (Barth and Dale-Olsen, 2009), Australian data (Booth and Katic, 2011), U.S. data (Ransom and Oaxaca, 2010; Webber, 2015), German data (Hirsch, Schank and Schnabel, 2010), and in a meta-study (Sokolova and Sorensen, 2021). Of particular interest to our study, Vick (2017) uses matched employer-employee data from Brazil and finds male elasticities from 1.638 to 2.175 and female elasticities from 1.22 to 1.502.

[16] For the sake of simplicity, male workers are assumed to be indifferent regarding the gender of firm leadership.

be an absence of taste-based discrimination against female workers by female managers. Another possibility is that female leaders are seen as having a better assessment of the productivity of female workers (Flabbi et al., 2019).[17] Regardless of the specific mechanism, this assumption implies that relative to a male-led firm with identical productivity, a female-led firm will employ a larger share of female workers and have a wider male-female wage gap, as in Stylized Facts 2 and 4. Comparative statics in Appendix $A.2$ are consistent with both intuition and stylized facts. We present these results as our first two theorems. The proofs are in the Math Appendix.

Theorem 1. *High amenity firms are characterized by a wider gender wage gap relative to low amenity firms.*

Theorem 2. *High amenity firms are characterized by a larger share of female employees than low amenity firms.*

Next, we consider firm size as determined by the firm-specific productivity parameter T_j. It has direct theoretical effects on the gender wage gap and workforce balance. Comparative statics results summarized in Equation (26) indicate that more productive firms (larger T_j) will have a larger labor force. They will also exhibit a wider gender wage gap, consistent with Stylized Fact 3. We express this as the following theorem.

Theorem 3. *The gender wage gap will be wider in larger firms.*

Higher productivity will also affect the gender workforce balance. From Equation (27), larger firms will have a less balanced gender workforce, as stated in the theorem below.

Theorem 4. *The workforce will be less gender-balanced in larger firms.*

[17] Alternative explanations for the preference of female workers for female leadership include the idea expressed in the Sociology literature of female leaders as "agents of change" who promote gender-equalizing hiring practices and pay grades.

4.4 The Effects of an Exogenous Export Shock

To empirically estimate the differential effect of female leadership on the gender wage gap and workforce balance, we make use of an exogenous shock to firm demand caused by the large and unexpected 1999 Brazilian *Real* exchange rate devaluation. This shock increased the price charged by Brazilian firms in foreign markets as measured in local currency. Thus, we theoretically model a currency devaluation as a positive output price shock and derive the effects of such a price increase on wages and labor supply by gender in Math Appendix A.4.

Intuitively, the increase in output price causes profit-maximizing producers to expand their output level. This necessitates an expansion in employment. If the level of amenities is fixed in the short run, employment can only be increased by raising wages. Given the greater wage elasticity of labor supply for male workers, the marginal expense of additional male workers is less than that of additional female workers. Because of this, the proportion of female employees will decline.

Comparative statics show that female and male wages increase due to an output price increase. The first-order effects of an increase in the output price on the gender wage gap are net neutral, and by Equation (31), the sign of the second-order effects is ambiguous.

Theorem 5. *The effects of an exogenous output price shock on the gender wage gap are ambiguous and increasing in the overall employment of the firm.*

Comparative statics also show that firms will increase both female and male employment in response to an increase in the output good price. By Equation (32), the net effect on gender workforce balance will be negative.

Theorem 6. *An exogenous output price increase will reduce the firm-level share of female* *employees. The magnitude of this effect is decreasing in firm employment.*

Next, we develop the empirical framework used in this study.

5 Methodology

Our research design will exploit the plausibly exogenous variation caused by the 1999 devaluation of the Brazilian *Real* to examine whether exports shatter the glass ceiling. We begin with an overview of the 1999 devaluation of the *Real*.

5.1 Quasi-Natural Experiment

The fundamental barrier to identification that arises in evaluating the effect of exports on employment and wages is the simultaneity of firm choices regarding export status, wage policies, and workforce composition. Idiosyncratic productivity shocks could generate a spurious correlation between export status and wages if positive productivity shocks induce firms to enter into (or expand) the quantity of exports and also increase hiring and wage offers (Schank, Schnabel and Wagner, 2007). Exogenous variation in exporting is needed to identify the effect of increased exports on the outcomes of interest.

We exploit the large and unanticipated 1999 Brazilian *Real* exchange rate devaluation as an exogenous shock primarily affecting exporting firms. Export surges have been preceded by large real exchange rate devaluations in several developing countries, including Brazil (Freund and Pierola, 2012). The use of a large real exchange rate devaluation as an export shock has gained considerable attention in the literature and has been used to investigate other international trade-related issues in Mexico (Verhoogen, 2008), Argentina (Brambilla, Lederman and Porto, 2012), and Brazil (Araújo and Paz, 2014; Almeida and Poole, 2017).

In July of 1994, the Brazilian government implemented a new macroeconomic stabilization plan called the *Plano Real*. This plan successfully reduced the annual inflation rate from 2,500 percent in 1993 to a maximum of 12 percent in 2002. One of its prominent features was the adoption of a crawling-peg exchange rate system to restore public confidence in the domestic currency. After implementing the plan, the Brazilian government was unable to keep budget deficits under control. This slowly eroded the government's ability to sustain the crawling-peg system. In January 1999, an unexpected and large speculative attack on the domestic currency left the Brazilian government with no choice but to abandon the crawling peg and adopt a free-floating exchange rate system. Between the 13^{th} and the 29^{th} of January, the *Real* depreciated by approximately 50 percent. This large real exchange rate devaluation was not reverted in the following years, as shown in Figure 2.

In the aftermath of the devaluation, exports increased by more than 10 percent in 2000 relative to 1998 and by another 17 percent by 2002, as seen in Figure 3. This strong export growth continued in subsequent years and surpassed the seven percent per year threshold used by Freund and Pierola (2012) to characterize export surges. To ensure that exports are causing the labor force reallocation, the exchange rate shock must also increase the share of firm output that is exported. In the case of the Brazilian *Real* devaluation, the export share of output increased more than 30 percent between 1998 and 2004. Moreover, this increase in share was not simply a substitution of domestic for foreign demand. While manufacturing output remained roughly constant between 1995 and 1999, it increased by more than 20 percent between 1999 and 2004.[18] Thus, firms experienced an export-induced increase in demand and presumably had to adjust their employment level accordingly.[19]

For a devaluation to be effective in changing exporting firm behavior, it must be both unanticipated and perceived as permanent. Black markets for foreign currencies are a ubiquitous feature of developing economies. As the black market is free of any government controls,

[18] The manufacturing output and export share figures are available upon request.

[19] Another potential concern is the existence of a credit crunch in the aftermath of a major devaluation. From Figure A.1 in the Online Appendix, there was no contraction in the amount of outstanding loans in the period of interest and no break in the trend of credit expansion.

black market rates reflect agents' expectations. The absence of any substantial deviation between black-market exchange rates and the official exchange rate before the devaluation, as seen in Figure 4, is further evidence that the devaluation was not widely anticipated and that the exchange rate shock should be considered exogenous. Furthermore, we observe two factors in support of the Brazilian devaluation being perceived as permanent by exporting firms: The crawling peg exchange rate system was substituted by a floating regime, and the crawling-peg exchange rate misalignment was widely perceived as being caused by economic imbalances, which the Brazilian government did not address.

5.2 Empirical Methodology

We assess Theorems 1, 2, 5, and 6 by contrasting firm behavior before and after the positive export shock induced by the 1999 real exchange rate devaluation. The core of the empirical strategy comes from the theoretical model, in which a price shock affects firms in proportion to their productivity. Although all firms face the same shock, their responses are heterogeneous. Thus, we implement a difference-in-differences methodology to estimate an Average Treatment Effect. Since productivity is not observable, we use the firm-level size measured as $\ln(employment)$ as a proxy for productivity due to the strong positive correlation between productivity and employment in Brazilian firms (De Negri, 2005).[20]

Our benchmark econometric specification estimates a system of two equations similar to those used by Verhoogen (2008). In the first equation, the change in the outcome of interest between 1995 and 1998 (pre-devaluation period) is regressed on the initial period (1995) firm-level size. In the second equation, the change between 2004 and 2000 (post-devaluation period) in the outcome of interest is regressed on the post-devaluation initial period (2000) firm-level size, as depicted below.

[20] Unfortunately, the available data contain no other variable that could be used as a proxy for productivity. Nonetheless, Verhoogen (2008) and Frías, Kaplan and Verhoogen (2012) uses different proxies for Mexico (employment, sales, and sales per worker) and finds comparable results.

$$\Delta y_{98-95,j} = \mu_{pre} + \varphi_{0,j}\eta_{pre} + X_j\beta_{pre} + \epsilon_{pre,j} \tag{16}$$

$$\Delta y_{04-00,j} = \mu_{post} + \varphi_{0,j}\eta_{post} + X_j\beta_{post} + \epsilon_{post,j} \tag{17}$$

where $\Delta y_{98-95,j}$ and $\Delta y_{04-00,j}$ are the change of firm j's outcome of interest before and after the devaluation period, respectively. μ is the intercept, $\varphi_{0,j}$ is the initial period firm-level size, X_j is a matrix of additional regressors, including industry and state fixed effects and ϵ_j is the stochastic disturbance term.

Under this specification, the effect of the export shock on firm-level outcomes is computed as the difference between the post- and the pre-shock estimated coefficient of the initial period firm size, $\Delta\eta = \eta_{post} - \eta_{pre}$. Theorem 5 implies an ambiguous sign of $\Delta\eta$ for the male-female wage gap outcome. For the female share, Theorem 6 predicts a negative coefficient. Verhoogen (2008) motivated using the initial period firm-size explanatory variable to account for heterogeneous effects of the export shock by firm size.[21] That is, small firms are untreated by the devaluation of the *Real* and $\Delta\eta \approx 0$. Large firms that receive treatment in the form of expanded exports potentially experience $\Delta\eta \neq 0$.

Our identification strategy also assumes that the effect of unanticipated real exchange rate devaluation on exports is uncorrelated with other shocks that could differentially affect firms according to their size (Verhoogen, 2008). Under these conditions, while differential trends between small and large firms may exist, they are eliminated through differencing, leaving consistent estimates of the effect of the exchange rate shock. Firm productivity may be subject to time-varying shocks (Verhoogen, 2008). Although all firms receive such shocks, larger (or more productive) firms may receive more benefit from these shocks (Acemoglu, Aghion and Zilibotti, 2006). Because of this, the productivity innovation will be correlated

[21] This effect is also seen in models of monopolistic competition where firm sales, exports, and employment are monotonically increasing and continuous in firm productivity (Melitz, 2003).

with the initial firm size and $\widehat{\eta}$ will not be consistently estimated by ordinary least squares (OLS). However, if both the distribution of the productivity shocks and their effects on outcomes are time-invariant, the bias in $\widehat{\eta}$ is unchanged in both the pre- and post-devaluation period and is removed when differencing. Under this assumption of time-invariance, the OLS estimates of Equations (16) and (17) are consistent (Verhoogen, 2008).

Following Verhoogen (2008), we estimate Equations (16) and (17) as a Seemingly Unrelated Regression (SUR) and cluster standard errors at the industry level to account for industry-level heteroskedasticity and shocks. (Bertrand, Duflo and Mullainathan, 2004) Our specifications use long differences (1998–1995 and 2004–2000) in contrast to differences in adjacent years because firms may respond slowly to an unanticipated export shock. The percentage of female employees and wage gap outcome variables are themselves estimates. Because of this, we further correct for heteroskedasticity by weighting each firm-level observation by the square root of firm size measured by the number of employees used in the calculation of the estimated outcome.

Recent developments in the difference-in-differences methodology literature have called into question the statistical reliability of conventional panel fixed effects methods.[22] The average treatment effect, computed as a weighted average of the estimated individual firm or unit treatment effects, can contain negative weights. The likelihood of negative weights increases with differing lengths of treatment. When combined with heterogeneous treatment effects, the possibility exists for estimated average treatment effects of misleading magnitude or even mathematical sign. In our specific case, all firms are subject to the same length of treatment, decreasing the likelihood of negative weights when estimating an average treatment effect. In contrast to a conventional difference-in-differences design in which there are separate treatment and control groups, all firms receive the treatment of the devaluation. However, smaller non-export-oriented firms would not benefit from treatment.[23]

[22]See De Chaisemartin and d'Haultfoeuille (2020), Callaway and Sant'Anna (2021), and Goodman-Bacon (2021).

[23]Verhoogen (2008) explains that if there were two distinct groups of manufacturing firms with respect to

Directly estimating the effect of the gender of firm leadership on the gender wage gap and workforce balance is complicated by their endogeneity. However, the ability to compare the responses of female versus male-led firms to an exogenous shock enables us to obtain consistent estimates of the effect of female firm leadership. To do so, we estimate our difference-in-difference specifications separately for female and male-led firms and estimate a triple difference $\widehat{\Delta^2\gamma} = \widehat{\Delta\eta^{♀}} - \widehat{\Delta\eta^{♂}}$ by SUR. By using a triple difference estimator, our coefficients are robust with respect to several possible deficiencies, including the endogeneity of female leadership and heterogeneous time trends by gender. Theorem 1 implies $\widehat{\Delta^2\gamma} > 0$ for the male-female wage gap. Theorem 2 predicts $\widehat{\Delta^2\gamma} > 0$ for the share of female employees. In the next section, we present and discuss the estimates obtained using this methodology with Brazilian data.

6 Results

We begin with cross-section regressions on firm size (as proxied by employment) in both the pre and post devaluation periods and by the gender of firm leadership in Table 3. The estimated coefficients on $\ln(1+exports)$ is positive and highly significant across all specifications, indicating a strong positive correlation between firm size and exporting, as predicted by Melitz (2003). With this necessary condition for our empirical design met, we turn to gender-based outcomes. We find abundant evidence in Table 3 that the gender wage gap is wider in larger firms, consistent with Theorem 3. Estimated coefficients for the pre-devaluation period, the post-devaluation period, for all firms, and for firms by the gender of firm leadership are positive and highly significant. This is for the Male-Female wage gap for all employees, for employees disaggregated by whether they have a college degree, or disaggregated by whether their position is skilled or unskilled. The prediction of Theorem 4 of a negative effect of size on gender workforce balance can be seen in the estimated coeffi-

productivity instead of a continuum, his empirical methods could be characterized as a triple-difference.

cients for firm size reported for male-led firms in Table 3 columns (3) and (6). Nonetheless, female-led firms instead exhibit a positive coefficient in columns (2) and (5). Note that these cross-section estimates for female-led firms captures both the effects of Theorems 2 and 4. The conflicting implications of these theorems may lead to these positive estimated coefficients. Disaggregating by occupational categories in Table 4, larger, more productive firms have a wider gender wage gap, consistent with Theorem 3, with the exception of unskilled blue-collar employees in the post-devaluation period, two of which do not significantly differ from zero. By occupation, the proportion of female employees is now either greater or unchanged by firm size, all in conflict with Theorem 4.

In Table 5, we report estimates of Equations (16) and (17) and a difference-in-differences using data from all firms. In Column 1, the effects of the exchange rate shock on firm-level exports are estimated using $\ln(1 + exports_{jt})$ as the dependent variable. The estimated coefficient for firm size is positive and statistically significant in both the pre and post-devaluation periods, as found in Mexico (Verhoogen, 2008) and Brazil (Araújo and Paz, 2014). The coefficient for the post-devaluation period is substantially larger, as seen by the large and highly significant difference-in-differences estimated coefficient in the third row. Consistent with our identifying assumption, these estimates indicate that in response to the devaluation of the *Real*, firm-level exports increase, and more so in larger firms.

The remaining columns of Table 5 report difference-in-difference estimates for the percentage of female employees for all classifications of employees at all firms. For all workers, as reported in Column 2, the change in the percentage of female employees in all firms was not significantly affected by the positive output price shock caused by the devaluation of the *Real*. This result remains when disaggregating by whether an employee has earned a college degree. When disaggregating by whether a position is skilled, the percentage of female employees significantly increases in response to the output price shock for both skilled and unskilled employees. This is suggestive of export effects among employees with high school degrees only. Each of these results contradicts Theorem 6, which predicted the percentage of female employees would decrease.

Table 6 reports estimated changes in the male-female wage gap. After the devaluation, the overall wage gap widened more in larger firms, as seen in column (1). This result is caused by effects in median wage employees, as opposed to either high wage or low wage employees. Further disaggregation shows the impact on workers without college degrees and unskilled workers. In contrast, the wage gap for college-educated workers and skilled workers did not significantly change, consistent with Theorem 5.

