Do Gender Disparities Exist Despite a Negative Gender Earnings Gap?

ABSTRACT

In 2009, for the first time, Puerto Rico's unconditional median earnings gender gap presented a statistically significant negative sign. We document the elements that lead to an overall improvement of women's economic position but found that the unconditional earnings gap turns positive once observable characteristics are considered. For instance, we found that the negative gender gap disappears just by adjusting for educational attainments as a new indicator of gender gaps. In general, relative differences in returns on education and a glass ceiling effect moderated by dependent children are two of the explanatory factors allowing for the continuation of gender disparities within groups. There is also a direct association between women's representation in a given occupation/education group and the gender earnings gap.

Keywords: Gender pay gap, children, return to education, discrimination

JEL Codes: J16, J31, J08

1. Introduction

Gender wage gaps have declined in many countries in recent decades, but the unexplained component attributed to this gap has not decreased (Weichselbaumer &Winter-Ebmer, 2005). In 2009, Puerto Rico became the first country (to our knowledge) in which women's median earnings were above men's median earnings. This outcome is matched by the second-lowest difference in the world in labor participation rates between genders in 2012. Does a closed gender gap represent an absence of gender disparities? If not, what type of gender disparities persist despite the closed gap? These are the questions that we attempt to answer.

As in Puerto Rico, Arulampalam, Booth and Bryan (2007) found that in many European countries the overall gender earnings gap conceals significant differences in wage distribution. To test the possibility of gender disparities in earnings, we apply three econometric methods to a representative sample of individuals: Propensity Score Matching, Oaxaca-Blinder decomposition, and gap decomposition by quantiles à la Melly (2005a).

After controlling for a host of covariates such as education, marital status, experience, type of employment, and physical impairments, we found three distinctive results. Firstly, there is a glass ceiling effect fueled by relative differences in returns on endowments for men and women. Secondly, this glass ceiling effect is largely moderated by the number of children living in each household. In other words, there is evidence of a "maternal wall", as coined in the related literature. This concurs with the results of Angelov, Johansson and Lindahl (2016), who found that the gender wage gap within a heterosexual marriage is larger when the marriage enters parenthood, and O'Neill (2003), who stated that family responsibilities affect the productivity and labor choices of women.

Thirdly, we also found that a relatively large proportion of women in certain occupations *increases* the gender earnings gap. That is, the gap is even larger because of a certain "premium for

underrepresentation" in those occupations in which men have lower representation than women and among those educational groups in which men are underrepresented, as discussed below. This can be associated with the term "glass escalator" used in the related literature (Williams, 1992), where men are promoted more easily in occupations where they are underrepresented. However, this finding may contradict the conventional wisdom that observed lower gender inequality with higher female representation. For instance, Cohen and Huffman (2007) state, "These studies imply that there is less gender inequality under conditions of greater female representation (and higher status) in management" (p. 683).

Section 1.1 elucidates some factors that may have driven this negative gender pay gap in Puerto Rico. Section 1.2 proposes a new measurement of the gender earnings gap that improves cross-country comparisons. The empirical models and data used are described in section 3. Section 4 discusses the results. Lastly, section 5 presents conclusions and policy recommendations.

1.1 Evolution of Gender Earnings Gap in Puerto Rico

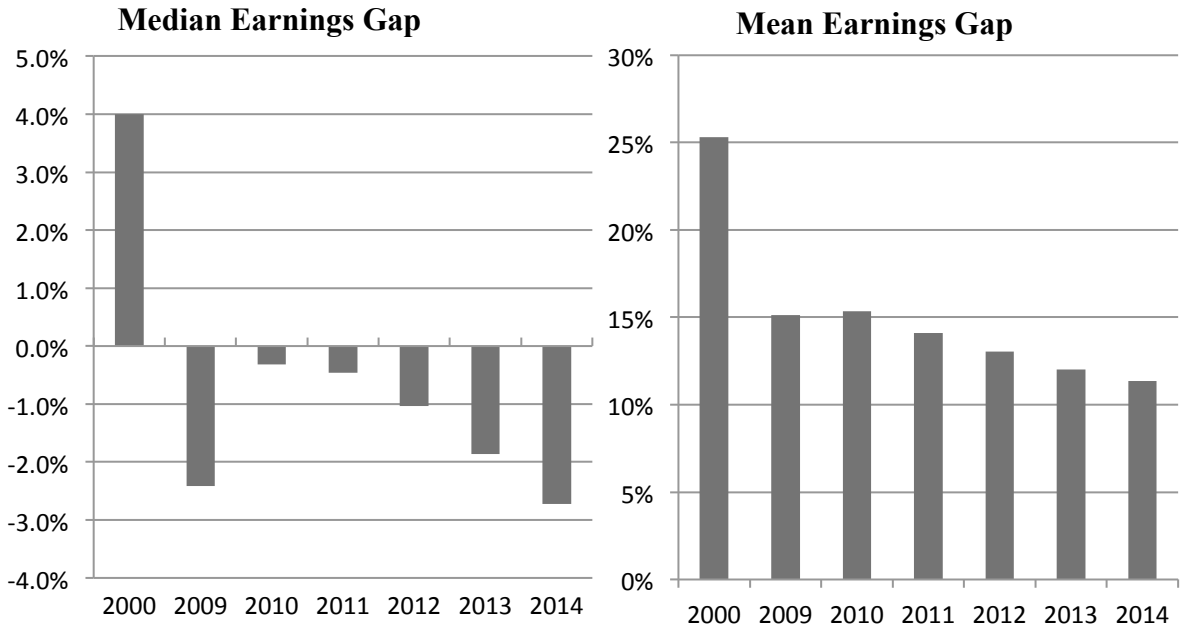
For the first time female median earnings in Puerto Rico exceeded male median earnings in 2009, according to data collected by the Puerto Rico Community Survey (PRCS, a reduced form of the American Community Survey, prepared by the U.S. Census Bureau) annual sample. This trend has continued since then. An exploration of the data available from the 2000 Census and the PRCS allows for a closer look at this occurrence.[1]

Figure 1 shows median earnings and mean earnings gender gaps for 2000 and from 2009 to 2014, for the population aged 16 and older that reported positive earnings. The median earnings gender gap turned negative by 2009 and remained so for the rest of the period under study, also becoming statistically significant since 2009. Meanwhile, the mean earnings gap stayed positive the entire time,

[1] The exploratory analysis is based on data from the 2000 Census 5% sample for Puerto Rico and PRCS 5 year samples from 2009 to 2014. The PRCS has been carried out since 2005. Therefore, 5 year samples are available from 2009 onward. The use of 5 year samples allows for reduced sampling error and more accurate estimates.

although it dwindled overtime. The divergence pattern between the median and the mean earnings gaps is due to a stronger concentration of earnings at the top of the men's distribution. Thus, the unconditional median earnings gap appears to be negative because the men**'s** earnings distribution is more skewed than female earnings. To better understand this pattern, employment rates, hours worked, and education level are examined.

