Reducing wage inequality through gender gaps: Good intentions and promising results, but do not force it too much*

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Abstract

This article presents a wage inequality decomposition by gender that changes the traditional focus of centering on the gender gap's determinants and the unexplained component issue to analyzing the gap based on its impact on global wage inequality. The decomposition determines the maximum relative gender wage allowed before it begins to actually increase inequality. Accordingly, a labor model is constructed to evaluate the impact of establishing restrictions on intra-occupational gender pay gaps within each company; specifically, a restriction in which the average wage of one gender cannot exceed α times the average wage of the other gender. For an $\alpha = 2$, the model predicts a 15 to 20% wage inequality reduction, with a cost for the economy of 0.27 to 0.74% of Costa Rica's 2008 GDP. However, with a tighter restriction of $\alpha = 1$, the inequality reduction dissipates, and could even reverse into a wage inequality increment.

JEL Codes: D31, E64, J16, J31
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1. Introduction

Some of the most usual and basic methods used to study wage gender gaps are becoming obsolete for some countries. A common approach in these studies is to decompose the gender gap into a series of variables in order to identify their determinants. For example, some variables that frequently explain the gender gap are age, human capital (education), labor force experience, having children, economic sector and working time, and the part of the gap that remains unexplained may be due to unobserved variables, as well as due to a component of gender discrimination (Goldin and Rouse (2000), Goldin (2014), Sarsons (2019)). However, despite the contributions of these methods, for some countries the gender gap is becoming more difficult to explain, and therefore, more susceptible to persist over time. For instance, Blau and Kahn (2017) find that in the US, the period of strongest wage convergence between men and women was the 1980s, but progress has been slower since then, coinciding with a general increment of the unexplained part of the gap, going from 71% in 1980 to 85% in 2010, based on a human capital model specification; Goldin (2014) elucidates that the explained portion of the gender wage gap decreased over time as human capital investments between men and women converged, providing an explanation to why the unexplained portion of the gap rose relative to the explained portion. Similarly, according to Brynin (2017), although the unadjusted gap for the United Kingdom decreased by 50% between 1994 and 2014, the part that could be explained has decreased as well, going from 47% to 31.7%, a situation that the author attributes to unobservable variables. Furthermore, this phenomenon regarding the high unexplained part of the gap is also found in other countries such as Nicaragua, Honduras, El Salvador and Costa Rica.[1]

This paper develops a novel wage inequality decomposition by gender, which changes the focus from the gap's determinants and the associated unexplained component issue to analyzing the gap based on its impact on global wage inequality. More specifically, the decomposition isolates a single component that quantifies the impact of gender gaps on total wage inequality, and determines the maximum relative gender wage allowed before it begins to actually increase wage inequality. Furthermore, the article estimates the impact of a policy change regarding relative gender wage restrictions on inequality growth and occupational gender gaps evolution.

The previous studies mentioned present a common situation that different countries experience, regarding the size and growth of the unexplained component of the gender gap. Moreover, not being able to fully explain the gap could lead to its persistence in time, and prolong it for countries that are already experiencing persistence, such as the United States.[2] In fact, according to the OECD (2015), currently, most of its country members present a substantial gender wage gap. To counter this phenomenon of the gender gap, different strategies that do not arise from the mentioned methods are being proposed. For instance, laws requiring a minimum percent of each gender in the boards of companies. Bertrand, Black, Jensen, and Lleras-Muney (2019) document that the gender gap in earnings within boards fell substantially, however, the reform didn't benefit the larger set of women employed, only those who made it into the board. Then, laws that prohibit employers from enforcing pay secrecy; Kim (2015) compares the wages of 6 states that declared wage secrecy illegal before 2012, with states that did not, and finds that in the former women's wages were 3% higher and the gender gap was reduced between 12 to 15% for women with a university degree and between 6 and 8% for women without a title. Another proposal has been laws that ban employers from asking potential hires about past earnings; regarding this specific law in California, Hansen and McNichols (2020) estimate that women over 35 see a 2.3 percentage point increase in their earnings ratio relative to males, and that married women with all of their children over 5 see a 4.7 percentage point increase

[1] See Enamorado, Izaguirre, and Ñopo (2009), Cedeño, González, and Pizarro (2015) and Rodríguez and Segura (2015).

[2] See Miller and Vaggins (2018), and the report of Hegewisch and Williams-Baron (2016) for the Institute for Policy Research for Women.

in their relative earnings ratio.

Among these past proposals, Coghlan and Hinkley (2018) also suggest that firms should be instructed to publish their gender gaps, both at a company level and by occupation. Transparency laws have shown potential to reduce the gender gap by approximately 30 percent (see Baker, Halberstam, Kroft, Mas, and Messacar (2019)). However, even if firms were required to make such a publication, public pressure to correct certain gaps, especially those that could be considered scandalous, does not guarantee a change in the company's behavior regarding its salary policy. Therefore, this article evaluates the potential impacts of directly imposing restrictions on the gender gaps. However, such restriction must be strategically designed to counter the gap's persistence. Blau and Kahn (2017) find that by 2010, gender differences in occupation and industry are the most important variables in explaining the gender wage gap, despite occupational upgrading of women relative to men. Furthermore, Goldin (2014) adds that the majority of the current earning's gap comes from within occupation differences in earnings rather than from between occupation differences, and Card, Cardoso, and Kline (2016) point out as well that firm-specific pay policies may in fact be important for understanding the gender wage gap. Accordingly, this article considers direct restrictions on the intra-occupational gender gaps within each company. Now, as Hansen and McNichols (2020) ascertain, even when blunt policies can sometimes have their intended effects, it is still possible they will also have other consequences. For example, Piketty, Saez, and Zucman (2018) posit that the reduction in the gender gap has played an important role in mitigating the rise of inequality in the US since the late 1960s. That is why the article focuses on the effects that such intra-occupational restrictions within each firm could have in: i) wage inequality, ii) the gender gap of each occupation in the economy, and iii) in the cost that firms will incur for complying with such restriction. This is done for three specific years, 2008, 2013 and 2018, with a rich micro database of Costa Rica's formal employment sector. To do so, three steps are completed.

As a first step, a novel wage inequality decomposition by gender is developed, using wage dispersion as the measure for inequality. An advantage of this definition of inequality is that according to Helpman, Itskhoki, Muendler, and Redding (2016), the decomposition of this inequality measure allows quantifying the relative importance of possible sources of wage differences. In this new decomposition, wage inequality can be broken down into gender related components, controlling for several characteristics of the economy, such as: economic sector, type of company (public or private), company, and occupation. These components account for wage differences within the same gender across each controlling characteristic of the economy, as well as wage gaps between genders within each occupation for each firm. This between-within notion is crucial in the wage inequality studies conducted by Helpman, Itskhoki, Muendler, and Redding (2016), Song, Price, Guvenen, Bloom, and von Wachter (2018) and Alvarez, Benguria, Engbom, and Moser (2018). However, the new decomposition differs not only in that it accounts for gender, but in the specific aspect that it incorporates the between-within wage differences notion for several factors simultaneously. Similarly, Brown, Moon, and Zoloth (1980) use a between-within differences approach to break down gender wage gaps, into intra-category and inter-category components, where these could be industry or occupation.

Furthermore, the gender gap component that arises from the decomposition sets the foundation for the gender gap restriction (α), since it establishes that inequality increases precisely when a gender wage within an occupation of a specific firm is over two times the other gender wage. By means of this criterion, around 40% of the economy's departments (occupations within the company) are not fulfilling the gender restriction. Finally, the gender based wage decomposition shows that the growth in inequality between 2008 and 2018 is mainly explained by an increase in a segregation's effect (30% of the total increase occurs by $\Delta(\mathbb{P}_M + \mathbb{P}_F)$), and by an increase in the salary differences within men of the same occupation of each company (26% occurs due to $\Delta\mathbb{W}_M$) and the same for women (around 19% due to $\Delta\mathbb{W}_F$).

In the second step, I develop a model of labor microsimulation that incorporates the reactions of agents (firms and workers) to restrictions on intra-occupational gender gaps in each company. The first main decision concerns how each department within each firm, endogenously determines job growth based on its expectation, complying with the restriction, and avoiding higher firing and payroll expected costs. The second main frame of the model comprehends the pressure on wages that the gender-occupation differentiated labor markets generate through supply and demand, and the re-match of workers and employers through a series of characteristics such as: wage, gender, occupation, location and experience. In general, the model focuses on how companies adapt to the restriction in a shocked labor market, how the pairing between agents in this market is readjusted due to this distortion, and the additional cost the firms undertake regarding firing and monthly payroll.

A microsimulation model is chosen to study the impact of the restriction, besides the decomposition, because according to Bourguignon and Spadaro (2006) these allow to simulate the effects of policy on heterogeneous economic agents and to evaluate the results at individual and aggregate levels. To carry out this methodology it is necessary to have a database and characteristics of individual agents (see details in section 2), the policy rules that will be incorporated into the economic environment, and a theoretical model that considers the reactions of the agents. Bourguignon and Spadaro (2006) show that a model of labor microsimulation can be computed for agents with specific characteristics that choose consumption and amount of work to offer, subject to budget restrictions, so that they maximize their utility. Similarly, an optimization would be associated with companies that demand work so that their profits are maximized. However, this way of approaching the microsimulation does not directly incorporate certain important aspects such as the salary structure within firms and the intra-occupational gender gaps, therefore, section 3.2 expands on how these factors are incorporated and how agents behave in the labor market.

In the third step, results from the labor model with the gender gap restriction incorporated are discussed. To do so, the economy's wages introduced into the model, and the ones the model produces are used to compute the change in: the economy's occupational gender gaps, the decomposition's components, and the additional cost incurred by the firms. First, the labor microsimulation shows that gaps tend to deteriorate (move away from the equalization of averages) in favor of men for those occupations with little female participation, and tend to deteriorate in favor of women if the occupation has low male participation. Mechanic, builder and transporter are some of the former occupations, whereas some of the latter are preschool and special education, domestic workers and beauty services.

The model also shows that the constraint produces a decrease in total inequality that varies between 15 and 20%. This reduction is mainly achieved through lesser wage differences among workers of the same gender within the same department. However, if the restriction is tightened too much ($\alpha = 1$), this global inequality reduction dissipates, and could even revert into an increment. Finally, the absorption of the standard $\alpha = 2$ restriction by the economy also generates a net impact cost that is estimated between 0.25 and 0.75% points of 2008 GDP. When the previous results are compared as one, it can be seen that choosing a single α to implement is not straightforward. A tighter restriction diminishes not only the volatility in the gender gaps' deterioration, but also the wage inequality reduction. Meanwhile, a standard $\alpha = 2$ restriction or a more flexible one, concurrently produces an exacerbated inequality narrowing and gender gap deterioration in highly segregated occupations.

The rest of the article is organized as follows: section 2 presents the wage data used, section 3 explains the decomposition of wage inequality by gender and the microsimulation model, then, results are discussed in section 4, and finally, some concluding remarks are presented in section 5.

2. Data

I use the wage database of the Social Security in Costa Rica (CCSS).[3] Wages in the database correspond to all people that contribute to the Social Security System, either from public o private firms. Even though this base is not a sample, but a complete set of workers and firms, the informal sector is excluded, and according to Programa Estado de la Nación (2019), this sector represents approximately 40% of all jobs. Therefore, all results are representative only for the formal sector of Costa Rica.

The previous base contains information about characteristics of workers and their employers. Regarding workers, we have information about their salary (real January 2008 wages), gender, number of monthly contributions or quotas to the Social Security System, date in which they started working for the company they contribute in the respective month, occupation (in detail and in code, based on the Costa Rican Occupation Classification, COCR, 2011 version) and respective employer (if there is any, because there are independent workers in the data set). Regarding employers, the following information is available: location (province, canton and district), number of workers, economic sector (in detail and in code, based on the International Standard Industrial Classification of all economic activities, ISIC, revision 3.1) and type of company (public or private). Lastly, the base has a monthly frequency and is available for 2008, 2013 and 2018. For more details on the cleaning process that was carried out in the base see Appendix A. Complementary information from labor legislation is also used to calibrate certain aspects of the dynamics of the labor microsimulation model, specifically, the legislation corresponding to layoffs and annual bonuses.

The final base used contains information on $923,663$ workers and $21,279$ companies for 2008, $1,143,024$ and $24,687$ for 2013, and $1,449,656$ workers and $27,082$ companies for 2018. The economic sectors are classified into 20 categories and occupations into 43 classes; more precision on these classifications are found in Tables 5 and 7, respectively. Additionally, Table 5 present statistics on average wage and labor force gender composition for each sector.

3. Methodology

3.1. Wage inequality decomposition by gender

There are many ways to measure wage inequality in an economy, some of these are, according to Sarlo, Clemens, and Emes (2015): the distribution of wages, percentile curves, the ratio of wages to specific percentiles (pcts: 50-10, 90-10, 90-50), the Gini coefficient, and others. In this research, the dispersion of wages is used as a measure of inequality. The variance of the wages of an economy with N workers in a specific period t, will be denoted as $\mathbb{T}$ and is defined as the average of squared deviations of each wage (ω_i) with respect to the average wage ($\overline{\omega}$); $\mathbb{T}$ describes how different or unequal workers' wages are from each other. Equation (1) expresses the definition of the wage inequality described.

$$\mathbb{T}(\omega) \equiv \frac{1}{N}\sum_{i=1}^{N}(\omega_i - \overline{\omega})^2 \tag{1}$$

Equation (2) presents the first phase of the decomposition of the variance of wages; total inequality

[3]This data set is obtained by the Institute for Research in Economic Sciences of the University of Costa Rica (IICE-UCR), and is used with the proper authorization and confidential agreements of the IICE. The identity of workers and firms is protected by ID codes that the CCSS created.

can be broken down into five parts when taking into account the structure of the labor market (see Appendix B):

$$\mathbb{T}(\omega) = \mathbb{B}(s) + \mathbb{B}(T,s) + \mathbb{B}(f,T,s) + \mathbb{B}(\vartheta,f,T,s) + \mathbb{W}(i,\vartheta,f,T,s) \tag{2}$$

The $\mathbb{B}(\cdot)$ components from the previous decomposition show how different wages are between: i) sectors (s), ii) types of companies (T), public or private, controlling for sector s, iii) companies (f) controlling for type T and sector s, and iv) occupations ϑ in the same firm f, of type T and in sector s. For more details see equations (3) and (4), which present the components of inequality between sectors and between types of companies as an example.

$$\mathbb{B}(s) \equiv \frac{1}{N}\sum_{s\in S} N_s(\overline{\omega}_s - \overline{\omega})^2 \tag{3}$$

$$\mathbb{B}(T,s) \equiv \frac{1}{N}\sum_{s\in S}\sum_{T\in s} N_{T,s}(\overline{\omega}_{T,s} - \overline{\omega}_s)^2 \tag{4}$$

Next, equation (5) presents the last component of the decomposition, which takes the intuition of how unequal are the workers within the same occupation in a company f, for each occupation of each firm.[4]

$$\mathbb{W}(i,\vartheta,f,T,s) \equiv \frac{1}{N}\underbrace{\sum_{s\in S}\sum_{T\in s}\sum_{f\in T}\sum_{\vartheta\in f}}_{\sum_{s,T,f,\vartheta}}\sum_{i\in\vartheta}(\omega_i - \overline{\omega}_{\vartheta,f,T,s})^2 \tag{5}$$