Table 7 presents estimates for employees by the five broad occupational categories. The difference-in-difference estimated coefficients (third row) for the percentage of female employees (odd columns) are positive and highly significant for Professional or Managerial employees and Technical or Supervisory employees, marginally significant for Unskilled White Collar employees, and otherwise insignificant. As with the more aggregated estimates, these conflict with Theorem 6. In contrast, the estimated effects on the Male-Female wage gap do not significantly differ from zero, as predicted by Theorem 5 for all occupational categories except Skilled Blue Collar employees. Although we do not have data to measure changes in the levels of non-wage amenities, note that an increase in the percentage of female employees without a corresponding increase in relative wages for Professional or Managerial and Technical or Supervisory employees is suggestive of additional non-wage compensation.

We repeat the previous difference-in-differences analyses for the subsample of female-led and male-led firms and estimate a triple difference, which is the additional response of female-led firms to the exogenous output price shock relative to male-led firms. We report estimated coefficients in Tables 8 through 10. We first examine the change in firm exports, reported in Table 8 Column (1). In Panel A, female-led firms have a positive but insignificant change in exports. In contrast, the exports of male-led firms do significantly increase in response to the devaluation (Panel B). The difference in the reaction of female-led and male-led firms is negative and highly significant, as seen in Panel C. Male-led firms are more responsive than female-led firms to the export-induced demand shock.

The remainder of Table 8 provides estimates of changes in the percentage of female employees. Panel A shows that the export shock induced female-led firms to increase their share of female workers across all categories except for workers with college degrees. In contrast, there was no significant change in the percentage of female employees in male-led firms (Panel B). This result is consistent with Theorem 6. In Panel C, the additional increase in the percentage of female workers in female-led firms relative to male-led firms is positive in all categories but positive and significant only for employees with a college degree. This result is consistent with Theorem 2.

Table 9 reports differential changes by type of firm leadership for the male-female wage gap outcomes. From Panel A, we can see that the export shock induced female-led firms to widen the average wage gap and the wage gap of the other subcategories. However, it was insignificant for skilled workers, the median, and the 90^{th} percentile. The only case of a narrowing wage gap took place among college workers. Interestingly, a similar pattern emerges for male-led firms, though the magnitude of the coefficients is smaller in almost all cases. As a result, the triple difference estimated coefficients in Panel C are positive, in contrast with Theorem 1. There are two exceptions: with two standard deviations of the wage gap and the wage gap of unskilled employees, both of which are negative but do not significantly differ.

Table 10 reports estimates disaggregated by occupational category. For female-led firms in Panel A, the change in the percentage of female employees increased in all categories except for Unskilled White-Collar employees, which remained unchanged. In three of the occupational categories, the wage gap also significantly increased. The absence of a similar pattern in Panel B is a fascinating contrast between female and male-led firms. By comparison, the male-led firms' only statistically significant results are a widening wage gap for Skilled Blue Collar and an increase in the female share for Technical and Supervisory. In Panel C, we find that female and male-led firms respond to the exogenous price shock differently only for Professional and Managerial employees, whereas female-led firms have both a larger increase in the percentage of female employees and the male-female wage gap. However, these seemingly contradictory results are consistent with both Theorems 1 and 2. The remaining triple-difference coefficients are imprecisely estimated.

6.1 Discussion

The empirical estimates obtained in this study provide evidence that gender-based labor outcomes are related to firm size, and that female-led firms respond differently to an export shock than male-led firms, even after controlling for firm size. We find empirical evidence broadly consistent with the Theorems developed from our monopsonistic model of the labor market.

Turning to the scholarly literature and alternate explanations for our findings, Black and Strahan (2001) find more equal rent-sharing between female and male employees after a negative demand shock induced by the reform of interstate banking rules in the United States – a narrowing of the gender wage gap. We find that in response to the positive demand shock induced by the devaluation of the *Real*, the average wage gap widened, consistent with Black and Strahan (2001). Note that a positive correlation between the wage gap and economic profits is also predicted by a model of employer-based discrimination, where more productive (and larger and more profitable) firms will discriminate more if their owner has a taste for discrimination (Becker, 2010). Our findings for female-led firms conflict with the results of Becker's model for two reasons. First, as firm size is positively correlated with gender disparities in these firms, this widening wage gap could be interpreted as employers not practicing taste-based discrimination. Second, the Becker model also predicts that a positive shock to economic profits leads to a smaller female share; that is, the wage gap and female share should move in opposite directions after the shock. While this result is supported by the findings of Black and Brainerd (2004) that the negative shock from globalization led to a greater female share in manufacturing employment in the United States, it does conflict with our results that a positive shock increased female share.[24]

Our study relates to the literature on the effects of mandated increased female representation in Norwegian corporate boards of directors. Our results most closely resemble those of Bertrand et al. (2019), who find that increased female representation in the C-suite caused the gender pay gap to decline among corporate board members but not for other categories of employees. We find that in female-led firms, the workforce gender balance significantly improved relative to male-led firms only for college-educated employees and for Professional and Managerial employees. We interpret this as further cracks in the glass ceiling. In contrast, the gender pay gap further widened in female-led firms for Professional and Managerial employees. This result conflicts with Flabbi, Piras and Abrahams (2017), who find a smaller gender wage gap in female-run Latin American and Caribbean manufacturing firms (Flabbi et al., 2017) but is consistent with the predictions of our model of a monopsonistic labor market.

6.2 Robustness Checks

We use two approaches to examine the robustness of our findings that female and male-led firms differ in their responses to an exogenous demand shock. First, we implement an alternate statistical inference methodology where the gender of firm leadership is counterfactually assigned by random, or randomization-based inference. In the second robustness check, we implement an alternate definition of a female-led firm and re-estimate the main specifications of our model.

[24]Both Paz and Ssozi (2021) using Brazilian industry-level household data and the 2000s China shock were inconsistent with Becker's model.

Athey and Imbens (2017) argue for using randomization-based inference methods in both laboratory and natural economic experiments. The data sets used in these experimental designs contain the universe of all available observations. It follows that stochastic variation in estimated parameters is caused by the assignment of treatment status and not sampling from a larger population as when using conventional sampling-based inference. To implement randomization inference methods within our study, we re-estimate the triple-difference specifications 5,000 times with random reassignment of the treatment status, whether an individual firm is female-led. In the bottom row of Tables 8, 9, and 10, we report the inverse empirical cumulative distribution of each estimated coefficient in square brackets with statistical significance indicated by the number of $^{+}$ signs. In Table 8, Column (1), the inverse empirical cumulative distribution of the quad difference estimated parameter -0.110 is indicated in square brackets as 0.003 or $[F^{-1}(-0.110) = 0.003]$, meaning that 0.3% of the 5,000 estimated coefficients using randomly assigned counterfactual treatment status were less than -0.110, the coefficient found using actual treatment status. This result is significant at a 1% level, as indicated by $^{+++}$.

Using randomization-based inference methods, we find significance levels broadly consistent with those found using clustered standard errors with two noteworthy exceptions. In Table 9, Column (3), randomization methods indicate that the difference in the change of the 10^{th} percentile of the male-female wage gap is significant at a 5% level $F^{-1}(0.009) = 0.993$,[25] but using clustered standard errors, the difference is not significant. We also find a large disagreement in significance levels in Table (10). In column 4, the change in the male-female wage gap for Professional and Managerial employees is significant at the 1% level using clustered standard errors but insignificant using randomization methods. In columns 8 and 9, the coefficients are significant at the 10% level, while they are insignificant using clustered methods. In summary, we find broad agreement in the significance levels of our results whether

[25] We implement two-tailed tests of significance. Results are significant at the 5% level if $F^{-1}(0.009) < 0.025$ or $F^{-1}(0.009) > 0.975$.

using conventional clustered standard errors or randomization inference methods. We find the two points of wider disagreement between the two inference methodologies interesting, but a careful examination of the difference is beyond the scope of this paper.

In the next robustness check, we define female-led firms to be those that exhibited at least one female in a leadership position for at least one year between 1995 and 1998, while male-led firms are defined as before. As a result, firms with females in leadership positions only after 1998 are excluded from the sample and the number of female-led firms declines to 10,993. We then re-estimate the triple-difference econometric models reported in Tables 8 through 10. These new estimates are in the Online Appendix in Tables A.3 through A.5, respectively. Only the new estimates in Panels A and C of these new tables will differ from those using the original female-led firm definition. The results in the third row of Panel A in Table A.3 are comparable to those in Table 8, except that the coefficients for female share college and skilled workers do not significantly differ from zero. Except for the female share of skilled workers, the other triple-difference coefficients in Panel C are positive, although imprecisely estimated. This is not unexpected, given the complexity of our models and the drastic reduction in sample size.

For the wage gap outcomes, Table A.4 reports in the third row of Panel A estimates with comparable signs to those of Table 9. Nevertheless, for the 10^{th} percentile and unskilled worker wage gap, the estimated coefficients are now negative and are of a much smaller magnitude. Only the estimated effect on the gender wage gap for employees with a college education is statistically significant. In Panel C, most coefficients are near zero and lack statistical significance. Finally, at the occupational level, the estimates displayed in the third row of Panel A in Table A.5 present a few sign reversals relative to those in Table 10. In Panel C, the results indicate a narrowing wage gap for Managerial and Professional, and Unskilled Blue Collar employees, and an increase in the female share of Unskilled Blue Collar employees.

The estimated coefficients of this robustness exercise indicate that removing the firms that only hired female managers after the devaluation did not substantially change the estimated response to the exchange rate devaluation of the remaining female-led firms. However, the coefficients had a smaller magnitude and were imprecisely estimated, possibly caused by the large reduction in sample size. Our results are robust to the definition of a female-led firm.

7 Conclusion

To examine the effect of female leadership on firm-level gender equality outcomes, we construct a model of male and female workers who choose between firms with monopsony power based on wages and amenities. In our model, amenities are considered a within-firm club good, which provide more utility to female workers than male workers, resulting from social norms leading to different roles in the household based on gender. Within this context, female leadership is modeled as an increase in firm-level amenities due to a better understanding of the value and needs of female employees. Our model predicts results by firm size, the response to shocks to the output price, and the effects of firm amenities, i.e., female leadership. Most interestingly, our model predicts that female-led firms will be characterized by both a larger gender wage gap and a more gender-balanced workforce relative to male-led firms. We use Brazilian administrative employer-employee matched data to test these predictions and evaluate the additional effect of female firm leadership relative to male leadership. Our triple-difference model corrects for various endogeneity and selection issues by comparing changes in outcomes of interest before versus after the large unanticipated devaluation of the Brazilian *Real* in manufacturing firms with female versus male leadership.

Firms responded to the increased export demand induced by the exogenous price shock by a further widening of the overall gender wage gap and an increase in the share of female employees for some but not all occupations. We do find heterogeneous responses by the gender of firm leadership. Among professional or managerial employees, we observe highly significant results consistent with the predictions of our theoretical model. Female-led firms will exhibit less equal wages and a greater share of female employees than male-led firms. For other occupational groups, by skill level, educational level, and in aggregate, we find evidence broadly consistent with the theoretical predictions of our model regarding the gender of firm leadership but, in some cases, lacking statistical significance. Overall, we find evidence that the glass ceiling is being further cracked by an export shock in firms that have females in leadership positions, though these same forces appear to reinforce the gender wage gap.

References

ACEMOGLU, D., P. AGHION, AND F. ZILIBOTTI (2006): "Distance to Frontier, Selection, and Economic Growth," *Journal of the European Economic Association*, 4, 37–74.

ALMEIDA, R. K., AND J. P. POOLE (2017): "Trade and Labor Reallocation With Heterogeneous Enforcement of Labor Regulations," *Journal of Development Economics*, 126, 154–166.

ARAÚJO, B. C., AND L. S. PAZ (2014): "The Effects of Exporting on Wages: An Evaluation Using the 1999 Brazilian Exchange Rate Devaluation," *Journal of Development Economics*, 111, 1–16.

ASHENFELTER, O., D. CARD, H. S. FARBER, AND M. R. RANSOM (2021): "Monopsony in the Labor Market New Empirical Results and New Public Policies,"Technical Report Working Paper 652, IRS Working Papers.

ATHEY, S., AND G. W. IMBENS (2017): "The Econometrics of Randomized Experiments," in *Handbook of Economic Field Experiments* Volume 1: Elsevier, 73–140.

BARON, J., B. GANGLMAIR, N. PERSICO, T. SIMCOE, AND E. TARANTINO (2024): "Representation is not sufficient for selecting gender diversity," *Research Policy*, 53, 104994.

BARTH, E., AND H. DALE-OLSEN (2009): "Monopsonistic Discrimination, Worker Turnover, and the Gender Wage Gap," *Labour Economics*, 16, 589–597.

BECKER, G. S. (2010): *The Economics of Discrimination*: University of Chicago press.

BERGER, D. W., K. F. HERKENHOFF, AND S. MONGEY (2019): "Labor Market Power," Working Paper 25719, National Bureau of Economic Research, 10.3386/w25719.

Berik, G., Y. v. d. M. Rodgers, and J. E. Zveglich (2004): "International Trade and Gender Wage Discrimination: Evidence From East Asia," *Review of Development Economics*, 8, 237–254.

Bertrand, M., S. E. Black, S. Jensen, and A. Lleras-Muney (2019): "Breaking the Glass Ceiling? The Effect of Board Quotas on Female Labour Market Outcomes in Norway," *The Review of Economic Studies*, 86, 191–239.

Bertrand, M., E. Duflo, and S. Mullainathan (2004): "How Much Should We Trust Differences-in-Differences Estimates?" *The Quarterly Journal of Economics*, 119, 249–275.

Black, S. E., and E. Brainerd (2004): "Importing Equality? The Impact of Globalization on Gender Discrimination," *ILR Review*, 57, 540–559.

Black, S. E., and P. E. Strahan (2001): "The Division of Spoils: Rent-Sharing and Discrimination in a Regulated Industry," *American Economic Review*, 91, 814–831.

Booth, A. L., and P. Katic (2011): "Estimating the Wage Elasticity of Labour Supply to a Firm: What Evidence Is There for Monopsony?" *Economic Record*, 87, 359–369.

Brambilla, I., D. Lederman, and G. Porto (2012): "Exports, Export Destinations, and Skills," *American Economic Review*, 102, 3406–38.

Callaway, B., and P. H. Sant'Anna (2021): "Difference-in-Differences With Multiple Time Periods," *Journal of Econometrics*, 225, 200–230.

Card, D., A. R. Cardoso, J. Heining, and P. Kline (2018): "Firms and Labor Market Inequality: Evidence and Some Theory," *Journal of Labor Economics*, 36, S13–S70.

Cardoso, A. R., and R. Winter-Ebmer (2010): "Female-Led Firms and Gender Wage Policies," *ILR Review*, 64, 143–163.

Carrington, W. J., and K. R. Troske (1998): "Sex Segregation in U.S. Manufacturing," *Industrial and Labor Relations Review*, 51, 445–464.

Cohen, P. N., and M. L. Huffman (2007): "Working for the Woman? Female Managers and the Gender Wage Gap," *American Sociological Review*, 72, 681–704.

Corradini, V., L. Lagos, and G. Sharma (2022): "Collective Bargaining for Women: How Unions Can Create Female-Friendly Jobs,"Technical Report 15552, IZA Discussion Paper.

De Chaisemartin, C., and X. d'Haultfoeuille (2020): "Two-Way Fixed Effects Estimators With Heterogeneous Treatment Effects," *American Economic Review*, 110, 2964–96.

De Negri, F. (2005): "Padrões Tecnológicos E De Comércio Exterior Das Firmas Brasileiras," in *Inovações, padrões tecnológicos e desempenho das firmas industriais brasileiras. Brasília: IPEA*.

Flabbi, L., M. Macis, A. Moro, and F. Schivardi (2019): "Do Female Executives Make a Difference? The Impact of Female Leadership on Gender Gaps and Firm Performance," *The Economic Journal*, 129, 2390–2423.

Flabbi, L., C. Piras, and S. Abrahams (2017): "Female Corporate Leadership in Latin America and the Caribbean Region: Representation and Firm-Level Outcomes," *International Journal of Manpower*, 38, 790–818.

Freund, C., and M. D. Pierola (2012): "Export Surges," *Journal of Development Economics*, 97, 387–395.

Frías, J. A., D. S. Kaplan, and E. Verhoogen (2012): "Exports and Within-Plant Wage Distributions: Evidence From Mexico," *American Economic Review*, 102, 435–40.

Goodman-Bacon, A. (2021): "Difference-in-Differences With Variation in Treatment Timing," *Journal of Econometrics*, 225, 254–277.

Helpman, E., O. Itskhoki, M.-A. Muendler, and S. J. Redding (2017): "Trade and Inequality: From Theory to Estimation," *Review of Economic Studies*, 84, 357–405.

Hensvik, L. E. (2014): "Manager Impartiality: Worker-Firm Matching and the Gender Wage Gap," *ILR Review*, 67, 395–421.