Figure 1. Gender Gaps Trends in Puerto Rico, 2000 and 2009-2014



Source: Puerto Rico 2000 Census, PRCS (2009-2014 PRCS 5years samples)

For all the years examined, employment population rates, as well as estimated total hours worked, are higher for males than for females. Nevertheless, the relative differences have decreased. In 2000, the estimated employment to population ratio for men was 15% higher than for females. By 2014, the difference declined to 9%. Similarly, the divergence in mean estimated hours worked between men and women went from 10% in 2000 to 5% by 2014. An increasing relative work effort could have benefited women's position in the labor market and contributed to the reduction in the

gender gap. That increased effort could also signal higher labor force attachment, which can also contribute to improving women's relative standing.

Differences in education are also important, as shown in Table 1. In 2000, working women reported higher levels of educational attainment than men for individuals aged 25 and older. That year, 46% of working men indicated having post-secondary education and only 22% had obtained a bachelor's (BA) degree or higher. The corresponding percentages for women were 65.5 and 37%, respectively. Through the following years the education gap in favor of women widened. By 2014, 45% of working women had a BA or higher degree while only 27% of men reported the same.

Table 1. Median earnings gender gap within education levels, 2000 and 2014

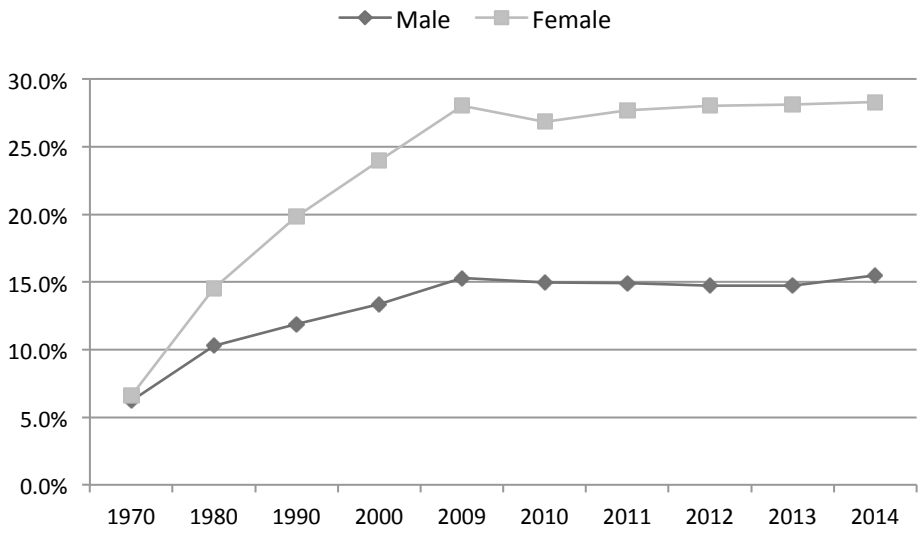
	Within Group Median Earnings Gender Gap	
Education Level	2000	2014
No High School diploma	17%	14%
High School diploma	17%	12%
Post-secondary w/o BA	25%	17%
BA	25%	22%
MA	24%	18%
Ph.D. or professional degree	36%	24%

Note: Median earnings gaps are estimated following OECD; as the ratio between the gap and men's median earnings. Sample here is limited to individuals aged 25 or more.
Source: Puerto Rico 2000 Census, PRCS (2009-2014 PRCS 5years samples)

Nevertheless, this reflects changes in educational trends that date much earlier. By 1970 (the first year for which educational attainment data is available for Puerto Rico) among 22 to 28 years old, the rate of BA completion was similar for men and women, 6.2 and 6.6 percent, respectively. In 1980, while the percentage of women age 22 to 28 with BAs increased to 15 %, the corresponding figure for men only increased to 10%. By 1990, the percentage of women with bachelor's degrees (BAs) surpassed the corresponding percentage for men among working age adults in Puerto Rico. By now, almost 30% of females 22 to 28 have completed a BA degree, while only 18 % of males have done the

same. As can be seen in Figure 2, most of the increase in the college completion gap occurred between 1970 and 2009, after that BA completion rates have remained stable for both sexes. We can infer from the graph that the prolonged recession that started in 2006, and persists to this day, has halted, not only the increase in the gender educational gap, but also the improvement in education levels overall.

Figure 2. Percentage of 22 to 28 years old with BA Degrees



Source: Puerto Rico 1970,1980, 1990 and 2000 Census, PRCS (2009-2014 PRCS 5years samples)

That is, the rapid increase in female college completion during the pre-recession period and the stagnation thereafter, indicates that gender differences in post-secondary education in Puerto Rico are likely related to the economic transformation. Lee (2014) explains how the industrialization process eliminated the gender gap in school enrollment, which traditionally favored men in China. In Puerto Rico between 1970 and 2014, the manufacturing employment share decreased from 19 to 9%, while the services sector share increased from 17 to 34 %.[2] The increase in the service sector may have been an important contributor to the gender gap, particularly if men specialize in services that do not

[2] Numbers for 1970 were obtained from Dietz (1989) and recent figures were estimated according to official data from the Puerto Rico Planning Board.

required post-secondary education. Another important element is the growth in public administration and in finance, insurance, and real estate employment. Taken together, these sectors' employment share increased from 17.4 in 1970 to 27.5 in 2010. According to the Bureau of Labor Statistics, while women composed 44% of all workers in Puerto Rico in 2017, they accounted for 51% of government employees and 59% of employees in the finance, insurance, and real estate sector. In recent years, both sectors have decreased their employment share, having been greatly affected by the economic crisis, which may help explained the stagnation of the gender educational gap.

At first glance, it seems that an increase in work effort and educational attainment may have improved women's labor force positioning. This was corroborated in the empirical model below (Table 5 in the Discussion section). A puzzling fact is that, within educational groups, median earnings gender gaps are positive and higher for those with post-secondary degrees, as shown in Table 1 for the years 2000 and 2014. This persistence of significant earnings gaps in favor of men within education groups points to disparities in the labor market that warrant a more rigorous statistical analysis, such as follows in the rest of this article.

1.2 Gender Earnings Gaps: International Comparison

All the countries included in the data gathered by the Organization for Economic Co-operation and Development (OECD) have a positive gender pay gap. For instance, in 2013 Belgium had the lowest earnings gap ratio in the OECD, where women earned on average 6% less than men. Given that Puerto Rico does not participate in the databases prepared by the OECD on the gender earnings gap, in Appendix 1 we inserted data obtained from the PRCS to compare gaps between countries.[3]

In doing so, we observed that Puerto Rico would be the first country where the unconditional gender earnings gap was closed. In 2013, the median earnings of women working full time were $22,973, for men $22,171. However, this simple measure of the gender earnings gap can be misleading

[3] This value come from the PRCS 2013 one year-sample Census tabulations.

because it does not consider differences in endowments (e.g., skills, education, and experience, among others) that could have led to higher productivity. For instance, in Norway and Germany women's educational attainment was a little higher than that of men, making gender disparities more dramatic.

