Impact of schooling on the gender wage gap in Ecuador during 2010-2020

Impacto de la escolaridad en las brechas salariales por género en Ecuador durante 2010-2020

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Abstract

Globally, gender wage gaps are very latent, where women continue to be the most affected by receiving lower salaries than men, even with equal job characteristics. The objective of this research focused on determining the effect of schooling on gender wage gaps in the 24 provinces of Ecuador during 2010-2020. Data were collected from the National Survey of Employment, Unemployment and Underemployment (ENEMDU) of the National Institute of Statistics and Census [INEC] (2021). The Oaxaca-Blinder method (1973) and Propensity Score Matching (PSM) were used as econometric process. The results obtained indicate that there is a direct relationship between income and academic level; and an indirect relationship between salaries and experience. On the other hand, the salary decomposition showed the existence of salary discrimination against the female gender. Likewise, the matching by score indicated that the academic level does have a contractive effect on wage gaps. With the results obtained, it is recommended that policy makers encourage greater participation of women in administrative positions, through operating regulations, strategic agreements and public-private cooperation, thus contributing to the reduction of gender inequality.

Keywords: *Wage gaps; Education; Inequality; Gender.*

Resumen

A nivel mundial, las brechas salariales por género son muy latentes, donde las mujeres siguen siendo las más afectadas por percibir salarios inferiores al de los hombres e incluso con iguales características laborales. El objetivo de esta investigación se centró en determinar el efecto de la escolaridad en las brechas salariales por género en las 24 provincias del Ecuador durante 2010-2020. Los datos fueron recopilados de la Encuesta Nacional de Empleo, Desempleo y Subempleo (ENEMDU) del Instituto Nacional de Estadísticas y Censos [INEC] (2021). Se empleó como proceso econométrico el método de Oaxaca-Blinder (1973) y el Propensity Score Matching (PSM). Los resultados obtenidos indican que existe una relación directa entre los ingresos y el nivel académico; y, una relación indirecta entre los salarios y la experiencia. Por otra parte, mediante la descomposición salarial se pudo constatar la existencia de discriminación salarial en contra del género femenino. Así mismo, el emparejamiento por puntaje nos indicó que el nivel académico si tiene efecto contractivo sobre las brechas salariales. Con los resultados obtenidos, se recomienda a los hacedores de política incentivar una mayor participación de las mujeres en cargos administrativos, a través de regulaciones de funcionamientos, acuerdos estratégicos y cooperación públicos privados, siendo un coadyuvante en la disminución de la desigualdad de género.

Palabras claves: *Brechas salariales; Educación; Desigualdad; Género.*

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Introduction

The gender pay gap can be defined as the monetary amount that an employee receives from his or her employer, and that this amount in comparison with other employees, who perform similar activities, presents an inequity or unequivocal wage redistribution; In this sense, wage gaps by gender are expressed as a percentage and in some cases are obtained by dividing the salaries of men and women, giving us as a result values between 0 and 1, which means that when there is a result of 1, labor wages are equal, and if they are less than 1, there is wage inequality (UN Women, 2021). In this sense, the global wage gap is approximately 33%, which means that for every dollar that men earn for their labor wages, women receive 77 cents of a dollar (UN, 2021).

Likewise, it will take 135.60 years to eliminate the wage gap between men and women worldwide, since there was an increase in the wage gap in 2021 compared to the previous year, due to the drop in performance in some developed economies.
On the other hand, the wage gap in Latin America and the Caribbean is 71.20%, placing it in third place geographically; thus, in order to partially eradicate the gender wage gap in these regions, 68.90 years are needed (World Economic Forum, 2021). Likewise, in Ecuador, the wage gap is around 0.72 percentage points, making it the best positioned country in Latin America and the second best positioned in comparison with the Caribbean, since the first place is occupied by Barbados with 0.87 points (Pasquali, 2021).

On the other hand, the theoretical basis for the characteristic analysis of wage determination and wage gaps is based on the Mincerian income equation proposed by Mincer (1974), which establishes the differences in human capital endowments, where its main focus is to analyze and measure the returns to education; However, there are other theoretical models that not only rely on education and experience, but also introduce some observable factors for the analysis of descriptive characteristics to achieve a broader analysis of the returns to education, where gender, ethnicity, place of birth, etc., are some of the determinants of the returns to education. These are some of the determinants of wage gaps (Becker, 1957; Arrow, 1973; Welch, 1990).

