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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 in women's economic position and find that the unconditional earnings gap turns positive once observable characteristics are considered. For instance, we find that the negative gender gap disappears when we adjust 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.

JEL Codes: J16, J31, J08

Keywords: Gender pay gap, underrepresented, maternal wall, return to education, discrimination

Gender wage gaps have declined in many countries in recent decades, but the unexplained component attributed to this gap has not decreased.[1] In 2009, Puerto Rico became the first country (when compared to international databases) in which women's median earnings are 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 we seek to address in this article.

Arulampalam, Booth, and Bryan find that in many European countries, the overall gender earnings gap conceals significant differences in wage

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1. Weichselbaumer and Winter-Ebmer (2005).

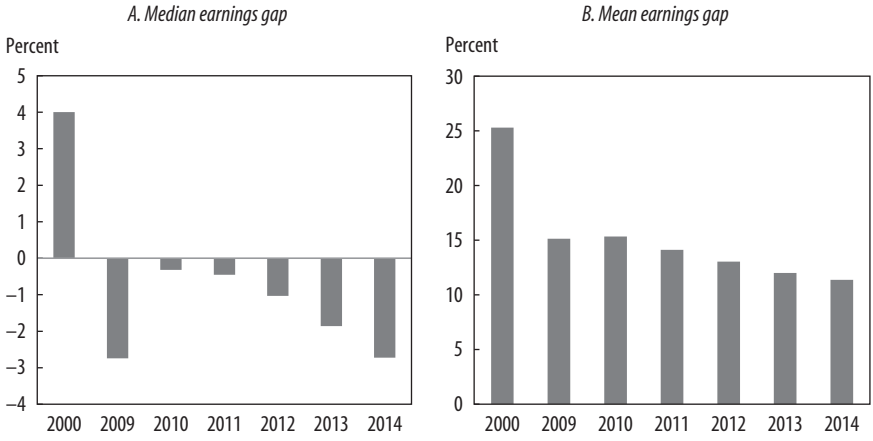
distribution.[2] To test the possibility of gender disparities in earnings in Puerto Rico, we apply three econometric methods to a representative sample of individuals: propensity score matching, Blinder-Oaxaca decomposition, and gap decomposition by quantiles à la Melly.[3] After controlling for a host of covariates such as education, marital status, experience, type of employment, and physical impairments, we find three distinctive results. First, there is a glass ceiling effect fueled by relative differences in returns on endowments for men and women. Second, this glass ceiling effect is largely moderated by the number of children living in each household. In other words, there is evidence of a so-called maternal wall, as coined in the related literature. This concurs with the results of Angelov, Johansson, and Lindahl, who find that the gender wage gap within a heterosexual marriage is larger when the marriage enters parenthood, and O'Neill, who states that family responsibilities affect the productivity and labor choices of women.[4]

Third, we also find that in certain occupations, a relatively large proportion of women *increases* the gender earnings gap. That is, the gap is larger than average because of a "premium for underrepresentation" in occupations in which men have lower representation than women and among those education groups in which men are underrepresented, as discussed below. This may be associated with the so-called glass escalator described in the related literature, whereby men are promoted more easily in occupations where they are underrepresented.[5] However, this finding may contradict the conventional wisdom that gender inequality should be lower with higher female representation. For instance, Cohen and Huffman state, "These studies imply that there is less gender inequality under conditions of greater female representation (and higher status) in management."[6]

The next section elucidates some factors that may have driven this negative gender pay gap in Puerto Rico. The article then proposes a new measurement of the gender earnings gap that improves cross-country comparisons. Subsequent sections describe the empirical models and data used and discuss the results. The final section presents conclusions and policy recommendations.

2. Arulampalam, Booth, and Bryan (2007).
3. Melly (2005a).
4. Angelov, Johansson, and Lindahl (2016); O'Neill (2003).
5. Williams (1992).
6. Cohen and Huffman (2007, p. 683).

FIGURE 1. Gender Gap Trends in Puerto Rico, 2000 and 2009–2014



Source: Puerto Rico 2000 Census, PRCS (2009–2014 PRCS five-year samples).