Is there an easy technique to improve this measure of the gender gap? Yes. We proposed a simple method to facilitate the cross-country comparison of the gender earnings gap by considering the data on education that is generally available in supra national entities. In particular, we divided the ratio of median earnings between genders by the ratio of mean years of schooling between genders.[4]

$$EAG = \frac{\frac{E_F}{E_M}}{\frac{S_F}{S_M}} \quad (1)$$

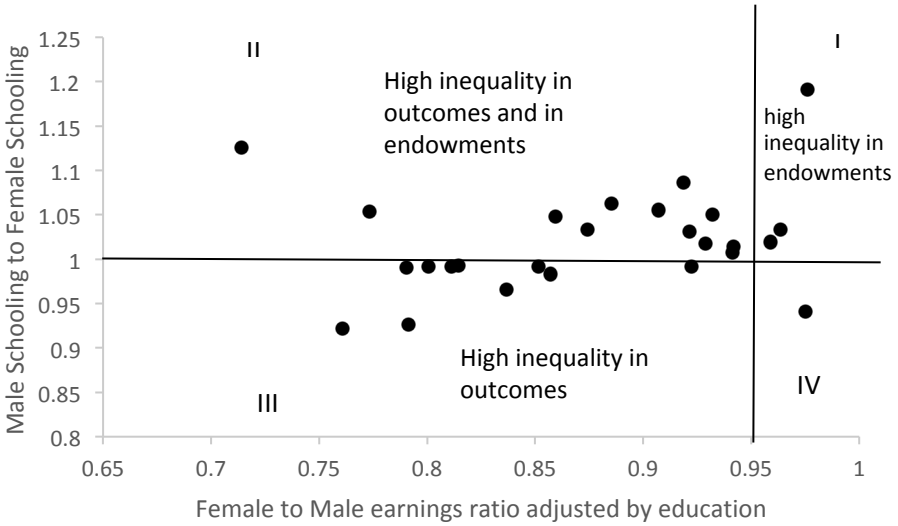
where EAG is the education-adjusted earnings ratio, E is median earnings, S are the years of schooling, M stands for male and F for female. The international data on education come from the United Nations Development Programme (UNDP) and the data on earnings come from the OECD, which includes employees and the self-employed, just like our data from the PRCS.

In Figure 3 we show the potential relationship between gender differences in schooling and our education-adjusted income gap. An optimal situation would be that both gender differences fluctuate around one, close to the intersection of the quadrants. If a country has substantial inequality in endowments such as schooling and few differences in our adjusted measurement of the income gap, it would be placed in quadrant I. The most unequal countries are located in quadrant II. The most equal countries will be those whose schooling ratio is less than one and earnings ratio is greater than Belgium (the most equal country in the OECD). The only country that had data on both earnings and schooling and fell within quadrant IV in 2013 was Puerto Rico. However, Puerto Rico's earnings gap was no longer 3% in favor of women once education is considered: in our adjusted gap, women's

[4] It is important to point out that this proposed indicator is not a general indicator of gender inequality, such as the Gender-Related Development Index: there are some poor countries with a low adjusted income ratio because their source of gender inequality is educational attainment.

median earnings is 3% lower than that of men. Although this conditional gender pay gap would not indicate the degree of disparities, it takes advantage of available information to improve the simple gender earnings gap published by supranational entities and allows better comparison.

Figure 3. Gender Differences in Schooling vs. Education-Adjusted Earnings Gap by Country, 2013



Note: Each dot represents a country with their respective ratio of schooling and ratio of earnings.
Source: Authors' estimates based on OECD (2018), UNDP (2015)

It would appear that education contributed to close the overall gender gap in Puerto Rico where women were able to advance more in their educational attainment relative to men (11.9 years vis-à-vis 11.2 for men in 2013) than in the U.S. where women exceed men by 0.01 years. But, are there gender disparities among workers with similar educational levels? We attempt to answer this and related questions in the next sections.

2. Data

We use the PRCS because it provides socioeconomic data and, thus, important covariates that can shed light on our intriguing case study. We use mean earnings per hour (i.e., the sum of salaries plus pay received by self-employed persons divided by worked hours) as our dependent variable. A wage of $4.83 per hour (two-thirds of the statutory minimum wage) is established as a lower bound. Logarithms are applied to hourly earnings to reduce the relatively large dispersion. The covariates, in

Table 2, come from the same source. Experience is calculated following the convention of age minus schooling years minus five. The sample is limited to individuals 24 to 65 years old.

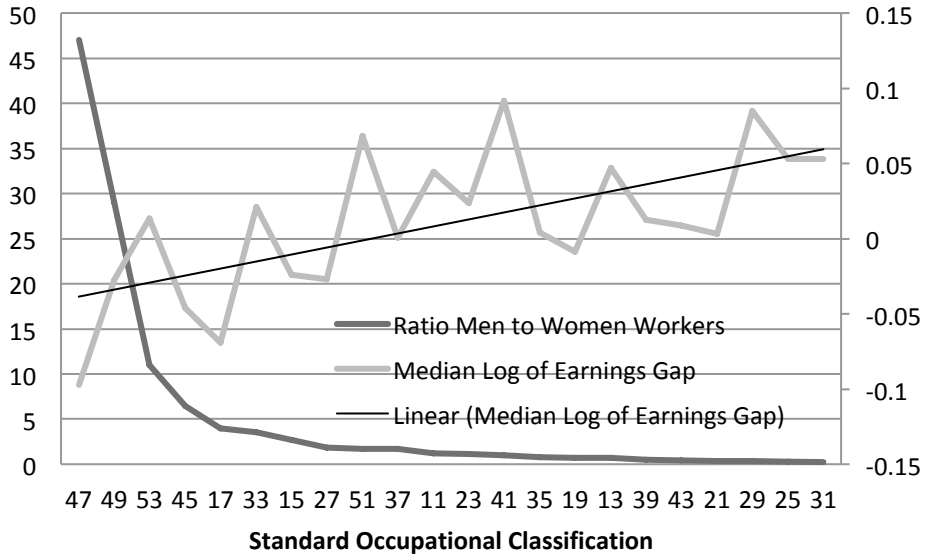
Table 2. Descriptive statistics, average of 2010-14

Variables	Mean	Standard Deviation	Mean (Males)	Mean (Females)	Number of Observations
Log hourly earnings	2.51	0.61	2.53	2.50	43,078
Sex	0.48	0.50			43,078
Age	41.8	10.6	41.79	41.78	43,078
Experience	21.8	11.2	22.41	21.08	43,078
Number of Children	0.89	1.04	0.81	0.99	43,078
Marital Status	0.45	0.50	0.49	0.41	43,078
Self-employment	0.11	0.31	0.15	0.06	43,078
Public Employment	0.25	0.44	0.21	0.30	43,078
Proportion of Men in Occupation	0.53	0.27	0.67	0.37	43,009
Years of Schooling	15.01	3.06	14.39	15.69	43,078
Kaitz Ratio	0.67	0.20	0.68	0.65	43,009

Notes: Includes only working population age 24 to 65 with hourly earnings at least 2/3 of minimum wage. Sample was weighed.
Source: PRCS (2016)

Table 2 presents mean values for men and women age 24 to 65 with hourly earnings at least 2/3 of the minimum wage. On average, women have more years of schooling, are less likely to be married, have more children, and are more likely to be public employees. Men, on the other hand, have more work experience and are more likely to be self-employed. Having more children to take care of is a disparity that can potentially limit women's measured productivity. Assuming that mothers are exogenously assigned a greater role in child rearing (e.g. by social norms), the unexplained gap traditionally found between men and women earnings can be aggravated by the larger number of children. This hypothetical effect will be tested with our empirical models below.

