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Peers and the Gender Wage Gap

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Abstract

This study investigates the importance of peer effects in the Portuguese economy, as well as their impact on the gender wage gap. Peer effects are measured using the average of the co-workers fixed effects. While also accounting for individual heterogeneity and firm and job-title sorting, the results show evidence of positive peer effects on wages (of 4.83% from an increment of one standard deviation in peers' "quality"), while 5% of the existent gender wage gap can be justified by differences in peer effects. Allowing for heterogeneity in peers' spillovers reveals how female workers are more susceptible to spillovers from their female peers in spite of also being more exposed to them due to market segregation.

Keywords: Peer Effects, Gender Wage Gap, Fixed Effects Estimation, Gender Segregation

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1 Introduction

The current focus of gender wage gap studies is no longer the role of within-job wage discrimination, as the importance of this channel has significantly decreased over time (Petersen and Morgan (1995)). Instead, current research stresses the importance of "allocative discrimination", referring to the differential access of women to certain job-titles and firms. Hence, the focus of research is now more on the firms and the worker's function within the firm.

This focus on firms brings something new to the spotlight: what if someone's co-workers within the firm have also an impact on the worker's wage (Cornelissen et al. (2017))? This dissertation explores this possibility, attempting to quantify the importance of peers' spillovers on the worker's wage. The identification of these peer effects is only possible due to within-firm variation in peer groups as workers move between firms.

In the end, a positive and significant peer effect on wages is found, of about 4.83% from an increment of one standard deviation in the average co-workers "quality". When decomposing the gender wage gap, besides the importance of individual heterogeneity and firm/job-title sorting, peer effects account for about 5% of the existing gap. Also, if allowing heterogeneity in peer influence, there is evidence that female workers are more sensible to spillovers from their female peers, even after controlling for their exposure to them.

The remainder of this dissertation has the following structure: section 2 reviews the literature related to this topic; section 3 presents a summarized introduction to recent literature on the Portuguese gender wage gap; section 4 describes the methodological approach used, while section 5 describes the characteristics and advantages of the available dataset; section 6 shows results on the importance of peer effects, as well as the contribution of peers for the Portuguese gender wage gap and, at last, section 7 concludes.

2 Literature Review

The gender wage gap has long been an economic topic of research. Demand-side justifications, such as the taste of employers, consumers and co-workers for discrimination (Becker (1957)), assert that the existing discriminatory wage premium depends on the preferences of the labor market itself towards women. Besides this, traditional explanations also encapsulate supply-side reasonings, based on gender differences in productivity (Mulligan and Rubinstein (2008)) and human capital accumulation, or on different labor market attachments due to career-family conflicts (Bertrand et al. (2010)).

Although one cannot neglect the potential channel of discrimination[1], gender differences in productivity and labor market attachment seem to be attenuated due to advances in educational attainment by women. Alternative explanations are thus needed to justify the remaining gap. Current literature focus on the key role of firm-specific factors on gender wage differentials. Firms are certainly heterogeneous in numerous dimensions. Firms not only offer different wage policies, but they also offer different packages of benefits, etc. Given this heterogeneity, if there is persistent gender segregation across firms, this could help explain the persistent wage gap over time. Card et al. (2015) use a rent-sharing model with worker and employer fixed effects to measure firm-specific pay premiums relative to some reference firm in the Portuguese market. They document how women are not only less likely to be hired in firms that pay higher premiums (the "sorting effect"), but that they are also more likely to receive lower average wage premiums compared to the market average (the "bargaining effect").

Bertrand and Hallock (2001) find similar conclusions when studying wage differences

[1]For instance, through the comparison of female and male job callback rates, the so-called audit studies provide cleaner evidence of the existent gender discrimination still faced by women when accessing the labor market (e.g. Neumark et al. (1996)).

among top corporate jobs in USA firms. According to them, about one third of the total compensation gap can be assigned to the fact that women are more likely to participate in smaller, low-paying firms. The authors also identify the importance of occupational allocation inside the firm: the under-representation of women in top positions (such as Chair, CEO or President) explains about half of the existent gender wage gap.

Another dimension that is often overlooked driving firm heterogeneity is the firm's labor force. One must reflect on the impact that co-workers may have on an individual's performance at work. The importance of belonging to a group dates back to the reference-group theory by Hyman (1942), which states that an individual's behavior is molded by the groups to which the individual belongs. According to this theory, the individual evaluates strengths and weaknesses according to a group's reference point and adjusts behaviors to act in accordance with it. Being firms an agglomerate of individuals working together, these mechanisms of self-appraisal will also manifest between the worker and corresponding peers. Battisti (2013) reinforces the importance of this dimension, showing that when including co-worker spillovers on a variance decomposition of wages, the part explained by firm effects decreases by about one fourth.

The study of peer effects applied to the labor market is relatively recent, as its main focus has been the education setting. This shift towards the labor market accompanies a current need in understanding what kind of productivity spillovers exist between co-workers and what consequences these spillovers may have for the constitution of teams in the workplace (Azmat and Petrongolo (2014)). Peer effects may arise either from knowledge transfers between co-workers, when workers learn more productive ways to execute their tasks; or from what researchers refer to as "peer pressure", when workers feel an urge to improve their performance at work when they interact with more productive co-workers or know they are being watched and judged (Guryan et al. (2009)).

There is evidence of both mechanisms. Mas and Moretti (2009), for instance, measure peer spillovers across supermarket cashiers and verify positive peer effects when workers are introduced to a highly productive co-worker in the same shift. However, these positive productivity spillovers only occur when they can be observed or interact frequently with the other co-workers, reinforcing the channel of "peer pressure". The authors look at these results as evidence of how free-riding problems that may arise in many workplaces can be minimized as social pressure increases. Chan et al. (2014) find similar conclusions among salespeople in a cosmetic department store in China. The authors built a peer-based learning model and verify positive peer effects from direct observation and teaching. These positive spillovers have also been verified in a wide range of lab experiments (such as in Falk and Ichino (2003)) where working in pairs increases worker's productivity.