In this sense, according to empirical evidence regarding gender wage discrimination and rates of educational returns, Cheng et al. (2021) mention that in the American country the population with a university academic level tends to earn more than those with secondary academic levels; thus, the academic returns of men with a university degree are higher than women, this at the age of 40 years. Sanchez et al. (2021) use cross-sectional data and implement an Oaxaca-Blinder (1973) methodology, where in 2019 inequality in economic remunerations tended to decrease by 46% compared to the previous year, which meant that women's labor remunerations were 52 US dollars less than that of men.

Therefore, we intend to evaluate the impact of academic level on gender wage gaps in Ecuador during 2010-2020. Therefore, the hypothesis we have is the one that indicates that the

The effects of academic level on wage gaps are positive; therefore, by means of these aspects, the general question is: What is the impact of academic level on wage gaps by gender in Ecuador during 2010-2020?

With respect to the findings found in this research, we obtained that the evolution between the average logarithm of income by gender and academic level tends to increase the higher the level of education of the individuals, with men's salaries being higher than women's; It was also determined that there is a strong positive correlation between the logarithm of income and academic level; it also indicates that there is a negative correlation between the logarithm of income, experience and poverty; and with a positive correlation also the location, being in this case the province; on the other hand, by means of the wage decomposition between men and women, the existence of wage discrimination in favor of women was confirmed. On the other hand, by means of score matching, it was observed that the effects of the level of education on wage gaps are positive, which means that the higher the education, the smaller the disparity.

This research makes some important contributions. First, it unravels the gender gaps in schooling in a developing country, a setting where studies are scarcer. Second, we technically address the possible self-selection bias in our studied relationship and make our results more robust, thus avoiding spurious correlations that weaken our arguments. Third, our results allow us to establish policy implications for the Ecuadorian context.

Finally, the research is divided into the following sections in addition to the title, summary: section 1) represents the introduction, which gives us a preview of the research; section 2) is the review of previous literature, which contains the background and empirical evidence, covering chronological research and studies conducted on the subject; section 3) presents the data and methodology, which contains a description of the variables and the econometric strategies that were implemented; section 4) shows the discussion of the results, subdivided into results obtained and discussion; section 5) indicates the conclusions.

Previous literature review Background

Salaries

Labor income or wages are economic considerations that people receive in exchange for activities they perform for their employers, where such wages throughout history have been a fundamental pillar to achieve advances in the quality of life of societies. In this sense, one of the first to address the issue of wages was Smith (1776), where he explains the theory of income, which is of great importance due to its relationship with wealth, since such wealth depends entirely on wages. On the other hand, employers

will not be able to obtain any increase in the economic benefits received, as long as wages are not reduced (Ricardo, 1817). Indeed, in order to enter into the context of wage increases, we must understand that the economic compensation received by the working class will depend strictly on the population size (Malthus, 1846).

In addition, Mill (1848) gives us some insights related to wages, where he emphasizes that labor income is strictly dependent on supply and demand. Equally important, it must be understood that the wages received by the working class are not really due to the cost of labor, but rather to the effort exerted at the time of performing such activity (Marx, 1867). Thus, Clark (1899) leads to the analysis of the relationship between marginal productivity and wages, where he explains that the wage of the last employee should not be higher than marginal productivity, since that would imply a loss of profits for the employer, so that the wage of the last employee should be equal to marginal productivity.

Likewise, the decrease in nominal wages would lead to a decrease in the population's consumption, since the working sector would not have sufficient resources to satisfy its basic needs (Keynes, 1936). For his part, Friedman (1993) explains that an increase in wages could lead to a possible increase in prices, although it could also be due to an increase in taxes or some other factors affecting production.

Genre

When we speak of gender we are formulating the identity characteristics in which people feel identified, regardless of their sex. Therefore, throughout history, work has been done on gender equality, so that there may be true equity in societies, since in some cases there is partiality for certain groups. In this sense, Friedan (1963) expands on issues related to gender, indicating that the problems women face are not precisely in tangible aspects such as socioeconomic status, but rather in the intangibility of their personal development. On the other hand, Chafetz (1984) indicates that women are at a disadvantage in society, not only in cultural and social aspects, but also in labor aspects, where in many cases, the activities carried out by women are those of inferior positions or of little relevance. Indeed, Scott (1990) in his historical gender research, explains some relevant issues regarding gender, where the relationship that exists with power is very close, since it has connections of social spheres and the inequality present in it. In addition, gender research advances have been characterized in different types, where the first type is based on the existing differences between genders, the second type is characterized by the inequality that exists between genders (Ritzer, 1993).