Figure 4. Log of Median Earnings Gender Gap vs. Representativeness, average of 2010–2014



Notes: The median log of earnings in the right axis was obtained as the ratio between the gap and men's median earnings. All civilian SOC groups are included.
Source: PRCS (2016)

Among our sample and for the whole population, mean log of hourly earnings are higher for males (2.53) than for females (2.50), while the median is slightly higher among women (2.402) than among men (2.390).[5] Still, the negative gender gap for median hourly earnings is not uniform across all groups. Among public and private employees, the gap is positive, while negative for self-employed workers. When the sample is divided by industrial classification, only 7 out of 19 groups evidence a negative median earnings gender gap. The leading negative gaps correspond to: Mining, Quarrying, and Oil and Gas Extraction (-50.4%), Construction (-8.8%), and Agriculture, Forestry, Fishing and Hunting (-7.6%). Likewise, 7 out 23 occupational categories present negative earnings gaps, among them: Construction and Extraction Occupations (-9.7%), Architecture and Engineering Occupations (-6.9%), Farming, Fishing and Forestry (-4.6%), and Installation, Maintenance and Repair (-2.7%). These industrial and occupational groups have traditionally been considered predominantly male. On the contrary, in occupations where women have a higher representation/participation, the median

[5] Using the standard mean comparison t-test and a non-parametric k-sample test on the equality of median, both differences were found statistically significant.

income gap is lower, as shown in Figure 4. We called this phenomenon the "premium for underrepresentation". Thus, we include the share of men in a given occupation as one potential determinant for disparities. This point will be revisited in the discussion section.

3. Empirical Models

In order to test for sensitivity to specification, several econometric methods are used. Firstly, to uncover the pay gap conditioned on certain observables, if any, we applied a nonparametric method known as propensity score-matching (PSM) that, according to Ñopo (2008), exceeds models that rely on linear equations. Secondly, an Oaxaca-Blinder decomposition is presented to evaluate the role that each observable factor plays with respect to the gender pay gap and to distinguish the effect of differences in endowments versus the unexplained gap. Thirdly, a semi parametric technique is implemented to examine gender differentials across the distribution. This technique complements the Oaxaca-Blinder results, because it allows for a similar decomposition of explained and unexplained gaps at different quantiles of the wage distribution and not only around the mean, as in the case of the Oaxaca-Blinder method. The combination of results pointing in the same direction can provide the basis for relatively robust conclusions.

PSM is an estimation technique in which a set of characteristics is created, assuming that they are exogenous to the model or not affected by the treatment analysis to be carried out. In this approach two units of study, treated and untreated individuals, are compared by assigning similar characteristics to each individual so that they only differ in the main characteristic, which is sex in our study (Imbens, 2004; Moffitt, 2004). In particular, the propensity score p(x) can be defined as,

$$p(x) \equiv \Pr\{D = 1 | X = x\} \forall x \in \tilde{X}, where\ Y_0 \perp D | p(X) \quad (2)$$

where D is the indicator of the treatment (sex) received by unit i, X is the set of pre-treatment characteristics (all relevant differences between genders), and $\tilde{X}$ is the non-treated pool. We take advantage of our socioeconomic dataset to include in X the following variables: age (to approximate

experience), age squared (to approximate decreasing returns of earnings to longevity), race (to control for other types of disparities), schooling (to account for human capital differences), number of children (to control for the potential role of parenting division on the pay gap, as explained below), proportion of men in a given occupation (to control for the premium for underrepresentation), the ratio of minimum wage to median wage in a given occupation or the Kaitz ratio (since the role of the minimum wage has been found to be a factor of influence (Hallward-Driemeier, Rijkers & Waxman, 2015), and dummies for self-employment (pay gaps are different between salaried workers and self-employed), government worker (pay gaps are found to be lower in government), marital status, veteran status, and five different physical impairments (these last three could be another source of disparity).

The matching algorithm is defined to compute the missing potential outcomes for similar but untreated individuals for each sex group. Thus, PSM is the conditional probability of treatment given a vector of covariates. In this case, the mean treatment effects average the difference between observed and potential outcomes of each person and match each subject with at least one other subject (nearest neighbor). Average treatment effects on the treated are also used, as specified in Table 3, and both logit and probit are employed as treatment models to find consistent results.

We implement an Oaxaca–Blinder decomposition that allows the division of the male–female wage gap into the part explained by differences in characteristics and the unexplained portion (Blinder, 1973; Oaxaca, 1973). This decomposition takes the coefficients of a pooled model as a baseline. A three-way partition further allows us to divide the unexplained gap into the effect due to relative differences in returns to characteristics (coefficient effects) and the interaction factor. The unexplained gap is usually attributed to discrimination, but it may also reflect differences in unobserved variables.

During the last two decades, wage differential studies have increasingly focused on differences across the whole spectrum of the wage distribution and not only around the mean. Methods to extend the wage gap decomposition using quantile regressions relying on counterfactual decompositions have

been developed by Machado and Mata (2005) and Melly (2005a). Both methods are based on the estimation of the conditional distribution of wages using quantile regressions. From the conditional distribution of wages, Machado and Mata obtained the marginal density through a process of random sampling. The marginal distribution is then used to estimate counterfactual distributions to assess the contribution of changes in characteristics and returns to the wage gap. Melly followed a similar procedure, integrating the conditional distribution over the range of covariates to obtain an unconditional distribution and then decomposing the changes in the unconditional distribution into those due to changes in characteristics, those due to changes in covariates, and a residual. As stated by Arulampalam, Booth and Bryan (2006), an increasing gap throughout the wage distribution has been interpreted as the result of a glass ceiling, especially if it accelerates at the top of the distribution. They also defined a wider wage gap at the bottom of the distribution as a sticky floor. We used these methods to evaluate the presence of sticky floors or glass ceilings in the case of Puerto Rico.