While the previous studies focused on peer effects in worker's productivity, the study developed by Cornelissen et al. (2017) is possibly the first one to study peer effects on wages. The study investigates if peer-induced productivity gains lead to higher wages. They conclude that although these peer-induced wage increases are small, they are still significant and larger in magnitude when considering low-skilled occupations. Ultimately, they propose that peer effects not only increase worker's productivity, but also generate wage spillovers. This result suggests that if workers react differently to peers according with their gender, peer effects may be an alternative explanation for the existing gender wage differentials.

Literature suggests women and men to interact with each other differently. Cross and Madson (1997) reveal how through social and cultural assimilation of gender roles and norms, women become more socially interdependent, while men are more focused on their own attributes and their ability to distinguish themselves from others. Women are thus expected to value greatly their sense of belonging to a group, which could be interpreted as them being

more susceptible to the influence of peers than men. In the workplace, Sias et al. (2003), show how cross-sex co-working relationships are mainly based on workplace factors, meaning that men and women friendships at work are less personal. Given that workplace relationships work as informal communication vehicles for career opportunities (Rawlins (1992)), these less intimate friendships between men and women may hinder women's access to these networks, and disproportionally affect women's career and wage development in cases where these networks are dominated by men (Kanter (1977)). This ultimately will have an impact on the path of the gender wage gap.

Peers' influence may also have to do with the type of working environment and consequent externalities they create. For instance, many behavioral and psychological lab experiments denounce how differently women bargain payments compared to men. Women are more likely to settle for the proposed monetary offer (Eckel and Grossman (2001)) without bargaining, and when bargaining, they are less successful at it, bargaining for higher compensations less often than men (Small et al. (2007)). This is particularly relevant in the existence of bargaining externalities at the workplace (Battisti (2013)). In such cases, a less aggressive competitive negotiation from peers may have a negative impact on the development of a worker's wage. In Card et al. (2015), the authors show how although firm-mobility flows between workers are very similar, women tend to be hired in the new firm with a consistently lower salary than men. One can interpret this as a disparity in the average bargaining power between men and women. Finally, social psychology literature also suggests women to be more risk-averse than men, and less prone to competition (Niederle and Vesterlund (2007)). If behavioral spillovers are indeed possible, this may limit a worker's wage trajectory in work environments that reward the ability to compete and take risks.

3 The Portuguese Gender Wage Gap

Portugal made headlines two years ago when it was revealed as the country in the European Union where the gender wage gap increased more from 2011 to 2016 (Eurostat (2018)). Although it decreased in 2017, Portugal still had the seventh largest gender wage gap (16.3%) of the group, reinforcing the significance of this problem in the Portuguese economy.

Cardoso et al. (2016) show how traditional supply-side justifications for the gender wage gap do not fit the Portuguese labor market: not only the female labor force participation and working hours are similar to those of men (even in periods of childbirth and consequent child-rearing years) but also the expected differences in human capital accumulation have been dissipated and even benefit women. The authors stress instead the importance of gender segregation at the firm and job-title level. In total, they propose that two fifths of the gender wage gap can be explained by the allocation of women to firms and job-titles of lower "quality", as they offer weaker remuneration levels. The remaining three fifths are allocated to discrimination.

Card et al. (2015) propose instead other source of inequality: the fact that women have a smaller relative bargaining power. The authors show how women's salaries are less sensible to increases in their employer's profitability, meaning that they appropriate a smaller portion of firm rents. They argue that this bargaining difference explained about 15% of the gender wage gap in Portugal in the period between 2002 and 2009.

Given that peers reflect the degree of segregation within a certain firm or job-title, while also influencing the performance of the worker, measuring their impact on the gender wage gap may help shed a new light on the importance of the firm dimension in the wage determination process of the worker.

4 Empirical Setting

4.1 Base Model

The starting building block of this dissertation is an extension of the original Mincer (1958) earnings function, one of the most widely used models in labor economics to attest the importance of work experience on the gender wage gap. As a starting point, only observable characteristics were considered. The equation is as follows:

$$ln(w_{ifjt}) = \beta_0 + \beta_1 Age_{it} + \beta_2 Age_{it}^2 + \beta_3 Ten_{ift} + \beta_4 Ten_{ift}^2 + \beta_5 Educ_{it} + \beta_6 Fem + \delta_t + \varepsilon_{ifjt} \quad (1)$$

where $ln(w_{ifjt})$ is the natural logarithm of the real hourly wage of worker i, working at firm f, holding a job-title j, at year t. In terms of observables, the worker's *Age* is included to account for the worker's labor market experience, while *Ten* measures the worker's time at the corresponding firm (quadratic terms for *Age* and *Ten* are also included); *Educ* controls for the worker's level of education, *Fem* is a gender dummy (equal to 1 in case of female, 0 for male), and δ_t represents time fixed effects. Finally, ε_{ifjt} is the disturbance component, assumed to respect the assumptions of zero conditional mean and strict exogeneity. The wage measure excludes any premium payments for overtime hours, reducing the potential bias from conflating regular hours payments with those earned in irregular hours (Petersen and Morgan (1995)).