Evolution of the Gender Earnings Gap in Puerto Rico

Female median earnings in Puerto Rico exceeded male median earnings for the first time 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). This trend has continued since then. An exploration of the data available from the 2000 Census and the PRCS allows a closer look at this occurrence.[7]

Figure 1 shows median earnings and mean earnings gender gaps for 2000 and from 2009 to 2014, for the population aged sixteen years and older that reported positive earnings. The median earnings gender gap turned negative in 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, although it dwindled over time. The divergence of the

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

TABLE 1. Median Earnings Gender Gap within Education Levels, 2000 and 2014
Percent

	Within-group median earnings gender gap	
Education level	*2000*	*2014*
No high school diploma	17	14
High school diploma	17	12
Postsecondary without bachelor's	25	17
Bachelor's degree	25	22
Master's degree	24	18
Ph.D. or professional degree	36	24

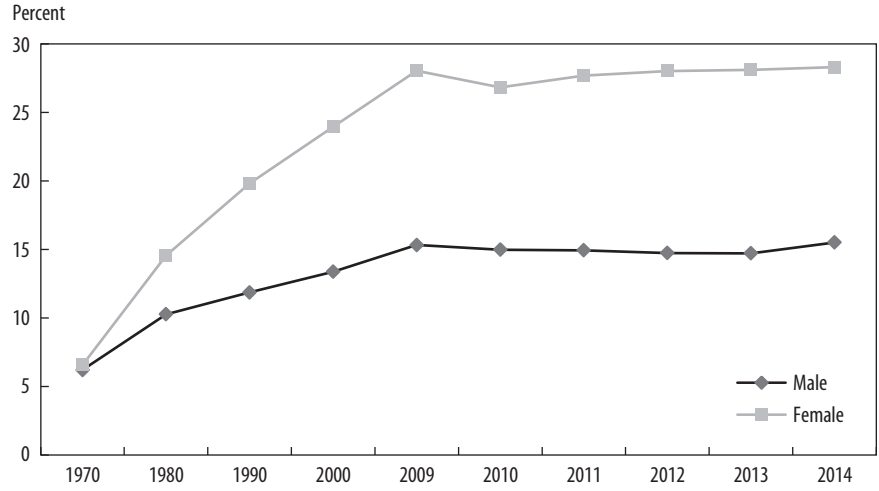
Source: Puerto Rico 2000 Census and 2009–2014 PRCS (five-year samples).
Note: Median earnings gaps are estimated as the ratio between the gap and men's median earnings, following the OECD. The sample is limited to individuals aged twenty-five years or more.

median and 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, we examine employment rates, hours worked, and education level.

For all the years studied, 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 percent higher than for women. By 2014, the difference had declined to 9 percent. Similarly, the divergence in mean estimated hours worked between men and women went from 10 percent in 2000 to 5 percent 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 signalhigher 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 twenty-five and older. That year, 46 percent of working men indicated having postsecondary education and only 22 percent had obtained a bachelor's degree or higher. The corresponding percentages for women were 65.5 and 37.0 percent, respectively. Through the following years the education gap in favor of women widened. By 2014, 45 percent of working women had a bachelor's degree or higher, while only 27 percent of men reported the same.

FIGURE 2. Share of Twenty-Two- to Twenty-Eight-Year-Olds with a Bachelor's Degree



Source: 1970, 1980, 1990, and 2000 Puerto Rico Censuses; 2009–2014 PRCS (five-year samples).

Nevertheless, this reflects changes in educational trends that date to much earlier. By 1970 (the first year for which educational attainment data are available for Puerto Rico), the rate of bachelor's degree completion was similar for men and women aged twenty-two to twenty-eight years, at 6.2 and 6.6 percent, respectively. In 1980, while the percentage of women twenty-two to twenty-eight with B.A.s increased to 15 percent, the corresponding figure for men increased to only 10 percent. By 1990, the percentage of women with bachelor's degrees surpassed the corresponding percentage for men among working-age adults in Puerto Rico. Currently, almost 30 percent of females aged twenty-two to twenty-eight years have completed a bachelor's degree, while only 18 percent of males have done so. As shown in figure 2, most of the increase in the college completion gap occurred between 1970 and 2009, after which bachelor's degree 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 education gender gap, but also the improvement in education levels overall.

That is, the rapid increase in female college completion rates during the pre-recession period and the stagnation thereafter indicate that gender differences in postsecondary education in Puerto Rico are likely related to the economic

transformation. Lee explains how the industrialization process eliminated the gender gap in school enrollment, which traditionally favored men in China.[8] In Puerto Rico between 1970 and 2014, the manufacturing employment share decreased from 19 to 9 percent, while the service sector share increased from 17 to 34 percent.[9] 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 required postsecondary 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 percent in 1970 to 27.5 percent in 2010. According to the Bureau of Labor Statistics, while women made up 44 percent of all workers in Puerto Rico in 2017, they accounted for 51 percent of government employees and 59 percent 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 explain the stagnation of the education gender gap.