Then, from equation (2), the five components mentioned are broken down using the gender variable and equation (6) is obtained (see Appendix B); figure 7 presents a tree graph of the decomposition.

$$\begin{aligned}\mathbb{T}(\omega) = {} & \mathbb{G}_M + \mathbb{G}_F + \mathbb{W}_M + \mathbb{W}_F + \mathbb{P}_M + \mathbb{P}_F + \mathbb{B}(s)_M + \mathbb{B}(s)_I + \mathbb{B}(s)_F + \mathbb{B}(T,s)_M + \mathbb{B}(T,s)_I + \mathbb{B}(T,s)_F \\ & + \mathbb{B}(f,T,s)_M + \mathbb{B}(f,T,s)_I + \mathbb{B}(f,T,s)_F + \mathbb{B}(\vartheta,f,T,s)_M + \mathbb{B}(\vartheta,f,T,s)_I + \mathbb{B}(\vartheta,f,T,s)_F\end{aligned} \tag{6}$$

In general, each $\mathbb{B}(\cdot)$ inequality component is broken down into three subcomponents; equation (7) presents an example with $\mathbb{B}(s)$. The first subcomponent $\mathbb{B}(s)_M$ reflects: i) wage inequality between men from different sectors and ii) penalization (inequality increment) due to differences in gender composition (δ) between sectors (take as example: $\overline{\omega}_{s,M} = \overline{\omega}_M$). The above insights are analogous to the third subcomponent $\mathbb{B}(s)_F$ that is applied to women. Finally, the second subcomponent penalizes the correlation between $\mathbb{B}(s)_M$ and $\mathbb{B}(s)_F$ for a certain sector s; that is, if both men and women in sector s are, simultaneously, above or below the economy's average, in terms of wages and composition, it is taken as an inequality relative to the other sectors.

$$\mathbb{B}(s) = \underbrace{\sum_{s\in S}\frac{N_s}{N}([\delta_{s,M}\overline{\omega}_{s,M} - \delta_M\overline{\omega}_M]^2)}_{\mathbb{B}(s)_M} + \underbrace{\sum_{s\in S}\frac{N_s}{N}2[\delta_{s,M}\overline{\omega}_{s,M} - \delta_M\overline{\omega}_M][\delta_{s,F}\overline{\omega}_{s,F} - \delta_F\overline{\omega}_F]}_{\mathbb{B}(s)_I} + \underbrace{\sum_{s\in S}\frac{N_s}{N}([\delta_{s,F}\overline{\omega}_{s,F} - \delta_F\overline{\omega}_F]^2)}_{\mathbb{B}(s)_F}$$

$$\mathbb{B}(s) = \mathbb{B}(s)_M + \mathbb{B}(s)_I + \mathbb{B}(s)_F \tag{7}$$

Then, the intra-occupational inequality component, $\mathbb{W}(i,\vartheta,f,T,s)$, is broken down into six subcom-

[4] Workers within an occupation in a specific firm have already been divided into two additional groups G regarding gender, in preparation for the next phase of the decomposition.

ponents. The first two are shown in equations (8) and (9), and refer to the wage inequality within men of the same specific occupation in f ($\mathbb{W}_M$), and the wage differences within women in the same specific occupation in f ($\mathbb{W}_F$). The subcomponents of equations (10) and (11) encompass a penalty (inequality increment) to each gender for not dominating completely the occupation: the more one group dominates in terms of composition, the more influence it has over the other. For example, the inequality within women of the same specific occupation ϑ in f receives a penalty the more segregated they become ($\uparrow N_{\vartheta,M} \Rightarrow \delta_{\vartheta,M} \rightarrow 1$), and this penalty disappears as the female gender dominates the composition ($\delta_{\vartheta,M} \rightarrow 0$); note that the penalty depends on the number of individuals affected and is quantified based on the respective gender average salary.

$$\mathbb{W}_M \equiv \sum_{s,T,f,\vartheta} \sum_{M \in \vartheta} \sum_{i \in M} (\omega_i - \overline{\omega}_{\vartheta,M})^2 \tag{8}$$

$$\mathbb{W}_F \equiv \sum_{s,T,f,\vartheta} \sum_{F \in \vartheta} \sum_{i \in F} (\omega_i - \overline{\omega}_{\vartheta,F})^2 \tag{9}$$

$$\mathbb{P}_M \equiv \sum_{s,T,f,\vartheta} N_{\vartheta,M} \overline{\omega}^2_{\vartheta,M} \delta^2_{\vartheta,F} \tag{10}$$

$$\mathbb{P}_F \equiv \sum_{s,T,f,\vartheta} N_{\vartheta,F} \overline{\omega}^2_{\vartheta,F} \delta^2_{\vartheta,M} \tag{11}$$

Finally, equations (12) and (13) show the subcomponents associated with intra-occupational gender gaps. A peculiarity of these gaps is their dual benefit-penalty character, similar to the $\mathbb{P}$ components. Within a firm's occupation, there are two components associated with the gaps, $\mathbb{G}_{\vartheta,M}$ and $\mathbb{G}_{\vartheta,F}$.

$$\mathbb{G}_M \equiv \sum_{s,T,f,\vartheta} N_{\vartheta,M} \delta^2_{\vartheta,F} \overline{\omega}_{\vartheta,F} (\overline{\omega}_{\vartheta,F} - 2\overline{\omega}_{\vartheta,M}) \equiv \sum_{s,T,f,\vartheta} \mathbb{G}_{\vartheta,M} \tag{12}$$

$$\mathbb{G}_F \equiv \sum_{s,T,f,\vartheta} N_{\vartheta,F} \delta^2_{\vartheta,M} \overline{\omega}_{\vartheta,M} (\overline{\omega}_{\vartheta,M} - 2\overline{\omega}_{\vartheta,F}) \equiv \sum_{s,T,f,\vartheta} \mathbb{G}_{\vartheta,F} \tag{13}$$

The duality of the gender gap components is understood as follows. If the average male wage of a certain occupation in a firm f is 10 times the female's, this causes $\mathbb{G}_{\vartheta,M}$ to be negative and therefore $W_{\vartheta,M}$ decreases ($\mathbb{G}_{\vartheta,M} + W_{\vartheta,M} < W_{\vartheta,M}$); inequality within men decreases because despite having inequality within them, there is a positive aspect, on average they are better in terms of wage than the other gender group, and this reduces the effect of inequality for the male gender; similarly, with regard to the female group, not only there is inequality within them, but their group is on average below the male group, so their situation worsens ($\mathbb{G}_{\vartheta,F} + W_{\vartheta,F} > W_{\vartheta,F}$). This type of intuition of double impact by gender can also be observed in some discrimination models in the literature on gap and wage decompositions using econometric estimation.[5]

An important aspect to note is that strict inequality between averages is not punished, but only inequality above a threshold; in this case, the threshold is two times the other wage average. This is convenient since the decomposition doesn't control for all the characteristics of the individuals; for example, variables such as education, age, experience, among others are excluded. Similarly, an equalization of wage averages for each gender would lead to an absence of a gender gap in the respective occupation in the company f, a positive aspect that is rewarded with a decrease in inequality for each gender, that is, $\mathbb{G}_{\vartheta,G} + W_{\vartheta,G} < W_{\vartheta,G}, \forall\, G \in \{M, F\}$.

[5]See Oaxaca and Ransom (1994) for an example of how discrimination can be divided into the advantage of one group and the disadvantage of the other.

Equation (6), and all those associated, allow calculations of various gender-specific origins of total wage inequality, as well as the gender-specific source of the growth of total inequality over time. Additionally, the previous inequality decomposition formalizes an intra-occupational gender gap by company that will be taken as the basis for its restriction (a threshold of α) in the subsequent exercise of labor microsimulation. Since the decomposition gives specific limits that the intra-occupational gender gap can take before starting to penalize ($\alpha = 2$), these will be used initially as the restriction to carry out the microsimulation with the aim of approximating the impact on: inequality, firms' additional costs for complying, and the gender gap in each occupation of the economy. It is important to note that the α threshold refers to the legal gender gap restriction that is going to be imposed, not the threshold that the decomposition uses to penalize gender gaps, which is constant at 2. Finally, it is worth emphasizing that the restriction on intra-occupational gender gaps are not only imposed in the microsimulation exercise due to the motivation expressed in the introduction, but because according to the decomposition there is a point where the inequality measure, instead of rewarding the gender gap situation, penalizes it (increases inequality).

3.2. Labor market microsimulation

The economy in this model takes a similar structure than the one presented in the wage inequality decomposition by gender; that is, a structure based on: economic sector, type of firm (public or private), firm, occupation within firm and gender. Initially, workers' wages are used to compute the decomposition components and the gender wage gap for each occupation in the economy. These calculations will be compared to the respective ones when the labor market has absorbed the effect of the restrictions on the intra-occupational gender gaps within each firm. We are interested in the possible effects of such restrictions in the short term, therefore, for each of the available years in the data set we will use the information for February and November as the initial and final periods of time in the model; we don't consider January and December since the model is interested in each firm's stable jobs, not in the seasonal ones.

3.2.1. Agents and characteristics

The model starts with a given economy at the initial period of time chosen, in which there are workers and firms. Workers can be divided into independents and employees. Also, each worker has a wage and characteristics, such as gender, occupation, wage decile within the firm, and experience; experience is computed as the maximum between number of monthly contributions to Social Security and number of months worked for the current firm. On the other hand, each firm has an economic sector and type associated, location, as well as a payroll that consists of different occupations. Firms that are registered at the initial period are denoted as old or established, and those that arise after the initial period are denoted as new; the same occurs for workers.

3.2.2. The intra-occupational gender gap restrictions within each firm

The restrictions that are going to be imposed in the initial period establish that for each occupation within a firm, each gender average wage cannot be greater than α times the other. Equation (14) presents the restriction that must be fulfilled. The restriction arises from the $\mathbb{G}_{\mathbb{M}}$ and $\mathbb{G}_{\mathbb{F}}$ components, which emphasize that gender gaps increase inequality when surpasses a threshold of 2; so, an $\alpha > 2$ would be considered a more flexible restriction, since it allows gender gaps over the penalization threshold, and vice versa, a $\alpha < 2$ would be a more stringent constraint. Also, the restriction doesn't apply to those occupations within firms that consist of only one person, but it does to those that consist of only one gender (occupational segregation).

$$\max\{\overline{\omega}_{\vartheta,f,M}, \overline{\omega}_{\vartheta,f,F}\} \leq \alpha \min\{\overline{\omega}_{\vartheta,f,M}, \overline{\omega}_{\vartheta,f,F}\} \tag{14}$$

We assume all firms will meet the restriction in the given time for adjustment of one year (actually, 10 months) based on: i) credible sanctions and strict vigilance on behalf of the regulatory agency, ii) threat of repercussion on behalf of the consumers since the intra-occupational gaps are to be public according to Coghlan and Hinkley (2018) (publicity factor). Some other assumptions are going to be established in order to guarantee that the restrictions don't cease to have meaning. Specifically, that some actions on behalf of the firms are restricted and the reasons such deeds might be in fact out of range: i) gender falsification, since the regulatory agency can cross the CCSS information with the one in Registry and Immigration; ii) fake the worker's occupation, since the agency can corroborate it with his work history and his inscription to the respective professional association; iii) forge the employee's wage, since the employer-employee incentives could conflict on aspects such as taxes, social contributions and pension; iv) forge a position in the firm for which social contributions are paid but no wage payment is made, because of personal inspections made by the regulatory agency. Lastly, legally, firms cannot reduce wages unilaterally.

Each firm has a payroll that can be divided by occupation. These occupations within firms are going to be referred to as departments. Each of these departments can be classified in five categories according to their initial fulfillment of the restriction, $R \in \{0, 1, 2, 3, 4\}$. An R type 0 indicates that the department meets the restriction from the start. Type 1 and 2 makes reference to departments in which the restriction is not met, favoring men or women, respectively. Finally, R type 3 and 4 characterize departments that have no women or men, respectively. If an occupation in a firm f has no workers of a specific gender, if could be argued that a gender gap is not valid (even one of the $\mathbb{G}_{\vartheta,G}$ components would disappear since one of the gender proportions would be zero); however, in this wage inequality decomposition by gender a value of zero will be assigned to a missing gender's average wage (as if this gender receives no retribution) with the specific objective of taking into consideration that occupational segregation is one of the documented causes of wage gender gaps. [6]

3.2.3. Statistics on the intra-occupational gender gap restriction in each company

Table 1 shows the percentage of departments (occupations within firm, for all firms) that at the beginning of each period are not complying with the intra-occupational gender gap restriction; the above statistics are presented differentiated by those occupations in companies that experience a segregation problem (more than one worker and only one gender). The data shows that a large part of the occupations that must make adjustments to meet the restriction are due to a segregation issue. In general, around 38% of the occupations in companies are not meeting the restriction each year (with $\alpha = 2$), and of these, 94% are due to segregation problems. See Table 6 for the same analysis but in monthly frequency.

[6] See Blau and Kahn (2017), Coghlan and Hinkley (2018) and Khitarishvili, Rodriguez-Chamussy, and Sinha (2018).

Table 1: Percentage of occupations within companies that are not complying with the intra-occupational gender restriction: 2008, 2013 and 2018.

Alpha	**(with segregation)**			**(without segregation)**		
	08	13	18	08	13	18
$\alpha = 1$	63.38	60.74	61.59	26.07	25.55	27.14
$\alpha = 1.5$	42.95	40.53	39.89	5.64	5.34	5.44
$\alpha = 2$	39.48	37.22	36.57	2.17	2.03	2.12
$\alpha = 2.5$	38.34	36.07	35.41	1.03	0.88	0.97
$\alpha = 3$	37.85	35.68	34.98	0.54	0.49	0.54

Note: Occupations in each company that consist of more than one worker and contain only one type of gender (occupational segregation) are also subject to the intra-occupational gender restriction.