Thus, feminist groups conceive sex and gender with different perceptions, where sex is the biological conditions of people, while gender is distinguished as something that the community refers to sexuality, within this gender there are some singularities that differentiate each one, either unreal or authentic characteristics (Haslanger, 2001). On the other hand, gender from the point of view of society has been framed in hierarchical prototypes, where the leader of this hierarchy are men (Maffía et al., 2010).

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Educational level

Smith (1776) promoted human capital for the first time, in such a way that in reference to education he indicates that men who have been educated academically and in which they made an investment of time and money to be able to educate themselves, will have to obtain profits at least equal to that investment at the time of being able to perform labor activities. On the other hand, Malthus (1806) explains that although it is true that helping low-income societies economically can lower or slightly reduce economic scarcity, in the course of time this will return and the problem itself will not be eliminated. Indeed, education contributes positive features to societies, having an economic impact on labor wages, since people's wage income tends to increase whenever an increase in labor skills is needed, not to mention the fact that experience goes hand in hand with education (Mincer, 1958). Likewise, education represents progress in the lives of people with scarce economic resources, since its productive factor is based on socioeconomic growth, an increase in their intellect and an increase in their capabilities (Schultz, 1961). Thus, investment in education represents an expense for family economies, which means that it will not generate income during the time spent in academic training, remaining in the economically inactive population, but these costs will be covered when they belong to the labor market and their salary is high (Becker, 1964).

In addition, Modrego (1990) explains the positive relationship that acquiring new knowledge has on the opportunities that people will have, and thus the main focus that countries, especially those who govern them, should have on educational planning. Likewise, Gravot (1993) points out that, at the moment of insertion in the labor market, people not only contribute physically at work, but also cognitively, which is acquired through education; therefore, the academic level will have a positive impact on the productive process, resulting in an increase in capital. In addition, Musgrave and Musgrave (1994) present an analysis very similar to that of Schultz, since they affirm the existence of an effective and determining relationship at the moment of requiring a suitable labor salary for the position held, since this requirement is born from education. In this sense, the determinants for the existence of wage disparities are rooted in the complementary relationship between capital and labor, since it depends on education (Marshall, 2013).

Empirical Evidence

European Continent

In Norway, wage gaps have arisen as a result of the high qualification requirements in metropolitan areas (Rattso & Stokke, 2020). Meanwhile, in Switzerland, exactly in the cleaning sector, where women are less likely than men to be able to accept a better paid job (Bieberstein et al., 2020). Meanwhile, in Spain there is the presence of a glass ceiling, which is based on undescribed internal institutional regulations that prevent women from freely accessing higher positions, these regulations being a trigger for the existence of wage gaps (Marfil-Cotilla & Campos-Soria, 2021).

Likewise, the Spanish country establishes that the population will be governed by equality before the law, without discriminating against any person on the basis of sex or ideology (Angulo, 2021). Inclusively, the appropriate wage distribution is found to directly favor middle and upper class workers in society (Ramos et al., 2021). In Germany, wage disparities within the sentimental attachment spectrum do not tend to decrease in the long term (Dieckhoff et al., 2020). Likewise, Italy lacks a sustainable economic level and its technological level is in an initial process (Castagnetti & Giorgetti, 2019). It should be added that Italy presents wage disparities due to labor mobility; since such mobility generates that men obtain increases in income of 30% logarithmically; on the contrary, for women it is only 8.3% (Del-Bono & Vuri, 2011).

In relation to, Poland the disparities in economic income by gender present significant adjustments; for such a reason, the increase in the minimum wage will provoke negative affections on the beginning working class, with a relatively low level of experience and with scarce economic resources (Majchrowska & Strawiński, 2018). On the other hand, in Belgium, disparities may have an onset strictly linked to changes made in the wage bill; where, such adjustments lead to a decrease in human capital and a wage increase, positively affecting the labor force (Fuss, 2009). On the other hand, wage differentials may be associated with new labor bindings in Ireland, given the population's need to labor to alleviate poverty (Lydon & Lozej, 2018). In the same sense, labor hiring and the increase in hours worked in Denmark may be causing wage gaps; thus, 30% of these gaps are explained by female labor (Gallen et al., 2019).