At first glance, it seems that an increase in work effort and educational attainment may have improved women's labor force positioning. This is corroborated in the empirical model presented below. However, within education groups, median earnings gender gaps are positive and higher for those with postsecondary 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.

Gender Earnings Gaps: International Comparison

All the countries included in the data gathered by the Organization for Economic Cooperation 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 6 percent less than men, on average. Because Puerto Rico does not participate in the databases prepared by the OECD on the gender earnings gap, in table 2 we inserted data obtained from the PRCS

8. Lee (2014).

9. Numbers for 1970 were obtained from Dietz (1989); recent figures were estimated based on official data from the Puerto Rico Planning Board.

TABLE 2. Disparities in Income and Schooling, 2013

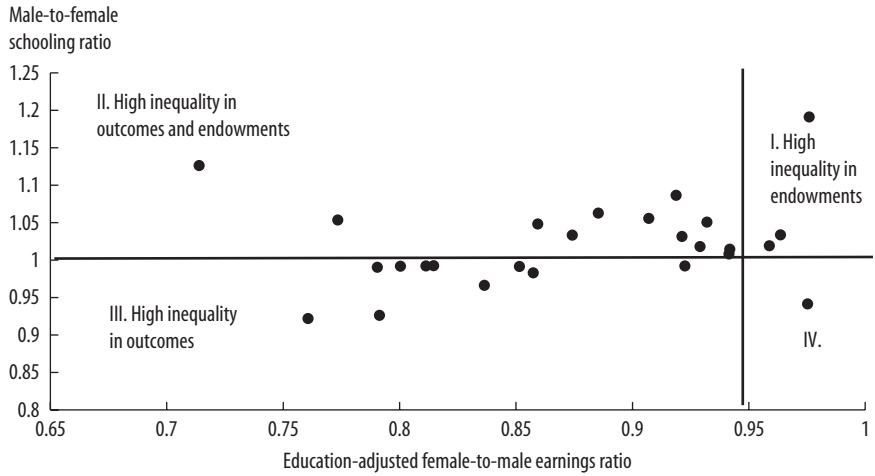
Country	*Women's median earnings to men's median earnings*	*Average years of schooling*	
		Female	*Male*
Austria	0.820000	12.5	13.1
Australia	0.819468	8.9	10.6
Belgium	0.940871	10.5	10.7
Canada	0.806968	12.3	12.2
Chile	0.893333	9.6	9.9
Colombia	0.928571	7.0	7.1
Czech Republic	0.846212	12.1	12.5
Germany	0.859341	12.6	13.3
Denmark	0.932311	11.9	12.3
Finland	0.798216	10.3	10.2
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	10.0
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	8.0	8.5
Puerto Rico	1.036173	11.9	11.2
Slovakia	0.858907	11.6	11.5
Sweden	0.865795	11.8	11.4
United Kingdom	0.825180	12.8	11.8
United States	0.820930	13.0	12.9

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

to compare gaps between countries.[10] 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, the figure was $22,171. However, this simple measure of the gender earnings gap can be misleading because it does not consider differences in endowments (such as skills, education, and experience) 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.

10. This value come from the 2013 PRCS one-year sample census tabulations.

FIGURE 3. Gender Differences in Schooling versus Education-Adjusted Earnings Gap by Country, 2013



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

To facilitate the cross-country comparison of the gender earnings gap, we propose a simple method using the data on education that are generally available in supranational entities. In particular, we divide the ratio of median earnings between genders by the ratio of mean years of schooling between genders:[11]

$$\text{EAG} = \frac{(E_F / E_M)}{(S_F / S_M)}, \tag{1}$$

where EAG is the education-adjusted earnings ratio, E is median earnings, S is years of schooling, and M stands for male and F for female. The international data on education come from the United Nations Development Programme (UNDP); the data on earnings are from the OECD and include 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

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

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 low 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's (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 percent in favor of women once education is considered: in our adjusted gap, women's median earnings are 3 percent lower than those of men. Although this conditional gender pay gap would not indicate the degree of disparity, it takes advantage of available information to improve the simple gender earnings gap published by supranational entities and allows better comparison.

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

Data and Models

We use the PRCS because it provides socioeconomic data and thus important covariates that can shed light on our intriguing case study. Our dependent variable is mean earnings per hour (that is, the sum of salaries plus pay received by self-employed persons divided by hours worked). 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 come from the same source. Experience is calculated following the convention of age minus schooling years minus five. The sample is limited to individuals twenty-four to sixty-five years old.