3.2.4. Firms and their absorption of the restriction's effect

Equation (15) defines a monthly labor force expenditure for each department ($\mathbb{E}_{t,\vartheta,f}$), that accounts for wages and a part of the legal annual bonus of each worker. Then, since we have information for the initial and final years in study, equation (16) defines the expected job growth of the occupation within firm. Associated with the optimal path, g^*, is a cost, C^*, that the department is willing to undertake to achieve its expectations. We assume each department's goal, g^*, is a reflection of unobservable variables such as the firm's sales and general situation that the department is going to experience from the initial period until the final one, excluding the restriction of interest.

$$\mathbb{E}_{t,\vartheta,f} = \sum_{i \in \vartheta,f} \left(\omega_{i,\vartheta,f} + \frac{\omega_{i,\vartheta,f}}{12} \right) \tag{15}$$

$$g^*_{t+1,\vartheta,f} = L_{t+1,\vartheta,f} - L_{t,\vartheta,f} \tag{16}$$

$$\mathbb{C}^*(g^*_{\vartheta,f}) = \mathbb{E}^*_{t+1,\vartheta,f} - \mathbb{E}_{t,\vartheta,f} \tag{17}$$

Regarding the intra-occupational restrictions, it is important to emphasize that, initially, they represent an impact on firms' employee structure and the labor market, not a shock on goods and services' demand or on sales. At the beginning, this will force firms' departments to review if their payroll meets the restriction and think how this novel policy affects its optimal path of action regarding employment. The effective labor job growth, $g_{\vartheta,f}$ is endogenous to the model, since the effective cost, $\mathbb{C}(g)$, when adapting to the restriction could be higher than the initial expected optimal cost or savings associated with $g^*_{\vartheta,f}$ that the departments were willing to undertake. Each department's ideal scenario is to implement the optimal path of job growth as long as the associated updated cost is no greater than the initial expected cost. If that is not possible, the firm will adjust its job growth, with an established preference, so that it doesn't exceed the initial expected cost. Equation (18) presents the optimization that each department undergoes in order to find the effective g.

$$g_{\vartheta,f}: \quad \mathbb{C}(g_{\vartheta,f}) \leq \mathbb{C}^*(g^*_{\vartheta,f}) \quad st \quad g_{\vartheta,f} \leq g^*_{\vartheta,f} \; and \; g_{\vartheta,f} = -L_{\vartheta,f} \prec \cdots \prec g_{\vartheta,f} = 0 \prec \cdots \prec g_{\vartheta,f} = g^*_{\vartheta,f} \tag{18}$$

In general, for each possible g that the department considers, it generates a possible way to deal with the restriction (wages and payroll modifications) and an associated expenditure for the final period. Then, the final g is chosen so that the effective cost is no greater than C^*. Now, there is one piece missing in the determination of the effective job growth for each department, and that is how each department, using a possible g value, manages to meet the restriction and computes the updated cost of the final period $\mathbb{C}(g_{\vartheta,f})$. There are three possible cases to analyze, g positive, negative and equal to zero, but since there is heterogeneity in the circumstances each department experiences (types of R), then, the three cases will differ slightly according to the situation; since R type 1 and R type 3 are analogous to R type 2 and type 4, respectively, only types 0, 1 and 3 will be explained according to the three possible cases of g. Also, there is an additional heterogeneity that depends on the firm's creation date; that is, if the firm or department within the firm arises in between the initial and final period in the economy (new), or if the department already existed in the initial period.

First, departments or firms that arise after the restriction is established are viewed as payroll plans that are to be executed but haven't. Since these departments are just emerging it makes no sense in seeing g as negative or zero, just positive. Since none of the workers have been hired yet, each department can change the gender of the positions to be filled so that if R is greater than zero the restriction can be met, and so that the optimal path regarding $g^*_{\vartheta,f}$ and $\mathbb{C}^*$ can be maintained; this unofficial discrimination that dwells in assigning gender to jobs based on the firm's incentives to meet the restriction will be discussed promptly. Initially, since none of the departments know exactly the direction of the effect on wages by the forthcoming shock on the labor market, they just determine the wages of the positions based on their payroll plans and what they need to fulfill the restriction.

For departments that were already operating (not new), a positive g implies that they open positions with wages so that R becomes type 0 or stays 0. New positions, g, are divided among genders according to the current department's gender composition; if the department has only men or women, then g is divided according to the respective occupation's gender composition in that sector. Now, regarding the new positions' wages, if the department already has R type 0, then, the new positions will be assigned the gender's average wage. If the department has an R type 1, male positions will be assigned the male average wage and the female positions' wages are set at the least sum possible but just enough so that the R type is transformed to 0. Finally, if the department has an R type 3 (only men), the male positions are given the average male wage, while the female positions are given wages such that at the least sum possible the R type is transformed to 0.

A g of zero means that the department doesn't have the expectation of hiring or firing. So, if its R is type 0 it just compares the null cost increment to the expected increment that could be negative (saving by restructure). If R is type 1, then, the adjustment is done through the increment of specific (strategic) wages in order to transform R to type 0 or through the increment of the lowest gender average wage and adjustment of all associated wages according to their deviations.[7] Then, if the department has an R type 3 (all men) it has no option but to hire one female worker with a wage such that the restriction is met. For a negative g, the department analyzes which workers' firing would reduce the R type and executes the firing for those that have the least firing cost associated.[8]

[7]Note that the associated cost ($n\gamma$) for moving the gender average wage or moving specific wages to finally change the gender average is the same; the change (γ) that the average salary of one of the genders requires to be optimal in satisfying R (that is, $\overline{\omega}^*$) can be redistributed equally (first option) or arbitrarily (second option).

$$take\ \overline{\omega} = \frac{\sum_{i=1}^{n} \omega_i}{n} \Rightarrow \overline{\omega}* = \overline{\omega} + \gamma = \frac{n\gamma + \sum_{i=1}^{n} \omega_i}{n}$$

[8]The firing cost of a worker is defined as the annual bonus plus the severance pay that depends on the amount of months that the employee worked for the firm.

For the R type 3 and 4 cases, after the firing, the departments stills needs to hire a person of the opposite gender with a wage such that the payroll achieves an R type 0.

As it was already explained, for each possible g that the department considers, starting with $g^*_{\vartheta,f}$, it generates a way to deal with the restriction and the associated cost, $\mathbb{C}(g_{\vartheta,f})$. Then, the final g is chosen so that the associated cost is less or equal to the initial expected cost, $\mathbb{C}^*$, respecting the preference established in equation (18). After the job growth within each department is endogenously computed, there are going to be positions eliminated or some positions created, as well as wage modifications and worker firings. These changes affect the demand and supply of the labor market and produce an upward or downward pressure to the wages of the positions that are going to be placed in the market by the departments of all firms. The movement of the demand curve of certain occupation depends on new and eliminated positions in ϑ. Analogously, the movement of the supply curve depends on new workers that enter ϑ labor market and workers that exit that specific market.

Previously, it was shown that in order to complete each firm's strategy, they discriminate according to gender when filling each position (each position has a assigned gender); this informal (not official) discrimination when filling positions is a special characteristic in these labor markets, since it would not be realistic to expect that firms will consider both genders when they have incentives to fill them with a strategic one in order to meet the intra-occupational restriction. Therefore, since the impact on the labor market for a specific occupation could be different for each gender, the exercise on moving curves will be done once for male and one for female. The model has one labor market for each gender-occupation in the economy. Each of these markets will determine the gender average wage in the occupation that must prevail in order to match the demand and supply of workers of that specific gender. I assume that supply and demand take a basic linear form presented in equations (19) and (20).

$$S : \overline{\omega}_{\vartheta,G} = \theta_{S,\vartheta,G} * L^S_{\vartheta,G} \tag{19}$$

$$D : \overline{\omega}_{\vartheta,G} = -\sigma_0 L^D_{\vartheta,G} + \theta_{D,\vartheta,G} \tag{20}$$

The parameter σ_0 represents the labor demand elasticity.[9] In the initial period we have the average wage and the number of workers employed for each gender-occupation; this information is used in each of the market equations to compute $\theta_{S,\vartheta,G}$ and $\theta_{D,\vartheta,G}$ for the initial equilibrium. These parameters are used, along with the demand and supply movements after the departments' reaction to the restriction, to recalculate the average gender wage equilibrium in occupation ϑ, and therefore, compute the pressure on wages in that specific labor market for the new positions. Equation (21) presents the pressure the wages may suffer during the negotiations of new positions because of the changes the labor market for each occupation and differentiated by gender is suffering; specifically, $\omega_{z,\vartheta,G}$ is the wage that the department assigned to the position it was sending to the market and $\Delta\overline{\omega}_{\vartheta,G}$ the change in the average wage determined by the labor market for occupation ϑ and gender G. Therefore, final wages for the new positions are determined by the departments' specific situation regarding the intra-occupational restriction in their initial state, and pressure in the labor market. This is an important clarification, because according to Card, Cardoso, and Kline (2016), in traditional competitive labor market models, wages are determined by market-level supply and demand factors rather than by the wage-setting policies of particular firms. Furthermore, Bertrand, Goldin, and Katz (2010) and Card, Cardoso, and Kline (2016) put forward that wages can vary across firms if there are market-based compensating differentials for firm-wide amenities or disamenities,

[9]Since this parameter is not endogenous to the model, it is calibrated according to Alfaro, Campos, and Lankester (2019), who estimated the labor demand elasticity for the comprehensive period 2005-2017, resulting in a -0.358% impact on labor demand by a 1% increment in wages. The previous elasticity is algebraically transformed in order to calculate σ_0.

such as long hours of work. In this article, a new circumstance is introduced that justifies the wage differences across firms and that pertains the very different situations that a single occupation could be experiencing in two different firms regarding the gender gap compliance (type of R and the gap magnitude).

$$\omega'_{z,\vartheta,G} = \omega_{z,\vartheta,G} + \Delta\overline{\omega}_{\vartheta,G} \tag{21}$$

3.2.5. Search and matching

Once the new positions have been incorporated into each labor market differentiated by occupation and gender, the matching between employer and employees starts. It is during this process that the pressure of the market materializes into a change of the initial wages associated to each position. It is important to point out that only the wages of positions that will be filled are affected by current changes in supply and demand; that is because wages of positions already hold by workers are assumed to be subject to previous agreements. Nevertheless, all workers in the economy, including the ones that are categorized as independents in the database and the new ones that will be incorporated to the labor force during the period of time in question, can compete for the positions that arise, even if they already have a job.

There is no limit to the amount of applications that a worker can send, but each worker will apply specifically to those that: i) have the same occupation as the worker has; ii) offer wages greater or equal to the current ones; iii) are located in the same province-canton in which the worker currently works; the variable canton of the current job is used as a proxy of where the workers are willing to go work; for fired workers the wage to compare to is the previous one and for new workers is the one they would have had according to the information of the final period of analysis. The application of each worker contains: gender, wage decile in their firm, and experience.

Each occupation within a firm receives all applications and applies an initial filter according to the gender they wanted to put in the position. Then, each department assigns a priority number to each remaining application according to the following criteria: experience and wage decile (proxy of worker importance and position in old or current firm). Each department simultaneously offers each available position to the highest priority application until it is filled.

Workers receive all jobs offers at the same time, but they don't decide immediately; they have some space to wait other offers that might be rejected by other candidates; if there are several positions offered, the one with the highest wage is chosen. If a position is rejected, then, the department sends the offer to the next priority application in line. If a position is not filled by any of the applicants, then, departments marginally raise the wage offered three times so that remaining workers are encouraged to apply;[10] if no wage is enough to fill the position, then it is filled from an unobservable pool of unemployed and informal workers. These last positions cannot be declared as deserted since it would imply that the firms can function without them and were not really necessary in the first place.

When the matching ends, all departments are going to be able to see how much did the pressure in the labor market and other conditions deviated their initial strategy to meet the restriction. At this point, if the deviation prevented the departments from achieving an R type 0, then, they move upward the lowest gender average wage and adjust, using deviations from the mean, all associated wages to that gender in order to finish meeting the restriction.

After this process is complete all departments must meet the intra-occupational restriction and the calculations on decomposition components, gender gaps in the economy's occupations and the departments' effective cost $\mathbb{C}$ can be recalculated in order to proceed with the impacts of the restriction.

[10] Each wage increment when a position is not filled is defined as a 10% of the minimum wage allowed in the database, that is, 100.000 colones.

4. Results

4.1. Wage inequality decomposition by gender

Table 2: Components of the wage inequality decomposition by gender: basic decomposition and expanded (first and second phases) for 2008, 2013 and 2018.

Component	Contribution to $\mathbb{T}$			Contribution to $\Delta\mathbb{T}$		
	08	**13**	**18**	**08-13** ($\Delta\mathbb{T}$: 45.6%)	**13-18** ($\Delta\mathbb{T}$: 14.5%)	**08-18** ($\Delta\mathbb{T}$: 66.6%)
$\mathbb{W}_{gender}$	0.9999	0.9986	0.9984	0.9959	0.9966	0.9961
$\mathbb{B}_{gender}$	0.0001	0.0014	0.0016	0.0041	0.0034	0.0039
$\mathbb{W}(\vartheta, f, T, s)$	0.3923	0.4079	0.4246	0.4422	0.5400	0.4732
$\mathbb{B}(s)$	0.1028	0.1316	0.1058	0.1948	-0.0721	0.1104
$\mathbb{B}(T, s)$	0.0126	0.0244	0.0159	0.0502	-0.0426	0.0208
$\mathbb{B}(f, T, s)$	0.2352	0.1849	0.1990	0.0744	0.2969	0.1448
$\mathbb{B}(\vartheta, f, T, s)$	0.2571	0.2513	0.2546	0.2384	0.2779	0.2509
$\mathbb{W}_M$	0.2734	0.2674	0.2676	0.2543	0.2687	0.2589
$\mathbb{W}_F$	0.0956	0.1186	0.1323	0.1692	0.2263	0.1873
$\mathbb{P}_M$	0.1171	0.1311	0.1381	0.1619	0.1862	0.1696
$\mathbb{P}_F$	0.1074	0.1099	0.1145	0.1154	0.1460	0.1250
$\mathbb{G}_M$	-0.1077	-0.1216	-0.1272	-0.1521	-0.1656	-0.1564
$\mathbb{G}_F$	-0.0936	-0.0976	-0.1006	-0.1064	-0.1216	-0.1112
$\mathbb{B}(s)_M$	0.0333	0.0305	0.0223	0.0244	-0.0348	0.0057
$\mathbb{B}(s)_I$	0.0155	0.0392	0.0211	0.0912	-0.1042	0.0294
$\mathbb{B}(s)_F$	0.0540	0.0619	0.0625	0.0792	0.0669	0.0753
$\mathbb{B}(T, s)_M$	0.0056	0.0079	0.0041	0.0130	-0.0225	0.0018
$\mathbb{B}(T, s)_I$	0.0041	0.0103	0.0068	0.0240	-0.0170	0.0110
$\mathbb{B}(T, s)_F$	0.0029	0.0061	0.0050	0.0132	-0.0031	0.0080
$\mathbb{B}(f, T, s)_M$	0.1614	0.1143	0.1123	0.0111	0.0984	0.0387
$\mathbb{B}(f, T, s)_I$	0.0402	0.0358	0.0462	0.0263	0.1182	0.0554
$\mathbb{B}(f, T, s)_F$	0.0336	0.0347	0.0405	0.0371	0.0804	0.0508
$\mathbb{B}(\vartheta, f, T, s)_M$	0.1978	0.1760	0.1725	0.1281	0.1483	0.1345
$\mathbb{B}(\vartheta, f, T, s)_I$	0.0028	0.0166	0.0212	0.0468	0.0530	0.0488
$\mathbb{B}(\vartheta, f, T, s)_F$	0.0565	0.0587	0.0610	0.0635	0.0765	0.0676

Note: A positive sign in the contribution to $\Delta\mathbb{T}$ column indicates that the component's growth is in the same direction as the inequality growth.