4. Discussion

We observed in section 1.2 that the negative gender gap disappears once we take into consideration endowment factors such as years of schooling. What would happen to the negative gender gap if we control for even more variables such as experience and marital status? Once again, the pay gap goes from negative to positive, as shown in Table 3.

In the first model, shown in Table 3, we applied the average treatment effect on the treated using logit as the treatment model and controlling for other sources of disparities, such as race, age, age squared, number of children, Kaitz ratio, proportion of men in a given occupation, marital status, self-employment, and government employment. We found a statistically significant result showing that, on average, being a woman lowers one's average logarithmic earnings by -0.17 (the logarithmic mean earnings were 2.51). Searching for robust results, we then applied logit using the average treatment effect and found that the positive pay gap still holds, though with a lower magnitude. Testing

sensitivity even further we used probit as the treatment model and enhanced the number of covariates to include five different physical impairments and veteran status. The outcome was still qualitatively similar but with a lower magnitude: on average women earn -0.06 less (in logarithmic terms) than men. That is, regardless of the choice of treatment models or covariates, we obtained consistent results pointing out statistically significant earnings disparities in favor of men once the observable characteristics were taken into consideration.

Table 3. PSM Results, average of 2010–2014

Dependent Variable:	**Model 1 (average treatment effect on the treated):** Logit	**Model 2 (average treatment effect):** Logit	**Model 3 (average treatment effect):** Probit
Logarithm of mean earnings per hour	**Covariates**: race, age, squared age, number of children, Kaitz ratio, proportion of men in a given occupation, dummies for marital status, self-employment, and government worker.	**Covariates:** race, age, squared age, number of children, Kaitz ratio, proportion of men in a given occupation, dummies for marital status, self-employment, and government worker.	**Covariates:** race, age, squared age, number of children, Kaitz ratio, proportion of men in a given occupation, years of schooling, dummies for marital status, self-employment, government worker, five different physical impairments, and veteran status.
Female vs. male	-0.17*** (.001)	-0.09*** (.0009)	-0.06*** (.0009)
n	976,927	976,927	976,927

Notes: Robust standard errors are shown in parentheses. Sample shown is after weighing.
Source: Authors' estimates based on PRCS (2016)

Are these results invariant to changes in the empirical model? Yes. Table 4 illustrates the outcomes from the Blinder-Oaxaca decompositions with the log of hourly earnings as the dependent variable. After controlling for a similar list of covariates, the predicted log of hourly earnings for men (2.53) is 1.2% higher than the average for females (2.50).[6]

Table 4. Blinder-Oaxaca Decomposition, average of 2010-14

6 The analysis includes five dummy variables corresponding to highest educational degree obtained which includes: high school diploma, post-secondary education without a bachelor's degree, Bachelor's degree (BA), master's degree (MA) and professional degree or doctorate.

Dependent Variable: Logarithm of hourly earnings	Oaxaca Decomposition All Observations (n=43,063)		Oaxaca Decomposition Workers with children (n=22,211)		Oaxaca Decomposition Workers without children (n=20,852)	
	Coef.	P-value	Coef.	P-value	Coef.	P-value
Predicted value males	2.527	0.000	2.607	0.000	2.463	0.000
Predicted value females	2.496	0.000	2.494	0.000	2.498	0.000
Difference	0.032	0.000	0.113	0.000	-0.034	0.000
Explained						
Total	**-0.059**	**0.000**	-0.009	0.292	**-0.096**	**0.000**
Unexplained						
High School diploma	0.007	0.103	**0.020**	**0.001**	-0.003	0.590
Post-secondary w/o BA	**0.025**	**0.000**	**0.050**	**0.000**	0.004	0.650
BA	**0.031**	**0.000**	**0.063**	**0.000**	0.002	0.836
MA	**0.012**	**0.000**	**0.020**	**0.000**	0.004	0.338
Ph.D. or professional degree	0.004	0.065	**0.009**	**0.001**	-0.001	0.771
Age	**0.357**	**0.043**	**0.881**	**0.001**	-0.001	0.691
Age squared	-0.177	0.052	**-0.440**	**0.002**	0.048	0.690
Number of children	**0.020**	**0.000**	**0.039**	**0.018**		
Married	0.005	0.348	0.002	0.859	0.005	0.221
Self-employed	**-0.006**	**0.015**	**-0.007**	**0.040**	-0.006	0.077
Public employee	**-0.029**	**0.000**	**-0.029**	**0.000**	**-0.031**	**0.000**
% of men in SOC	**-0.045**	**0.051**	-0.036	0.272	-0.033	0.315
Kaitz Ratio	**-0.097**	**0.042**	**-0.113**	**0.074**	-0.100	0.175
Constant	0.029	0.800	-0.264	0.122	**0.265**	**0.100**
Total	**0.091**	**0.000**	**0.122**	**0.000**	**0.062**	**0.000**

Note: * All estimations include industry and occupation dummy variables. Coef. stands for coefficients.
Source: Authors' estimates based on PRCS (2016)

Nevertheless, when the gap is decomposed, the estimated explained gap is -0.06, meaning that when the observed characteristics of the two groups are taken into consideration, in the absence of disparities, the average predicted value for males should be 2.4% lower instead of 1.2% higher.[7] The

[7] The explained gap measures the difference that should be expected in the dependent variable between the two groups given their characteristics. Since the reference group is male, a negative explained gap implies that given the characteristics of the two groups, men should have a lower wage. The unexplained gap is the difference between the total predicted gap and the explained part. A positive gap implies that men are receiving a wage higher than expected given their characteristics, in part due to relative differences in returns to characteristics measured by the coefficients.

resultant unexplained gap corresponds to 3.6% of the average female log of hourly earnings. This unexplained gap is partly due to a greater gender gap among individuals with similar education, especially for workers with post-secondary, bachelor's and master's degrees, which coincidentally are the educational groups in which women outnumber men in our sample. Because women have had higher educational returns than men (in the Mincerian sense) from decades ago (Cao and Matos, 1988),[8] it is economically rational for women to study more than men on average, so they can catch up with men's earnings in the labor market. In fact, post-secondary education plays a larger role in reducing women's poverty propensity than men's (Segarra-Alméstica, 2018).

Women have relatively lower return on experience (proxied by age) than men, exacerbating gender disparities. Being a private employee also contributes to a larger wage gap. This outcome was also observed in high-income countries such as Germany (Melly, 2005b). However, as the distance between minimum wage and median wage decreases in a given industry, the gender pay gap decreases. Thus, the minimum wage appears to dampen gender disparities. It is important to point out that the minimum wage is closer to the median wage in Puerto Rico (with a Kaitz ratio of 74% in 2015) than in the U.S. (43% in 2015).

Contrary to ordinary expectations, higher percentages of female workers in a given occupation are conducive to a bigger gap. These results corroborate the inverse relationship observed in Figure 4 between the male share and the median earnings gap in a given occupation. This finding, together with greater gender gaps within education groups in which women dominate, is consistent with the idea of a premium pay for men when they are scarce (which we call "premium for underrepresentation"). It would appear that the market sets the relative wage of labor by the size of its supply more than by endowment considerations.