Table 3 presents mean values of the variables for men and women age twenty-four to sixty-five with hourly earnings at least two-thirds 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

TABLE 3. Descriptive Statistics, 2010–14 Average

Variable	*Mean*	*Standard deviation*	*Mean (males)*	*Mean (females)*	*No. 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

Source: PRCS (2016).

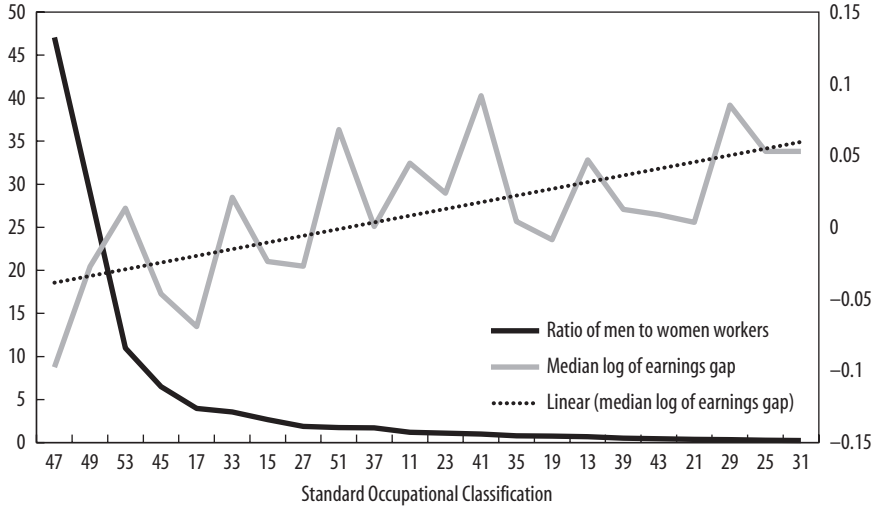
Note: Weighted sample of working population aged twenty-four to sixty-five years with hourly earnings of at least two-thirds of the minimum wage.

potentially limit women's measured productivity. Assuming that mothers are exogenously assigned a greater role in child rearing (for example, by social norms), the unexplained gap traditionally found between men's and women's earnings can be aggravated by a larger number of children. We test this hypothetical effect with our empirical models below.

Among our sample and for the whole population, the mean log of hourly earnings is 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).[12] Still, the negative gender gap for median hourly earnings is not uniform across all groups. The gap is positive among public and private employees, while it is negative for self-employed workers. When the sample is divided by industrial classification, only seven out of nineteen groups show a negative median earnings gender gap. The leading negative gaps correspond to mining, quarrying, and oil and gas extraction (–50.4 percent); construction (–8.8 percent); and agriculture, forestry, fishing, and hunting (–7.6 percent). Likewise, seven out of twenty-three occupational categories present negative earnings gaps, including construction and extraction (–9.7 percent); architecture and engineering (–6.9 percent); farming, fishing, and forestry (–4.6 percent); and installation, maintenance, and repair (–2.7 percent). These industrial and occupational groups have traditionally been considered predominantly male.

12. Using the standard mean comparison *t* test and a nonparametric *k*-sample test on the equality of median, both differences were found to be statistically significant.

FIGURE 4. Log of Median Earnings Gender Gap versus Occupational Share, 2010–14 Average



Source: PRCS (2016).

Note: The median log of earnings on the right axis was obtained as the ratio between the gap and men's median earnings. All civilian groups in the Standard Occupational Classification (SOC) system are included.

In contrast, in occupations where women have a higher representation or participation, the median income gap tends to favor men, as shown in figure 4. We call this phenomenon the premium for underrepresentation, and we include the share of men in a given occupation as one potential determinant of disparities. This point is revisited in the discussion section.

Empirical Models

We use several econometric methods to test for sensitivity to specification. First, to uncover the pay gap conditioned on certain observables, if any, we apply a nonparametric method known as propensity-score matching (PSM) that, according to Ñopo, exceeds models that rely on linear equations.[13] Second, a Blinder-Oaxaca 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. Third, a semiparametric technique is implemented to examine gender

13. Ñopo (2008).

differentials across the distribution. This technique complements the Blinder-Oaxaca 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 Blinder-Oaxaca method. A 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 differ only in the main characteristic, which is sex in our study.[14] In particular, the propensity score $p(x)$ can be defined as

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

where $Y_0 \perp D|p(X)$ and where D is the indicator of the treatment (sex) received by unit i, X is the set of pretreatment characteristics (all relevant differences between genders), and $\tilde{X}$ is the untreated pool. We take advantage of our socioeconomic data set 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), the number of children (to control for the potential role of parenting division on the pay gap, as explained below), the 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), and dummy variables 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).[15]

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

14. Imbens (2004); Moffitt (2004).
15. On the Kaitz ratio, see Hallward-Driemeier, Rijkers, and Waxman (2015).

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, and both logit and probit are employed as treatment models to find consistent results.