Hirsch, B. (2013): "The Impact of Female Managers on the Gender Pay Gap: Evidence From Linked Employer–Employee Data for Germany," *Economics Letters*, 119, 348–350.

Hirsch, B., E. Jahn, and C. Schnabel (2018): "Do Employers Have More Monopsony Power in Slack Labor Markets?" *ILR Review*, 71, 676–704.

Hirsch, B., T. Schank, and C. Schnabel (2010): "Differences in Labor Supply to Monopsonistic Firms and the Gender Pay Gap: An Empirical Analysis Using Linked Employer-Employee Data From Germany," *Journal of Labor Economics*, 28, 291–330.

Huber, K., V. Lindenthal, and F. Waldinger (2019): "Discrimination, Managers and Firm Performance: Evidence From" Aryanizations" in Nazi Germany,"Technical Report 1599, Centre for Economic Performance, LSE.

Kambourov, G., and I. Manovskii (2009): "Occupational Mobility and Wage Inequality," *Review of Economic Studies*, 76, 731–759.

Krishna, P., J. P. Poole, and M. Z. Senses (2012): "Trade, Labor Market Frictions, and Residual Wage Inequality Across Worker Groups," *American Economic Review*, 102, 417–23.

Kunze, A., and A. R. Miller (2017): "Women Helping Women? Evidence From Private Sector Data on Workplace Hierarchies," *Review of Economics and Statistics*, 99, 769–775.

Macis, M., and F. Schivardi (2016): "Exports and Wages: Rent Sharing, Workforce Composition, or Returns to Skills?" *Journal of Labor Economics*, 34, 945–978, 10.1086/686275.

Madalozzo, R. (2011): "CEOs and Board Composition: Can the Lack of Identification be a Reason for Glass Ceilings in Brazil?" *Revista de Administração Contemporânea*, 15, 126–137.

Maida, A., and A. Weber (2019): "Female Leadership and Gender Gap Within Firms: Evidence From an Italian Board Reform," *ILR Review*, 0019793920961995.

Manning, A. (2011): "Chapter 11 - Imperfect Competition in the Labor Market," in *Handbook of Labor Economics* ed. by Card, D., and Ashenfelter, O. Volume 4: Elsevier, 973–1041, https://doi.org/10.1016/S0169-7218(11)02409-9.

——— (2021): "Monopsony in Labor Markets: A Review," *ILR Review*, 74, 3–26, 10.1177/0019793920922499.

Matsa, D. A., and A. R. Miller (2013): "A Female Style in Corporate Leadership? Evidence From Quotas," *American Economic Journal: Applied Economics*, 5, 136–69.

McFadden, D. (1973): "Conditional Logit Analysis of Qualitative Choice Behavior in Frontier of Econometrics," *Frontiers in Econometrics*, 105–142.

Melitz, M. J. (2003): "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," *Econometrica*, 71, 1695–1725.

Paz, L. S. (2014): "The Impacts of Trade Liberalization on Informal Labor Markets: A Theoretical and Empirical Evaluation of the Brazilian Case," *Journal of International Economics*, 92, 330–348.

Paz, L. S., and J. Ssozi (2021): "The Effects of Chinese Imports on Female Workers in the Brazilian Manufacturing Sector," *The Journal of Development Studies*, 57, 807–823.

Pigou, A. C. (1924): *The Economics of Welfare*: Macmillan.

Pitts, J., S. Orozco-Aleman, and J. Rezek (2014): "The Role of Supervisors in the Determination of Wages and Wage Gaps," *Applied Economics*, 46, 3533–3547.

Ransom, M. R., and R. L. Oaxaca (2010): "New Market Power Models and Sex Differences in Pay," *Journal of Labor Economics*, 28, 267–289.

Schank, T., C. Schnabel, and J. Wagner (2007): "Do Exporters Really Pay Higher Wages? First Evidence From German Linked Employer–Employee Data," *Journal of International Economics*, 72, 52–74.

Sharma, G. (2023): "Monopsony and Gender."

Sokolova, A., and T. Sorensen (2021): "Monopsony in Labor Markets: A Meta-Analysis," *ILR Review*, 74, 27–55.

Stojmenovska, D. (2019): "Management Gender Composition and the Gender Pay Gap: Evidence From British Panel Data," *Gender, Work & Organization*, 26, 738–764.

Tsou, M.-W., and C.-H. Yang (2019): "Does Gender Structure Affect Firm Productivity? Evidence From China," *China Economic Review*, 55, 19–36.

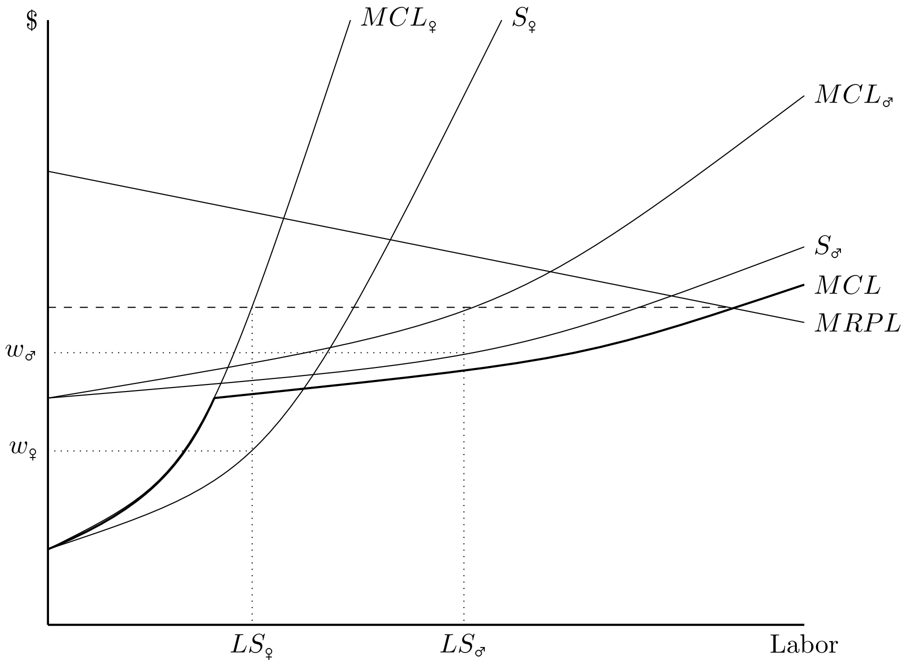
Verhoogen, E. A. (2008): "Trade, Quality Upgrading, and Wage Inequality in the Mexican Manufacturing Sector," *The Quarterly Journal of Economics*, 123, 489–530.

Vick, B. (2017): "Measuring Links Between Labor Monopsony and the Gender Pay Gap in Brazil," *IZA Journal of Development and Migration*, 7, 1–28.

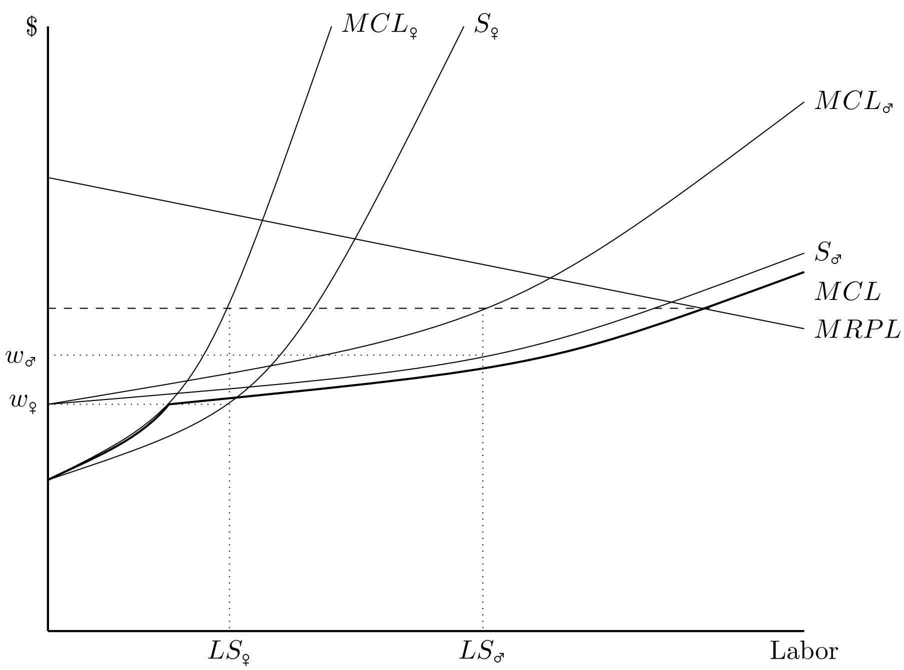
Webber, D. (2016): "Firm-Level Monopsony and the Gender Pay Gap," *Industrial Relations: A Journal of Economy and Society*, 55, 323–345.

Webber, D. A. (2015): "Firm Market Power and the Earnings Distribution," *Labour Economics*, 35, 123–134.

Figure 1: Third Degree Monopsony Wages



(a) High Amenity Firm



(b) Low Amenity Firm

Figure 2: Monthly real exchange rate index

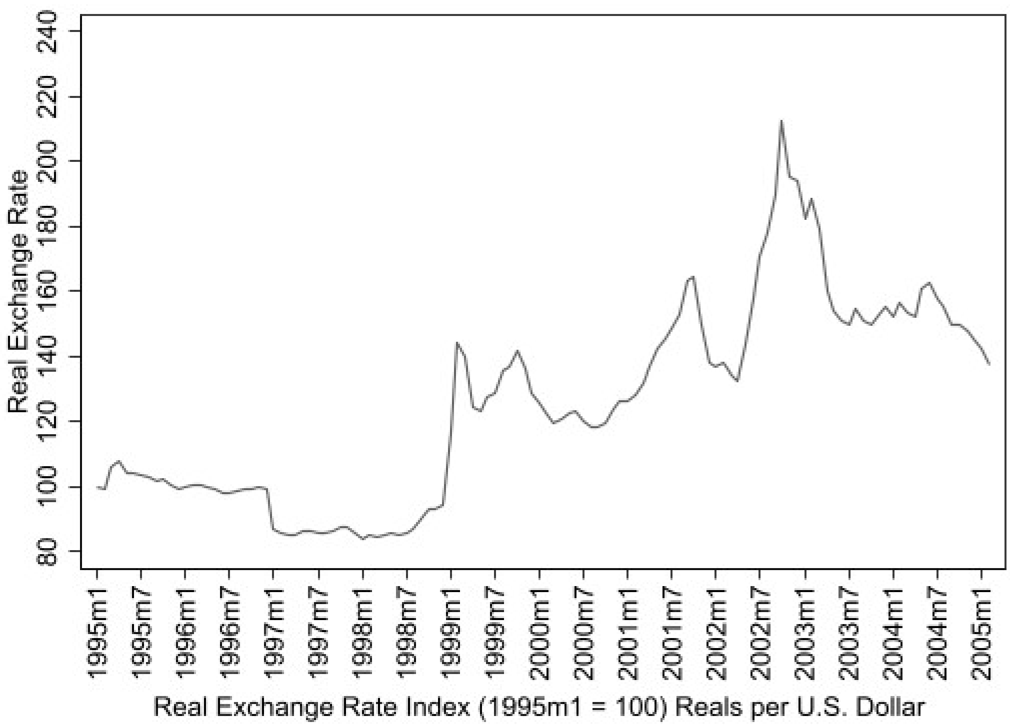


Figure 3: Nominal export volume of manufacturing in billions of USD and Export share of domestic manufacturing output for Brazil.

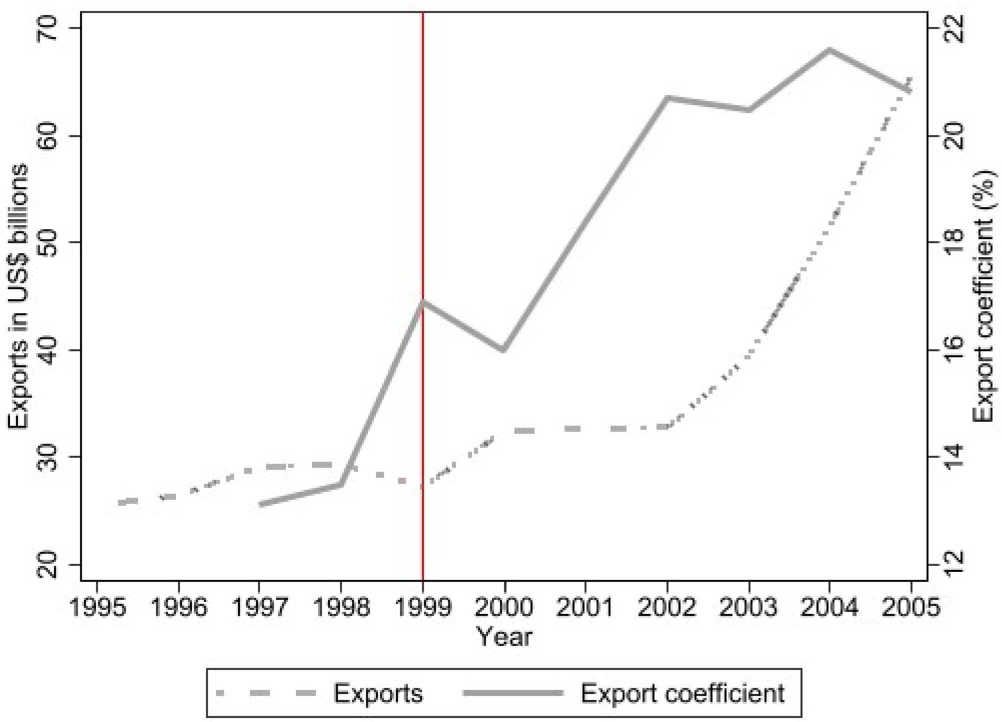


Figure 4: Nominal official and nominal black market exchange rate.