[8] Results from Mincer's equation in our data set also pointed out similar findings.

The Oaxaca analysis was repeated after dividing the sample into workers with and without children. The explained gap was statistically significant and relatively high for workers without children but not for those with children, signaling the relatively strong difference made by the presence of dependents. For workers with children, the predicted log of wage is 4.3% higher for men, while among workers without children it is 1.4% lower, when compared to women. Nevertheless, the analysis indicates that among workers with children, based on their characteristics, men and women should have similar hourly earnings. In the case of workers without children, men's log of hourly earnings should be 3.8% lower than women. The relative differences in returns on education increase for workers with children, while for workers with no children, relative differences in returns on personal characteristics do not appear to contribute to the unexplained gap. Even though employment characteristics do appear to play a role, in the case of workers without children, most of the unexplained gap is picked up by the constant coefficient.

Table 5. Summary Blinder-Oaxaca Decomposition, 2000 and 2009-2013

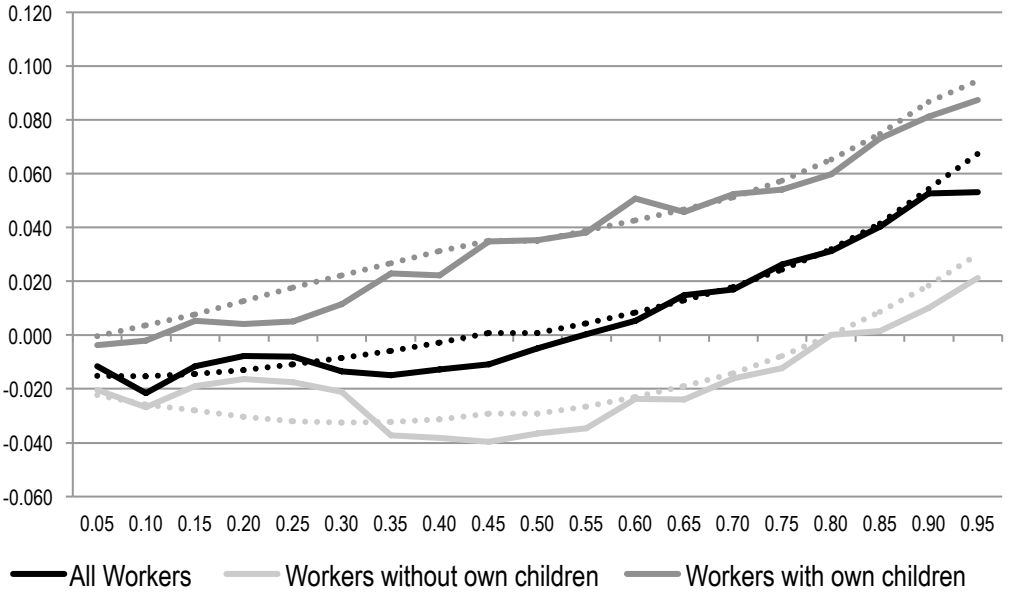
	2000	**2009**	**2010**	**2011**	**2012**	**2013**
Predicted value males	2.304	2.480	2.517	2.533	2.542	2.551
Predicted value females	2.205	2.420	2.458	2.479	2.494	2.511
Difference	0.099	0.060	0.059	0.053	0.048	0.040
Explained	-0.022	-0.048	-0.043	-0.046	-0.051	-0.048
Unexplained	0.121	0.108	0.102	0.099	0.099	0.088

Note: The dependent variable is the log of hourly earnings. Includes all observations age 24-65 with estimated hourly earnings at least two-thirds of the minimum wage.
Source: Authors' estimates based on 2000 Census data and PRCS 5 years samples 2009-2013

In order to analyze the contribution of explained and unexplained factors to the reduction in the gender wage gap over time, the Oaxaca decomposition was replicated with the 2000 census data and the PRCS for years 2009-2013. A summary of the results is presented in Table 5. Even though a slight but continuous reduction in the unexplained gap has contributed to a decrease in the overall gap, the

main factor triggering the reduction in the gender pay gap was the improvement in women's relative endowment, evidenced between 2000 and 2009 as a major decrease in the explained gap.[9]

Figure 5. Relative Earnings Raw Gap and Relative Predicted Gap by Quantile, average 2010-14