Next, we implement a Blinder-Oaxaca decomposition that allows the division of the male-female wage gap into the part explained by differences in characteristics and the unexplained portion.[16] 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.

Over 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 and by Melly.[17] 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 obtain the marginal density through a process of random sampling.[18] 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 follows 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.[19] Arulampalam, Booth, and Bryan interpret an increasing gap throughout the wage distribution as the result of a glass ceiling, especially if it accelerates at the top of the distribution, and a wider wage gap at the bottom of the distribution as a sticky floor.[20] We use these methods to evaluate the presence of sticky floors or glass ceilings in the case of Puerto Rico.

16. Blinder (1973); Oaxaca (1973).
17. Machado and Mata (2005); Melly (2005a).
18. Machado and Mata (2005).
19. Melly (2005a).
20. Arulampalam, Booth, and Bryan (2007).

TABLE 4. PSM Results, 2010–14 Average

Explanatory variable	*Model 1 Average treatment effect on the treated*	*Model 2 Average treatment effect*	*Model 3 Average treatment effect*
Female vs. male	–0.17***	–0.09***	–0.06***
	(0.0010)	(0.0009)	(0.0009)
Treatment model	Logit	Logit	Probit
No. observations	976,927	976,927	976,927

Source: Authors' estimates based on PRCS (2016).

Notes: The dependent variable is the logarithm of mean earnings per hour. In models 1 and 2, the covariates are race, age, age squared, number of children, Kaitz ratio, proportion of men in a given occupation, and dummy variables for marital status, self-employment, and government worker. In model 3, the same covariates are used, plus dummy variables or five different physical impairments and for veteran status. The sample shown is after weighting. Robust standard errors are in parentheses.

Discussion

We observed above that the negative gender gap disappears once we take into consideration endowment factors such as years of schooling. When we control for even more variables, such as experience and marital status, the pay gap again goes from negative to positive, as shown in table 4. In the first model shown in the table, 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. To test 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 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 model or covariates, we obtained consistent results pointing to statistically significant earnings disparities in favor of men once the observable characteristics were taken into consideration.

These results are invariant to changes in the empirical model. Table 5 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

TABLE 5. Blinder-Oaxaca Decomposition, 2010–14 Average

	All observations		*Workers with children*		*Workers without children*	
Variable	*Coefficient*	*P value*	*Coefficient*	*P value*	*Coefficient*	*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	**–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
Postsecondary without degree	**0.025**	**0.000**	**0.050**	**0.000**	0.004	0.650
Bachelor's degree	**0.031**	**0.000**	**0.063**	**0.000**	0.002	0.836
Master's degree	**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**
Share of men in occupation	**–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**
Unexplained total	**0.091**	**0.000**	**0.122**	**0.000**	**0.062**	**0.000**
No. observations	43,063		22,211		20,852	

Source: Authors' estimates based on PRCS (2016).
Notes: The dependent variable is the logarithm of hourly earnings. All estimations include industry and occupation dummy variables.

1.2 percent higher than the average for women (2.50).[21] 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 percent lower instead of 1.2 percent higher.[22] The resultant unexplained gap corresponds to 3.6 percent of the average female log of

21. The analysis includes five dummy variables corresponding to highest educational degree obtained: high school diploma, postsecondary education without a bachelor's degree, bachelor's degree, master's degree, and professional degree or doctorate.

22. 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 higher-than-expected wage given their characteristics, in part due to relative differences in returns to characteristics measured by the coefficients.

hourly earnings. This unexplained gap is partly due to a greater gender gap among individuals with similar education, especially for workers with some postsecondary education or a bachelor's or master's degree, which coincidentally are the education groups in which women outnumber men in our sample. Because women have had higher educational returns than men (in the Mincerian sense) in the past few decades, 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.[23] In fact, postsecondary education plays a larger role in reducing women's poverty propensity than men's.[24]

Women have a 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 is also observed in high-income countries such as Germany.[25] The gender pay gap decreases, however, as the distance between the minimum wage and the median wage decreases in a given industry. Thus the minimum wage appears to dampen gender disparities. Notably, the minimum wage is closer to the median wage in Puerto Rico (with a Kaitz ratio of 74 percent in 2015) than in the United States (43 percent in 2015).