4.2 Extended Model

Following this, this dissertation will borrow from the methodological approach presented in Cardoso et al. (2016). The authors estimated a wage regression with three high-dimensional fixed effects to attest the importance of individual-/firm-/job-title-specific characteristics on the gender wage gap. In addition, to measure the potential spillovers from the interaction with

peers, the methodology presented in Arcidiacono et al. (2012) is also adopted. This procedure makes use of an additional variable to account for the potential spillovers the worker's wage might suffer from the interaction with co-workers. The additional variable is the average of the co-workers fixed effects.[2] These approaches are summarized in the following equation:

$$ln(w_{ifjt}) = X_{ift}\beta + \alpha_i + \phi_{fj} + \gamma\overline{\alpha}_{-i} + \delta_t + \varepsilon_{ifjt} \tag{2}$$

where X_{ift} and δ_t are, respectively, the set of observed time-varying attributes of worker i and the time fixed effects, already presented in equation (1); α_i refers to the worker fixed effect, while ϕ_{fj} is the firm/job-title fixed effect. These two fixed effects are used to capture any observed and unobserved time-invariant heterogeneity at the individual, firm and job-title level. Finally, $\overline{\alpha}_{-i} = \frac{1}{N_{ijt-i}} \sum_{k \in N_{ijt-i}} \alpha_k$ represents the leave-out average of the individual fixed effects of worker i's co-workers, being N_{ijt-i} the total number of peers of individual i. Peers are defined as all the workers of firm f, that share the same job-title j as worker i at year t. The coefficient of interest is γ, measuring the influence of peers in the natural logarithm of worker i's real hourly wage. Controlling for the gender of worker i, this model allows for heterogeneity in the response to peers, revealing how differently women and men will be affected by their co-workers. This equation assumes the worker fixed effect to be constant throughout time. Arcidiacono et al. (2012) stress the importance of this "static ability" to guarantee that the coefficient γ is identifiable, even in cases where one does not have multiple observations per worker in each period.[3]

[2]The usage of fixed effects to measure peer spillovers is said to be especially suited in settings where time-varying unobservable characteristics of peers do not affect individual decisions, as they have limited control over their outcome variable.

[3]Naturally, equation (2) requires the estimation of multiple high-dimensional fixed effects. This entails the inversion of a huge matrix, something too demanding for the typical OLS procedure. To overcome this obstacle, the iterative algorithm presented by Guimaraes and Portugal (2010) was used.

For the estimation of the fixed effects associated with the worker's peers, equation (2) must also satisfy a proportionality assumption between the estimated direct effect of peer and individual characteristics on the natural logarithm of worker i's real hourly wage. This implies that individual characteristics of α_i which are equally important in impacting the outcome variable, will also be equally important when operating through the peers' characteristics in $\overline{\alpha}_{-i}$. This assumption is determinant for estimation purposes as it allows the application of Theorem 1 of Arcidiacono et al. (2012), guaranteeing asymptotic normality and consistency for the peer effect estimator, γ. Furthermore, this also demands residuals between any two observations to be uncorrelated (meaning $E(\varepsilon_{ifjt}|X_{ift}, \alpha_i, \phi_{fj}, \overline{\alpha}_{-i}) = 0$). Hence, when controlling for the different fixed effects included in equation (2), the remaining variation in real hourly wage is expected to come exclusively from random shocks.[4]

It is important to also notice how worker mobility is determinant for the identification of the multiple fixed effects. For instance, as workers change from firm to firm, one can identify variations in the "quality" of the worker's peer group induced by these changes, allowing the identification of the fixed effect of the peers. Besides this, the same mobility across firms is determinant to define the fixed effect associated to each specific firm. Further differences in the worker's wage can only be attributed to worker-specific characteristics (even if unobservable), allowing the identification of the worker fixed effect.

A few challenges still need to be considered in relation to equation (2). Manski (1993) references the so-called "reflection problem", arising in the identification of peer effects. This problem arises because when measuring the impact of the behavior of worker j on worker i's behavior, it becomes challenging to tell which worker is indeed the one affecting the other's

[4]One can thus expect that no time-varying unknowns are impacting both the worker i's hourly wage and the composition of that worker's peer group in a systematic way.

behavior. If it is the case that both workers affect each other simultaneously, the estimated peer effect may reflect the dual direction of spillovers. This inability to distinguish the actual peer effect from a "mirrored" behavior across workers turns unfeasible the identification of spillover effects. However, this rises as a problem due to the linear-in-means structure of many peer models. This type of structure induces perfect collinearity between the expected average outcome and the group and its mean characteristics (Bramoullé et al. (2009)).[5] The presented equation in this dissertation evades this problem since it measures peer influence through the average fixed effect of co-workers, and not through their average hourly wage. Manski (1993) also points out the difficulty in disentangling real social peer effects from "correlated effects". Indeed, co-workers may behave in a similar way, not necessarily due to behavioral spillovers, but because they share individual characteristics and the same institutional environment - the phenomenon of homophily. These common conditions manifest themselves through the "correlated effects" which may hinder the estimation of the peer effects. This issue is addressed in equation (2) with the inclusion of the worker and firm/job-title fixed effects.

Another important aspect for the identification of peer effects is the inclusion of individual characteristics in X_{ift}. It could happen that individual features which are relevant in explaining the worker's wage, are also linked to the "quality" of worker i's peers, measured by $\overline{\alpha}_{-i}$. In such cases, if these characteristics would to be excluded from equation (2), the estimated coefficient for the importance of peers could be overstated. Besides this, the usage of time dummies is also important as they capture the growth in real hourly wages, while controlling for possible trends in the average "quality" of worker i's peer group.

Finally, worker sorting across firms and job-titles must also be taken into consideration.

[5] In linear-in-means models, besides individual and reference group characteristics, the outcome of each individual also depends on the mean outcome of the individual's peer group.