Table 2 presents the calculation of each of the components of the inequality decomposition by gender, as a percentage of total inequality, both for the first and second phase of the decomposition. In addition, it presents how much each component contributes to the growth of inequality; specifically, between 2008 and 2013 the total inequality measure increases 46%, between 2013 and 2018 a 15%, and between 2008 and 2018 a total of 67%. The increase in wage inequality after 2008 coincides with the post-crisis period, in which the 2008 Gini coefficient experienced an increase of 3.9%, going from 48.7 to 50.6 according to World Bank data. Now, between 2008 and 2018, the Gini coefficient does not show a positive growth but falls to 48. However, this measure is calculated through a survey,

and is on household income not wage income. Using the formal worker wage database we find that the comparable Gini coefficient is 38.9 for 2008, 41.6 for 2013, and 40.9 in 2018; this shows that the inequality in real wage distribution for formal workers grew by 5.1% between 2008 and 2018. It is important to note that the variance of wages and the Gini coefficient on workers' wages do not measure exactly the same aspect; the first focuses on closeness between wages, and the second on proportions of distribution. This is the reason why their growth magnitudes don't match.
Finally, the table also presents the basic version of the decomposition according to gender. The latter shows that almost all of the growth in total inequality can be attributed to salary differences within each gender (99.6% due to $\mathbb{W}_{gender}$) and the remaining almost insignificant to salary differences between genders. (0.4% due to $\mathbb{B}_{gender}$). However, such a distinction between components, and more specifically, the vagueness in the definition of the dominant component, does not allow a deep understanding of the nature of the problem that is shown with the salary differences within each gender group.
The analysis of wage inequality based on the first phase of the decomposition reflects that the inequality in each year of study depends mainly on the wage differences within workers of the same occupation in each company (around 41% due to $\mathbb{W}(\vartheta, f, T, s)$), followed by salary differences between occupations of the same company (25% due to $\mathbb{B}(\vartheta, f, T, s)$). Finally, the wage differences between public and private companies, controlling for the economic sector, do not contribute significantly to the measure of total inequality. Likewise, much of the growth in wage inequality can be explained by an increase in the wage differences within occupations in each company (47% of the growth in inequality occurs by $\Delta\mathbb{W}(\vartheta, f, T, s)$) and by means of a growth in the salary differences between occupations of the same company (around 25% of the growth in inequality occurs by $\Delta\mathbb{B}(\vartheta, f, T, s)$).
The previous analysis, now carried out for the second phase of decomposition, shows the importance of the following components in total inequality ($\mathbb{T}$): i) the differences within men of the same occupation in each company (27% due to $\mathbb{W}_M$), ii) the penalty for occupational segregation in each firm (24% of $\mathbb{T}$ comes from $\mathbb{P}_M + \mathbb{P}_F$), and iii) the award for the fact that a certain number of occupations in each company do not initially breach the restriction (around -22% arises from $\mathbb{G}_M + \mathbb{G}_F$). It is important to note that the previous award not only depends on how many departments were initially complying with the restriction, but also on the weights that magnify the award or penalty, for example, the number of workers in each occupation of each firm. Finally, in this more precise decomposition the growth in inequality is mainly explained by an increase in the segregation penalty (30% of the total increase occurs by $\Delta(\mathbb{P}_M + \mathbb{P}_F)$), and by an increase in the salary differences within men of the same occupation of each company (26% occurs due to $\Delta\mathbb{W}_M$) and the same for women (around 19% due to $\Delta\mathbb{W}_F$). Also, it is important to note that the growth in total inequality is slowed by a growth in the occupational benefit within each company for meeting the gender gap restriction (around -27% from $\Delta(\mathbb{G}_M + \mathbb{G}_F)$).
A question that naturally arises when looking at which components explain the inequality measure and its growth, is why do we impose a restriction on a component like $\mathbb{G}_M + \mathbb{G}_F$ if it seems to be that the differences within men of the same occupation in each company are more important? Such a question must be answered in two parts. First, the restriction is not only for the gaps between the gender average wages that characterize $\mathbb{G}_M + \mathbb{G}_F$, but also applies to the gender segregation and dominance issue in each department that manifests in $\mathbb{P}_M + \mathbb{P}_F$; the latter represents an important component in inequality and its growth, and the former could become more negative (decrease in inequality measure) if remaining violations of the restriction were eliminated. Second, it is not necessary to implement an additional constraint to $\mathbb{W}_M$ and remove the one on gender gaps; this occurs because although each component measures something different, an interdependence is inherently created between them when an impulse such as the restriction in question is introduced, mainly

between the differences within each gender, $\mathbb{W}_M$,$\mathbb{W}_F$, and the gender gaps, $\mathbb{G}_M + \mathbb{G}_F$. Specifically, this interdependence, which will allow the impact of the restriction to also manifest itself in the differences within each gender, occurs because when firms try to adapt gender wage averages to the restriction, they are inevitably modifying wages within each gender, allowing the constraint to flow to these other components. Such insight will be taken up later in the microsimulation results.

4.2. Impact of the restriction on the occupational gender gaps in the economy

Figure 1 shows that the impacts on gender gaps of each occupation in the economy is particularly important for occupations with low participation of some gender. Moreover, those with low male participation (left) tend to present a deterioration in the gaps in favor of women (move away from $y = 1$, see Figure 2), and occupations with low female participation (right) present a deterioration of the gaps in favor of men.

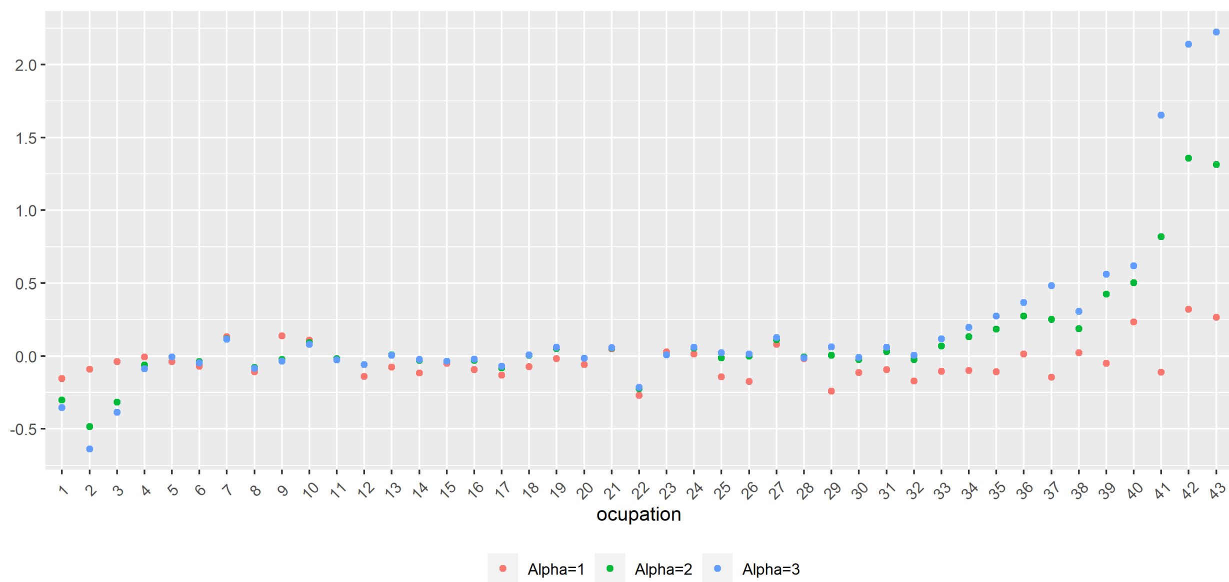

Figure 1: Impact on gender wage gaps for each occupation, $\frac{\overline{\omega}_{M,t+1}}{\overline{\omega}_{F,t+1}} - \frac{\overline{\omega}_{M,t}}{\overline{\omega}_{F,t}}$: Feb2008-Nov2008.

Note: The occupations are ordered from highest to lowest proportion of women in the composition. The first three are: 1 (preschool and special education), 2 (domestic workers) and 3 (beauty). The last three are: 41 (mechanic), 42 (builder) and 43 (transporter). The list of all occupations is in Table 7.

Figure 2: Gender wage gaps for each occupation in the initial and final period: Feb2008-Nov2008, alpha 2.

Note: The occupations are ordered from highest to lowest proportion of women in the composition. The first three are: 1 (preschool and special education), 2 (domestic workers) and 3 (beauty). The last three are: 41 (mechanic), 42 (builder) and 43 (transporter). The list of all occupations is in Table 7.

Figures 1, 3 and 4 show that with a more stringent restriction ($\alpha = 1$), the previous effect of deterioration in the gaps in favor of some gender ceases, because the restriction imposes that these salary averages must be equalized in each department, so, the counterfactuals approach $y = 1$. Subsequently, with greater flexibility ($\alpha = 3$) the effect is contrary to the previous one, since a greater margin is allowed in the differences between averages.

Figure 3: Gender wage gaps for each occupation in the initial and final period: Feb2008-Nov2008, alpha 1.

Note: The occupations are ordered from highest to lowest proportion of women in the composition. The first three are: 1 (preschool and special education), 2 (domestic workers) and 3 (beauty). The last three are: 41 (mechanic), 42 (builder) and 43 (transporter). The list of all occupations is in Table 7.

Figure 4: Gender wage gaps for each occupation in the initial and final period: Feb2008-Nov2008, alpha 3.

Note: The occupations are ordered from highest to lowest proportion of women in the composition. The first three are: 1 (preschool and special education), 2 (domestic workers) and 3 (beauty). The last three are: 41 (mechanic), 42 (builder) and 43 (transporter). The list of all occupations is in Table 7.

Figures 8 to 15 present the previous effects for the Feb2013-Nov2013 and Feb2018-Nov2018 periods. Initially, it could have been speculated that for a certain occupation ϑ, if the value that the gaps can take is reduced or limited, a movement towards the line of equal averages ($y = 1$) should be observed, or at least some stability compared to initial gaps, as with occupations in the center of the graph. However, despite the fact that the previous argument reflects the intuition of what the restriction is doing, there is an important opposite effect in occupations with significant segregation. First, it is important to note that the fact that the gender gaps in each occupation of each company cannot be greater than α, does not imply a transmission of this property to the occupations in the economy.[11] Now, one reason that explains the effect observed in occupations with a high concentration of one gender, is that these occupations of the economy accumulate many of the departments with an R type 3 and 4. Since these occupations in companies must comply with the restriction, but they consist entirely of one gender, they are forced by the same restriction to hire at least one member of the opposite gender, either by opening new positions or using those that they had expected to open due to growth. So, for example, for the set of departments where there were no women, an entry of this gender will be observed, but it may be at low wages relative to the few women who were already in that occupation of the economy. This causes the average salary of the few women in the occupation of the economy to decrease and the gap to deteriorate in favor of men. The same would occur for occupations with low male participation. However, the effect is much greater in the case of female segregation (occupations to the right of the graph), because the data shows that this problem of occupational segregation occurs mainly for women (more R type 3 departments than type 4). Finally, this effect is consistent through the other simulations.

[11] The following example shows how two single-occupational companies can comply with the restriction without necessarily transferring that property to the occupation in the economy. Firm 1 has a woman with salary 1 and a man with salary 2, and firm 2 has a woman with salary 2 and a man with salary 4. Both comply with the restriction and the global gender gap is equally 2. However, this possible final scenario of the simulation could have culminated with three women with salary 1 in firm 1. In the same way, companies comply with the restriction, but the gap of this occupation in the economy is now 2.4.

4.3. Impact on wage inequality

Table 3: Wage inequality decomposition by gender: Feb2008-Nov2008 microsimulation.

Component	$\alpha = 1$ Relative change (ΔT: -15.71%)	$\alpha = 2$ Relative change (ΔT: -19.53%)	$\alpha = 3$ Relative change (ΔT: -19.47%)
$\mathbb{T}$	1.0000	1.0000	1.0000
$\mathbb{W}_{\text{gender}}$	1.0025	0.9997	1.0000
$\mathbb{B}_{\text{gender}}$	-0.0025	0.0003	0.0000
$\mathbb{W}(\vartheta, f, T, s)$	1.2181	0.8775	0.8256
$\mathbb{B}(s)$	0.0086	0.0015	0.0014
$\mathbb{B}(T, s)$	-0.0187	-0.0362	-0.0368
$\mathbb{B}(f, T, s)$	-0.1962	0.0629	0.0884
$\mathbb{B}(\vartheta, f, T, s)$	-0.0119	0.0943	0.1215
$\mathbb{W}_M$	0.9266	0.6779	0.6692
$\mathbb{W}_F$	0.1420	0.1557	0.1602
$\mathbb{P}_M$	0.0638	0.1038	0.1083
$\mathbb{P}_F$	-0.2220	-0.0463	-0.0289
$\mathbb{G}_M$	-0.0009	-0.0797	-0.1000
$\mathbb{G}_F$	0.3087	0.0660	0.0169
$\mathbb{B}(s)_M$	-0.0162	-0.0198	-0.0184
$\mathbb{B}(s)_I$	0.0031	-0.0146	-0.0131
$\mathbb{B}(s)_F$	0.0217	0.0358	0.0328
$\mathbb{B}(T, s)_M$	-0.0079	-0.0172	-0.0173
$\mathbb{B}(T, s)_I$	-0.0067	-0.0141	-0.0145
$\mathbb{B}(T, s)_F$	-0.0041	-0.0049	-0.0050
$\mathbb{B}(f, T, s)_M$	0.0689	0.1182	0.1146
$\mathbb{B}(f, T, s)_I$	-0.2079	-0.0543	-0.0272
$\mathbb{B}(f, T, s)_F$	-0.0572	-0.0009	0.0010
$\mathbb{B}(\vartheta, f, T, s)_M$	0.0791	0.0379	0.0351
$\mathbb{B}(\vartheta, f, T, s)_I$	-0.0429	0.0514	0.0814
$\mathbb{B}(\vartheta, f, T, s)_F$	-0.0481	0.0051	0.0050

Note: A positive sign in the relative change implies that that specific component moves in the same direction as the total inequality.

Table 3 presents the effects of the short-term restriction on the inequality components. Specifically, for $\alpha = 2$, a reduction in total wage inequality is observed with a decrease of 19.5%. The reduction is mainly driven by a decrease in wage differences within men of the same occupation in each company (68% of $\Delta\mathbb{T}$ due to $\Delta\mathbb{W}_M$), as well as in differences within women (16% due to $\Delta\mathbb{W}_F$). The model suggests that when firms (more specifically, occupations within firms) are more vigilant of gender average wages, because of the restriction they must fulfill, wages within each gender tend to be relatively closer as a mechanism to maintain a better control of the respective average wage. Also, there is a decrease in the effect of segregation (penalization for not dominating, $\mathbb{P}_M + \mathbb{P}_F$) that contributes 5% to the reduction of inequality; however, the effect almost goes unnoticed because it is lowered by an increase in the female segregation effect ($\mathbb{P}_F$). This increment's cause does not lie in an increasing male dominance in each department, but in the fact that the restriction allowed the extreme female segregation to come into surface; if you turn your attention to equation 11, you will see the final penalization is dependent on how many women are affected and their wage, which were both 0 at the beginning for R type 3 cases.