Contrary to ordinary expectations, higher percentages of female workers in a given occupation are conducive to a larger 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 the 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.

We repeated the Blinder-Oaxaca analysis 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 percent higher for men than women, while among workers without children it is 1.4 percent lower. Nevertheless, the analysis indicates that among

23. Cao García and Matos Díaz (1988). Results from Mincer's equation in our data set point to similar findings.

24. Segarra-Alméstica (2018).

25. Melly (2005b).

TABLE 6. Summary Blinder-Oaxaca Decomposition, 2000 and 2009–2013

Statistic	*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

Source: Authors' estimates, based on 2000 Census data and 2009–2013 PRCS (five-year samples).

Notes: The dependent variable is the log of hourly earnings. Includes all observations of workers aged twenty-five to sixty-five years with estimated hourly earnings at least two-thirds of the minimum wage.

workers with children, men and women should have similar hourly earnings based on their characteristics. In the case of workers without children, men's log of hourly earnings should be 3.8 percent lower than women's. 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.

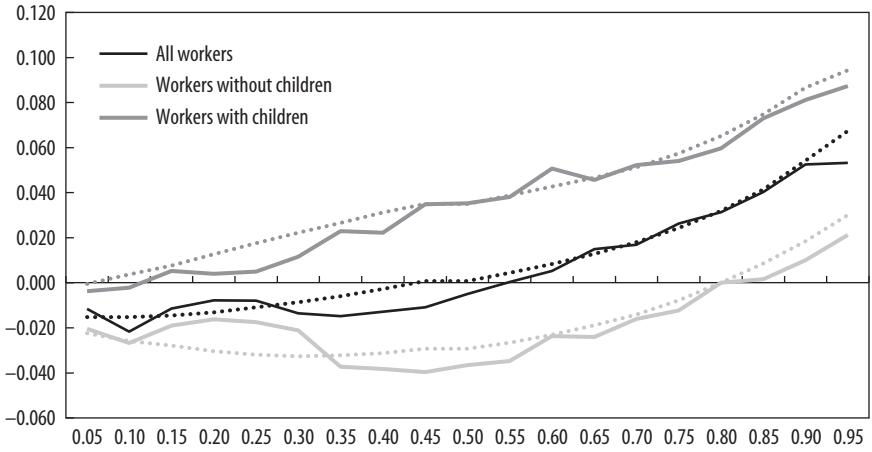
To analyze the contribution of explained and unexplained factors to the reduction in the gender wage gap over time, we repeated the Blinder-Oaxaca decomposition using the 2000 census data and the PRCS for 2009–13. A summary of the results is presented in table 6. There has been a slight but continuous reduction in the unexplained gap, which has contributed to a decrease in the overall gap. However, the main factor explaining 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.[26]

Figure 5 presents the relative raw gaps, estimated as the difference between the percentiles of the log of hourly earnings of men and women, divided by the percentile for the entire sample.[27] 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, hourly earnings are higher for women than for men. For workers without children, this is true for most of the distribution. In contrast, for workers with

26. Detailed results are available from the authors on request.

27. A negative value indicates higher hourly wages for females, while a positive value reflects higher wages for males.

FIGURE 5. Relative Earnings: Raw Gap and Predicted Gap by Quantile, 2010–14 Average



Source: Authors' estimates based on PRCS (2016).