This has tremendous importance in this setting since the reviewed literature suggests considerable gender differences in job sorting in the Portuguese labor market (Cardoso et al. (2016)). Both the firms and job-titles with largest male representation are very different from those with largest female representation. To control for the sorting of female and male workers of different abilities across firms, job-titles or both, equation (2) includes the firm and job-title fixed effect. The same sorting mechanism can also be verified across different peer groups with different abilities. The inclusion of the individual fixed effect is determinant to account for this extra potential sorting channel.

It is however important to question if equation (2) is the most appropriate one to study the relevance of peer effects. In fact, the average worker fixed effect of worker *i*'s co-workers might not be a good measure of spillovers and thus future studies with different specifications of spillovers are still of the highest value. For instance, instead of the arithmetic average of fixed effects, one could use a weighted average of those fixed effects, weighting differently workers who are either more similar in characteristics or execute very similar functions within the firm as to worker *i*. In addition to this, one should also wonder if the definition of a worker's peer group is the most adequate one. It could be the case that the relevant reference group to worker *i* is not only the set of workers that share the same job-title. Another possible extension could be the consideration of a heterogeneous peer group for each worker *i* within a firm f. Bramoullé et al. (2009) introduced this notion by allowing a specific peer group for each individual. Indeed, membership to a specific reference group may exceed the notion of being employed in the same firm or to share the same job-title as another worker. Spillovers may result from other sources of interdependency across workers such as friendship relationships, the share of values, common interests or beliefs. When taking this into account in the selection of a worker's peer group, one might be getting closer to the nature and importance of the social networks that are established

across peers and that may affect many of the worker's labor outcomes.

4.2.1 Heterogeneity in Peer Influence

Lastly, we propose an alternative specification of equation (2), allowing for the existence of heterogeneity in the influence of peers. This specification is important to investigate the extent at which workers are affected differently according with their peers' gender. The following equation is thus to be estimated:

$$ln(w_{ifjt}) = X_{ift}\beta + \alpha_i + \phi_{fj} + \lambda\overline{\alpha}_{m-i} + \zeta\overline{\alpha}_{f-i} + \delta_t + \varepsilon_{ifjt} \tag{3}$$

where $\overline{\alpha}_{m-i}$ and $\overline{\alpha}_{f-i}$ represent, respectively, the mean of the individual fixed effects of worker i's male and female co-workers, while λ and ζ are measures of the influence of the male and female peers in the natural logarithm of worker i's real hourly wage.

5 Data

The data source employed in this dissertation is the Portuguese Personnel Records (*Quadros de Pessoal*), a longitudinal matched employer-employee dataset collected each year by the Portuguese Ministry of Employment. This is a mandatory census covering all private business firms with at least one paid employee at the time of the survey. Public administration employees, independent contractors, household servants and unemployed individuals are not covered. It offers an extensive range of information concerning the workers (such as their education level, gender, age, tenure and occupation) and firms (concerning location, sales and size).

This dataset presents several advantages. For instance, given its legally compulsory nature, it guarantees a high response rate, avoiding the potential panel attrition that is so common in

many panel datasets. Secondly, not only the accuracy of the collected information is frequently double-checked, but there is also the legal demand for the data to be displayed in a public space within the firm, contributing for the reliability of the data provided, while reducing potential measurement errors, other very common problem in panel datasets.

Another advantage concerns its construction: this dataset assigns to each worker an identifying code based on their social security number. The same happens for each firm. Since this is a longitudinal set, one is able to track the different workers across time and match them to the firm they are working for. Furthermore, since it also collects information on the occupation of each worker within the firm, one will be able to track the team of workers that execute the same function in each firm in a given year, allowing the identification of the peer groups.

The final dataset of this dissertation results from several restrictions: it is only comprised of full-time workers in mainland Portugal, between 1994 and 2013 (with the exception of 2001); employees in agriculture and fishery industries are not included; workers are aged between 16 and 64 years old, have at maximum 50 years of tenure and their wages exceed 80% of the compulsory minimum wage (the minimum remuneration allowed for apprentice level). All the firms considered have at least two workers, and always mixed in terms of gender. This was imposed to guarantee that each job-title had at least one female and one male worker within the same firm for every given year. Given these criteria, the final dataset has information on 1.7 million workers, observed between 1 and 19 times across the studied time period.

6 Empirical Results

Figure 1 represents the evolution of the Portuguese gender wage gap throughout the period of analysis. The average, "raw", gender pay gap was of 26 log points across this period, and

showcased a decreasing evolution, especially throughout the 90's and the early 2000's. When adjusting for the worker's age and tenure, the wage gap is only slightly smaller: it reduces to 25 log points, reinforcing how similar men and women are in those observable characteristics. This measure also follows an identical path. One must however notice how from mid-2000's