Now, the initial objective of the intra-occupational gender gap restriction in each company was to counter the penalties that arose from $\mathbb{G}_M$ or $\mathbb{G}_F$, for having average wages of a gender above the allowed limit. However, despite the fact that the departments no longer present penalties for this reason, only reward for complying with the restriction, Table 3 shows that the sum of these components don't contribute much to the reduction of inequality; specifically, $\mathbb{G}_F$ contributes and $\mathbb{G}_M$ doesn't. This occurs because the penalties for not complying with the restriction had a dual character (the benefit of one gender group was a disadvantage for the other), so, by reducing the penalties of one group we are taking away the benefit of the opposite gender.[12] An extension of this point is shown in the $\alpha = 1$ case, in which the restriction requires gender gaps to be below the penalization threshold of 2. In this case all departments receive a benefit for having gender gaps below the penalization threshold; furthermore, $\mathbb{G}_F$ contributes more to the inequality reduction since the female gender not only got rid of its domination penalties, but is now receiving benefits because of the gender gap elimination; on the other hand, $\mathbb{G}_M$ doesn't contribute much because on one side lost the benefits of being the dominating gender and on the other receives some new benefits because of the gender gap elimination.

Table 3 also shows that the decrease in total inequality is also observed when the constraint is tightened ($\alpha = 1$), with a decrease of 15.7%, and when the constraint is relaxed ($\alpha = 3$), with a decrease of 19.47%. It can be seen that tighten the gender gap restriction dissipates the wage inequality reduction. The model's results suggest that their are two main drivers for this effect, which can be better seen in the first decomposition phase of the Feb2013-Nov2013 simulation (Table 9), since that is the case with the most prominent reversion of the inequality reduction. The first reason pertains the differences within gender, which may experience an increase of dispersion when more drastic changes in wages are needed in order to abide the $\alpha = 1$ restriction; this occurs mainly for the gender with the lowest average wage, which in this case refers to $\mathbb{W}_F$. Second, as inequality within gender decreases as a mechanism to maintain control of the average wages that determine the restriction fulfillment, and because the $\alpha = 1$ constraint requires the equalization of both genders' average wage, differences between occupations, firms, type and sector tend to increase; that is, the higher the concentration of wages within each occupation for each firm, the more evident becomes the differences between those concentrated units. The past effects are also presented, with variations in magnitudes, in the other simulations (see Annex C).

Figure 5 shows the impact of the restriction on total wage inequality for all simulations. It shows how a more severe restriction is counterproductive, even reversing the potential benefit of inequality reduction.

[12] Suppose there is a single-occupation company in which there is a man with a salary of 4 and a woman with a salary of 1. This generates a benefit for the man of $-7 = (1 - 2 * 4)$, a penalty for the woman of $2 = (4 - 2 * 1)$ and a global benefit of -5. For simplicity, we will ignore the gap weights for this example. Now, suppose that by abiding by the restriction the salary of the man falls to 2 (remember that it is actually a group of men whose average can drop through the use of scheduled job layoffs and new low-wage jobs), and the woman's wage remains at 1. This generates an impact of $0 = (2 - 2 * 1)$ to the woman (punishment ceases because of the restriction) and for men the impact is of $-3 = (1 - 2 * 2)$ (they still draw a benefit, although smaller, for being above the woman's salary). In this situation the aggregate prize has dropped to -3.

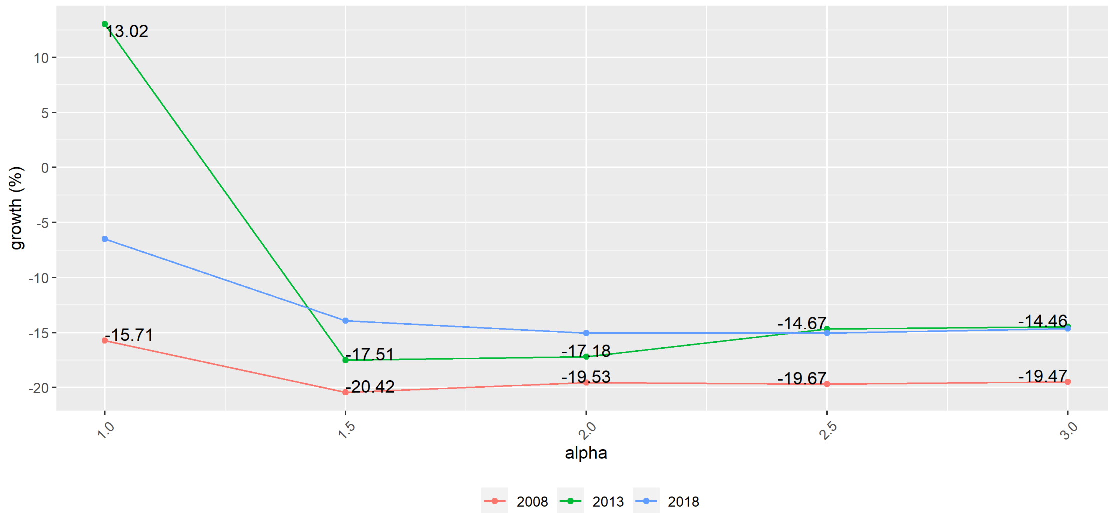

Figure 5: Restriction's impact on total wage inequality: Feb2008-Nov2008, Feb2013-Nov2013 and Feb2018-Nov2018 simulations.

A last important aspect that must be emphasized is that the results of the microsimulations are especially interesting to analyze with respect to the initial situation and not with respect to the not modeled (real) final results. This is because the simulations, despite considering agent reactions, only focus their attention on a single event of interest, the restriction, and not on other events that may have occurred in that period of time. For this reason, they should not be compared directly with the final results that would have happened without the restriction on the intra-occupational gender gaps. This precaution is of vital importance to avoid falling into disproportionate optimism or unfounded accusations. Specifically, there are going to be scenarios where from one period to another the measure of total inequality will increase or decrease; if it decreases, and the restriction produces a labor scenario where inequality also decreases, but not as much as if the restriction had not been applied, voices will arise against state intervention, claiming that this is proof that the involvement of the Government not only consumes resources but also increases distortion in the economy. On the other hand, if the inequality measure increases from one period to another, and the simulation produces a scenario where it decreases, other voices could praise the successful government intervention. In reality, what the simulations argue is that the restriction on the intra-occupational gender gaps in each company can produce, by themselves (ignoring other events), a decrease in wage inequality, which is materialized through an interrelation of the components: occupational segregation, gender gaps and inequality within the same gender.

4.4. Costs for complying with the restriction

After the intra-occupational gender gap restriction is established, each occupation within a firm endogenously determines its labor growth so that it deviates as little as possible from the expected one, while not exceeding the monthly payroll expenditure it was aiming to have in the future. However, this final monthly expenditure is also affected by wage pressures in the labor market on new positions and by workers that take jobs at other companies during the labor matching. These processes cause the final payroll expenditure of each department to deviate from what they were aiming to when complying with the restriction; some might not be affected, but others will be taking on a higher payroll expenditure and others a benefit from the market pressures on certain jobs for specific genders. Furthermore, departments can also part from what they expected to spend in firing processes ($\mathbb{CF}$); form example, a occupation within a firm that was expecting to reduce its size could end firing one additional worker when complying with the restriction in order to meet the department's payroll expenditure aim.[13] The measure of additional cost incurred by the economy (cost impact: $\mathbb{CI}$), specifically, the firms' departments, by complying with the restriction is presented in equation (22); it consists of the additional monthly payroll expenditure and the additional firing cost.

$$\mathbb{CI} = \sum_{f} \sum_{\vartheta \in f} \left([\mathbb{E}_{t+1,\vartheta,f} - \mathbb{E}^{*}_{t+1,\vartheta,f}] + [\mathbb{CF}_{t+1,\vartheta,f} - \mathbb{CF}^{*}_{t+1,\vartheta,f}] \right) \tag{22}$$

Table 4: Additional costs for complying with the restriction (% 2008 GDP)

Alpha	Firing cost			Payroll cost			Payroll savings			Net costs		
	2008	2013	2018	2008	2013	2018	2008	2013	2018	2008	2013	2018
$\alpha = 1$	0.57	0.55	1.03	0.13	0.13	0.18	0.12	0.18	0.15	0.58	0.51	1.06
$\alpha = 1.5$	0.53	0.49	0.94	0.06	0.06	0.07	0.14	0.24	0.22	0.45	0.31	0.79
$\alpha = 2$	0.52	0.48	0.91	0.05	0.05	0.05	0.15	0.25	0.22	0.42	0.27	0.74
$\alpha = 2.5$	0.52	0.47	0.90	0.05	0.04	0.05	0.15	0.25	0.23	0.41	0.26	0.71
$\alpha = 3$	0.51	0.46	0.89	0.04	0.04	0.04	0.15	0.26	0.23	0.40	0.25	0.70

The restrictions produce additional costs (either by firing processes or payroll) for more than half of the economy's departments; the amount of occupations within firms affected rises as the α increases, affecting as much as 81% of all departments. Table 4 presents the additional firing-payroll cost as percentage of the 2008 GDP (all wages are in 2008 real colones). In average, and for the $\alpha = 2$ case, the consolidated group of affected departments that expected to grow end up paying 9.8% more from what they aimed to increase its payroll expenditure; similarly, the group of affected departments the expected to reduce its size end up achieving only 30% of what they aimed to reduce their payroll expenditure. On the other hand, the savings that some departments experiment are not only product of benefits through the market pressures in specific jobs, but because the model instructs all firms to stop planned wage raises that are not generated by the model itself to comply with the restrictions. Graph 6 shows that the net monetary impact the economy experiences is increasing on α, and due to its accelerated effect it resembles a smooth quadratic function; that is, the more rigor one puts into the restriction, the higher the cost the economy is going to assume, because it affects more departments, in a more rigid way. The net impact ranges from 0.25 GDP % points in the best scenario to 1.06 GDP % points in the worst case. The quadratic shape effect in the cost impact is originated in the accelerated manner departments are affected by the severity of the restriction (see Tables 1 and 6).

[13] The wage database has no information about who was laid off, only those that could have been (changed firms or exited the labor force); therefore, we calculated the maximum firing cost each department could have undertaken and compare it with the effective firing cost. If the latter exceeds the former, it counts as an additional cost, so, this measure of impact on cost consists of a floor value.

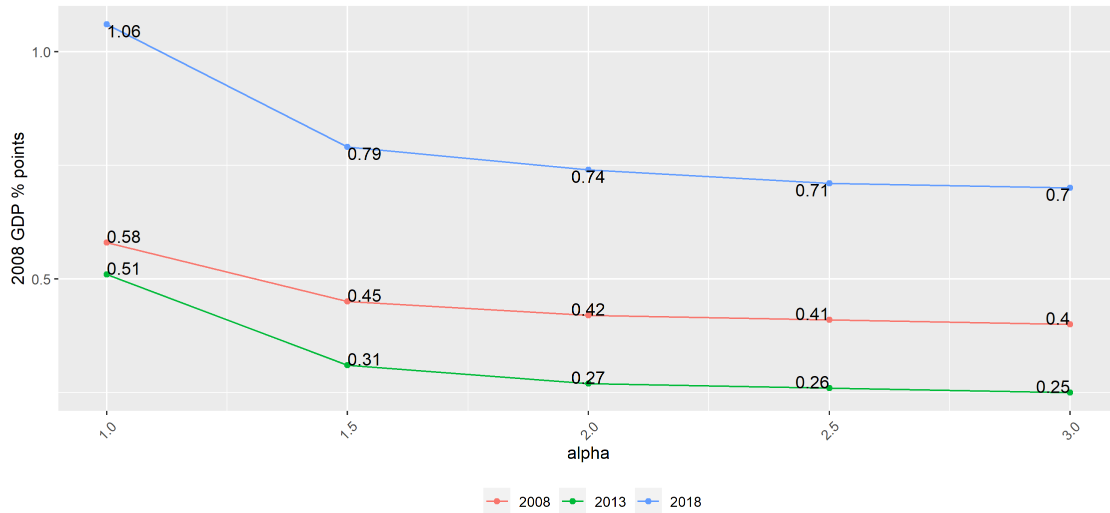

Figure 6: Restriction's net cost for the economy: Feb2008-Nov2008, Feb2013-Nov2013 and Feb2018-Nov2018 simulations.

4.5. Discussion

The previous results' sections have shown that the $\alpha = 2$ restriction that arose from the gender gap component in the inequality decomposition could have promising results. The model suggests that it not only limits the magnitude of the gender gap within each occupation in each firm, but it reduces wage inequality between 15 and 20%, and causes little disruption in most of the economy's occupational gender gaps. Naturally, a distortion cost is generated among the agents, which goes between 0.27 and 0.74 2008 GDP percentage points. It is worth mentioning that this impact cost represents a floor value since the additional firing cost could be undervalued, and the calculation doesn't take into account the government's operational costs in order to carry out and ensure the firms' compliance with the restriction.

Even though an $\alpha = 2$ is suggested by the wage inequality decomposition, one could think that the restriction's rigor should be set according to its benefits and downsides. The model's results suggest that toughen the restriction not only diminishes the inequality reduction but it can backfire and increase it. Also, this strategy carries a higher absorption cost for the economy. The positive effect associated with an $\alpha = 1$ is that it causes the economy's occupational gender gaps to near themselves to the equality line ($y = 1$). On the other hand, a more flexible restriction still limits the departments' gender gaps within a range, and does it with a slightly lesser impact cost and with a similar wage inequality reduction. As it was already seen, this $\alpha = 3$ has the downside that produces a gender gap deterioration in highly segregated occupations; however, this issue could be solved with a differentiated α restriction, according to gender concentration within each occupation in the economy. Moreover, those occupations with a high percentage of men or women, or entirely without one of the genders, specifically the occupations that show volatility in section 4.2, could be given the most rigorous restriction of $\alpha = 1$, while the others an $\alpha = 2$.

5. Concluding Remarks

This article evaluates the impact of a mandatory restriction on intra-occupational gender gaps within each company. To do so, a novel wage inequality decomposition is developed in order to relate gender-specific components, like differences within gender, gender gaps and occupational segregation, to the global measure of inequality. Then, this decomposition is used to set the basis of a labor market microsimulation that models the firms and workers' reactions to the restriction. This allows quantifying the impact of the restriction on wage inequality, occupational gender gaps in the economy and the additional cost firms incur into for complying.

First, the wage inequality decomposition shows there has been a 67% growth in the inequality measure between 2008 and 2018; most of it is explained by an increment in the gender segregation and dominance component (30% of inequality growth) and higher wage differences within men of the same occupation in each company (26%). Additionally, for the study years, around 40% of the departments in the economy (occupations in each company) violate the standard intra-occupational gender gap restriction of $\alpha = 2$ by having a gender average wage over two times the other gender average; and, 94% of these departments initially violate the restriction because of occupational segregation (departments with more than one worker and only one type of gender present).