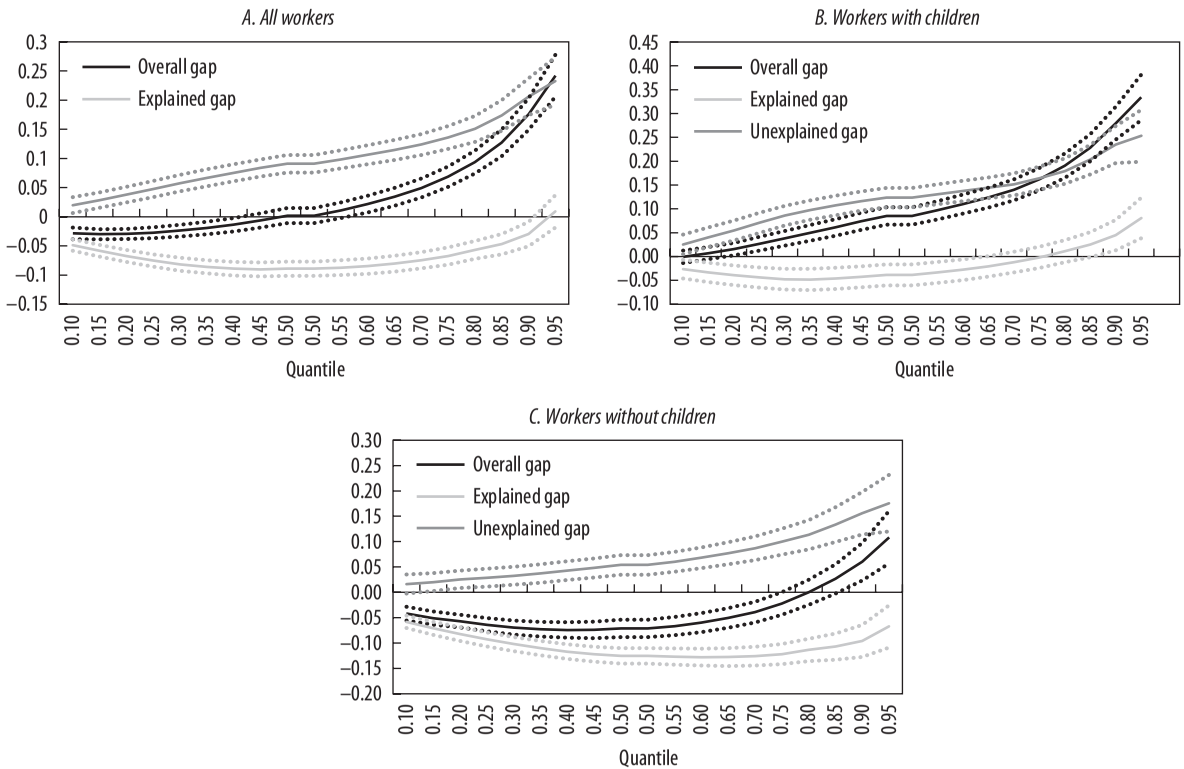
Note: On the vertical axis, we illustrate the estimated ratio of male-to-female log of hourly earnings. The dotted lines graph the relative predicted gaps obtained using the Melly (2005a) method.

children, men's 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.

To explore whether the increasing gap is associated with differences in endowments, we estimated hourly earnings decompositions by quantiles 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.[28] The sample is divided according to the presence of children in the household. 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, and it rises rapidly and continuously from there on. The relative difference in returns on endowments, measured by unexplained effects, is positive and increasing through the entire

28. Melly (2005a). Similar results were obtained using the Machado and Mata (2005) method.

FIGURE 6. Predicted Overall Gap Decomposed by Explained and Unexplained Gap, 2010–14 Average



Source: Authors' estimates, based on PRCS (2016).
Note: On the vertical axis, we illustrated the estimated ratio of men's to women's log of hourly earnings; the confidence intervals are marked by dotted lines.

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 seventy-fifth 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 it is responsible for most of the overall gap.

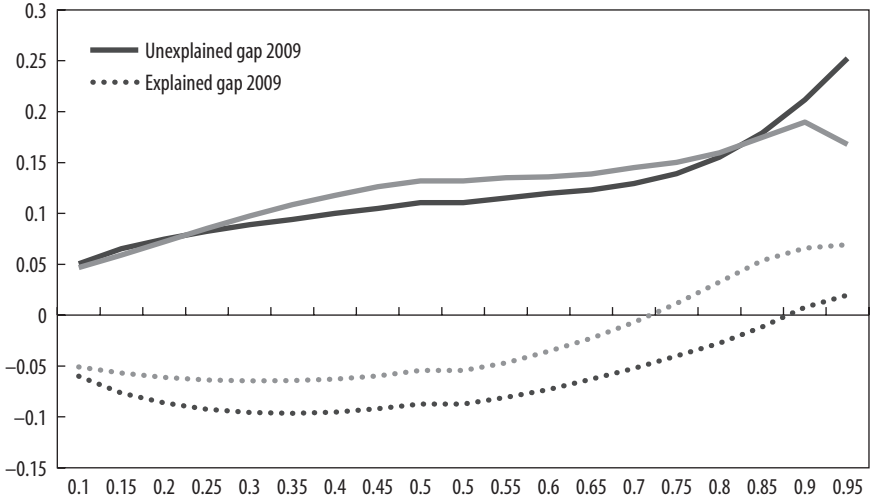
For workers without children, women's education levels are more favorable than men along the entire distribution, and differences in work experiences between genders are lower than for workers with children. Women without children have a more pronounced endowment advantage relative to men than those with children. Also, the average experience for women without children is higher than for men. The relative advantage of 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 percent of women had 0.29 more years of schooling than women at the eightieth percentile, but 0.07 fewer years of experience. Meanwhile, the top 10 percent of men had 0.59 more years of schooling than men at the eightieth percentile and 2.41 more years of experience.