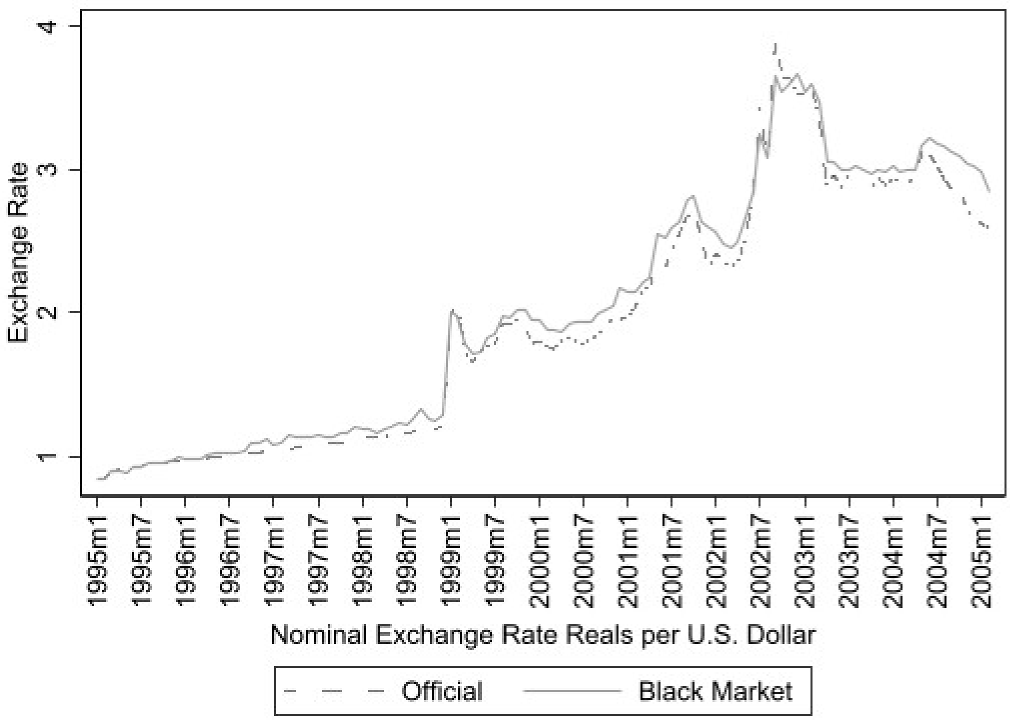


Table 1: Summary Statistics: Balanced Panel

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	1995 Sample				2004 Sample			
VARIABLES	Sample	Female	Male	t	Full	Female	Male	t
Employment	51.791	25.741	177.850	-19.000	53.461	24.459	193.802	-21.750
	(356.068)	(115.228)	(810.509)	***	(346.408)	(106.996)	(788.389)	***
	[60,095]	[49,803]	[10,292]		[60,095]	[49,803]	[10,292]	
ln(1+Exports)	0.985	0.605	2.822	-40.576	1.280	0.776	3.724	-48.374
	(3.386)	(2.635)	(5.412)	***	(3.852)	(2.983)	(6.032)	***
	[60,095]	[49,803]	[10,292]		[60,095]	[49,803]	[10,292]	
College Degree	0.015	0.011	0.030	-25.288	0.025	0.019	0.056	-35.086
	(0.063)	(0.061)	(0.071)	***	(0.078)	(0.071)	(0.102)	***
	[60,095]	[49,803]	[10,292]		[60,095]	[49,803]	[10,292]	
Skilled Employee	0.111	0.101	0.161	-28.590	0.262	0.240	0.367	-45.831
	(0.191)	(0.188)	(0.195)	***	(0.268)	(0.265)	(0.254)	***
	[60,095]	[49,803]	[10,292]		[60,095]	[49,803]	[10,292]	
Proportion of Female Employees								
Unskilled White Collar	0.358	0.352	0.369	-3.264	0.377	0.375	0.381	-1.183
	(0.373)	(0.391)	(0.329)	***	(0.388)	(0.406)	(0.345)	
	[21,012]	[14,475]	[6,537]		[24,253]	[16,763]	[7,490]	
Professional or Managerial	0.378	0.369	0.400	-6.077	0.359	0.292	0.507	-50.469
	(0.383)	(0.401)	(0.337)	***	(0.378)	(0.379)	(0.330)	***
	[23,322]	[16,293]	[7,029]		[30,811]	[21,248]	[9,563]	
Skilled Blue Collar	0.211	0.196	0.281	-22.647	0.195	0.183	0.250	-18.299
	(0.331)	(0.328)	(0.340)	***	(0.323)	(0.320)	(0.327)	***
	[56,322]	[46,503]	[9,819]		[54,576]	[44,968]	[9,608]	
Technical or Supervisory	0.513	0.516	0.506	2.140	0.516	0.519	0.508	2.794
	(0.390)	(0.407)	(0.338)	**	(0.377)	(0.393)	(0.314)	***
	[30,549]	[22,683]	[7,866]		[40,997]	[31,719]	[9,278]	
Unskilled Blue Collar	0.181	0.166	0.228	-9.413	0.191	0.175	0.235	-11.300
	(0.315)	(0.309)	(0.328)	***	(0.320)	(0.314)	(0.329)	***
	[12,911]	[9,704]	[3,207]		[19,133]	[14,018]	[5,115]	
College Degree	0.345	0.334	0.362	-4.171	0.416	0.380	0.471	-15.210
	(0.364)	(0.387)	(0.327)	***	(0.386)	(0.412)	(0.336)	***
	[11,484]	[6,913]	[4,571]		[15,860]	[9,673]	[6,187]	
No College Degree	0.264	0.245	0.355	-33.043	0.281	0.262	0.372	-34.735
	(0.318)	(0.318)	(0.305)	***	(0.311)	(0.312)	(0.288)	***
	[59,978]	[49,696]	[10,282]		[59,985]	[49,708]	[10,277]	
Skilled	0.412	0.403	0.440	-8.501	0.403	0.385	0.467	-22.892
	(0.366)	(0.384)	(0.305)	***	(0.354)	(0.367)	(0.293)	***
	[29,793]	[22,238]	[7,555]		[44,131]	[34,516]	[9,615]	
Unskilled	0.250	0.233	0.336	-29.592	0.253	0.236	0.334	-28.439
	(0.324)	(0.322)	(0.319)	***	(0.323)	(0.323)	(0.313)	***
	[59,094]	[48,913]	[10,181]		[58,023]	[47,921]	[10,102]	
All Employees	0.265	0.246	0.357	-33.653	0.285	0.265	0.382	-37.627
	(0.317)	(0.317)	(0.302)	***	(0.309)	(0.311)	(0.282)	***
	[60,095]	[49,803]	[10,292]		[60,095]	[49,803]	[10,292]	

Notes: Standard deviations appear below each mean in parentheses. All statistics are annual data reported at the firm level. The first four rows contain data that is not gender specific. The following rows report the percentage of female employees by occupation, skill, and educational level. Columns 4 and 8 contain an equality of female and male sample means t test with unequal variances. *** $p < 0.01$, ** $0.01 \leq p < 0.05$, * $0.05 \leq p < 0.1$.

Table 2: Summary Statistics: Male-Female Wage Gap

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	1995 Sample				2004 Sample			
VARIABLES	Sample	Female	Male	t	Full	Female	Male	t
Unskilled White Collar	0.228	0.239	0.214	2.934	0.188	0.195	0.178	2.184
	(0.427)	(0.462)	(0.376)	***	(0.403)	(0.428)	(0.370)	**
	[9,676]	[5,420]	[4,256]		[10,520]	[5,825]	[4,695]	
Professional or Managerial	0.400	0.401	0.399	0.187	0.341	0.387	0.294	9.965
	(0.556)	(0.601)	(0.493)		(0.544)	(0.563)	(0.520)	***
	[10,446]	[5,860]	[4,586]		[13,488]	[6,747]	[6,741]	
Skilled Blue Collar	0.216	0.204	0.249	-8.813	0.226	0.215	0.254	-8.019
	(0.349)	(0.361)	(0.316)	***	(0.316)	(0.324)	(0.295)	***
	[20,492]	[14,687]	[5,805]		[18,843]	[13,328]	[5,515]	
Technical or Supervisory	0.223	0.208	0.248	-4.899	0.228	0.219	0.245	-4.286
	(0.494)	(0.525)	(0.436)	***	(0.451)	(0.480)	(0.382)	***
	[14,271]	[8,994]	[5,277]		[21,493]	[14,522]	[6,971]	
Unskilled Blue Collar	0.192	0.193	0.190	0.253	0.186	0.180	0.195	-2.017
	(0.365)	(0.374)	(0.347)		(0.283)	(0.292)	(0.268)	**
	[3,936]	[2,527]	[1,409]		[5,878]	[3,610]	[2,268]	
College Degree	0.440	0.464	0.419	2.849	0.359	0.394	0.332	4.707
	(0.567)	(0.625)	(0.510)	***	(0.537)	(0.584)	(0.497)	***
	[5,308]	[2,477]	[2,831]		[7,050]	[3,055]	[3,995]	
No College Degree	0.234	0.232	0.243	-2.907	0.208	0.217	0.180	11.132
	(0.348)	(0.366)	(0.286)	***	(0.312)	(0.324)	(0.271)	***
	[35,769]	[27,031]	[8,738]		[40,456]	[30,849]	[9,607]	
Skilled	0.257	0.246	0.277	-4.093	0.202	0.204	0.198	1.155
	(0.481)	(0.515)	(0.414)	***	(0.421)	(0.447)	(0.357)	
	[15,501]	[9,892]	[5,609]		[25,992]	[17,962]	[8,030]	
Unskilled	0.220	0.212	0.242	-7.468	0.226	0.224	0.232	-1.996
	(0.345)	(0.360)	(0.296)	***	(0.329)	(0.336)	(0.309)	**
	[32,033]	[23,845]	[8,188]		[32,184]	[23,737]	[8,447]	
10th Percentile	0.150	0.128	0.217	-17.750	0.158	0.137	0.228	-18.765
	(0.459)	(0.478)	(0.384)	***	(0.454)	(0.468)	(0.401)	***
	[36,100]	[27,309]	[8,791]		[41,089]	[31,364]	[9,725]	
90th Percentile	0.363	0.376	0.321	8.603	0.333	0.362	0.237	22.882
	(0.568)	(0.588)	(0.498)	***	(0.507)	(0.518)	(0.455)	***
	[36,100]	[27,309]	[8,791]	[41,089]	[31,364]	[9,725]		
All Employees	0.251	0.247	0.263	-4.073	0.238	0.243	0.222	5.871
	(0.365)	(0.384)	(0.297)	***	(0.344)	(0.358)	(0.291)	***
	[36,100]	[27,309]	[8,791]		[41,089]	[31,364]	[9,725]	

Notes: Standard deviations appear below each mean in parentheses. The number of observations appears below each standard deviation in square brackets. All statistics are annual data reported at the firm level. Missing observations result from firms without female employees of the indicated category or occupation. Columns 4 and 8 contain an equality of female and male sample means t test with unequal variances. *** $p < 0.01$, ** $0.01 \leq p < 0.05$, * $0.05 \leq p < 0.1$.

Table 3: Cross-Sectional Estimates

	Firm Size$_{1995}$			Firm Size$_{2000}$		
	All	Female Leadership		All	Female Leadership	
Outcome / Regressor	Firms	Y	N	Firms	Y	N
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(1 + Exports)$	1.100***	0.792***	1.684***	1.272***	0.890***	2.020***
	(0.008)	(0.008)	(0.024)	(0.009)	(0.010)	(0.029)
Male-Female Wage Gap	0.022***	0.026***	0.018***	0.013***	0.014***	0.017***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Male-Female Wage Gap — College Degree	0.032***	0.054***	0.025***	0.043***	0.054***	0.051***
	(0.006)	(0.010)	(0.007)	(0.006)	(0.010)	(0.007)
Male-Female Wage Gap — No College Degree	0.019***	0.023***	0.015***	0.009***	0.012***	0.013***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Male-Female Wage Gap — Skilled	0.043***	0.050***	0.037***	0.027***	0.025***	0.039***
	(0.003)	(0.004)	(0.004)	(0.002)	(0.004)	(0.003)
Male-Female Wage Gap — Unskilled	0.026***	0.031***	0.019***	0.019***	0.022***	0.018***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
% Female Employees	0.010***	0.013***	-0.011***	0.007***	0.010***	-0.024***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
% Female Employees — College Degree	0.045***	0.038***	0.049***	0.056***	0.046***	0.052***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
% Female Employees — no College Degree	0.010***	0.013***	-0.012***	0.007***	0.010***	-0.024***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
% Female Employee — Skilled	0.063***	0.069***	0.034***	0.055***	0.066***	-0.006***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
% Female Employee — Unskilled	0.011***	0.014***	-0.008***	0.010***	0.014***	-0.018***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	60,095	49,803	10,292	60,095	49,803	10,292

Notes: Two-digit industry and state fixed effects are included in each specification. Columns (1) through (3) specifications are estimated with data for 1995, whereas columns (4) through (6) are estimated with data for 2000. Columns (1) and (4) report estimated coefficients using data from all firms. Subsamples in columns (2) and (5) contain firms in which at least one female was present in the C-Suite in any year between 1995 and 2004. Columns (3) and (6) contain firms without females in the C-Suite in any year between 1995 and 2004. Standard errors are clustered at the industry level and are reported in parentheses. *** $p < 0.01$, ** $0.01 \leq p < 0.05$, * $0.05 \leq p < 0.1$.

Table 4: Cross-Sectional Estimates by Occupational Group

	Firm Size$_{1995}$			Firm Size$_{2000}$		
	All	Female Leadership		All	Female Leadership	
Outcome / Regressor	Firms	Y	N	Firms	Y	N
	(1)	(2)	(3)	(4)	(5)	(6)
Occupation 1: Unskilled White Collar						
% Female Employees	0.055***	0.056***	0.039***	0.060***	0.063***	0.029***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
Male-female wage gap	0.015***	0.022***	0.017***	0.013***	0.017***	0.015***
	(0.003)	(0.005)	(0.004)	(0.003)	(0.006)	(0.005)
Occupation 2: Professional or Managerial						
% Female Employees	0.057***	0.058***	0.034***	0.060***	0.064***	0.000
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
Male-female wage gap	0.041***	0.061***	0.027***	0.042***	0.055***	0.043***
	(0.004)	(0.006)	(0.005)	(0.004)	(0.006)	(0.005)
Occupation 3: Skilled Blue Collar						
% Female Employees	0.017***	0.018***	0.009***	0.017***	0.019***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Male-female wage gap	0.028***	0.030***	0.021***	0.019***	0.021***	0.013***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Occupation 4: Technical or Supervisory						
% Female Employees	0.068***	0.081***	0.024***	0.064***	0.079***	-0.003
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
Male-female wage gap	0.044***	0.051***	0.037***	0.038***	0.040***	0.040***
	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)
Occupation 5: Unskilled Blue Collar						
% Female Employees	0.017***	0.015***	0.018***	0.017***	0.015***	0.018***
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Male-female wage gap	0.013***	0.018***	0.016***	0.003	0.012**	-0.004
	(0.004)	(0.005)	(0.006)	(0.004)	(0.006)	(0.006)
Observations	60,095	49,803	10,292	60,095	49,803	10,292

Notes: Two-digit industry and state fixed effects are included in each specification. Columns (1) through (3) specifications are estimated with data for 1995, whereas columns (4) through (6) are estimated with data for 2000. Columns (1) and (4) report estimated coefficients using data from all firms. Subsamples in columns (2) and (5) contain firms in which at least one female was present in the C-Suite in any year between 1995 and 2004. Columns (3) and (6) contain firms without females in the C-Suite in any year between 1995 and 2004. Standard errors are clustered at the industry level and are reported in parentheses. *** $p < 0.01$, ** $0.01 \leq p < 0.05$, * $0.05 \leq p < 0.1$.

Table 5: Difference-in-Difference Estimates: Pooled Sample by Percentage of Female Employees

		Δ% Female Employees				
			College Degree		Skilled	
	Δ ln(1+Exports)	All	Y	N	Y	N
	(1)	(2)	(3)	(4)	(5)	(6)
	coeff	coeff	coeff	coeff	coeff	coeff
	(se)	(se)	(se)	(se)	(se)	(se)
Firm Size (pre)	0.026***	-0.002***	0.000	-0.002***	0.001	-0.002***
	(0.006)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Firm Size (post)	0.076***	-0.001***	-0.000	-0.001***	0.004***	-0.001***
	(0.007)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Δ Firm Size	0.050***	0.001	-0.000	0.001	0.003***	0.002**
	(0.014)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Observations	120,190	120,190	20,144	119,904	60,457	116,175

Notes: Observations are weighted by the square root number of firm employees. Two-digit industry and state fixed effects are included in each specification. Standard errors are clustered at the industry level and reported in parentheses. *** $p < 0.01$, ** $0.01 \leq p < 0.05$, * $0.05 \leq p < 0.1$.

Table 6: Difference-in-Difference Estimates: Pooled Sample by Wage Gap

	Δ Male-Female Wage Gap								
			Percentile			College Degree		Skilled	
	Mean	Std Dev	10^{th}	50^{th}	90^{th}	Y	N	Y	N
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	coeff	coeff	coeff	coeff	coeff	coeff	coeff	coeff	coeff
	(se)	(se)	(se)	(se)	(se)	(se)	(se)	(se)	(se)
Firm Size (pre)	-0.004***	-0.001**	-0.003***	-0.005***	-0.002*	0.002	-0.004***	-0.005***	-0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)
Firm Size (post)	0.001**	0.001	-0.001	0.001	0.000	-0.004	0.001*	-0.002*	0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)
Δ Firm Size	0.006***	0.002	0.003	0.006**	0.003	-0.006	0.005**	0.003	0.011***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.004)	(0.005)	(0.002)	(0.003)	(0.004)
Observations	69,136	48,633	69,136	69,136	69,136	8,885	67,990	30,227	55,053

Notes: Observations are weighted by the square root number of firm employees. Two-digit industry and state fixed effects are included in each specification. Standard errors are clustered at the industry level and are reported in parentheses. *** $p < 0.01$, ** $0.01 \leq p < 0.05$, * $0.05 \leq p < 0.1$.

Table 7: Difference-in-Difference Estimates: Pooled Sample by Occupational Group

	Unskilled White Collar		Professional or Managerial		Skilled Blue Collar		Technical or Supervisory		Unskilled Blue Collar	
	Δ% Female Employees	Δ M-F Wage Gap	Δ% Female Employees	Δ M-F Wage Gap	Δ% Female Employees	Δ M-F Wage Gap	Δ% Female Employees	Δ M-F Wage Gap	Δ% Female Employees	Δ M-F Wage Gap
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	coeff	coeff	coeff	coeff	coeff	coeff	coeff	coeff	coeff	coeff
	(se)	(se)	(se)	(se)	(se)	(se)	(se)	(se)	(se)	(se)
Firm Size (pre)	-0.002***	-0.003	0.001	0.000	-0.001***	-0.007***	0.001	-0.007***	-0.004***	0.002
	(0.001)	(0.002)	(0.001)	(0.002)	(0.000)	(0.001)	(0.000)	(0.002)	(0.001)	(0.003)
Firm Size (post)	0.002**	0.001	0.009***	0.005**	-0.000	0.009***	0.007***	-0.006***	-0.002	0.008*
	(0.001)	(0.003)	(0.001)	(0.003)	(0.000)	(0.001)	(0.001)	(0.002)	(0.001)	(0.004)
Δ Firm Size	0.004*	0.004	0.008***	0.005	0.001	0.016***	0.007***	0.002	0.002	0.006
	(0.002)	(0.006)	(0.002)	(0.005)	(0.001)	(0.004)	(0.001)	(0.004)	(0.004)	(0.009)
Observations	34,732	14,163	41,348	16,265	108,246	31,017	58,016	23,608	17,403	4,257

Notes: Observations are weighted by the square root number of firm employees. Two-digit industry and state fixed effects are included in each specification. Standard errors are clustered at the industry level and are reported in parentheses. *** $p < 0.01$, ** $0.01 \leq p < 0.05$, * $0.05 \leq p < 0.1$.