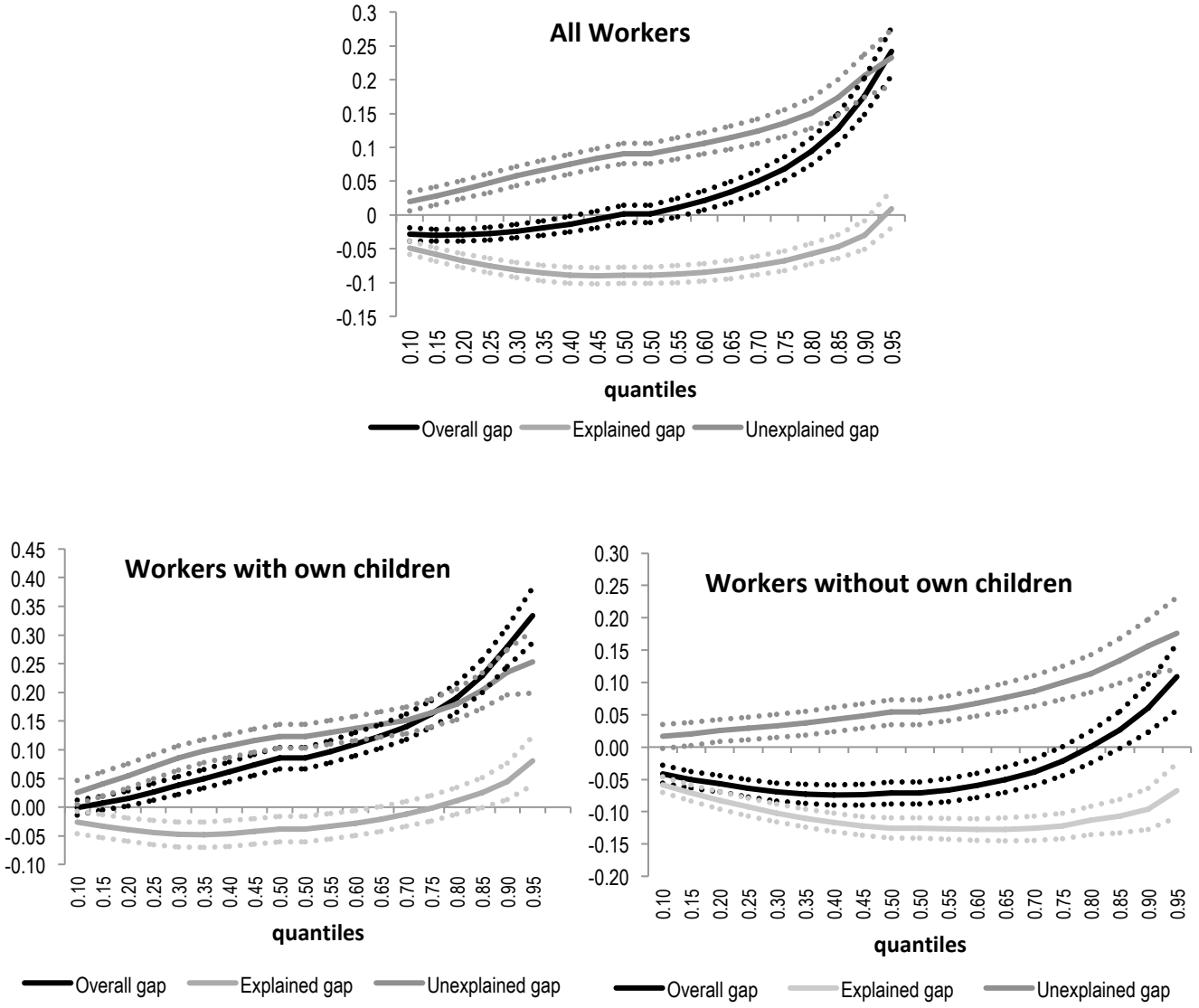


Note: In the vertical axis we illustrated the estimated ratio of men to female log of hourly earnings. Relative predicted gaps obtained using the Melly (2005a) method are presented by dotted lines.
Source: Authors' estimates based on PRCS (2016)

Figure 5 presents the relative raw gaps estimated as the difference between the percentiles of the log of hourly earnings of males and females, divided by the percentile for entire sample.[10] The gap between workers with children and workers without children suggests that having children exacerbates the pay gap. Among all workers we find that, in the bottom half of the distribution, female hourly earnings are higher than for men. For workers without children, this is true for most of the distribution. On the other hand, for workers with children, male hourly earnings surpass women's for almost the entire distribution. The raw relative gaps present a slight decrease around the twenty-fifth to the thirty-fifth percentile of the distribution, hinting at a slight sticky wage effect, but for the most part they show an increasing tendency in accordance with the glass ceiling hypothesis.

[9] Detailed results can be provided by the authors upon request.
[10] A negative value indicates higher hourly wages for females, while a positive value reflects higher wages for males.

Figure 6. Predicted overall gap decomposed by explained and unexplained gap, average of 2010-14



Note: In the vertical axis we illustrated the estimated ratio of men to female log of hourly earnings and the confidence intervals are represented by dotted lines.
Source: Authors' estimates based on PRCS (2016)

To explore whether or not the increasing gap is associated with differences in endowments, hourly earnings decompositions by quantiles were estimated using the male distributions as the baseline. Figure 6 presents the decomposition of the gap into the explained gap (due to differences in endowments) and the unexplained gap (due to differences in the coefficients), using Melly's method

(2005a).[11] The sample is divided according to the presence of children in the household. Dotted lines represent the confidence intervals.

For all workers, the gender gap becomes positive around the middle of the distribution, coincidentally around the quantile where the explained gap (the characteristics' effects) is most negative but shows a rapid and continuous increase from there on. The relative difference in returns on endowments, measured by unexplained effects, is positive and increasing through the entire distribution. For workers with children, a fraction of the increase in the gap at the top of the distribution is attributable to the fact that around the 75th percentile men's characteristics become more favorable than women's. This comes as a result of men having more experience throughout the distribution and catching up with women's education at the top of the distribution. Nevertheless, the unexplained gap is positive and increasing throughout the distribution, and responsible for most of the overall gap.

For workers without children, women's educational levels are more favorable than men along the entire distribution and differences in work experiences between genders are lower than for workers with children. Women without children have a more pronounced endowment advantage relative to men than those with children. Also, the average experience for females with children is higher than for males. The relative advantage in female endowments becomes more prominent in the middle of the distribution, and it dwindles at the high end of the distribution. However, that change in women's relative endowment is mostly related to men's relative experience. In 2014 the top 10% of women had 0.29 more years of schooling than women at the 80th percentile but 0.07 fewer years of experience. Meanwhile, the top 10% of men had 0.59 more years of schooling than men at the 80th percentile and 2.41 more years of experience.

[11] Similar results were obtained using the Machado Mata (2005) method.

A positive and increasing unexplained gap causes the overall gap to become positive in the upper part of the distribution, consistent with a glass ceiling effect. This glass ceiling effect is evident when looking at absolute and relative gaps and prevails even when a pooled model is used as the baseline instead of the male distribution.[12] In other words, the decomposition analysis shown in Figure 6 would lead to the conclusion that, when we look at the predicted gap instead of the raw gap, the glass ceiling effect is accentuated mostly due to the coefficient effects, signaling that significant disparities may still lurk beneath the improvement in women's earnings.

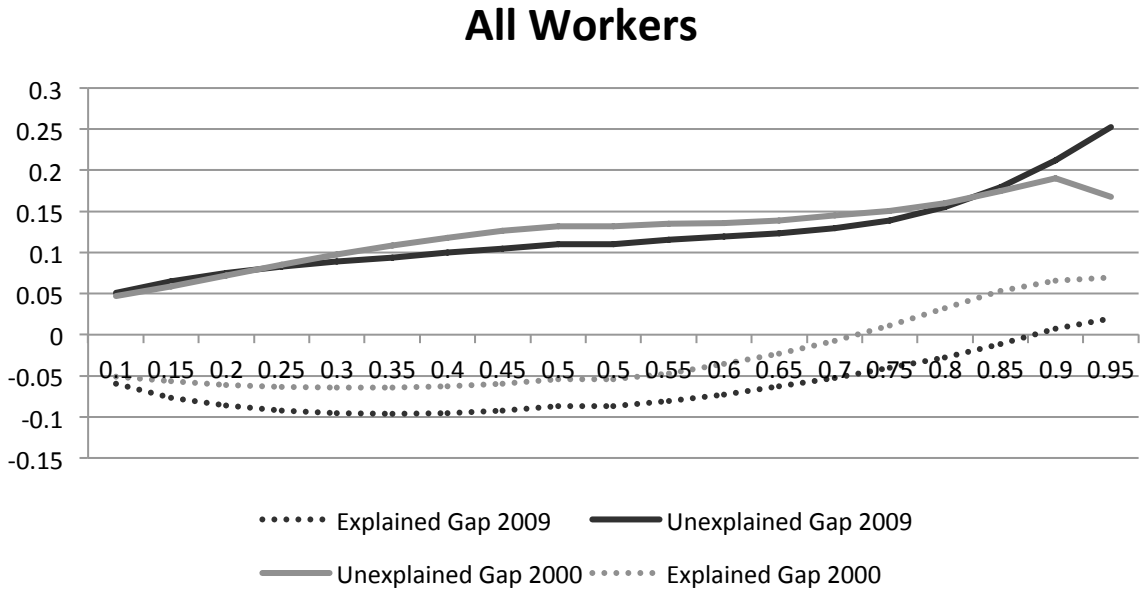
The top 20% of women were concentrated in occupations 25 (Education, Training, and Library), 29 (Health Care Practitioners, and Technical), and 43 (Office and Administrative Support), while the top 20% of men dominated in 11 (Management) and 41 (Sales and Related). The top 20% of men earned more than the top 20% of women in all occupations except for occupation 19 (Life, Physical, and Social Science), 31 (Healthcare Support), and 47 (Construction and Extraction). The largest earning differences were observed in occupation 29: these exclusive men earned on average 18% more than their female counterparts. This is consistent with the "premium for underrepresentation" because men represented 36% of the Health Care Practitioners and Technical workforce. In addition, there is an intersection between glass ceiling, occupations, and dependent children. When crossing occupations with dependent children among the top 20% of workers, we observed that men with children earned on average more than men without children in all but two occupations. Meanwhile, women with children earned less than women without children in 16 out of 23 occupations.