Then, labor microsimulation shows that the effect of the restriction on gender gaps in the economy's occupations is particularly important for those with a high concentration of one gender; in general, these gaps tend to deteriorate (move away from the equalization of averages) in favor of men for those occupations with little female participation, and tend to deteriorate in favor of women if the occupation has low male participation. This deterioration of the gap is exacerbated when the restriction is relaxed and it is lessened with a more severe restriction (gender salary averages must be the same in each occupation of each company). The model also shows that the constraint of $\alpha = 2$ produces a decrease in total inequality that varies between 15 and 20%. This reduction is mainly achieved through lesser wage differences among workers of the same gender within the same department. However, this global inequality reduction dissipates, and could even revert into an increment, if the restriction is tightened too much ($\alpha = 1$). The absorption of the standard $\alpha = 2$ restriction by the economy also generates a net impact cost that is estimated between 0.25 and 0.75 GDP % points.

Finally, although this article highlights the potential benefits and disadvantages of imposing limits to the intra-occupational gender gaps within each firm, also raises two interesting points that should be embraced in future research. First, the labor microsimulation for the restriction centered its attention on the impacts in firms' labor decisions, but an extension of the model and data regarding each firm's production could provide further insides of the effects in their performance after the gender gap regulation. Second, the model suggests that the restriction generates a benefit via wage inequality reduction, along with a net cost incurred by firms for complying with the restriction. But, how these two effects should be compared in order to decide about the restriction's future implementation remains an opened question.

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Appendices

A. Wage database cleaning and manipulation

The Sicere wage database registers monthly labor aspects of workers insured in the Costa Rican Social Security Fund (CCSS); this insurance is compulsory for all formal jobs in the country. The base that the Institute for Research in Economic Sciencies (IICE) obtained from Sicere contains, for 2008, 2013 and 2018, the following variables: month, firm identifier, firm name (only for public companies or institutions), type of company (public or private), economic sector of the firm, location of the firm (province, canton and district), number of workers per firm, worker identifier, gender, date of birth, age, occupation, type of working time, monthly salary, type of worker (salaried or independent), work start date in firm and number of contributions to Social Security System.

In general, the base underwent a series of transformations in order to obtain the necessary conditions to implement the methodology. For example, because the interest is in the gender gaps, and these can be affected or formed by very large salary differences, we are not going to eliminate the outliers that could be the basis for those differences, but only those that may be associated with a typing error. Specifically, the observations with monthly salaries greater than 100 million colones (182 000 dollars) and lower than 100 thousand colones (182 dollars) are eliminated; the upper limit is set based on local research and news that identified the existence of people in the private sector with salaries around the mentioned amount; and the lower limit is established based on the minimum wage in 2008 and the amount of observations lost due to this filter. For public employees there is no need for the past upper limit, nevertheless, a different upper limit of 15 million colones is imposed to offset a common circumstance in this sector regarding double wages due to late payment. Furthermore, only workers between the ages of 17 and 85 are kept; some dates are corrected due to obvious errors in the year of birth. All occupations and locations that do not have a valid value are respectively recoded into an additional category of the variable. The economic sectors that are not detailed for a few firms in the base are approximated through the occupation of their workers.

Subsequently, part-time workers are filtered out because they are not of interest for this research, and because their wages are not comparable with full-time ones. Independent workers are kept during the manipulation of the base because they will be an input for the labor supply in the microsimulation, however, they are eventually filtered out because the measures of inequality and gender gaps are analyzed for companies and therefore only for employees. Then, workers without an assigned gender are eliminated; this modifies to a certain extent the exact conformation of specific companies, however, not only are they relatively few (from 0.03 to 1.8% of total observations, depending on the period), but this step is unavoidable because gender is the central variable in the research. For workers with more than one job in the same month, only the job with the highest salary will be considered, because the second one is probably a part-time job.

In order to calculate some statistics for each year, a transformation is going to be applied to the base in order to obtain an annual frequency. To do so, the annual average wage will be computed for each worker; workers who worked only one month in the year will be eliminated due to the intuition of an annual labor force for each firm; also, if any individual had more than one employer in the year, it will be taken as a worker of the firm where he earned the most in those 12 months. Finally, only the companies that after the modifications have a number greater or equal to 4 workers are kept; this is partly because of the volatility associated with small sized firms, but also because the regulation of the gender gap that is going to be introduced makes little sense in companies with one person or in very extreme cases such as 2 or 3 people. Finally, Table 5 show statistics of the final observations used, specifically, the average wage and the labor force gender composition by sector.

Table 5: Descriptive statistics for economic sectors: gender composition of labor force (δ) and average wage ($\overline{\omega}$) for years 2008, 2013 and 2018.

Sector		δ_M			δ_F			$\overline{\omega}_M$			$\overline{\omega}_F$	
	08	13	18	08	13	18	08	13	18	08	13	18
Agriculture	0.82	0.84	0.83	0.18	0.16	0.17	234.06	246.87	271.10	200.40	227.02	253.85
Mining	0.89	0.89	0.91	0.11	0.11	0.09	288.58	296.26	328.30	226.11	251.84	309.03
Manufacturing	0.71	0.71	0.69	0.29	0.29	0.31	367.31	411.94	438.55	273.84	334.09	374.66
Energy supply	0.79	0.79	0.79	0.21	0.21	0.21	546.29	675.83	698.38	466.05	719.76	725.59
Construction	0.94	0.93	0.92	0.06	0.07	0.08	241.53	262.49	286.62	293.89	374.22	393.40
Retail	0.65	0.64	0.64	0.35	0.36	0.36	300.80	328.61	367.93	256.39	289.86	336.01
Hotels and restaurants	0.56	0.54	0.53	0.44	0.46	0.47	240.28	256.40	281.54	207.42	223.99	250.52
Transportation	0.82	0.81	0.80	0.18	0.19	0.20	289.52	322.43	350.03	312.18	358.02	397.23
Information and communication	0.65	0.63	0.62	0.35	0.37	0.38	444.75	465.58	524.04	346.69	367.92	418.78
Finance	0.65	0.64	0.58	0.35	0.36	0.42	623.94	697.25	753.38	541.27	633.13	668.48
Real state	0.76	0.75	0.72	0.24	0.25	0.28	326.01	327.96	386.45	332.82	313.91	381.70
Public administration	0.65	0.64	0.65	0.35	0.36	0.35	437.49	568.73	588.67	526.21	703.91	743.61
Education	0.31	0.32	0.30	0.69	0.68	0.70	451.38	620.97	679.54	407.37	554.91	615.56
Social and health	0.43	0.43	0.40	0.57	0.57	0.60	709.89	929.86	902.22	591.36	773.20	733.45
Cultural and association	0.55	0.56	0.55	0.45	0.44	0.45	327.31	391.12	461.68	304.31	356.93	399.77
International activities	0.38	0.37	0.43	0.62	0.63	0.57	780.18	989.28	954.56	655.13	757.04	746.91
Water and waste management	0.68	0.73	0.74	0.32	0.27	0.26	366.86	458.46	432.66	280.26	473.82	492.45
Professional and scientific	0.64	0.63	0.61	0.36	0.37	0.39	465.44	494.34	598.79	391.36	413.76	516.21
Other services	0.75	0.74	0.72	0.25	0.26	0.28	224.89	256.46	288.18	202.71	236.94	273.96
Other	0.57	0.57	0.60	0.43	0.43	0.40	301.46	345.83	493.54	256.92	292.84	416.71

Note: Average wages are read in thousands of real January 2008 colones. The agricultural sector includes agriculture, livestock, fishing and forestry. Retail includes wholesale and retail sales, as well as other sales that do not conform to other sectors. The transport sector includes not only aspects of transport services, but storage and trips abroad. The information sector groups information manipulation and presentation, including surveys. The water and waste management sector includes environmental protection.

Table 6: Percentage of occupations within companies that are not complying with the intra-occupational gender restriction: monthly data for 2008, 2013 and 2018.

Alpha	**(including segregation)**			**(without segregation)**		
	Feb08	Feb13	Feb18	Feb08	Feb13	Feb18
$\alpha = 1$	57.38	54.46	55.30	21.81	21.58	22.83
$\alpha = 1.5$	41.22	38.14	37.73	5.65	5.26	5.26
$\alpha = 2$	37.88	34.94	34.61	2.31	2.06	2.14
$\alpha = 2.5$	36.73	33.88	33.44	1.15	1.00	0.97
$\alpha = 3$	36.22	33.44	33.01	0.64	0.56	0.54

Note: Occupations in each company that consist of more than one worker and contain only one type of gender (occupational segregation) are also subject to the intra-occupational gender restriction.

Table 7: List of occupations.

Code	Occupation	Code	Occupation
1	Preschool and Special Education	23	Entertainment and Culture
2	Domestic Employees	24	Communicator
3	Beauty	25	Seller
4	Caregiver	26	Medical equipment operator
5	Primary and secondary education	27	Chemistry
6	Social scientist	28	Others
7	Nursing	29	Executive
8	Dentist	30	Operator (production line)
9	Professional in language	31	Computer scientist
10	Nutritionist	32	Agriculture
11	Pharmaceutical and other health sciences	33	Production Supervisor
12	Clerk	34	Printing and Design
13	Lawyer	35	Engineer and Mathematics
14	Food professional	36	Logistical and customs support
15	Public Attention	37	Religious and thinker
16	Cleaning and maintenance	38	Electrician
17	Administration and Business	39	Pawn
18	University Education	40	Security
19	Economy and Finance	41	Mechanic
20	Politician	42	Builder
21	Biologist and geologist	43	Transporter
22	Medicine	44	-

B. Wage inequality decomposition

We take the variance of wages as the total wage inequality ($\mathbb{T}$) in the economy. The first phase of the decomposition will part the total inequality into between and within inequality components according to the following aspects of the economy: sector (s), type of firm (T), firm (f), occupation (ϑ), gender (G) and worker (i):

$$\mathbb{T}(\omega) \equiv \frac{1}{N}\sum_{i=1}^{N}(\omega_i - \overline{\omega})^2 = \frac{1}{N}\underbrace{\sum_{s\in S}\sum_{T\in s}\sum_{f\in T}\sum_{\vartheta\in f}\sum_{G\in\vartheta}\sum_{i\in G}}_{\Sigma_\phi}\underbrace{(\omega_i - \overline{\omega})^2}_{(\omega_i - \overline{\omega}_s + \overline{\omega}_s - \overline{\omega})^2}$$

First, using the Binomial Theorem, we know that:

$$(x+y)^2 = \binom{2}{0}x^2y^0 + \binom{2}{1}x^1y^1 + \binom{2}{2}x^0y^2 = x^2 + 2xy + y^2$$

We start the decomposition by summing and subtracting $\overline{\omega}_s$ within the factor. Take $x = \omega_i - \overline{\omega}_s$ and $y = \overline{\omega}_s - \overline{\omega}$, and because of the Binomial Theorem we can separate these terms into the sum of their products. We apply this technique to all other aspects of the economy until equation (23) is obtained.

$$\begin{aligned}
\mathbb{T}(\omega) =& \frac{1}{N}\sum_{\phi}(\omega_i - \overline{\omega}_s)^2 + \frac{2}{N}\sum_{s\in S}\sum_{T\in s}\sum_{f\in T}\sum_{\vartheta\in f}\sum_{G\in\vartheta}\sum_{i\in G}(\omega_i - \overline{\omega}_s)(\overline{\omega}_s - \overline{\omega}) + \frac{1}{N}\sum_{s\in S}\sum_{T\in s}\sum_{f\in T}\sum_{\vartheta\in f}\sum_{G\in\vartheta}\sum_{i\in G}(\overline{\omega}_s - \overline{\omega})^2 \\
\iff& \frac{1}{N}\sum_{\phi}(\omega_i - \overline{\omega}_s)^2 + \frac{2}{N}\sum_{s\in S}[(\overline{\omega}_s - \overline{\omega})\underbrace{\sum_{T\in s}\sum_{f\in T}\sum_{\vartheta\in f}\sum_{G\in\vartheta}\sum_{i\in G}(\omega_i - \overline{\omega}_s)}_{0}] + \underbrace{\frac{1}{N}\sum_{s\in S}N_s(\overline{\omega}_s - \overline{\omega})^2}_{\mathbb{B}(s)}
\end{aligned}$$

Note that because of the aggregation over the workers, all intermediate terms by the form of $2xy$ disappear.

$$\begin{aligned}
\iff& \frac{1}{N}\sum_{\phi}(\omega_i - \overline{\omega}_{T,s})^2 + \frac{2}{N}\sum_{s\in S}\sum_{T\in s}\sum_{f\in T}\sum_{\vartheta\in f}\sum_{G\in\vartheta}\sum_{i\in G}(\omega_i - \overline{\omega}_{T,s})(\overline{\omega}_{T,s} - \overline{\omega}_s) + \frac{1}{N}\sum_{\phi}(\overline{\omega}_{T,s} - \overline{\omega}_s)^2 + \mathbb{B}(s) \\
\iff& \frac{1}{N}\sum_{\phi}(\omega_i - \overline{\omega}_{T,s})^2 + \frac{2}{N}\sum_{s\in S}\sum_{T\in s}[(\overline{\omega}_{T,s} - \overline{\omega})\underbrace{\sum_{f\in T}\sum_{\vartheta\in f}\sum_{G\in\vartheta}\sum_{i\in G}(\omega_i - \overline{\omega}_{T,s})}_{0}] + \underbrace{\frac{1}{N}\sum_{s\in S}\sum_{T\in s}N_{T,s}(\overline{\omega}_{T,s} - \overline{\omega}_s)^2}_{\mathbb{B}(T,s)} + \mathbb{B}(s) \\
\iff& \frac{1}{N}\sum_{\phi}(\omega_i - \overline{\omega}_{f,T,s} + \overline{\omega}_{f,T,s} - \overline{\omega}_{T,s})^2 + \mathbb{B}(T,s) + \mathbb{B}(s) \\
\iff& \frac{1}{N}\sum_{\phi}(\omega_i - \overline{\omega}_{f,T,s})^2 + \mathbb{B}(f,T,s) + \mathbb{B}(T,s) + \mathbb{B}(s) \\
\iff& \frac{1}{N}\sum_{\phi}(\omega_i - \overline{\omega}_{\vartheta,f,T,s} + \overline{\omega}_{\vartheta,f,T,s} - \overline{\omega}_{f,T,s})^2 + \mathbb{B}(f,T,s) + \mathbb{B}(T,s) + \mathbb{B}(s) \\
\iff& \underbrace{\frac{1}{N}\sum_{\phi}(\omega_i - \overline{\omega}_{\vartheta,f,T,s})^2}_{\mathbb{W}(i,\vartheta,f,T,s)} + \mathbb{B}(\vartheta,f,T,s) + \mathbb{B}(f,T,s) + \mathbb{B}(T,s) + \mathbb{B}(s)
\end{aligned}$$

$$\boxed{\mathbb{T}(\omega) = \mathbb{W}(i,\vartheta,f,T,s) + \mathbb{B}(\vartheta,f,T,s) + \mathbb{B}(f,T,s) + \mathbb{B}(T,s) + \mathbb{B}(s)} \tag{23}$$