Table 8: Triple-Difference Estimates: Percentage of Female Workers

		Δ% Female Employees					
			College Degree		Skilled		
	Δ ln(1+Exports)	All	Y	N	Y	N
	(1)	(2)	(3)	(4)	(5)	(6)
	coeff	coeff	coeff	coeff	coeff	coeff
	(se)	(se)	(se)	(se)	(se)	(se)
	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$
Panel A: Female Leadership						
♀ Firm Size (pre)	0.010	-0.005***	-0.003	-0.005***	-0.003***	-0.005***
	(0.007)	(0.000)	(0.002)	(0.000)	(0.001)	(0.000)
♀ Firm Size (post)	0.025***	-0.002***	0.003	-0.002***	0.003***	-0.002***
	(0.008)	(0.000)	(0.002)	(0.000)	(0.001)	(0.000)
Δ♀ Firm Size	0.015	0.002***	0.006	0.002***	0.006***	0.003***
	(0.016)	(0.001)	(0.004)	(0.001)	(0.002)	(0.001)
Observations	99,606	99,606	11,149	99,351	44,580	95,998
Panel B: Male Leadership						
♂ Firm Size (pre)	0.001	-0.001**	-0.000	-0.001***	0.002**	-0.001***
	(0.019)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
♂ Firm Size (post)	0.127***	-0.000	-0.002**	-0.001	0.004***	0.000
	(0.024)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
Δ♂ Firm Size	0.126***	0.000	-0.002	0.001	0.002	0.001
	(0.030)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
Observations	20,584	20,584	8,995	20,553	15,877	20,177
Panel C: F - M Leadership						
Δ♀ Firm Size	-0.110***	0.002	0.008**	0.002	0.003	0.001
-Δ♂ Firm Size	(0.034)	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)
	$[0.003]^{+++}$	[0.851]	$[0.973]^{+}$	[0.818]	[0.902]	[0.807]

Notes: Observations are weighted by the square root number of firm employees. Two-digit industry and state fixed effects are included in each specification. Standard errors are clustered at the industry level and are reported in parentheses. *** $p < 0.01$, ** $0.01 \leq p < 0.05$, * $0.05 \leq p < 0.1$. The inverse empirical cumulative distribution function relative to 1,000 randomized draws of treatment status is given in square brackets. $^{+++}$ significant at a 1% level, $^{++}$ significant at a 5% level, $^{+}$ significant at a 10% level. See Section 6.2 for further detail.

Table 9: Triple-Difference Estimates: Male-Female Wage Gap

	Δ Male-Female Wage Gap								
			Percentile			College Degree		Skilled	
	Mean	Std Dev	10^{th}	50^{th}	90^{th}	Y	N	Y	N
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	coeff	coeff	coeff	coeff	coeff	coeff	coeff	coeff	coeff
	(se)	(se)	(se)	(se)	(se)	(se)	(se)	(se)	(se)
	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$
Panel A: Female Leadership									
♀ Firm Size (pre)	-0.002	-0.000	-0.002	-0.003***	0.003	-0.006	-0.002*	-0.006**	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.008)	(0.001)	(0.003)	(0.001)
♀ Firm Size (post)	0.008***	0.000	0.008***	0.004***	0.011***	-0.009	0.006***	-0.001	0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.008)	(0.001)	(0.002)	(0.001)
Δ♀ Firm Size	0.010**	0.000	0.010**	0.007	0.008	-0.003***	0.008**	0.005	0.010**
	(0.004)	(0.003)	(0.005)	(0.005)	(0.006)	(0.000)	(0.004)	(0.005)	(0.005)
Observations	51,328	33,094	51,328	51,328	51,328	3,465	50,401	18,529	39,578
Panel B: Male Leadership									
♂ Firm Size (pre)	-0.005***	-0.002**	-0.004***	-0.004***	-0.004*	0.004	-0.005***	-0.005**	-0.003**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.004)	(0.001)	(0.002)	(0.001)
♂ Firm Size (post)	0.000	0.003**	-0.004**	0.001	-0.002	-0.003	0.002*	-0.001	0.008***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.004)	(0.001)	(0.002)	(0.002)
Δ♂ Firm Size	0.005*	0.005**	0.001	0.005	0.003	-0.008	0.007**	0.004	0.012*
	(0.003)	(0.002)	(0.004)	(0.003)	(0.006)	(0.006)	(0.003)	(0.004)	(0.006)
Observations	17,808	15,539	17,808	17,808	17,808	5,420	17,589	11,698	15,475
Panel C: F - M Leadership									
Δ♀ Firm Size	0.005	-0.004	0.009	0.002	0.006	0.005	0.001	0.002	-0.002
-Δ♂ Firm Size	(0.008)	(0.005)	(0.009)	(0.008)	(0.015)	(0.010)	(0.008)	(0.007)	(0.013)
	[0.934]	[0.077]	$[0.993]^{++}$	[0.815]	[0.790]	[0.521]	[0.737]	[0.683]	[0.301]

Notes: Observations are weighted by the square root number of firm employees. Two-digit industry and state fixed effects are included in each specification. Standard errors are clustered at the industry level and are reported in parentheses. *** $p < 0.01$, ** $0.01 \leq p < 0.05$, * $0.05 \leq p < 0.1$. The inverse empirical cumulative distribution function relative to 1,000 randomized draws of treatment status is given in square brackets. $^{+++}$ significant at a 1% level, $^{++}$ significant at a 5% level, $^{+}$ significant at a 10% level. See Section 6.2 for further detail.

Table 10: Triple-Difference Estimates: Occupational Group

	Unskilled White Collar		Professional or Managerial		Skilled Blue Collar		Technical or Supervisory		Unskilled Blue Collar	
	Δ% Female Employees	Δ M-F Wage Gap	Δ% Female Employees	Δ M-F Wage Gap	Δ% Female Employees	Δ M-F Wage Gap	Δ% Female Employees	Δ M-F Wage Gap	Δ% Female Employees	Δ M-F Wage Gap
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	coeff	coeff	coeff	coeff	coeff	coeff	coeff	coeff	coeff	coeff
	(se)	(se)	(se)	(se)	(se)	(se)	(se)	(se)	(se)	(se)
	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$
Panel A: Female Leadership										
♀ Firm Size (pre)	-0.003**	-0.001	-0.002*	-0.004	-0.003***	-0.002	-0.002**	-0.009***	-0.006***	-0.006
	(0.001)	(0.005)	(0.001)	(0.005)	(0.000)	(0.002)	(0.001)	(0.003)	(0.001)	(0.005)
♀ Firm Size (post)	-0.003	-0.003	0.017***	0.009	-0.000	0.013***	0.008***	0.007*	0.003*	0.007
	(0.002)	(0.006)	(0.001)	(0.006)	(0.000)	(0.002)	(0.001)	(0.004)	(0.002)	(0.007)
Δ♀ Firm Size	0.000	-0.003	0.019***	0.012***	0.003**	0.015**	0.010***	0.016**	0.009*	0.013
	(0.002)	(0.010)	(0.002)	(0.000)	(0.001)	(0.006)	(0.002)	(0.008)	(0.005)	(0.010)
Observations	22,367	6,902	26,936	7,576	89,110	21,327	42,225	13,791	12,400	2,461
Panel B: Male Leadership										
♂ Firm Size (pre)	-0.000	-0.007**	0.000	0.001	-0.000	-0.009***	0.002**	-0.009***	-0.003*	0.005
	(0.001)	(0.003)	(0.001)	(0.003)	(0.000)	(0.002)	(0.001)	(0.003)	(0.001)	(0.005)
♂ Firm Size (post)	0.003*	0.002	0.002**	0.009***	0.001**	0.008***	0.009***	-0.007***	-0.003	0.006
	(0.001)	(0.004)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.003)	(0.003)	(0.007)
Δ♂ Firm Size	0.003	0.010	0.002	0.008	0.002	0.017**	0.007***	0.002	-0.000	0.001
	(0.003)	(0.007)	(0.002)	(0.006)	(0.002)	(0.007)	(0.002)	(0.005)	(0.006)	(0.013)
Observations	12,365	7,261	14,412	8,689	19,136	9,690	15,791	9,817	5,003	1,796
Panel C: F - M Leadership										
Δ♀ Firm Size	-0.003	-0.012	0.017***	0.004***	0.001	-0.002	0.003	0.014	0.009	0.011
-Δ♂ Firm Size	(0.006)	(0.012)	(0.005)	(0.000)	(0.006)	(0.014)	(0.005)	(0.010)	(0.013)	(0.022)
	[0.268]	[0.126]	$[0.999]^{+++}$	[0.472]	[0.682]	[0.333]	[0.782]	$[0.971]^{+}$	$[0.952]^{+}$	[0.723]

Notes: Observations are weighted by the square root number of firm employees. Two-digit industry and state fixed effects are included in each specification. Standard errors are clustered at the industry level and are reported in parentheses. *** $p < 0.01$, ** $0.01 \leq p < 0.05$, * $0.05 \leq p < 0.1$. The inverse empirical cumulative distribution function relative to 1,000 randomized draws of treatment status is given in square brackets. $^{+++}$ significant at a 1% level, $^{++}$ significant at a 5% level, $^{+}$ significant at a 10% level. See Section 6.2 for further detail.

A Online Appendix

A.1 Data

Our data covers the period 1995-2004 and consists of two firm-level confidential administrative databases. These datasets were cleaned and merged by the Instituto de Pesquisa Econômica Aplicada (IPEA, Institute for Applied Economics Research - Brasília). The first dataset contains firm-level administrative records of foreign trade operations, provided by the *Secretaria de Comércio Exterior* (Secretary of Foreign Trade) of the *Ministério do Desenvolvimento, Indústria e Comércio Exterior* (Ministry of Development, Industry and Foreign Trade). This dataset contains records for firm-level export transactions, which detail the product code, value, quantity, weight, and destination country. The second administrative dataset is the RAIS (*Relação Anual de Informações Sociais*) from the MTE (*Ministério do Trabalho e Emprego*) or Ministry of Labor and Employment. Every firm must fill out and file the RAIS form annually, regardless of the number of employees throughout the year. All labor contracts must be reported, even if the duration of employment were as brief as a few days. If a firm has no employees, it must file a RAIS form to inform the Brazilian government that it has no employees. Because of these requirements, the RAIS dataset effectively covers almost all formal employment, with the exception of self-employed and informal workers. The RAIS form contains the firm's tax identification code and all employees' gender, age, level of educational attainment, occupation, and tenure.

These two datasets were merged by the firms' tax identification codes by the Instituto de Pesquisa Econômica Aplicada, (IPEA, Institute for Applied Economics Research - Brasília). as described by De Negri (2005). We consider a worker as employed at a certain firm in a given year if she (or he) worked for at least one day in December of that year. After merging, the data was cleaned and validated at the firm and then employee level. At the firm level, we retain only firms in manufacturing industries (CNAE-Brazilian Industry Classification version 1.0 codes ranging from 15 to 37) that were under the private sector law, i.e., those with *Tipo_Estb* variable equal to 1 and *Nat_Jurid* variable different from 2151, 4073, 2178, 2135, 2160, 2992, 2046, 2100, 2097, 2089, 2127, and 2062. The effect of this is to exclude firms owned by federal, state, or local levels.[26] Finally, we also dropped firms with zero employees in December 1995, 1998, 2000, and 2004.

At the employee level, we remove workers younger than 15 years of age or older than 65 years of age from the sample. We dropped workers with missing observable characteristics and wages. Approximately 1.5% of the employee records had no information about occupation. This is the variable with the largest share of missing values. Most importantly, these missing observations exhibit no discernible pattern by industry, year, worker characteristics, or firm size. Additionally, we removed from the sample temporary workers and workers who were not hired for an urban job using a labor contract under the Brazilian CLT labor law labor regulation (*Consolidaç ão das Leis do Trabalho*). If multiple jobs are recorded for a worker, we consider only the highest-paying job. The wage variable is defined as the natural logarithm of the hourly wage calculated as the ratio between the worker average wage (*rem_ media*) and the number of hours worked (*horas_ contratadas*).

To further disaggregate employees within firms, we use Helpman et al.'s (2017) five-category classification of occupations: Professional and Managerial, Skilled White-Collar, Unskilled White-Collar, Skilled Blue-Collar, and Unskilled Blue-Collar. The occupation is reported in our data using the CBO 1994 classification for 1995-2002 and the CBO2002 classification for 2003-2004. Helpman et al.'s (2017) five categories are defined using CBO 1994 codes. We use the official correspondence table from the Ministry of Labor and Employment as a crosswalk for the CBO 2002 occupations.

[26]These state-owned firms are excluded because their wage policies have to follow federal and state-specific laws, and hiring must take place through civil service examinations.

A.2 Math Appendix: Amenities

To derive the equilibrium effects of an exogenous increase in amenities within firm j, we apply total differentiation to female and male wages, and female and male log labor supply.

$$\begin{bmatrix} \frac{dw_{j♀}}{da} \\ \frac{dw_{j♂}}{da} \\ \frac{d\ln(S_{j♀}(\cdot))}{da} \\ \frac{d\ln\left(S_{j♂}(\cdot)\right)}{da} \end{bmatrix} = \begin{bmatrix} 0 & 0 & A_{13} & A_{14} \\ 0 & 0 & A_{23} & A_{24} \\ A_{31} & 0 & 0 & 0 \\ 0 & A_{42} & 0 & 0 \end{bmatrix} \begin{bmatrix} \frac{dw_{j♀}}{da} \\ \frac{dw_{j♂}}{da} \\ \frac{d\ln(S_{j♀}(\cdot))}{da} \\ \frac{d\ln\left(S_{j♂}(\cdot)\right)}{da} \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ \frac{\partial\ln(S_{j♀}(\cdot))}{\partial a} \\ 0 \end{bmatrix} \tag{18}$$

The A_{ij} represent the partial derivative of variable i with respect to variable j. For example,

$$A_{13} = \frac{\partial w_{j♀}}{\partial \ln\left(S_{j♀}\right)}$$

Applying Cramer's rule, we calculate

$$\begin{bmatrix} \frac{dw_{j♀}}{da} \\ \frac{dw_{j♂}}{da} \\ \frac{d\ln(S_{j♀}(\cdot))}{da} \\ \frac{d\ln\left(S_{j♂}(\cdot)\right)}{da} \end{bmatrix} = D^{-1}\cdot \begin{bmatrix} \left[A_{13} - A_{42}(A_{13}A_{24} - A_{14}A_{23})\right]\frac{\partial\ln(S_{j♀}(\cdot))}{\partial a} \\ A_{23}\frac{\partial\ln(S_{j♀}(\cdot))}{\partial a} \\ \left[1 - A_{24}A_{42}\right]\frac{\partial\ln(S_{j♀}(\cdot))}{\partial a} \\ A_{42}A_{23}\frac{\partial\ln(S_{j♀}(\cdot))}{\partial a} \end{bmatrix} \tag{19}$$

where

$$D = 1 - A_{13}A_{31} - A_{24}A_{42} + A_{31}A_{42}(A_{13}A_{24} - A_{14}A_{23})$$

Before determining the mathematical sign of D and of each calculated effect, we make the following simplifying assumptions with respect to the A_{ij}. The partial derivatives of female and male wages with respect to both female and male labor supply can be re-expressed as

$$\begin{bmatrix} A_{13} & A_{14} \\ A_{23} & A_{24} \end{bmatrix} = PT_j \begin{bmatrix} S_{j♀} \cdot \frac{\beta_♀}{1+\beta_♀} \cdot \frac{\partial^2 f(\cdot)}{\partial S_{j♀}^2} & S_{j♂} \cdot \frac{\beta_♀}{1+\beta_♀} \cdot \frac{\partial^2 f(\cdot)}{\partial S_{j♀} S_{j♂}} \\ S_{j♀} \cdot \frac{\beta_♂}{1+\beta_♂} \cdot \frac{\partial^2 f(\cdot)}{\partial S_{j♀} S_{j♂}} & S_{j♂} \cdot \frac{\beta_♂}{1+\beta_♂} \cdot \frac{\partial^2 f(\cdot)}{\partial S_{j♂}^2} \end{bmatrix} \tag{20}$$

For the vast majority of firms in our sample, $S_{j♂} > S_{j♀}$. As supported by the extant empirical literature, we assume that the indirect utility of male workers places a higher value on the relative wage than do female workers $\beta_♂ > \beta_♀$.[27] Finally, the second derivatives of the production function contained in the previous expression form the Hessian of the production function.

$$H = \begin{bmatrix} \frac{\partial^2 f(\cdot)}{\partial S_{j♀}^2} & \frac{\partial^2 f(\cdot)}{\partial S_{j♀} S_{j♂}} \\ \frac{\partial^2 f(\cdot)}{\partial S_{j♀} S_{j♂}} & \frac{\partial^2 f(\cdot)}{\partial S_{j♂}^2} \end{bmatrix}$$

A necessary condition for a unique profit maximizing set of inputs is that H be negative definite. This, in turn, requires that

$$\frac{\partial^2 f(S_♀, S_♂, T_j)}{\partial S_♂^2} < 0 \qquad \frac{\partial^2 f(S_♀, S_♂, T_j)}{\partial S_♀^2} < 0$$

and

$$\frac{\partial^2 f(S_♀, S_♂, T_j)}{\partial S_♂^2} \cdot \frac{\partial^2 f(S_♀, S_♂, T_j)}{\partial S_♀^2} - \left[\frac{\partial^2 f(S_♀, S_♂, T_j)}{\partial S_♂ \partial S_♀}\right]^2 > 0$$

If $\partial^2 f(\cdot)/\partial S_{j♀}^2$ and $\partial^2 f(\cdot)/\partial S_{j♂}^2$ are roughly similar in magnitude, then

$$\left|\frac{\partial^2 f(\cdot)}{\partial S_{j♀}^2}\right| > \left|\frac{\partial^2 f(\cdot)}{\partial S_{j♀} \partial S_{j♂}}\right| \quad \text{and} \quad \left|\frac{\partial^2 f(\cdot)}{\partial S_{j♂}^2}\right| > \left|\frac{\partial^2 f(\cdot)}{\partial S_{j♀} \partial S_{j♂}}\right|$$

The mathematical sign of both A_{14} and A_{23} depends on whether male and female labor are substitutes or complements. We assume they are perfect substitutes, resulting in a negative sign.