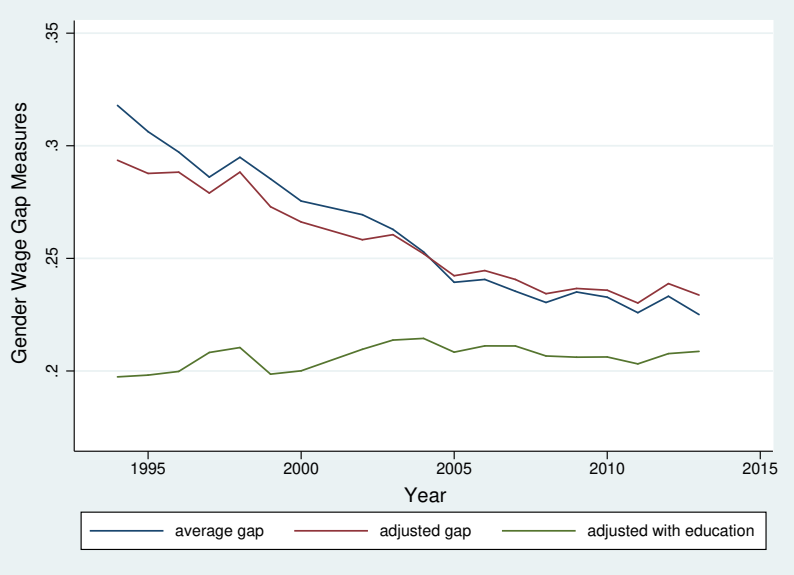


Figure 1: Evolution of the Gender Wage Gap

onwards, the gender wage gap almost stabilizes around the 23 log points mark, questioning the ongoing effort of women to match men's observable characteristics valued by the labor market. When controlling for education, the gender wage gap decreases to 21 log points, signaling that differences in education is one considerable driver of wage inequality. Still, one can no longer observe the decreasing trend as in the other two. The estimated gap actually increased in the studied period, reinforcing how the wage differential among genders must come from other sources besides the ones stemming from differences in observable characteristics.

The estimations of equations (1), (2) and (3) were performed, in order to shed a light on the mechanisms that may be behind this persistent wage gap. Results are presented in Table 1.

When estimating equation (1), the time-varying observable characteristics have all consid-

Dependent variable: $\ln(w_{ifjt})$			
Variables	Equation (1)	Equation (2)	Equation (3)
Estimated coefficients of covariates			
Age	0.0425^{***}	0.0171^{***}	0.0172^{***}
	(0.0003)	(0.0000)	(0.0000)
Age^2	-0.0003^{***}	-0.0002^{***}	-0.0002^{***}
	(0.0000)	(0.0000)	(0.0000)
Tenure	0.0309^{***}	0.0068^{***}	0.0068^{***}
	(0.0002)	(0.0000)	(0.0000)
Tenure^2	-0.0005^{***}	-0.0002^{***}	-0.0002^{***}
	(0.0000)	(0.0000)	(0.0000)
Education	0.0982^{***}	0.0000	0.0001^{***}
	(0.0002)	(0.0000)	(0.0000)
Gender Dummy	-0.2052^{***}	-0.0000	-0.0027^{***}
	(0.0013)	(0.0001)	(0.0001)
$\overline{\alpha}_{-i}$ (peers)		0.1781^{***}	
		(0.0005)	
$\overline{\alpha}_{m-i}$ (male peers)			0.0834^{***}
			(0.0005)
$\overline{\alpha}_{f-i}$ (female peers)			0.0822^{***}
			(0.0005)
Worker Fixed Effect	No	Yes	Yes
Firm and Job-title Fixed Effect	No	Yes	Yes
Sample Size	6,726,886	6,726,886	5,974,182
R^2	0.584	0.982	0.981

Table 1: Main regression results

Notes: All regressions executed using year fixed effects and robust standard errors, clustering for peer group (reported in brackets). Observations in equation (3) are fewer, given the cases when the worker has no other same-sex peer, and specific female or male average fixed effect cannot be estimated. Stars indicate significance levels of 1% (***), 5% (**) or 10% (*).

erable explanatory power, as well as the expected signs: increases in both age and tenure are expected to have a significant and positive impact on the worker's wage, even if at a decreasing rate (captured by the squared elements of the equation); the same happens for education. One must however be careful in interpreting these results as not only they are likely to be overstated and thus capturing the impact of other relevant variables present in the error term, but also, any interpretations are not free of the potential endogeneity problem of variables such as education.

The inclusion of the fixed effects, as expected, collapses the value of the variables that remain constant throughout time for worker i (as it does for the gender dummy). In what concerns the importance of peers, the γ coefficient is significant and positive, with a value of 0.1781. This means that an one standard deviation increment in the average "quality" of peers leads, on average, *ceteris paribus*, to an increase in the worker's hourly wages of about 4.83%.[6] Considering previous studies, this result lies somewhere in between: Battisti (2013) found a larger positive and significant impact on wages of 7.81%, while Cornelissen et al. (2017) identified at maximum a 0.6% increase in wages. The authors suggest that this low impact of peers might be due to the nature of the activities in their sample which limit the conditions for the rise of the typical spillover mechanisms of peer pressure and knowledge transfer.

Afterwards, equation (2) was estimated separately for both the female and male workers in the sample. These results are presented in Table 2.

Dependent variable: $\ln(w_{ifjt})$		
Variables	Equation (2) - Males	Equation (2) - Females
Estimated coefficients of covariates		
$\overline{\alpha}_{-i}$ (peers)	0.1761^{***}	0.1806^{***}
	(0.0006)	(0.0007)
Worker Fixed Effect	Yes	Yes
Firm and Job-title Fixed Effect	Yes	Yes
Sample Size	3,255,857	3,471,029

Table 2: Results for equation (2), by gender

Notes: Both regressions executed using time fixed effects and robust standard errors, clustering for peer group (reported in brackets). Stars indicate significance levels of 1% (***), 5% (**) or 10% (*).

The estimated impact of peer's spillovers is significantly positive for both, the female one being slightly larger than the male one (0.1806 v. 0.1761). To test if this difference is statis-

[6]This was calculated by multiplying the estimated γ coefficient of 0.1781 by the overall standard deviation of the peer effects, $\overline{\alpha}_{-i}$, of 0.271.

tically significant, an interaction variable between the peers "quality" variable, $\overline{\alpha}_{-i}$, and the gender dummy variable, *Fem*, was added to equation (2). Results are reported in Table 5 of the Appendix. The coefficient of the variable is indeed positive and significant, which corroborates the idea that women are slightly more sensitive to changes in the "quality" of their peers.