This completes the first phase of the decomposition. Now, we are interested in separating workers into categories according to certain characteristic of their own, in this case gender. The second phase begins as follows. Taking the within component in equation (23):

$$\mathbb{W}(i,\vartheta,f,T,s) \equiv \frac{1}{N}\sum_{s\in S}\sum_{T\in s}\sum_{f\in T}\sum_{\vartheta\in f}\sum_{G\in\vartheta}\sum_{i\in G}(\omega_i - \overline{\omega}_\vartheta)^2$$

$$\iff \frac{1}{N}\sum_{s\in S}\sum_{T\in s}\sum_{f\in T}\sum_{\vartheta\in f}[\underbrace{\sum_{M\in\vartheta}\sum_{i\in M}(\omega_i-\overline{\omega}_\vartheta)^2}_{\zeta}+\underbrace{\sum_{F\in\vartheta}\sum_{i\in F}(\omega_i-\overline{\omega}_\vartheta)^2}_{\varphi}]$$

Define $\delta_{\vartheta,M}$ y $\delta_{\vartheta,F}$ as the proportions of each gender in occupation ϑ in firm f. Then, $\delta_{\vartheta,M}+\delta_{\vartheta,F}=1$ y note that $\overline{\omega}_\vartheta=\delta_{\vartheta,M}\overline{\omega}_{\vartheta,M}+\delta_{\vartheta,F}\overline{\omega}_{\vartheta,F}$. Now, expanding ζ y φ of occupation ϑ in firm f:

$$\begin{aligned}
\zeta &\equiv \sum_{M\in\vartheta}\sum_{i\in M}(\omega_i^2-2\omega_{i,\vartheta}\overline{\omega}_\vartheta+\overline{\omega}_\vartheta^2)\\
&\iff \sum_{M\in\vartheta}\sum_{i\in M}(\omega_i^2-2\omega_i\delta_{\vartheta,M}\overline{\omega}_{\vartheta,M}-2\omega_i\delta_{\vartheta,F}\overline{\omega}_{\vartheta,F}+\delta_{\vartheta,M}^2\overline{\omega}_{\vartheta,M}^2+2\delta_{\vartheta,F}\delta_{\vartheta,M}\overline{\omega}_{\vartheta,F}\overline{\omega}_{\vartheta,M}+\delta_{\vartheta,F}^2\overline{\omega}_{\vartheta,F}^2)\\
&\iff \sum_{M\in\vartheta}\sum_{i\in M}[(\omega_i-\delta_{\vartheta,M}\overline{\omega}_{\vartheta,M})^2+(\delta_{\vartheta,F}^2\overline{\omega}_{\vartheta,F}^2+2\delta_{\vartheta,F}\delta_{\vartheta,M}\overline{\omega}_{\vartheta,F}\overline{\omega}_{\vartheta,M}-2\omega_i\delta_{\vartheta,F}\overline{\omega}_{\vartheta,F})]\\
&\iff \sum_{M\in\vartheta}\sum_{i\in M}(\omega_i-\delta_{\vartheta,M}\overline{\omega}_{\vartheta,M})^2+\sum_{M\in\vartheta}\sum_{i\in M}(\delta_{\vartheta,F}^2\overline{\omega}_{\vartheta,F}^2+2\delta_{\vartheta,F}\delta_{\vartheta,M}\overline{\omega}_{\vartheta,F}\overline{\omega}_{\vartheta,M}-2\omega_i\delta_{\vartheta,F}\overline{\omega}_{\vartheta,F})\\
&\iff N_{\vartheta,M}\delta_{\vartheta,F}^2\overline{\omega}_{\vartheta,F}^2+2N_{\vartheta,M}\delta_{\vartheta,F}\delta_{\vartheta,M}\overline{\omega}_{\vartheta,F}\overline{\omega}_{\vartheta,M}-2\delta_{\vartheta,F}\overline{\omega}_{\vartheta,F}\underbrace{\sum_{M\in\vartheta}\sum_{i\in M}\omega_i}_{N_{\vartheta,M}\overline{\omega}_{\vartheta,M}}+\sum_{M\in\vartheta}\sum_{i\in M}(\omega_i-\delta_{\vartheta,M}\overline{\omega}_{\vartheta,M})^2\\
&\iff N_{\vartheta,M}\delta_{\vartheta,F}^2\overline{\omega}_{\vartheta,F}^2+2N_{\vartheta,M}\delta_{\vartheta,F}\delta_{\vartheta,M}\overline{\omega}_{\vartheta,F}\overline{\omega}_{\vartheta,M}-2\delta_{\vartheta,F}\overline{\omega}_{\vartheta,F}N_{\vartheta,M}\overline{\omega}_{\vartheta,M}+\sum_{M\in\vartheta}\sum_{i\in M}(\omega_i-\overline{\omega}_{\vartheta,M}+\overline{\omega}_{\vartheta,M}-\delta_{\vartheta,M}\overline{\omega}_{\vartheta,M})^2\\
&\iff N_{\vartheta,M}\delta_{\vartheta,F}\overline{\omega}_{\vartheta,F}(\delta_{\vartheta,F}\overline{\omega}_{\vartheta,F}+2\delta_{\vartheta,M}\overline{\omega}_{\vartheta,M}-2\overline{\omega}_{\vartheta,M})+\sum_{M\in\vartheta}\sum_{i\in M}(\omega_i-\overline{\omega}_{\vartheta,M})^2+N_{\vartheta,M}[\overline{\omega}_{\vartheta,M}\underbrace{(1-\delta_{\vartheta,M})}_{\delta_{\vartheta,F}}]^2\\
&\iff N_{\vartheta,M}\delta_{\vartheta,F}\overline{\omega}_{\vartheta,F}(\delta_{\vartheta,F}\overline{\omega}_F-2\overline{\omega}_{\vartheta,M}\underbrace{(1-\delta_{\vartheta,M})}_{\delta_{\vartheta,F}})+\sum_{M\in\vartheta}\sum_{i\in M}(\omega_i-\overline{\omega}_{\vartheta,M})^2+N_{\vartheta,M}\overline{\omega}_{\vartheta,M}^2\delta_F^2\\
&\iff \underbrace{N_{\vartheta,M}\delta_{\vartheta,F}^2\overline{\omega}_{\vartheta,F}(\overline{\omega}_{\vartheta,F}-2\overline{\omega}_{\vartheta,M})}_{\mathbb{G}_{\vartheta,M}}+\underbrace{\sum_{M\in\vartheta}\sum_{i\in M}(\omega_i-\overline{\omega}_{\vartheta,M})^2}_{\mathbb{W}_{\vartheta,M}}+\underbrace{N_{\vartheta,M}\overline{\omega}_{\vartheta,M}^2\delta_{\vartheta,F}^2}_{\mathbb{P}_{\vartheta,M}}
\end{aligned}$$

Analogously for φ:

$$\varphi \equiv \underbrace{N_{\vartheta,F}\delta_{\vartheta,M}^2\overline{\omega}_{\vartheta,M}(\overline{\omega}_{\vartheta,M}-2\overline{\omega}_{\vartheta,F})}_{\mathbb{G}_{\vartheta,F}}+\underbrace{\sum_{F\in\vartheta}\sum_{i\in F}(\omega_i-\overline{\omega}_{\vartheta,F})^2}_{\mathbb{W}_{\vartheta,F}}+\underbrace{N_{\vartheta,F}\overline{\omega}_{\vartheta,F}^2\delta_{\vartheta,M}^2}_{\mathbb{P}_{\vartheta,F}}$$

Substituting ζ y φ in $\mathbb{W}$:

$$\mathbb{W}(i,\vartheta,f,T,s)=\frac{1}{N}\sum_{s\in S}\sum_{T\in s}\sum_{f\in T}\sum_{\vartheta\in f}\sum_{G\in\vartheta}(\mathbb{G}_{\vartheta,G}+\mathbb{W}_{\vartheta,G}+\mathbb{P}_{\vartheta,G})$$

Therefore, we obtain a gender decomposition for $\mathbb{W}(i,\vartheta,f,T,s)$:

$$\mathbb{W}(i,\vartheta,f,T,s)\equiv\mathbb{G}_M+\mathbb{G}_F+\mathbb{W}_M+\mathbb{W}_F+\mathbb{P}_M+\mathbb{P}_F \tag{24}$$

Now, taking the between sector component from equation (23), we substitute the average wages with their gender average wages by using the previously defined δs as weights .

$$\begin{aligned}
\mathbb{B}(s) &\equiv \frac{1}{N}\sum_{s\in S}N_s(\overline{\omega}_s-\overline{\omega})^2\\
&\iff \sum_{s\in S}\frac{N_s}{N}[(\delta_{s,M}\overline{\omega}_{s,M}+\delta_{s,F}\overline{\omega}_{s,F})-(\delta_M\overline{\omega}_M+\delta_F\overline{\omega}_F)]^2
\end{aligned}$$

$$\iff \sum_{s\in S}\frac{N_s}{N}[\underbrace{(\delta_{s,M}\overline{\omega}_{s,M}-\delta_M\overline{\omega}_M)}_{M}+\underbrace{(\delta_{s,F}\overline{\omega}_{s,F}-\delta_F\overline{\omega}_F)}_{F}]^2$$

$$\iff \underbrace{\sum_{s\in S}\frac{N_s}{N}M^2}_{\mathbb{B}(s)_M}+\underbrace{\sum_{s\in S}\frac{N_s}{N}2MF}_{\mathbb{B}(s)_I}+\underbrace{\sum_{s\in S}\frac{N_s}{N}F^2}_{\mathbb{B}(s)_F}$$

Analogously, we obtain:

$$\begin{aligned}
&\mathbb{B}(s) \equiv \mathbb{B}(s)_M + \mathbb{B}(s)_I + \mathbb{B}(s)_F \\
&\mathbb{B}(T,s) \equiv \mathbb{B}(T,s)_M + \mathbb{B}(T,s)_I + \mathbb{B}(T,s)_F \\
&\mathbb{B}(f,T,s) \equiv \mathbb{B}(f,T,s)_M + \mathbb{B}(f,T,s)_I + \mathbb{B}(f,T,s)_F \\
&\mathbb{B}(\vartheta,f,T,s) \equiv \mathbb{B}(\vartheta,f,T,s)_M + \mathbb{B}(\vartheta,f,T,s)_I + \mathbb{B}(\vartheta,f,T,s)_F
\end{aligned}$$

By incorporating the gender within and between decomposition we finally obtain:

$$\boxed{\begin{aligned}\mathbb{T}(\omega) \equiv &\mathbb{G}_M + \mathbb{G}_F + \mathbb{W}_M + \mathbb{W}_F + \mathbb{P}_M + \mathbb{P}_F + \mathbb{B}(s)_M + \mathbb{B}(s)_I + \mathbb{B}(s)_F + \mathbb{B}(T,s)_M + \mathbb{B}(T,s)_I + \mathbb{B}(T,s)_F + \\ &\mathbb{B}(f,T,s)_M + \mathbb{B}(f,T,s)_I + \mathbb{B}(f,T,s)_F + \mathbb{B}(\vartheta,f,T,s)_M + \mathbb{B}(\vartheta,f,T,s)_I + \mathbb{B}(\vartheta,f,T,s)_F\end{aligned}} \tag{25}$$

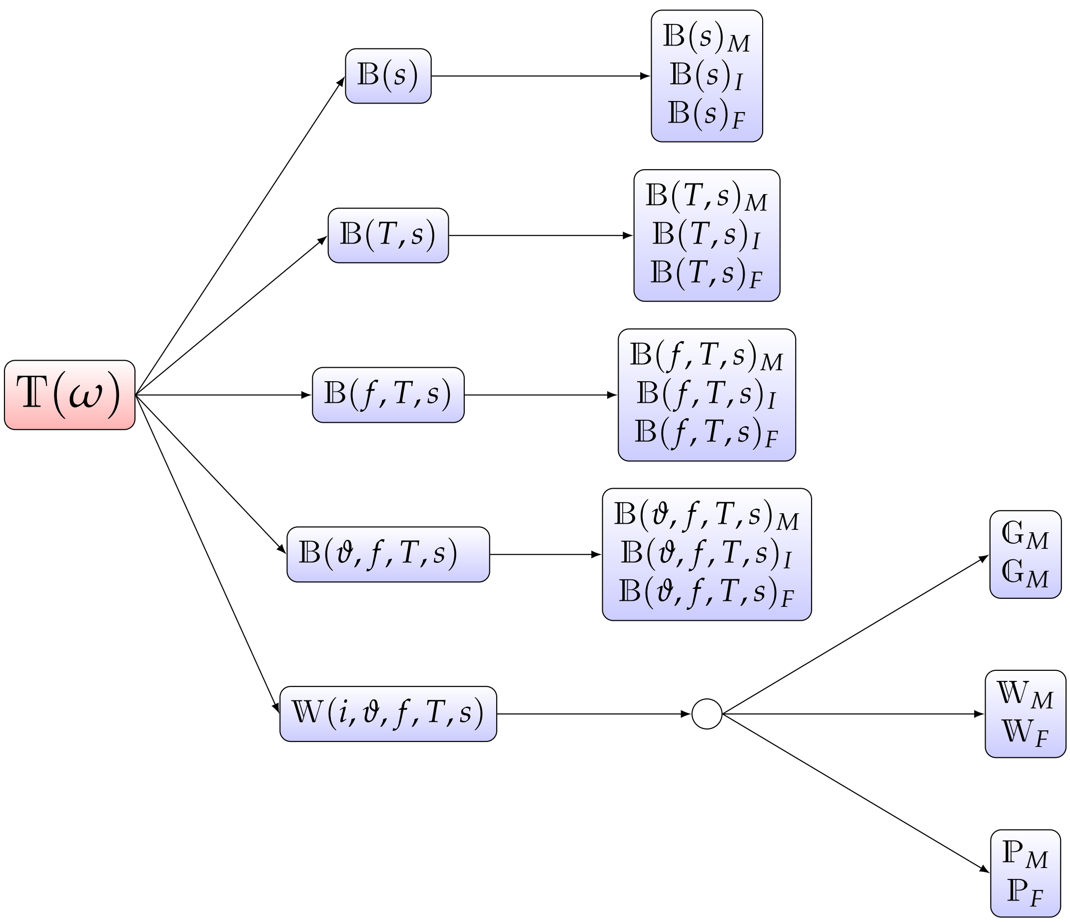

Figure 7: Wage inequality decomposition by gender in graph tree

C. Additional Results

Table 8: Components of the wage inequality decomposition by gender: basic decomposition and expanded decomposition (first and second phase) for 2008, 2013 and 2018 monthly data.