[27] See Equation (1) for further detail.

To aid in signing and evaluating the magnitudes of terms within Equation (19), we transform expressions of A_{ij} into elasticities.

$$\begin{aligned} A_{13}A_{31} &= \frac{\partial w_{j\female}}{\partial \ln(S_{j\female})} \cdot \frac{\partial \ln(S_{j\female}(\cdot))}{\partial w_{j\female}} \\ &= \frac{\partial w_{j\female}}{\partial S_{j\female}} S_{j\female}(\cdot) \cdot \frac{\epsilon_{j\female}}{w_{j\female}} \\ &= \underbrace{\gamma_{j\female}\epsilon_{j\female}}_{(-)} \end{aligned}$$

Let $\gamma_{j\female}$ be the elasticity of female wages with respect to female labor supply. Using Equation (13), this elasticity can be expressed in terms of the marginal revenue product of labor.

$$\begin{aligned} \gamma_{jg} &= \frac{\partial w_{jg}}{\partial S_{jg}} \cdot \frac{S_{jg}(\cdot)}{w_{jg}} \\ &= \frac{\partial\left[MRPL_{jg}(\cdot)/(1+E_{jg})\right]}{\partial S_{jg}(\cdot)} \cdot \frac{S_{jg}(\cdot)}{MRPL_{jg}/(1+E_{jg})} \\ &= \frac{\partial MRPL_{jg}(\cdot)}{\partial S_{jg}} \cdot \frac{S_{jg}(\cdot)}{MRPL_{jg}(\cdot)} \end{aligned}$$

By the diminishing marginal product of labor, $\gamma_{jg} < 0$. We are not aware of any guidance in the literature on possible magnitues of γ_{jg}. Under the simplifying assumption that male and female labor are perfect substitutes, the marginal product of labor and the rate at which it diminishes are equal by gender.

$$\begin{aligned} \frac{\gamma_{j\female}}{\gamma_{j\male}} &= \frac{(\partial MRPL_{j\female}(\cdot)/\partial S_{j\female}) \cdot (S_{j\female}(\cdot)/MRPL_{j\female}(\cdot))}{(\partial MRPL_{j\male}(\cdot)/\partial S_{j\male}) \cdot (S_{j\male}(\cdot)/MRPL_{j\male}(\cdot))} \\ &= \frac{S_{j\female}(\cdot)}{S_{j\male}(\cdot)} \end{aligned} \tag{21}$$

As the observed proportion of female workers is less than 50%, we have $\gamma_{j\male} < \gamma_{j\female} < 0$.

Similarly,

$$\begin{aligned} A_{24}A_{42} &= \frac{\partial w_{j\male}}{\partial \ln\left(S_{j\male}\right)} \cdot \frac{\partial \ln\left(S_{j\male}(\cdot)\right)}{\partial w_{j\male}} \\ &= \frac{\partial w_{j\male}}{\partial S_{j\male}} S_{j\male}(\cdot) \cdot \frac{\epsilon_{j\male}}{w_{j\male}} \\ &= \underbrace{\gamma_{j\male}\epsilon_{j\male}}_{(-)} \end{aligned}$$

$$\begin{aligned} A_{31}A_{42}(A_{13}A_{24} - A_{14}A_{23}) &= \frac{\partial \ln\left(S_{j\female}(\cdot)\right)}{\partial w_{j\female}} \cdot \frac{\partial \ln\left(S_{j\male}(\cdot)\right)}{\partial w_{j\male}} \left[\frac{\partial w_{j\female}}{\partial \ln\left(S_{j\female}\right)} \cdot \frac{\partial w_{j\male}}{\partial \ln\left(S_{j\male}\right)} - \frac{\partial w_{j\female}}{\partial \ln\left(S_{j\male}\right)} \cdot \frac{\partial w_{j\male}}{\partial \ln\left(S_{j\female}\right)}\right] \\ &= \frac{\epsilon_{j\female}}{w_{j\female}} \cdot \frac{\epsilon_{j\male}}{w_{j\male}} \cdot S_{j\female}S_{j\male} \cdot \left[\frac{\partial w_{j\female}}{\partial S_{j\female}} \cdot \frac{\partial w_{j\male}}{\partial S_{j\male}} - \frac{\partial w_{j\female}}{\partial S_{j\male}} \cdot \frac{\partial w_{j\male}}{\partial S_{j\female}}\right] \\ &= \underbrace{\epsilon_{j\female}\epsilon_{j\male}}_{(+)} \underbrace{\left(\gamma_{j\female}\gamma_{j\male} - \gamma_{j\female\male}\gamma_{j\male\female}\right)}_{(+)} \end{aligned}$$

The elasticities of labor supply with respect to wages are positive. If the Hessian is negative definite, the positive determinant ensures that the second term is also positive.

We can unambiguously sign the determinant as positive.

$$D = 1 - \underbrace{A_{13}A_{31}}_{(-)} - \underbrace{A_{24}A_{42}}_{(-)} + \underbrace{A_{31}A_{42}(A_{13}A_{24} - A_{14}A_{23})}_{(+)}$$

An exogenous increase in amenities unambiguously causes female wages to decline. With $D > 0$, the sign is determined by the sign of the numerator.

$$\left[\underbrace{A_{13}}_{(-)} - \underbrace{A_{42}(A_{13}A_{24} - A_{14}A_{23})}_{(+)}\right] \underbrace{\frac{\partial \ln\left(S_{j\female}(\cdot)\right)}{\partial a}}_{(+)}$$

Additive terms within the brackets have been previously signed. From female labor supply, Equation (5)

$$\frac{\partial \ln (S_{j♀}(\cdot))}{\partial a} = v'_{♀}(a_j) > 0$$

An exogenous increase in amenities also causes male wages to drop, as $A_{23} < 0$. Intuitively, this happens because firms replace male workers with female workers, as we explain next. The effect of an exogenous increase in amenities is an unambiguous increase in female employment.

$$\underbrace{[1 - A_{24}A_{42}]]}_{(+)} \underbrace{\frac{\partial \ln (S_{j♀}(\cdot))}{\partial a}}_{(+)}$$

Reduced male wages and no value placed on amenities cause the male labor supply to decrease.

Summarizing,

$$\begin{bmatrix} \frac{dw_{j♀}}{da} < 0 \\ \frac{dw_{j♂}}{da} < 0 \\ \frac{d \ln (S_{j♀}(\cdot))}{da} > 0 \\ \frac{d \ln \left(S_{j♂}(\cdot)\right)}{da} < 0 \end{bmatrix}$$

The effect of an exogenous increase in amenities on the gender wage gap is

$$\frac{d}{da}\left[\frac{w_{j♂}}{w_{j♀}}\right] = \frac{w_{j♀} \cdot \frac{dw_{j♂}}{da} - w_{j♂} \cdot \frac{dw_{j♀}}{da}}{w_{j♀}^2}$$

The sign of the effect on wages is determined by the sign of the numerator.

$$\begin{aligned} & w_{j♀} \cdot \frac{dw_{j♂}}{da} - w_{j♂} \cdot \frac{dw_{j♀}}{da} \\ & = w_{j♀} D^{-1} \left\{ A_{23} \frac{\partial \ln (S_{j♀}(\cdot))}{\partial a} \right\} - w_{j♂} D^{-1} \left\{ [A_{13} - A_{42}(A_{13}A_{24} - A_{14}A_{23})] \frac{\partial \ln (S_{j♀}(\cdot))}{\partial a} \right\} \end{aligned}$$

Factoring D and $\partial \ln (S_{j♀}(\cdot)) / \partial a$ from the expression above, the sign is determined by

$$\begin{aligned} & w_{j♀} A_{23} - w_{j♂} \left[A_{13} - A_{42}(A_{13}A_{24} - A_{14}A_{23}) \right] \\ & = w_{j♀} \gamma_{j♂♀} w_{j♂} - w_{j♂} \left[\gamma_{j♀} w_{j♀} - \frac{\epsilon_{j♂}}{w_{j♂}} (\gamma_{j♀} w_{j♀} \gamma_{j♂} w_{j♂} - \gamma_{j♀♂} w_{j♂} \gamma_{j♂♀} w_{j♀}) \right] \\ & = \underbrace{w_{j♀} w_{j♂} [\gamma_{j♂♀} - \gamma_{j♀}]}_{(+)} + \underbrace{w_{j♀} \epsilon_{j♂} (\gamma_{j♀} \gamma_{j♂} - \gamma_{j♀♂} \gamma_{j♂♀})}_{(+)} \end{aligned} \tag{22}$$

The sign of this expression is positive. The sign of each additive expression is determined by the necessary conditions for the Hessian to be negative definite: The determinant must be positive, and $|\gamma_{j♀}| > |\gamma_{j♂♀}|$. We conclude that an exogenous increase in amenities causes the gender wage gap to widen.

An exogenous increase in amenities will cause female employment to increase and male employment to decrease. Therefore, the gender workforce balance improves.

In summary, an exogenous increase in amenities causes both female and male wages to fall and the gender wage gap to increase. This means that increased amenities via female leadership, valued by female but not male employees, causes the gender workforce balance to improve despite a widening gender wage gap, that is, both an absolute and relative deterioration in wages. This concludes the proofs of Theorems 1 and 2.

A.3 Math Appendix: Firm size

In our theoretical model, one of the determinants of firm size measured by the firm's employment level is firm-level productivity. To derive the effects of a productivity increase in firm j's labor outcomes, we apply total differentiation to female and male wages, and female and male log labor supply.

$$\begin{bmatrix} \frac{dw_{j♀}}{dT} \\ \frac{dw_{j♂}}{dT} \\ \frac{d\ln(S_{j♀}(\cdot))}{dT} \\ \frac{d\ln\left(S_{j♂}(\cdot)\right)}{dT} \end{bmatrix} = \begin{bmatrix} 0 & 0 & A_{13} & A_{14} \\ 0 & 0 & A_{23} & A_{24} \\ A_{31} & 0 & 0 & 0 \\ 0 & A_{42} & 0 & 0 \end{bmatrix} \begin{bmatrix} \frac{dw_{j♀}}{dT} \\ \frac{dw_{j♂}}{dT} \\ \frac{d\ln(S_{j♀}(\cdot))}{dT} \\ \frac{d\ln\left(S_{j♂}(\cdot)\right)}{dT} \end{bmatrix} + \begin{bmatrix} \frac{\partial w_{j♀}}{\partial T} \\ \frac{\partial w_{j♂}}{\partial T} \\ 0 \\ 0 \end{bmatrix} \tag{23}$$

The A_{ij} represent the partial derivative of variable i with respect to variable j. For example,

$$A_{13} = \frac{\partial w_{j♀}}{\partial \ln\left(S_{j♀}\right)}$$

Applying Cramer's rule, we calculate

$$\begin{bmatrix} \frac{dw_{j♀}}{dT} \\ \frac{dw_{j♂}}{dT} \\ \frac{d\ln(S_{j♀}(\cdot))}{dT} \\ \frac{d\ln\left(S_{j♂}(\cdot)\right)}{dT} \end{bmatrix} = D^{-1} \cdot \begin{bmatrix} \left(1 - A_{24}A_{42}\right) \frac{\partial w_{j♀}}{\partial T} + A_{14}A_{42} \frac{\partial w_{j♂}}{\partial T} \\ A_{23}A_{31} \frac{\partial w_{j♀}}{\partial T} + \left(1 - A_{13}A_{31}\right) \frac{\partial w_{j♂}}{\partial T} \\ A_{31} \left[\left(1 - A_{24}A_{42}\right) \frac{\partial w_{j♀}}{\partial T} + A_{14}A_{42} \frac{\partial w_{j♂}}{\partial T}\right] \\ A_{42} \left[A_{23}A_{31} \frac{\partial w_{j♀}}{\partial T} + \left(1 - A_{13}A_{31}\right) \frac{\partial w_{j♂}}{\partial T}\right] \end{bmatrix} \tag{24}$$

where the sign of D is positive, as shown in Appendix A.2.

$$D = 1 - \underbrace{A_{13}A_{31}}_{(-)} - \underbrace{A_{24}A_{42}}_{(-)} + \underbrace{A_{31}A_{42}(A_{13}A_{24} - A_{14}A_{23})}_{(+)}$$

With $D > 0$, the mathematical sign of each effect in the matrix of Equation (24) is determined by the sign of each numerator.

From Equation (14),

$$\frac{\partial w_{jg}}{\partial T} = \frac{\beta_g}{1+\beta_g}\frac{\partial MRPL_g}{\partial T} > 0 \tag{25}$$

Given $\beta_{♀} < \beta_{♂}$, $\partial w_{j♀}/\partial T < \partial w_{j♂}/\partial T$ if the effect of a change in technology has a comparable effect on the marginal revenue product of labor by gender.

The sign of $dw_{j♀}/dT$ is theoretically ambiguous.

$$\frac{dw_{j♀}}{dT} = \underbrace{(1 - A_{24}A_{42})}_{(+)}\frac{\partial w_{j♀}}{\partial T} + \underbrace{A_{14}A_{42}}_{(-)}\frac{\partial w_{j♂}}{\partial T}$$

However, if the direct effect of a change in technology is larger in magnitude than feedback effects from the opposite gender, the net effect is positive.

The sign of $dw_{j♂}/dT$ is comparable.

$$\frac{dw_{j♂}}{dT} = \underbrace{A_{23}A_{31}}_{(-)}\frac{\partial w_{j♀}}{\partial T} + \underbrace{(1 - A_{13}A_{31})}_{(+)}\frac{\partial w_{j♂}}{\partial T}$$

Although the sign is theoretically ambiguous, if direct effects dominate feedback effects via the opposite gender, the net effect is positive.