To inquire whether or not the glass ceiling effect observed in 2014 is a persistent phenomenon, the Melly method was used to decompose the wage gap for a similar sample taken from the 2000 Census and from the PRCS 2009 five-year sample. Figure 7 presents our results on the predicted explained and unexplained gap estimates. In 2000, the unexplained gap increases faster at the beginning of the

[12] Additional results can be provided by the authors upon request.

distribution, more subtlety around the middle and then decreases after the 90th percentile. The 2000 data also shows a reduction in market disparities at the end of the distribution, but a glass ceiling effect appeared in 2009 and continued to 2014, as shown in Figure 6 and 7.

Figure 7. Predicted explained and unexplained gap, 2000 and 2009-2013



Note: In the vertical axis we illustrated the estimated ratio of men to female log of hourly earnings and the explained gaps are represented by dotted lines.
Source: Authors' estimates based on 2000 Census data and PRCS 5 years samples 2009-2013

While in 2000, the explained gap becomes positive around the 70th percentile, in 2009, as well as in 2014, the explained gap remains negative for almost the entire distribution. This indicates that female relative endowment improved, especially at the top of the distribution, which is consistent with the Oaxaca decomposition results presented in Table 5. Thus, a glass ceiling effect emerged in 2009 even when women improved their endowments at the top of the distribution.

4. Conclusions

Puerto Rico leads all countries in the OEDC database in terms of the unconditional gender earnings gap: since 2009, female median earnings in Puerto Rico surpassed male median earnings. An increasing relative work effort, as well as higher educational attainments by women vis-à-vis men, explain to a large extent the recent historical evolution for that gender gap. However, we found that such a negative unconditional gap in median earnings turns positive once endowment factors are taken into consideration.

Three main results explain why the unconditional earnings gap turns positive when it is conditioned to characteristics. Firstly, decomposition of the earnings gap by quantiles found a positive and increasing unexplained gap, evidencing a glass ceiling effect affecting women, that is exacerbated for female workers with children. Secondly, the presence of children in the household is another aspect that influences such gender disparities. The fact that the disparities effect in the propensity score matching decrease, the unexplained gap is reduced, and the glass ceiling effect lessens when the sample is restricted to workers with no children, indicates that part of the undervaluing of women's work comes from the perception that having children hinders their work performance. This finding adds to a growing body of research such as Angelov, Johansson and Lindahl (2016) and O'Neill (2003) that consider the impact that traditional parenthood has on gender disparities in the labor market. Nevertheless, there is still evidence of unequal treatment of women even in the absence of children.

Thirdly, our results indicate that men received a premium when they entered occupations or belonged to education groups dominated by women, hinting to the presence of a "glass escalator", where men are promoted more easily in occupations where they are underrepresented. The opposite is also true, representing a relatively novel result that appears to contradict the conventional wisdom: lower female representation is associated with lower gender earnings gap. Within occupations, premiums in favor of the underrepresented gender may also be the result of a self-selection process.

Individuals that choose occupations dominated by the opposite sex may possess unobserved characteristics that prompt few of them to be genuinely interested on those occupations and make them more productive. However, this type of argument will not explain the underrepresentation premiums within education groups. It would appear that in the labor market, relative supply considerations outweigh characteristics or endowments that would yield higher labor productivity and potentially higher profits.

Given that, in our case study, labor market disparities respond to differences in market valuation of endowment characteristics by gender and the presence of children, the unequal treatment of women could be addressed with the following recommendations. Policies that ease the burden of raising children for working parents and promote the sharing of parental responsibilities between men and women, such as the provision of adequate child care, promotion of flexible work schedules and warranted maternal and paternal leave on a similar level, can be a starting point. Gender-sensitive education can also improve women's economic opportunities. Given the presence of a glass ceiling, we suggest that more transparent hiring and promotion practices are necessary. It should be kept in mind that it may also be a means to other ends: increasing women's salaries may also lead to lower poverty rates and a stronger tax base.

Future research can evaluate factors that affect the relatively large educational gender gap observed in Puerto Rico and in other countries such as South Korea. Despite the fact that the economic factor seems to be a mayor driving force behind that gap, social and cultural factors should not be ignored. Smith and Niemi (2017) found that while girls see educational, relationship and social goals as complementary, boys tend to view these goals as at odds with each other. Also, the increase in migration flows between Puerto Rico and the US, as a result of the economic crisis, may alter the

incentive to invest in education or the timing of education. However, such analyses exceed the scope of this paper.

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Appendix 1

Table A1. Disparities in income and schooling, 2013

Country	Women median Earnings to Men Median Earnings	Female Average Years of Schooling	Male Average Years of Schooling
Austria	0.82	12.5	13.1
Australia	0.819468	8.9	10.6
Belgium	0.940871	10.5	10.7
Canada	0.806968	12.3	12.2
Chile	0.893333	9.6	9.9
Colombia	0.928571	7	7.1
Czech Republic	0.846212	12.1	12.5
Germany	0.859341	12.6	13.3
Denmark	0.932311	11.9	12.3
Finland	0.798216	10.3	10.2
U.K.	0.82518	12.8	11.8
Greece	0.887263	9.9	10.4
Hungary	0.912763	11.2	11.4
Ireland	0.872302	11.7	11.5
Iceland	0.854725	10.8	10
Israel	0.817805	12.6	12.5
Japan	0.734124	11.2	11.8
South Korea	0.634004	11.1	12.5
Mexico	0.845666	8.1	8.8
Norway	0.929919	12.7	12.6
New Zealand	0.934057	12.5	12.6
Portugal	0.833333	8	8.5
Puerto Rico	1.036173	11.9	11.2
Slovakia	0.858907	11.6	11.5
Sweden	0.865795	11.8	11.4
USA	0.82093	13	12.9

Source: Authors' estimates based on OECD (2018), UNDP (2015), PRCS (2016)