Furthermore, equation (3) was estimated to investigate the heterogeneity in peer influence. The results are presented back at Table 1. The model predicts that, on average, *ceteris paribus*, an increase of one standard deviation in the average "quality" of male (/female) peers induces an increase in the worker's hourly wages of 2.29% (/2.23%). The difference between the two is not statistically significant at a 5% significance level, meaning that for the average worker, the gender of the peers has no relevancy in explaining that worker's sensitivity to spillovers.

However, when estimating equation (3) separately for the male and female workers in the sample, the conclusions are very different. These results are shown in Table 3. Here the differences are not only statistically significant but they also show a clear dichotomy: male workers

Dependent variable: $\ln(w_{ifjt})$		
Variables	Equation (3) - Males	Equation (3) - Females
Estimated coefficients of covariates		
$\overline{\alpha}_{m-i}$ (male peers)	0.1124^{***}	0.0590^{***}
	(0.0007)	(0.0006)
$\overline{\alpha}_{f-i}$ (female peers)	0.0575^{***}	0.1172^{***}
	(0.0005)	(0.0009)
Worker Fixed Effect	Yes	Yes
Firm and Job-title Fixed Effect	Yes	Yes
Sample Size	2,873,649	3,100,533

Table 3: Results for equation (3) for both sexes

Notes: Both regressions executed using time fixed effects and robust standard errors, clustering for peer group (reported in brackets). Stars indicate significance levels of 1% (***), 5% (**) or 10% (*).

are more sensible to changes in the average "quality" of their male co-workers, while female workers are more sensitive to their female peers. This prediction goes hand-in-hand with the

Reference-group theory of Hyman (1942). Humans search for similarities between each other when interacting, and thus one can expect workers to establish richer work-related relationships with their same-sex peers. Kanter (1977) also identified gender as an important mechanism to establish trust relationships among co-workers. The author refers how this molded the constitution of teams within firms, and eventually lead to a highly segregated labor market. Indeed, in the studied sample, women are much more exposed to women than to men: the average share of female co-workers in the peer group for women is about 66%, while among men this share falls to 33% (kernel densities by gender are shown in Figure 4 of the Appendix). Still, this higher sensibility towards same-sex workers, does not seem to be simply because workers are also more exposed to them. Even when controlling for the share of female workers in the peer group (reported in table 6 of the Appendix) this dichotomy is maintained.

Taking all of this into consideration, it is important to attest how these mechanisms rise as sources of the gender wage gap. To shed a light on this matter, the Oaxaca (1973) decomposition was perfomed. This method decomposes the existing gap into the part that can be explained by differences in the determinants of the outcome in question between men and women, measuring the specific individual contribution of each of the proposed fixed effects for the gap. The results of the decomposition applied to equation (2) are presented in Table 4.

Gender Gap	Worker FE	Firm/Job-title FE	Peers AFE
0.2605	0.1344	0.1113	0.0139
(0.0005)	(0.0002)	(0.0003)	(0.0000)

Table 4: Results of the Oaxaca Decomposition for equation (2)

Notes: The model includes all the regressors present in equation (2), apart from the female dummy variable. Results not shown here due to their negligible size.

The results show how strongly connected the gender wage gap is to the individual component: differences in the worker fixed effect account for 13.44 log points of the existing gap

(more than 50% of the total gap). This is meant to reflect the influence of constant heterogeneity of individuals on their wages. While some perceive this as a reflection of differences in worker's unobservable productivity, it may also reflect gender discrimination that is not explained by any other component.

The sorting of workers between firms and job-titles (or combinations of both) also benefits men: 11.13 log points of the gender wage gap is explained by this mechanism. Evidence thus suggest that women are more likely to be employed in firms with less generous wage policies (measured by the component referring to the firm fixed effect), and on job-titles with lower remuneration status (reflected on the component related to job-title sorting). This women's disadvantage is clearly observed when looking at the kernel densities of these fixed effects as shown in Figure 2.

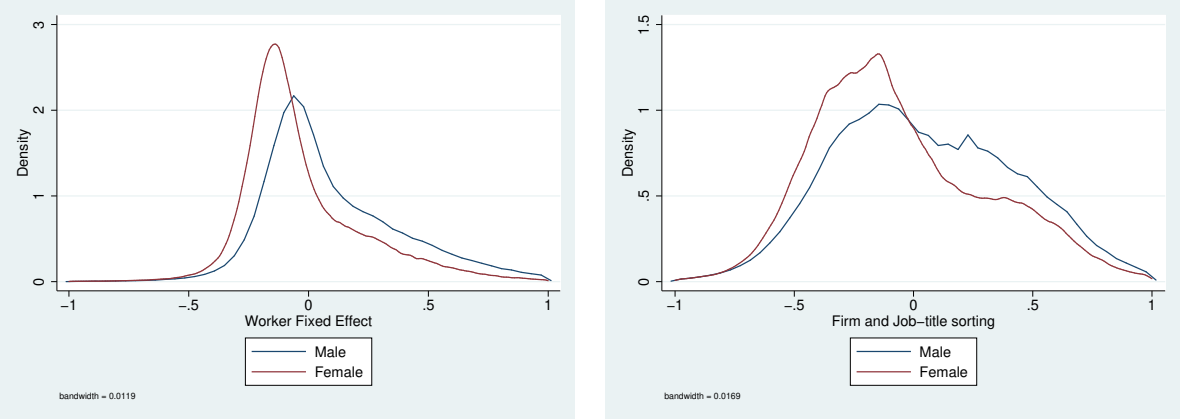


Figure 2: Kernel densities of Worker and Firm/Job-title fixed effects, by gender

Notes: The figures are represented using the epanechnikov kernel function. Observations limited to the range [-1,1] to gain readability, without loss of interpretative power.