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 effect is evident when we look at absolute and relative gaps and prevails even when a pooled model is used as the baseline instead of the male distribution.[29] In other words, the decomposition analysis shown in figure 6 suggests that, when we look at the predicted gap instead of the raw gap, the glass ceiling effect is accentuated mostly because of the coefficient effects, signaling that significant disparities may still lurk beneath the improvement in women's earnings.

The top 20 percent of women were concentrated in Standard Occupational Classification (SOC) 25 (education, training, and library), 29 (health care practitioners and technical occupations), and 43 (office and administrative support), while the top 20 percent of men dominated in 11 (management) and 41 (sales and related occupations). The top 20 percent of men earned more than the top 20 percent of women in all occupations except for classifications 19 (life, physical, and social science), 31 (health care support), and 47 (construction and extraction). The largest earnings differences were observed

29. Additional results are available from the authors on request.

FIGURE 7. Predicted Explained and Unexplained Gap: All Workers, 2000 and 2009–2013



Source: Authors' estimates, based on data from the 2000 Puerto Rico Census and the 2009–2013 PRCS (five-year samples).
Note: On the vertical axis, we illustrate the estimated ratio of men's to women's log of hourly earnings; the explained gaps are represented by dotted lines.

in classification 29: these exclusive men earned, on average, 18 percent more than their female counterparts. This is consistent with the premium for underrepresentation, as men represented 36 percent of health care practitioners and technical workers. In addition, there is an intersection between the glass ceiling, occupations, and dependent children. When crossing occupations with dependent children among the top 20 percent of workers, we find that men with children earned more, on average, than men without children in all but two occupations. Meanwhile, women with children earned less than women without children in sixteen out of twenty-three occupations.

To determine whether the glass ceiling effect observed in 2014 is a persistent phenomenon, we used the Melly method to decompose the wage gap for a similar sample taken from the 2000 Census and from the 2009 PRCS 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 distribution, more subtlely around the middle, and then decreases after the ninetieth percentile. The 2000 data also show 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 figures 6 and 7.

In 2000, the explained gap becomes positive around the seventieth percentile, whereas in 2009 and 2014, the explained gap remains negative for almost the entire distribution. This indicates that women's relative endowments improved, especially at the top of the distribution, which is consistent with the Blinder-Oaxaca decomposition results presented in table 6. Thus, a glass ceiling effect emerged in 2009 even when women improved their endowments at the top of the distribution.

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 and higher educational attainments by women vis-à-vis men largely explain the recent historical evolution of the gender gap. However, we found that the 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. First, a decomposition of the earnings gap by quantiles revealed a positive and increasing unexplained gap, evidence of a glass ceiling effect for women, which is exacerbated for female workers with children. Second, the presence of children in the household is another factor that influences gender disparities. When the sample is restricted to workers with no children, the disparities effect in the propensity score matching decreases, the unexplained gap is reduced, and the glass ceiling effect lessens. This 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 that considers the impact that traditional parenthood has on gender disparities in the labor market.[30] Nevertheless, there is still evidence of unequal treatment of women even in the absence of children.

Third, our results indicate that men receive a premium when they enter occupations or belong to education groups dominated by women, hinting at the presence of a so-called glass escalator, where men are promoted more easily in occupations where they are underrepresented. The opposite is also

30. See, for example, Angelov, Johansson, and Lindahl (2016); O'Neill (2003).

true, although it appears to contradict conventional wisdom: lower female representation is associated with a lower gender earnings gap. Within occupations, premiums in favor of the underrepresented gender may also be the result of a self-selection process. Individuals who choose occupations dominated by the opposite sex may possess unobserved characteristics that make them more productive and genuinely interested in those occupations. However, this type of argument does 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.

Insofar as the labor market disparities in our case study 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, the promotion of flexible work schedules, and warranted maternal and paternal leave on a similar level, could be a starting point. Gender-sensitive education can also improve women's economic opportunities. Because of the presence of a glass ceiling, we suggest that more transparent hiring and promotion practices are necessary. Narrowing the gender gap 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 should evaluate factors that affect the relatively large education gender gap observed in Puerto Rico and in other countries such as South Korea. Even though the economic factor seems to be a major driving force behind that gap, social and cultural factors should not be ignored. Smith and Niemi find that while girls see educational, relationship, and social goals as complementary, boys tend to view these goals as at odds with each other.[31] Also, the increase in migration flows between Puerto Rico and the United States 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 article.

31. Smith and Niemi (2017).

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