Component	Contribution to T						Contribution to ΔT		
	Feb08	**Nov08**	**Feb13**	**Nov13**	**Feb18**	**Nov18**	**Feb08-Nov08** ($\Delta\mathbb{T}$: -40.9%)	**Feb13-Nov13** ($\Delta\mathbb{T}$: -13.9%)	**Feb18-Nov18** ($\Delta\mathbb{T}$: -18.0%)
$\mathbb{T}$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
$\mathbb{W}_{\text{gender}}$	0.9999	0.9993	0.9996	0.9983	0.9992	0.9988	1.0008	1.0076	1.0011
$\mathbb{B}_{\text{gender}}$	0.0001	0.0007	0.0004	0.0017	0.0008	0.0012	-0.0008	-0.0076	-0.0011
$\mathbb{W}(\vartheta, f, T, s)$	0.4465	0.4597	0.4747	0.4378	0.4778	0.4575	0.4273	0.7038	0.5700
$\mathbb{B}(s)$	0.0964	0.0924	0.0724	0.1429	0.0755	0.0989	0.1022	-0.3652	-0.0307
$\mathbb{B}(T, s)$	0.0150	0.0120	0.0115	0.0291	0.0110	0.0154	0.0192	-0.0978	-0.0092
$\mathbb{B}(f, T, s)$	0.2056	0.1936	0.1808	0.1502	0.2072	0.1913	0.2228	0.3707	0.2793
$\mathbb{B}(\vartheta, f, T, s)$	0.2366	0.2422	0.2606	0.2400	0.2286	0.2369	0.2285	0.3886	0.1907
$\mathbb{W}_M$	0.3275	0.3291	0.3410	0.2907	0.3226	0.2762	0.3251	0.6537	0.5334
$\mathbb{W}_F$	0.0955	0.1087	0.0974	0.1296	0.1301	0.1571	0.0765	-0.1026	0.0073
$\mathbb{P}_M$	0.0890	0.1139	0.0989	0.1269	0.1052	0.1341	0.0529	-0.0748	-0.0261
$\mathbb{P}_F$	0.0790	0.1028	0.0794	0.1085	0.0971	0.1144	0.0447	-0.1012	0.0188
$\mathbb{G}_M$	-0.0791	-0.1052	-0.0838	-0.1190	-0.0951	-0.1234	-0.0413	0.1354	0.0334
$\mathbb{G}_F$	-0.0654	-0.0895	-0.0583	-0.0988	-0.0821	-0.1009	-0.0306	0.1933	0.0032
$\mathbb{B}(s)_M$	0.0283	0.0276	0.0185	0.0293	0.0174	0.0222	0.0292	-0.0485	-0.0044
$\mathbb{B}(s)_I$	0.0271	0.0044	0.0183	0.0469	0.0171	0.0184	0.0600	-0.1593	0.0108
$\mathbb{B}(s)_F$	0.0410	0.0604	0.0356	0.0667	0.0411	0.0583	0.0130	-0.1575	-0.0372
$\mathbb{B}(T, s)_M$	0.0052	0.0047	0.0037	0.0080	0.0029	0.0041	0.0059	-0.0235	-0.0028
$\mathbb{B}(T, s)_I$	0.0064	0.0036	0.0048	0.0133	0.0048	0.0066	0.0104	-0.0475	-0.0036
$\mathbb{B}(T, s)_F$	0.0034	0.0037	0.0030	0.0078	0.0033	0.0046	0.0029	-0.0268	-0.0028
$\mathbb{B}(f, T, s)_M$	0.1540	0.1314	0.1172	0.0928	0.1227	0.1093	0.1866	0.2685	0.1837
$\mathbb{B}(f, T, s)_I$	0.0292	0.0305	0.0344	0.0264	0.0479	0.0421	0.0274	0.0837	0.0740
$\mathbb{B}(f, T, s)_F$	0.0223	0.0316	0.0293	0.0310	0.0366	0.0399	0.0088	0.0185	0.0216 1
$\mathbb{B}(\vartheta, f, T, s)_M$	0.1730	0.1792	0.1962	0.1612	0.1584	0.1589	0.1640	0.4136	0.1561
$\mathbb{B}(\vartheta, f, T, s)_I$	0.0158	0.0037	0.0118	0.0197	0.0164	0.0185	0.0334	-0.0370	0.0068
$\mathbb{B}(\vartheta, f, T, s)_F$	0.0478	0.0593	0.0525	0.0590	0.0538	0.0596	0.0311	0.0120	0.0277

Note: A positive sign in the contribution to $\Delta\mathbb{T}$ column indicates that the component's growth is in the same direction as the inequality growth.

Table 9: Components of the wage inequality decomposition by gender: Feb2013-Nov2013 microsimulation.

Component	$\alpha = 1$ Relative change (ΔT: 13.02%)	$\alpha = 2$ Relative change (ΔT: -17.18%)	$\alpha = 3$ Relative change (ΔT: -14.46%)
$\mathbb{T}$	1.0000	1.0000	1.0000
$\mathbb{W}_{\text{gender}}$	0.9866	0.9983	0.9974
$\mathbb{B}_{\text{gender}}$	0.0134	0.0017	0.0026
$\mathbb{W}(\vartheta, f, T, s)$	0.4048	0.8338	0.8407
$\mathbb{B}(s)$	0.1245	-0.0185	-0.0237
$\mathbb{B}(T, s)$	0.0220	-0.0084	-0.0118
$\mathbb{B}(f, T, s)$	0.2529	0.0509	0.0138
$\mathbb{B}(\vartheta, f, T, s)$	0.1957	0.1422	0.1810
$\mathbb{W}_M$	-0.1188	0.6144	0.6333
$\mathbb{W}_F$	0.8020	0.0988	0.1204
$\mathbb{P}_M$	-0.0126	0.0676	0.0797
$\mathbb{P}_F$	0.3209	-0.0216	-0.0075
$\mathbb{G}_M$	-0.1038	-0.0141	-0.0348
$\mathbb{G}_F$	-0.4827	0.0887	0.0496
$\mathbb{B}(s)_M$	0.0183	-0.0038	-0.0039
$\mathbb{B}(s)_I$	0.0473	-0.0131	-0.0151
$\mathbb{B}(s)_F$	0.0589	-0.0015	-0.0047
$\mathbb{B}(T, s)_M$	0.0058	-0.0029	-0.0039
$\mathbb{B}(T, s)_I$	0.0086	-0.0035	-0.0053
$\mathbb{B}(T, s)_F$	0.0076	-0.0020	-0.0026
$\mathbb{B}(f, T, s)_M$	-0.0405	0.0913	0.0403
$\mathbb{B}(f, T, s)_I$	0.1970	-0.0389	-0.0296
$\mathbb{B}(f, T, s)_F$	0.0965	-0.0015	0.0031
$\mathbb{B}(\vartheta, f, T, s)_M$	-0.0747	0.1238	0.1314
$\mathbb{B}(\vartheta, f, T, s)_I$	0.1910	-0.0022	0.0247
$\mathbb{B}(\vartheta, f, T, s)_F$	0.0793	0.0206	0.0249

Note: A positive sign in the relative change implies that that specific component moves in the same direction as the total inequality.

Table 10: Components of the wage inequality decomposition by gender: Feb2018-Nov2018 microsimulation.

Component	$\alpha = 1$ Relative change (ΔT: -6.51%)	$\alpha = 2$ Relative change (ΔT: -15.04%)	$\alpha = 3$ Relative change (ΔT: -14.65%)
$\mathbb{T}$	1.0000	1.0000	1.0000
$\mathbb{W}_{\text{gender}}$	1.0194	0.9970	0.9962
$\mathbb{B}_{\text{gender}}$	-0.0194	0.0030	0.0038
$\mathbb{W}(\vartheta, f, T, s)$	1.6197	0.7838	0.7314
$\mathbb{B}(s)$	0.0689	-0.0208	-0.0239
$\mathbb{B}(T, s)$	0.0518	-0.0091	-0.0109
$\mathbb{B}(f, T, s)$	-0.2932	0.2466	0.2746
$\mathbb{B}(\vartheta, f, T, s)$	-0.4472	-0.0005	0.0288
$\mathbb{W}_M$	1.0324	0.5093	0.4976
$\mathbb{W}_F$	0.2019	0.2143	0.2218
$\mathbb{P}_M$	0.0660	0.0281	0.0298
$\mathbb{P}_F$	-0.3787	0.0112	0.0304
$\mathbb{G}_M$	0.0886	-0.0031	-0.0224
$\mathbb{G}_F$	0.6094	0.0240	-0.0258
$\mathbb{B}(s)_M$	0.0135	-0.0087	-0.0088
$\mathbb{B}(s)_I$	0.0808	-0.0065	-0.0063
$\mathbb{B}(s)_F$	-0.0254	-0.0056	-0.0088
$\mathbb{B}(T, s)_M$	0.0164	-0.0037	-0.0041
$\mathbb{B}(T, s)_I$	0.0228	-0.0035	-0.0045
$\mathbb{B}(T, s)_F$	0.0127	-0.0018	-0.0022
$\mathbb{B}(f, T, s)_M$	0.1025	0.1978	0.2013
$\mathbb{B}(f, T, s)_I$	-0.2712	0.0261	0.0468
$\mathbb{B}(f, T, s)_F$	-0.1245	0.0228	0.0265
$\mathbb{B}(\vartheta, f, T, s)_M$	0.0922	0.0608	0.0541
$\mathbb{B}(\vartheta, f, T, s)_I$	-0.3923	-0.0640	-0.0309
$\mathbb{B}(\vartheta, f, T, s)_F$	-0.1471	0.0027	0.0057

Note: A positive sign in the relative change implies that that specific component moves in the same direction as the total inequality.

Figure 8: Impact on gender wage gaps for each occupation, $\frac{\overline{\omega}_{M,t+1}}{\overline{\omega}_{F,t+1}} - \frac{\overline{\omega}_{M,t}}{\overline{\omega}_{F,t}}$: Feb2013-Nov2013.

Note: The occupations are ordered from highest to lowest proportion of women in the composition. The list of all occupations is in Table 7.

Figure 9: Gender wage gaps for each occupation in the initial and final period: Feb2013-Nov2013, alpha 2.

Note: The occupations are ordered from highest to lowest proportion of women in the composition. The list of all occupations is in Table 7.

Figure 10: Gender wage gaps for each occupation in the initial and final period: Feb2013-Nov2013, alpha 1.

Note: The occupations are ordered from highest to lowest proportion of women in the composition. The list of all occupations is in Table 7.

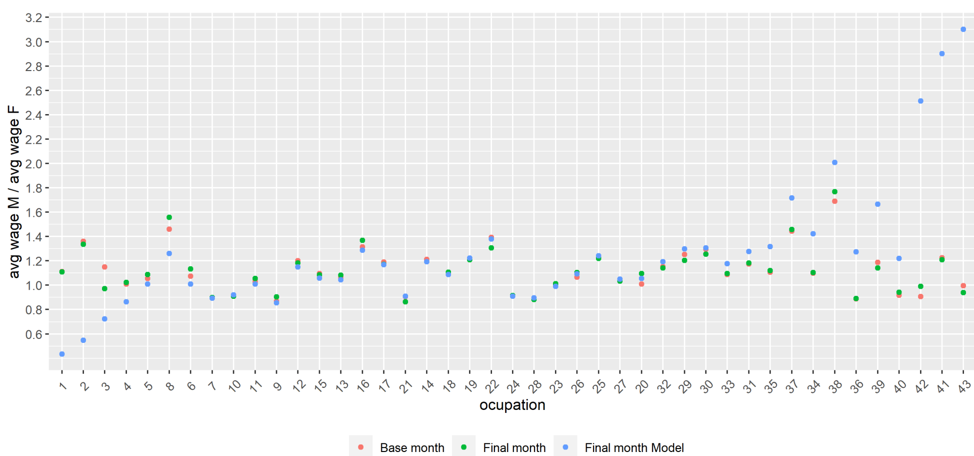

Figure 11: Gender wage gaps for each occupation in the initial and final period: Feb2013-Nov2013, alpha 3.

Note: The occupations are ordered from highest to lowest proportion of women in the composition. The list of all occupations is in Table 7.

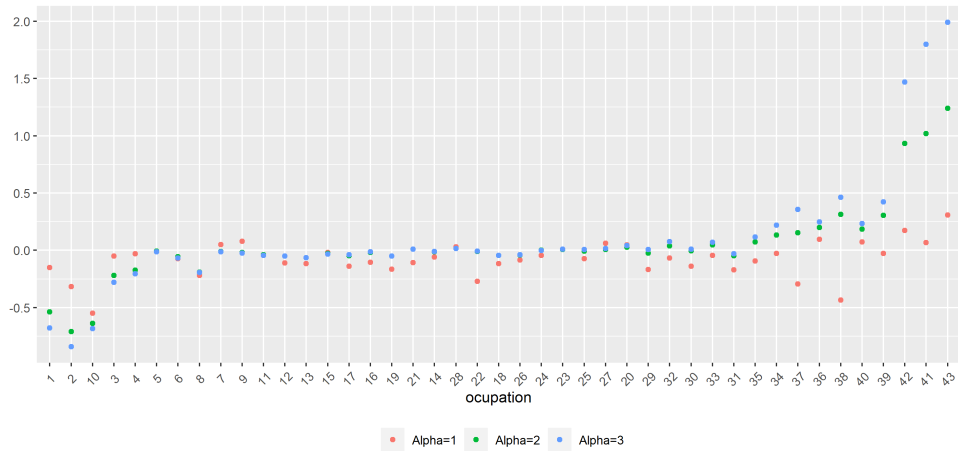

Figure 12: Impact on gender wage gaps for each occupation, $\frac{\overline{\omega}_{M,t+1}}{\overline{\omega}_{F,t+1}} - \frac{\overline{\omega}_{M,t}}{\overline{\omega}_{F,t}}$: Feb2018-Nov2018.

Note: The occupations are ordered from highest to lowest proportion of women in the composition. The list of all occupations is in Table 7.

Figure 13: Gender wage gaps for each occupation in the initial and final period: Feb2018-Nov2018, alpha 2.

Note: The occupations are ordered from highest to lowest proportion of women in the composition. The list of all occupations is in Table 7.

Figure 14: Gender wage gaps for each occupation in the initial and final period: Feb2018-Nov2018, alpha 1.

Note: The occupations are ordered from highest to lowest proportion of women in the composition. The list of all occupations is in Table 7.

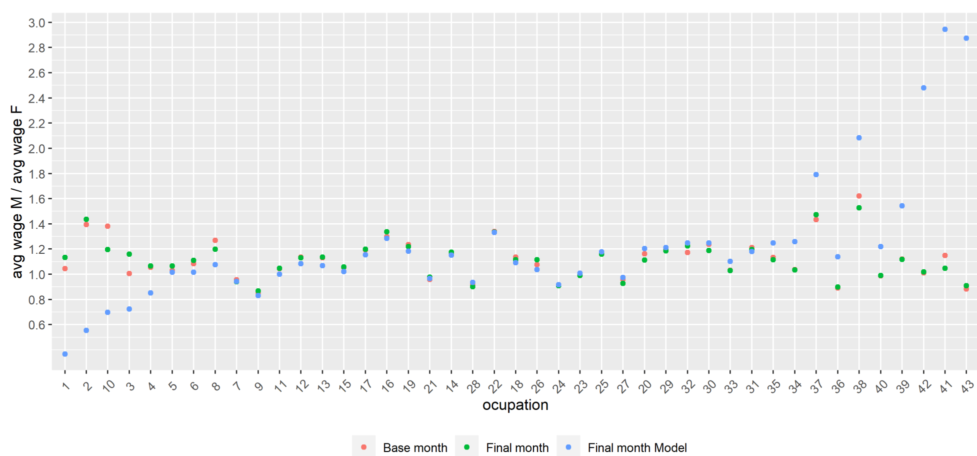

Figure 15: Gender wage gaps for each occupation in the initial and final period: Feb2018-Nov2018, alpha 3.

Note: The occupations are ordered from highest to lowest proportion of women in the composition. The list of all occupations is in Table 7.