Besides the direct discrimination that may arise from employers or costumers, several other mechanisms may answer why women are disproportionally allocated to low-paying firms. Gender differences in job search methods may be one of them: there is evidence that due to the strongly gendered nature of social interaction, women's social networks are dominated by

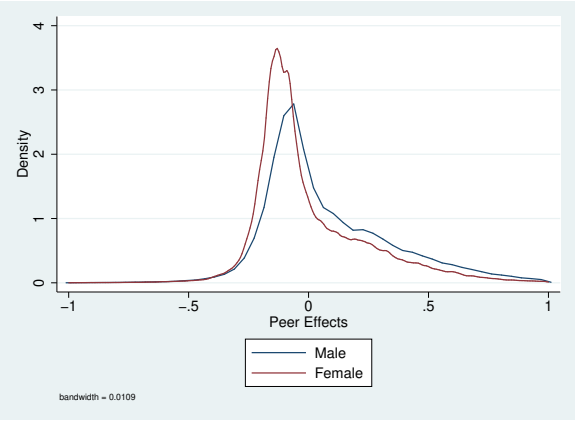
women. It is through these social networks than women may share job information between each other (Hanson and Pratt (1991)), and since women are more likely to be employed in low-paying firms, these social networks will bound other women to those same low-paying firms. The authors also mention how women value specific things in their job and as result may restrict their job search in terms of geographic location (for jobs closer to their home, for instance) or other characteristics (as more flexibility in working hours), which may limit their job possibilities. Other difference may lie on the effort applied: women may exercise less effort in job search, as culturally they find other productive ends to their time – such as home production. At last, this disadvantage may arise from women expecting market discrimination *ex ante*, falling in the culturally embedded idea that women's work is worth less (Alksnis et al. (2008)), bargaining less aggressively and ending up in worse firms with lower remuneration.

This shortcoming also extends to women's accessibility to high-paying job-titles. Again, one cannot discard direct discrimination yielding from employers' hiring choices. However, biased promotion decisions against female workers may also justify this phenomenon. Evidence suggests women to be perceived as less influential in their workplaces (Brass (1985)), hindering their accessibly to important networks related to promotions. Bergmann (1971) points instead to the phenomenon of overcrowding: discrimination pushes women to only a limited range of job-titles, and this over-supply pressures their wages downwards. Finally, others suggest that this occupational segregation is mostly due to differences in preferences (Hakim (2006)). Still, one should question the historical background of these differences and the extent at which they rise as social constructs in our modern society (Hartmann (1976)).

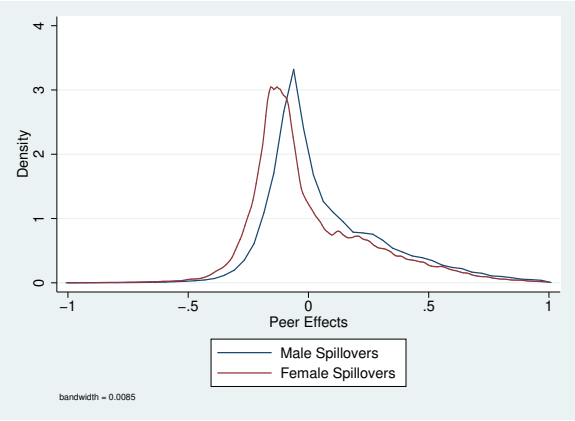
Finally, looking at the influence of peers on the gender wage gap (back at Table 4), differences in the average "quality" of peers account for 1.39 log points of the existing gap. Therefore, about 5% of the gender wage gap is created by differences in peers' spillovers between men and

women. The kernel density of these peer effects is presented on Figure 3 (a), by gender. When taking into account the gender of one's peers (results shown in Table 7 of the Appendix), the contribution of peers for the gender wage gap almost seems to be equally divided among genders: differences in the average "quality" of female peers account for 0.66 log points of the gender wage gap, while 0.7 is the contribution of differences in male peers.

As mentioned before, the Portuguese labor market is strongly segregated: there are job-titles heavily populated by women, and others by men. If the average peer "quality" of male and female co-workers was similar, peers' spillovers contribution for the gender wage gap would be mitigated. However, data suggests otherwise: the average peer "quality" of male co-workers is, on average, larger than the one from female co-workers, as observed in Figure 3 (b). Ultimately, peers' contribution to the gender wage gap comes down to the fact that women are not only more exposed, but they are also more sensible to their female peers' spillovers, which are, on average, smaller than the male ones. This, however, does not necessarily reflect lower skills from female



(a) Kernel densities of Peer Effects, by gender



(b) Kernel density of the Male/Female Spillovers

Figure 3

Notes: The figures are represented using the epanechnikov kernel function. Observations limited to the range [-1,1] to gain readability, without loss of interpretative power.

peers. The variable reflective of peers' spillovers was built as the average fixed effect of the

peers of worker *i*, being itself a combination of both the co-workers' unobservable skills and their wage returns. If female workers face market discrimination, than it is more than likely that they will experience lower wage returns, culminating in lower spillovers from them. In this way, the results suggest that it might be easier to push down wages in segments of the labor market that are heavily populated by female workers.

However, some behavioral mechanisms may still help exlain these weaker wage spillovers from female peers. As mentioned before, the fact that women tend to bargain their wages less aggressively, may result in lower wages – something augmented in female-dominated positions. Also, the commonly discussed queen bee syndrome, if existent, may also be at play. Women may focus solely in competing with each other, which might limit the commonly peer-induced effects from shared learning. More information would be needed though to test these hypotheses, as this dissertation still only scratches the surface of the potential importance of one's peers.