The effects on labor supply are a positive multiple of the effects on wages. Then

$$\begin{bmatrix} \frac{dw_{j♀}}{dT} > 0 \\ \frac{dw_{j♂}}{dT} > 0 \\ \frac{d\ln(S_{j♀}(\cdot))}{dT} > 0 \\ \frac{d\ln\left(S_{j♂}(\cdot)\right)}{dT} > 0 \end{bmatrix}$$

The effect of an exogenous increase in technology on the gender wage gap is

$$\frac{d}{dT}\left[\frac{w_{j\male}}{w_{j\female}}\right] = \frac{w_{j\female}\cdot\frac{dw_{j\male}}{dT} - w_{j\male}\cdot\frac{dw_{j\female}}{dT}}{w_{j\female}^2}$$

The sign of the effect on relative wages is determined by the sign of the numerator.

$$\begin{aligned}
&w_{j\female}\cdot\frac{dw_{j\male}}{dT} - w_{j\male}\cdot\frac{dw_{j\female}}{dT}\\
&= w_{j\female}D^{-1}\left[A_{23}A_{31}\frac{\partial w_{j\female}}{\partial T} + (1-A_{13}A_{31})\frac{\partial w_{j\male}}{\partial T}\right]\\
&- w_{j\male}D^{-1}\left[(1-A_{24}A_{42})\frac{\partial w_{j\female}}{\partial T} + A_{14}A_{42}\frac{\partial w_{j\male}}{\partial T}\right]\\
&= w_{j\female}D^{-1}\left[\gamma_{j\male\female}\epsilon_{j\female}\frac{w_{j\male}}{w_{j\female}}\frac{\beta_{\female}}{1+\beta_{\female}}\frac{\partial MRPL_{j\female}}{\partial T} + (1-\gamma_{j\female}\epsilon_{j\female})\frac{\beta_{\male}}{1+\beta_{\male}}\frac{\partial MRPL_{j\male}}{\partial T}\right]\\
&- w_{j\male}D^{-1}\left[(1-\gamma_{j\male}\epsilon_{j\male})\frac{\beta_{\female}}{1+\beta_{\female}}\frac{\partial MRPL_{j\female}}{\partial T} + \gamma_{j\female\male}\epsilon_{j\male}\frac{w_{j\female}}{w_{j\male}}\frac{\beta_{\male}}{1+\beta_{\male}}\frac{\partial MRPL_{j\male}}{\partial T}\right]
\end{aligned}$$

As both types of workers are perfect substitutes, the exogenous change in productivity affects both marginal revenue products of labor equally, $\partial MRPL_{j\female}/\partial T = \partial MRPL_{j\male}/\partial T$, this in addition to D^{-1} can be factored out of the previous expression leaving the sign unaffected.

$$\frac{w_{j\female}\beta_{\male}}{1+\beta_{\male}}(1-\gamma_{j\female}\epsilon_{j\female}-\gamma_{j\female\male}\epsilon_{j\male}) - \frac{w_{j\male}\beta_{\female}}{1+\beta_{\female}}(1-\gamma_{j\male}\epsilon_{j\male}-\gamma_{j\male\female}\epsilon_{j\female})$$

The first-order effects of this expression can be further expanded using Equation (14).

$$\begin{aligned}
\frac{w_{j\female}\beta_{\male}}{1+\beta_{\male}} - \frac{w_{j\male}\beta_{\female}}{1+\beta_{\female}} &= \left[\frac{b}{1+\beta_{\female}} + \frac{\beta_{\female}}{1+\beta_{\female}}MRPL_{j\female}\right]\frac{\beta_{\male}}{1+\beta_{\male}} - \left[\frac{b}{1+\beta_{\male}} + \frac{\beta_{\male}}{1+\beta_{\male}}MRPL_{j\male}\right]\frac{\beta_{\female}}{1+\beta_{\female}}\\
&= \underbrace{\frac{b}{(1+\beta_{\female})(1+\beta_{\male})}(\beta_{\male}-\beta_{\female})}_{(+)} + \underbrace{\frac{\beta_{\female}\beta_{\male}}{(1+\beta_{\female})(1+\beta_{\male})}(MRPL_{\female}-MRPL_{\male})}_{(?)}
\end{aligned} \tag{26}$$

If the marginal revenue products are equal or sufficiently close, given $\beta_{♀} < \beta_{♂}$, the first-order effects of an exogenous increase in technology cause the gender wage gap to widen.

The effect of an increase in technology on employee gender balance is

$$\begin{aligned}
\frac{d}{dT}\ln\left(\frac{S_{j♀}(\cdot)}{S_{j♂}(\cdot)}\right) &= \frac{d\ln\left(S_{j♀}(\cdot)\right)}{dT} - \frac{d\ln\left(S_{j♂}(\cdot)\right)}{dT} \\
&= A_{31}\cdot\frac{dw_{j♀}}{dT} - A_{42}\cdot\frac{dw_{j♂}}{dT} \\
&= \frac{\epsilon_{j♀}}{w_{j♀}}\cdot D^{-1}\left[\left(1-\gamma_{j♂}\epsilon_{j♂}\right)\frac{\beta_{♀}}{1+\beta_{♀}}\frac{\partial MRPL_{j♀}}{\partial T} + \gamma_{j♀♂}\epsilon_{j♂}\frac{w_{j♀}}{w_{j♂}}\frac{\beta_{♂}}{1+\beta_{♂}}\frac{\partial MRPL_{j♂}}{\partial T}\right] \\
&- \frac{\epsilon_{j♂}}{w_{j♂}}\cdot D^{-1}\left[\gamma_{j♂♀}\epsilon_{j♀}\frac{w_{j♂}}{w_{j♀}}\frac{\beta_{♀}}{1+\beta_{♀}}\frac{\partial MRPL_{j♀}}{\partial T} + \left(1-\gamma_{j♀}\epsilon_{j♀}\right)\frac{\beta_{♂}}{1+\beta_{♂}}\frac{\partial MRPL_{j♂}}{\partial T}\right]
\end{aligned}$$

The first-order effects are

$$D^{-1}\left[\frac{\epsilon_{j♀}}{w_{j♀}}\frac{\beta_{♀}}{1+\beta_{♀}}\frac{\partial MRPL_{♀}}{\partial T} - \frac{\epsilon_{j♂}}{w_{j♂}}\frac{\beta_{♂}}{1+\beta_{♂}}\frac{\partial MRPL_{♂}}{\partial T}\right]$$

If an exogenous change in technology is assumed to affect both marginal revenue products of labor equally, $\partial MRPL_{j♀}/\partial T = \partial MRPL_{j♂}/\partial T$, this in addition to D^{-1} can be factored out of the previous expression leaving the sign unaffected. Substituting in Equation (14) and simplifying, the sign of the first-order effects is equivalent to the sign of

$$\underbrace{(\beta_{♀}\epsilon_{j♀} - \beta_{♂}\epsilon_{j♂})b}_{(-)} + \underbrace{\beta_{♀}\beta_{♂}(MRPL_{♀}\epsilon_{j♀} - MRPL_{♂}\epsilon_{j♂})}_{(?)} \tag{27}$$

Given $\beta_{♀} < \beta_{♂}$ and $\epsilon_{j♀} < \epsilon_{j♂}$, the first part of the expression is unambiguously negative. The second expression is theoretically ambiguous. However, if $MRPL_{♀}$ and $MRPL_{♂}$ are equal or sufficiently close, the second expression also is negative.

In summary, if $MRPL_{♀}$ and $MRPL_{♂}$ are equal or sufficiently close which is the case under our assumptions of male and female workers being equally productive and perfect substitutes, an exogenous increase in technology (or higher productivity) will cause the gender wage gap to widen and the gender workforce balance to deteriorate. This means that more productive (larger) firms will exhibit a wider gender wage gap and a lower female share. This concludes the proofs of Theorems 3 and 4.

A.4 Math Appendix: Price Shock

To derive the equilibrium effects of an export shock within firm j, we apply total differentiation to female and male wages, and female and male log labor supply.

$$\begin{bmatrix} \frac{dw_{j♀}}{dP} \\ \frac{dw_{j♂}}{dP} \\ \frac{d\ln(S_{j♀}(\cdot))}{dP} \\ \frac{d\ln\left(S_{j♂}(\cdot)\right)}{dP} \end{bmatrix} = \begin{bmatrix} 0 & 0 & A_{13} & A_{14} \\ 0 & 0 & A_{23} & A_{24} \\ A_{31} & 0 & 0 & 0 \\ 0 & A_{42} & 0 & 0 \end{bmatrix} \begin{bmatrix} \frac{dw_{j♀}}{dP} \\ \frac{dw_{j♂}}{dP} \\ \frac{d\ln(S_{j♀}(\cdot))}{dP} \\ \frac{d\ln\left(S_{j♂}(\cdot)\right)}{dP} \end{bmatrix} + \begin{bmatrix} \frac{\partial w_{j♀}}{\partial p} \\ \frac{\partial w_{j♂}}{\partial p} \\ 0 \\ 0 \end{bmatrix} \tag{28}$$

The A_{ij} represent the partial derivative of variable i with respect to variable j. For example,

$$A_{13} = \frac{\partial w_{j♀}}{\partial \ln\left(S_{j♀}\right)}$$

Applying Cramer's rule, we calculate

$$\begin{bmatrix} \frac{dw_{j♀}}{dP} \\ \frac{dw_{j♂}}{dP} \\ \frac{d\ln(S_{j♀}(\cdot))}{dP} \\ \frac{d\ln\left(S_{j♂}(\cdot)\right)}{dP} \end{bmatrix} = D^{-1} \cdot \begin{bmatrix} [1 - A_{24}A_{42}] \cdot \frac{\partial w_{j♀}}{\partial P} + A_{14}A_{42} \cdot \frac{\partial w_{j♂}}{\partial P} \\ A_{23}A_{31} \cdot \frac{\partial w_{j♀}}{\partial P} + [1 - A_{13}A_{31}] \cdot \frac{\partial w_{j♂}}{\partial P} \\ A_{31} \cdot \left\{ [1 - A_{24}A_{42}] \cdot \frac{\partial w_{j♀}}{\partial P} + A_{14}A_{42} \cdot \frac{\partial w_{j♂}}{\partial P} \right\} \\ A_{42} \cdot \left\{ A_{23}A_{31} \cdot \frac{\partial w_{j♀}}{\partial P} + [1 - A_{13}A_{31}] \cdot \frac{\partial w_{j♂}}{\partial P} \right\} \end{bmatrix} \tag{29}$$

where the sign of D is positive, as shown in Appendix $A.2$.

$$D = 1 - \underbrace{A_{13}A_{31}}_{(-)} - \underbrace{A_{24}A_{42}}_{(-)} + \underbrace{A_{31}A_{42}(A_{13}A_{24} - A_{14}A_{23})}_{(+)}$$

With $D > 0$, the mathematical sign of each effect in the system of Equation (28) is determined by the sign of each numerator. The numerator of $dw_{j♀}/dP$ expressed in terms of elasticities is

$$\begin{aligned}[1 - A_{24}A_{42}] \cdot \frac{\partial w_{j♀}}{\partial P} + A_{14}A_{42} \cdot \frac{\partial w_{j♂}}{\partial P} &= \left[1 - \frac{\partial w_{j♂}}{\partial S_{j♂}} S_{j♂} \frac{\epsilon_{j♂}}{w_{j♂}}\right] \cdot \frac{\partial w_{j♀}}{\partial P} + \frac{\partial w_{j♀}}{\partial S_{j♂}} S_{j♂} \frac{\epsilon_{j♂}}{w_{j♂}} \cdot \frac{\partial w_{j♂}}{\partial P} \\ &= [1 - \gamma_{j♂}\epsilon_{j♂}] \cdot \frac{\partial w_{j♀}}{\partial P} + \gamma_{j♀♂}\epsilon_{j♂} \cdot \frac{\partial w_{j♂}}{\partial P}\end{aligned}$$

From Equation (14),

$$\frac{\partial w_{jg}}{\partial P} = \underbrace{\frac{\beta_g}{1 + \beta_g} MPL_g\left(S_{j♀}, S_{j♂}\right)}_{(+)}$$

The first-order effect of an exogenous price increase on female wages is positive. One second-order effect is positive, and the second negative. The negative second-order effect contains the cross-elasticity of female wages with respect to male labor supply, which we speculate is small. The total effect of an exogenous price increase on $w_{j♀}$ is positive.

The mathematics for $(dw_{j♂}/dP)$ is analogous. The numerator of $(dw_{j♂}/dP)$ is

$$A_{23}A_{31} \cdot \frac{\partial w_{j♀}}{\partial P} + [1 - A_{13}A_{31}] \cdot \frac{\partial w_{j♂}}{\partial P} = \gamma_{j♂♀}\epsilon_{j♀} \cdot \frac{\partial w_{j♀}}{\partial P} + [1 - \gamma_{j♀}\epsilon_{j♀}] \cdot \frac{\partial w_{j♂}}{\partial P}$$

As for $w_{j♀}$, the first-order effect of a price increase on $w_{j♂}$ is positive. One second-order effect is reinforcing, and the counteracting second-order effect is likely small. Together, the total effect of an exogenous price increase on $w_{j♂}$ is positive.

From Equation (29)

$$\frac{d\ln\left(S_{jg}(\cdot)\right)}{dP} = \frac{\partial \ln\left(S_{jg}(\cdot)\right)}{\partial w_{jg}} \cdot \frac{dw_{jg}}{dP}$$

The effect of an exogenous price increase on the labor supply of each gender is positive.

Summarizing,

$$\begin{bmatrix} \frac{dw_{j\female}}{dP} > 0 \\ \\ \frac{dw_{j\male}}{dP} > 0 \\ \\ \frac{d\ln(S_{j\female}(\cdot))}{dP} > 0 \\ \\ \frac{d\ln\left(S_{j\male}(\cdot)\right)}{dP} > 0 \end{bmatrix}$$

The effect of a positive price shock on the gender wage gap is

$$\frac{d}{dP}\left[\frac{w_{j\male}}{w_{j\female}}\right] = \frac{w_{j\female} \cdot \frac{dw_{j\male}}{dP} - w_{j\male} \cdot \frac{dw_{j\female}}{dP}}{w_{j\female}^2}$$

The sign of the effect on wages is determined by the sign of the numerator.

$$\begin{aligned} & w_{j\female} \cdot \frac{dw_{j\male}}{dP} - w_{j\male} \cdot \frac{w_{j\female}}{dP} \\ & = w_{j\female} \cdot \left[\gamma_{j\male\female}\epsilon_{j\female} \cdot \frac{\partial w_{j\female}}{dP} + (1-\gamma_{j\female}\epsilon_{j\female}) \cdot \frac{\partial w_{j\male}}{dP}\right] - w_{j\male} \cdot \left[(1-\gamma_{j\male}\epsilon_{j\male})\frac{\partial w_{j\female}}{\partial P} + \gamma_{j\female\male}\epsilon_{j\male}\frac{\partial w_{j\male}}{\partial P}\right] \end{aligned}$$

The first-order effects are offsetting and sum to zero.

$$\begin{aligned} w_{j\female} \cdot \frac{\partial w_{j\male}}{\partial P} - w_{j\male} \cdot \frac{\partial w_{j\female}}{\partial P} &= \frac{MRPL_{j\female}}{1+E_{\female}} \cdot \frac{\partial[MRPL_{j\male}/(1+E_{\male})]}{\partial P} - \frac{MRPL_{j\male}}{1+E_{\male}} \cdot \frac{\partial[MRPL_{j\female}/(1+E_{\female})]}{\partial P} \\ &= P \cdot \frac{MPL_{j\female}}{1+E_{\female}} \cdot \frac{MPL_{j\male}}{1+E_{\male}} - P \cdot \frac{MPL_{j\male}}{1+E_{\male}} \cdot \frac{MPL_{j\female}}{1+E_{\female}} \\ &= 0 \end{aligned}$$

We rearrange the second-order terms to facilitate comparisons.

$$[w_{j♀}\gamma_{j♂♀}\epsilon_{j♀} + w_{j♂}\gamma_{j♂}\epsilon_{j♂}]\frac{\partial w_{j♀}}{\partial P} - [w_{j♀}\gamma_{j♀}\epsilon_{j♀} + w_{j♂}\gamma_{j♀♂}\epsilon_{j♂}]\frac{\partial w_{j♂}}{\partial P}$$

If the marginal products of labor are equal by gender, the following relationship exists between the cross elasticities.

$$\frac{\gamma_{j♂♀}}{\gamma_{j♀♂}} = \frac{(\partial\left[MRPL_j(\cdot)/(1+E_{j♂})\right]/\partial S_{j♀})\cdot S_{j♀}(\cdot)/\left(MRPL_j(\cdot)/(1+E_{j♂})\right)}{(\partial\left[MRPL_j(\cdot)/(1+E_{j♀})\right]/\partial S_{j♂})\cdot S_{j♂}(\cdot)/\left(MRPL_j(\cdot)/(1+E_{j♀})\right)} = \frac{S_{j♀}}{S_{j♂}} \tag{30}$$

Given this, the second-order effects can be re-expressed as

$$\frac{1}{P}\left[\underbrace{\gamma_{j♀♂}(w_{j♀}^2\epsilon_{j♀}\frac{S_{j♀}}{S_{j♂}} - w_{j♂}^2\epsilon_{j♂})}_{(+)} + \underbrace{w_{j♀}w_{j♂}(\gamma_{j♂}\epsilon_{j♂} - \gamma_{j♀}\epsilon_{j♀})}_{(-)}\right] \tag{31}$$

With $\gamma_{j♀♂} < 0$, $w_{j♀} < w_{j♂}$, and $0 < \epsilon_{j♀} < \epsilon_{j♂}$, the first bracketed expression is unambiguously positive and inversely related to the percentage of female employees. Thus, this term will have a smaller magnitude for more productive (larger) firms as they have a smaller share of female workers per Theorem 4. In contrast, this term will have a larger magnitude for female-led firms since these firms employ a larger share of female workers per Theorem 2.