7 Conclusion

This dissertation explores alternative determinants of a worker's wage, as well as their impact on the persistent gender wage gap in the Portuguese economy. Besides the relevance of personal and firm/job-title characteristics, this study presents evidence of the importance of peer effects. As a novelty, it allows heterogeneity in peer influence, studying how peer effects stand when considering the interaction between the worker's gender and the gender of that worker's peers.

A significant and positive impact of peer effects was found on the logarithm of real hourly wages: an one standard deviation increment in co-workers "quality" is expected to spill a 4.83% increase in hourly wages. Besides this, evidence for the hypothesis that women are slightly more sensible to these spillovers was also found. When decomposing the gender wage gap, person

effects and firm and job-title sorting contribute the most (52% and 43%, respectively), while peer effects explained about 5% of it. This contribution results from female workers being more exposed and sensible to their female peers, whose spillovers are, on average, weaker. This, however, does not mean that female peers are worse than male ones. Instead, it reveals how job-titles strongly populated by women might create more room for wage discrimination, resulting in weaker spillovers from female peers.

Ultimately, this thesis attempted to provide additional evidence of the importance of one's peers in the work setting. Further work still needs to be explored in the hope of understanding the mechanisms through each these effects manifest. Nevertheless, either it is trough bargaining externalities, overcrowding of job-titles, etc., the results of this dissertation hopefully reinforced how market segregation rises as a great source of penalization for a women's wage.

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Appendix

Dependent variable: $\ln(w_{ifjt})$		
Variables	Equation (2)	Equation (2)*
Estimated coefficients of covariates		
Age	0.0171^{***}	0.0171^{***}
	(0.0000)	(0.0000)
Age^2	-0.0002^{***}	-0.0002^{***}
	(0.0000)	(0.0000)
Tenure	0.0068^{***}	0.0068^{***}
	(0.0000)	(0.0000)
Tenure^2	-0.0002^{***}	-0.0002^{***}
	(0.0000)	(0.0000)
Education	0.0000	0.0000
	(0.0000)	(0.0000)
Gender Dummy	-0.0000	-0.0000
	(0.0001)	(0.0001)
$\overline{\alpha}_{-i}$ (peers)	0.1781^{***}	0.1777^{***}
	(0.0005)	(0.0005)
(Gender Dummy)*($\overline{\alpha}_{-i}$)		0.0009^{**}
		0.0003
Worker Fixed Effect	Yes	Yes
Firm and Job-title Fixed Effect	Yes	Yes
Sample Size	$6,726,886$	$6,726,886$
R^2	0.982	0.982

Table 5

Notes: All regressions executed using time fixed effects and robust standard errors, clustering for peer group (reported in brackets).

Equation (2)* includes an additional covariate to test the significance of the difference between men's and women's sensibility to spillovers.

Stars indicate significance levels of 1% (***), 5% (**) or 10% (*).

Dependent variable: $\ln(w_{ifjt})$		
Variables	Equation (3)* - Males	Equation (3)* - Females
Estimated coefficients of covariates		
$\overline{\alpha}_{m-i}$ (male peers)	0.1118^{***}	0.0574^{***}
	(0.0007)	(0.0006)
$\overline{\alpha}_{f-i}$ (female peers)	0.0572^{***}	0.1160^{***}
	(0.0005)	(0.0009)
Share of Female Peers	-0.0125^{***}	-0.0147^{***}
	(0.0002)	(0.0003)
Worker Fixed Effect	Yes	Yes
Firm and Job-title Fixed Effect	Yes	Yes
Sample Size	$2,873,649$	$3,100,533$

Table 6

Notes: Equation (3)* controls for the share of female workers among peers. Both regressions executed using time fixed effects and robust standard errors, clustering for peer group (reported in brackets). Stars indicate significance levels of 1% (***), 5% (**) or 10% (*).

Gender Gap	Worker FE	Firm/Job-title FE	Female Peers AFE	Male Peers AFE
0.3021	0.1503	0.1333	0.0066	0.0070
(0.0005)	(0.0002)	(0.0003)	(0.0000)	(0.0000)

Table 7: Results of the Oaxaca Decomposition for equation (3)

Notes: The model includes all the regressors present in equation (3), apart from the female dummy variable. Results not shown here due to their negligible size.

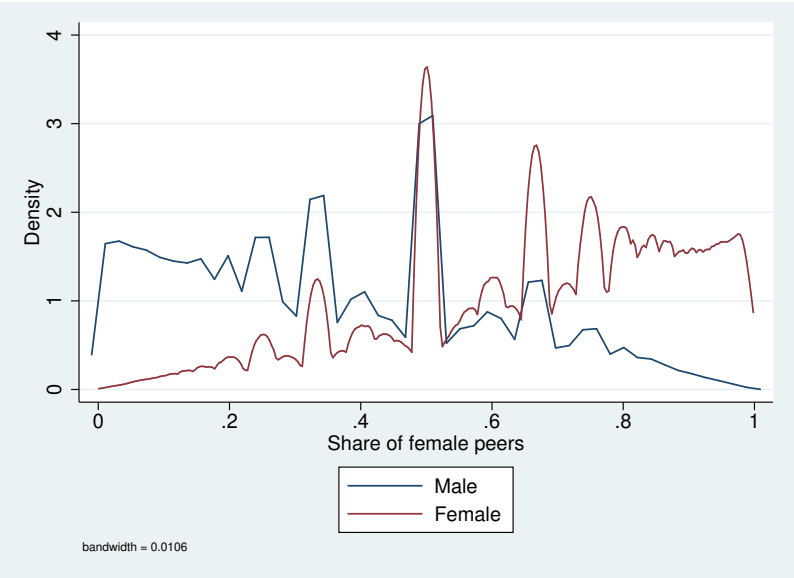

Figure 4: Kernel densities of the share of female peers, by gender

Notes: Figure represented using the epanechnikov kernel function.