Empirical studies have found that male labor supply is more responsive to wages than female labor supply, $\epsilon_{j♂} > \epsilon_{j♀}$. By Equation (21), $\gamma_{j♂} < \gamma_{j♀} < 0$. Together, these establish that the second additive term is negative. The necessary conditions to ensure that the Hessian is negative definite require that both $\gamma_{j♀}$ and $\gamma_{j♂}$ be larger in magnitude than $\gamma_{j♀♂}$. Because of this, the magnitude of the second term in Equation (31) with a negative sign is likely to dominate the magnitude of the first term, which is positive. In summary, we find the first-order effects of an exogenous price increase on the male-female wage gap to be offsetting and second-order effects ambiguous. In this context and under certain parameter conditions, an exogenous price increase will widen the wage gap in larger firms relative to smaller firms. The wage gap should widen less in female-led firms than in male firms of the same size. This concludes the proof of Theorem 5.

The effect of a demand shock on employee gender balance is

$$
\begin{aligned}
\frac{d}{dP}\ln\left(\frac{S_{j♀}(\cdot)}{S_{j♂}(\cdot)}\right) &= \frac{d\ln\left(S_{j♀}(\cdot)\right)}{dP} - \frac{d\ln\left(S_{j♂}(\cdot)\right)}{dP} \\
&= D^{-1}A_{31}\cdot\left\{[1-A_{24}A_{42}]\cdot\frac{\partial w_{j♀}}{\partial P} + A_{14}A_{42}\cdot\frac{\partial w_{j♂}}{\partial P}\right\} \\
&- D^{-1}A_{42}\cdot\left\{A_{23}A_{31}\cdot\frac{\partial w_{j♀}}{\partial P} + [1-A_{13}A_{31}]\cdot\frac{\partial w_{j♂}}{\partial P}\right\} \\
&= D^{-1}\left[A_{31}(1-A_{24}A_{41}) - A_{42}A_{23}A_{31}\right]\frac{\partial w_{j♀}}{P} \\
&- D^{-1}\left[A_{42}(1-A_{13}A_{31}) - A_{31}A_{14}A_{42}\right]\frac{\partial w_{j♂}}{\partial P} \\
&= (PD)^{-1}\left((\epsilon_{j♀}-\epsilon_{j♂})\epsilon_{j♀}\epsilon_{j♂}(\gamma_{j♂}-\gamma_{j♀})\epsilon_{j♀}\epsilon_{j♂}\left(\gamma_{j♂♀}\frac{w_{j♀}}{w_{j♂}} - \gamma_{j♀♂}\frac{w_{j♂}}{w_{j♀}}\right)\right] \\
&= (PD)^{-1}\left[\underbrace{(\epsilon_{j♀}-\epsilon_{j♂})}_{(-)} - \underbrace{\epsilon_{j♀}\epsilon_{j♂}(\gamma_{j♂}-\gamma_{j♀})}_{(-)} - \underbrace{\epsilon_{j♀}\epsilon_{j♂}\gamma_{j♀♂}\left(\frac{w_{j♀}}{w_{j♂}}\frac{S_{j♀}}{S_{j♂}} - \frac{w_{j♂}}{w_{j♀}}\right)}_{(-)}\right]
\end{aligned}
\tag{32}
$$

The effect of an exogenous price increase on the gender-employee balance is theoretically ambiguous. The first-order effects are negative. By Equation (21), $\gamma_{j♂} < \gamma_{j♀} < 0$, the second bracketed term is negative. Finally, if $S_{j♀} < S_{j♂}$ and $w_{j♂} > w_{j♀}$, then the third bracketed term is negative. Similar to the wage gap, the firm's workforce gender balance affects the magnitude of the expression. This third term will have a greater magnitude for more productive (larger) firms as they have a smaller share of female workers per Theorem 4 and a wider gender wage gap per Theorem 3. In contrast, this term will have a smaller magnitude for female-led firms relative to male-led firms since these firms employ a larger share of female workers per Theorem 2 and have a wider gender wage gap per Theorem

1. If second-order effects do not dominate first-order effects, an exogenous price increase causes the gender-employee balance to become less equal. The magnitude of this effect will be smaller the larger the firm size, and larger for female-led firms relative to male led firms. This concludes the proof of Theorem 6.

Figure A.1: Outstanding nominal credit volume of the banking sector in Brazil

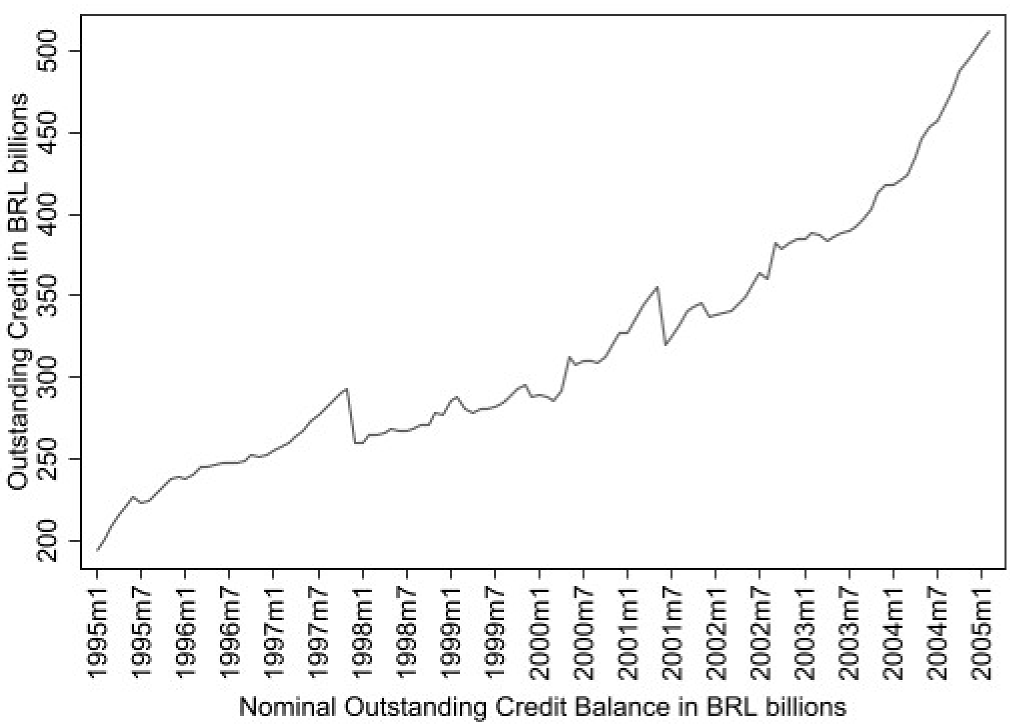


Table A.1: List of occupation codes for managerial and director (C-suite) positions.

	Classification		
Level	CBO 1994	CBO 1994	CBO 2002
Main subgroup	23		12
Occupations	2491	2422	1411
	4102	2424	1412
	4103	2432	1413
	4215	2415	1414
	5002	2413	1415
	5003	2433	1416
	5002	2414	1417
	5003	2436	1418
	2492	2437	1421
	2493	2435	1422
	3522	2434	1423
	3523	8410	1424
	2435	8340	1425
	2494	3444	1426
	2432	2423	1427
	2434	1912	
	2433	2429	
	2436	2439	
	2412	1912	
	2412	8929	

Table A.2: Cross-Sectional Estimates of Equation (1)

	(1)	(2)	(3)	(4)
Year	1995	1998	2000	2004
Age	0.098***	0.093***	0.087***	0.071***
	(0.000)	(0.000)	(0.000)	(0.000)
Age squared	-0.116***	-0.106***	-0.098***	-0.077***
	(0.000)	(0.000)	(0.000)	(0.000)
Tenure	0.005***	0.004***	0.004***	0.004***
	(0.000)	(0.000)	(0.000)	(0.000)
Years of schooling	0.079***	0.077***	0.076***	0.068***
	(0.000)	(0.000)	(0.000)	(0.000)
College	0.552***	0.597***	0.694***	0.809***
	(0.002)	(0.002)	(0.002)	(0.001)
Constant	-1.085***	-0.964***	-0.845***	-0.534***
	(0.008)	(0.007)	(0.007)	(0.005)
Observations	4,902,590	4,326,263	4,381,068	5,293,120
R^2	0.522	0.517	0.516	0.522

Notes: State fixed effects are included in each specification. The sample used contains only male workers. Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $0.01 \leq p < 0.05$, * $0.05 \leq p < 0.1$.

Table A.3: Triple-Difference Estimates: Percentage of Female Workers under More RestrictiveDefinition of Female-led Firms

		Δ% Female Employees				
			College Degree		Skilled	
	Δ ln(1+Exports)	All	Y	N	Y	N
	(1)	(2)	(3)	(4)	(5)	(6)
	coeff	coeff	coeff	coeff	coeff	coeff
	(se)	(se)	(se)	(se)	(se)	(se)
	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$
Panel A: Female Leadership						
♀ Firm Size (pre)	-0.074	-0.001	0.001	-0.001	0.003	-0.001
	(0.117)	(0.002)	(0.004)	(0.002)	(0.002)	(0.002)
♀ Firm Size (post)	0.176	0.004**	0.000	0.004**	0.002	0.007***
	(0.131)	(0.002)	(0.004)	(0.002)	(0.003)	(0.002)
Δ♀ Firm Size	0.250	0.005*	-0.000	0.005*	-0.001	0.008***
	(0.158)	(0.003)	(0.005)	(0.003)	(0.004)	(0.003)
Observations	1,302	1,302	1,064	1,301	1,251	1,286
Panel B: Male Leadership						
♂ Firm Size (pre)	0.001	-0.001**	-0.000	-0.001***	0.002**	-0.001***
	(0.019)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
♂ Firm Size (post)	0.127***	-0.000	-0.002**	-0.001	0.004***	0.000
	(0.024)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
Δ♂ Firm Size	0.126***	0.000	-0.002	0.001	0.002	0.001
	(0.030)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
Observations	20,584	20,584	8,995	20,553	15,877	20,177
Panel C: F - M Leadership						
Δ♀ Firm Size	0.124	0.004	0.002	0.004	-0.004	0.006
-Δ♂ Firm Size	(0.150)	(0.006)	(0.008)	(0.006)	(0.008)	(0.006)

Notes: Observations are weighted by the square root number of firm employees. Two-digit industry and state fixed effects are included in each specification. Standard errors are clustered at the industry level and are reported in parentheses. *** $p < 0.01$, ** $0.01 \leq p < 0.05$, * $0.05 \leq p < 0.1$.

Table A.4: Triple-Difference Estimates: Male-Female Wage Gap under More Restrictive Definition of Female-led Firms

	Δ Male-Female Wage Gap								
			Percentile			College Degree		Skilled	
	Mean	Std Dev	10^{th}	50^{th}	90^{th}	Y	N	Y	N
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	coeff	coeff	coeff	coeff	coeff	coeff	coeff	coeff	
	(se)	(se)	(se)	(se)	(se)	(se)	(se)	(se)	(se)
	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$
Panel A: Female Leadership									
♀ Firm Size (pre)	-0.013**	-0.009**	-0.007	-0.007	-0.022**	0.020*	-0.012**	-0.004	-0.010
	(0.005)	(0.004)	(0.007)	(0.005)	(0.011)	(0.012)	(0.005)	(0.007)	(0.007)
♀ Firm Size (post)	-0.008	-0.006	-0.008	-0.004	-0.020	-0.018	-0.005	0.000	-0.015*
	(0.006)	(0.005)	(0.006)	(0.005)	(0.013)	(0.011)	(0.006)	(0.006)	(0.009)
Δ♀ Firm Size	0.004	0.003	-0.001	0.003	0.002	-0.037**	0.006	0.004	-0.005
	(0.010)	(0.008)	(0.014)	(0.010)	(0.021)	(0.016)	(0.011)	(0.010)	(0.018)
Observations	1,249	1,193	1,249	1,249	1,249	815	1,228	1,136	1,112
Panel B: Male Leadership									
♂ Firm Size (pre)	-0.003***	-0.000	-0.003***	-0.004***	0.000	0.001	-0.003***	-0.005***	-0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.001)	(0.001)	(0.001)
♂ Firm Size (post)	0.002***	0.001	-0.000	0.001	0.001	-0.002	0.001*	-0.001	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)
Δ♂ Firm Size	0.005**	0.001	0.003	0.005**	0.001	-0.003	0.004*	0.003	0.011***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.004)	(0.006)	(0.002)	(0.003)	(0.004)
Observations	67,887	47,440	67,887	67,887	67,887	8,070	66,762	29,091	53,941
Panel C: F - M Leadership									
Δ♀ Firm Size -Δ♂ Firm Size	-0.000	0.002	-0.004	-0.001	0.001	-0.034	0.002	0.001	-0.016
	(0.051)	(0.030)	(0.069)	(0.049)	(0.103)	(0.030)	(0.053)	(0.033)	(0.072)

Notes: Observations are weighted by the square root number of firm employees. Two-digit industry and state fixed effects are included in each specification. Standard errors are clustered at the industry level and are reported in parentheses. *** $p < 0.01$, ** $0.01 \leq p < 0.05$, * $0.05 \leq p < 0.1$.

Table A.5: Triple-Difference Estimates: Occupational Group under More Restrictive Definition of Female-led Firms

	Unskilled White Collar		Professional or Managerial		Skilled Blue Collar		Technical or Supervisory		Unskilled Blue Collar	
	Δ% Female Employees	Δ M-F Wage Gap	Δ% Female Employees	Δ M-F Wage Gap	Δ% Female Employees	Δ M-F Wage Gap	Δ% Female Employees	Δ M-F Wage Gap	Δ% Female Employees	Δ M-F Wage Gap
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	coeff	coeff	coeff	coeff	coeff	coeff	coeff	coeff	coeff	coeff
	(se)	(se)	(se)	(se)	(se)	(se)	(se)	(se)	(se)	(se)
	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$	$[F^{-1}(\cdot)]$
Panel A: Female Leadership										
♀ Firm Size (pre)	0.003	-0.012	0.001	0.019*	-0.002	-0.017*	0.007*	-0.016*	-0.007	-0.002
	(0.004)	(0.012)	(0.003)	(0.011)	(0.002)	(0.009)	(0.003)	(0.009)	(0.005)	(0.019)
♀ Firm Size (post)	-0.004	0.039***	-0.001	-0.031**	0.003	-0.022*	0.011***	-0.012	0.009	-0.032
	(0.005)	(0.014)	(0.004)	(0.013)	(0.003)	(0.013)	(0.004)	(0.009)	(0.012)	(0.029)
Δ♀ Firm Size	-0.007	0.051**	-0.002	-0.050***	0.005	-0.005	0.004	0.004	0.016***	-0.030
	(0.007)	(0.025)	(0.005)	(0.019)	(0.004)	(0.025)	(0.007)	(0.016)	(0.000)	(0.036)
Observations	1,106	849	1,202	1,017	1,239	759	1,191	1,003	517	188
Panel B: Male Leadership										
♂ Firm Size (pre)	-0.000	-0.007**	0.000	0.001	-0.000	-0.009***	0.002**	-0.009***	-0.003*	0.005
	(0.001)	(0.003)	(0.001)	(0.003)	(0.000)	(0.002)	(0.001)	(0.003)	(0.001)	(0.005)
♂ Firm Size (post)	0.003*	0.002	0.002**	0.009***	0.001**	0.008***	0.009***	-0.007***	-0.003	0.006
	(0.001)	(0.004)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.003)	(0.003)	(0.007)
Δ♂ Firm Size	0.003	0.010	0.002	0.008	0.002	0.017**	0.007***	0.002	-0.000	0.001
	(0.003)	(0.007)	(0.002)	(0.006)	(0.002)	(0.007)	(0.002)	(0.005)	(0.006)	(0.013)
Observations	12,365	7,261	14,412	8,689	19,136	9,690	15,791	9,817	5,003	1,796
Panel C: F - M Leadership										
Δ♀ Firm Size	-0.010	0.041	-0.004	-0.059**	0.003	-0.022	-0.003	0.002	0.016***	-0.031***
-Δ♂ Firm Size	(0.014)	(0.036)	(0.011)	(0.029)	(0.008)	(0.047)	(0.014)	(0.023)	(0.000)	(0.000)

Notes: Observations are weighted by the square root number of firm employees. Two-digit industry and state fixed effects are included in each specification. Standard errors are clustered at the industry level and are reported in parentheses. *** $p < 0.01$, ** $0.01 \leq p < 0.05$, * $0.05 \leq p < 0.1$.