Asian Continent

Regarding gender wage gaps in Asia, specifically in Sri Lanka, the disparity obtained within this country shows a progressive decrease, due to the existence of liberal policies (Seneviratne, 2020). Reciprocally, wage gaps in South Korea over the years have experienced a reduction in disparity, as it moved from being an emerging economy, to being an advanced economy (Tromp, 2019). However, Wang and Cheng (2021) point out that wage gaps in China go beyond economic policies or advances in their eco- nomies. Similarly, in India there are cases of wage discrimination, even with new investments in education (Mohanty, 2021).

In the same sense, the existing wage disparity in Vietnam, wage gaps are found to average 29% and 15.5% of the unexplained component (Maitra, Neelim, & Tran, 2021). In relation to Hong Kong, wage disparities are associated with age and gender; since, as women enter the working stage, the fertility rate is expected to increase over the years (Yip & Wong, 2014). However, the gender wage gaps in Thailand narrowed; since, there is a higher female participation in labor aspects and the increase in female education (Nakavachara, 2010). Similarly, Ahmed & McGillivray (2015), refer to Bangladesh and its 31% reduction in wage gaps. The wage gaps in Turkey are mostly determined by the foreign labor force coming from Syria; thus, Syrian refugees are a negative factor, due to the fact that the labor force of Syrian refugees is a very important factor in Turkey's wage gap.

The wage disparities are also present in Afghanistan, being a country with a modernist Islamist doctrine; therefore, women are directly discriminated against (Noury & Speciale, 2016). Meanwhile, wage disparities are also present in Afghanistan, being a country with modernist Islamist doctrine; therefore, women are directly discriminated against (Noury & Speciale, 2016).

African Continent

In this regard, the wage gaps in the African continent, specifically in Egypt, denote the interest of governments to achieve a certain degree of equalization of employment opportunities by gender; thus, in the public sector, women obtain salary bonuses, which means that they receive bonuses, compensation, among others (Tansel, Keskin, & Ozdemir, 2020). In this sense, gender wage inequalities in South Africa present some particularities; it is for that reason that, women who are in the salaried and self-employed labor market, in which there is a greater female presence, inequalities within the same gender is high, given that women with salaried jobs earn more (Roberts & Schöer, 2021). Thus, Dinkelman and Ranchhod (2012), tell us about the regulation of the minimum wage in domestic workers, who belong to the informal sector, these adjustments do not present great significance in the analysis because there are no monitors of the application of the laws.

Likewise, union sectors modify wage inequalities in South Africa, since the wages of the general population compared to those who belong to such unions are extremely unequal, with the unions taking the lion's share of the high wages (Kerr & Wittenberg, 2021). On the other hand, in Guinea, wage inequality does not tend to have a negative effect on the egalitarian relationship with exports, as it was intuited to be affected in some way by the high inequality in the country (Latzer & Mayneris, 2021). However, wages within Ghana are extremely uneven; since, wage earners have labor wage premiums, which are within their annual income, significantly increasing the benefits they get as workers (Olarewaju et al., 2019). In contrast to, the Nigerian country the specifically productive inequalities show signs of reduction; since, the productive diversification dominated by men, who have support from the family and their own land restructure the productive market (Djido & Shiferaw, 2018).

American Continent

Analyzing wage inequality by gender in the Canadian country, it has been found that the gap is 77.2% in favor of women, which systematically means that for every dollar that men receive for work activities, women receive a salary of 0.77 US dollars, performing the same activities and with the same job characteristics (Ranaldi & Milanović, 2021). Meanwhile, in the United States, for the 1980s the female to male wage share was 53%; subsequently, by 2016 that proportion obtained an increase to 67% (Ghareh- gozli & Atal, 2020). Of equal importance, wage gaps due to the insertion of technological capital; and is that, by including robots and computers in the production process, there will be a labor discrimination to the capital factor; where, these robots will supplant 1000 workers and, therefore, tends to decrease the disparity by 0.3% (Ge & Zhou, 2020).

In addition, wage inequality is also presented by academic level; thus, people with university academic studies are likely to receive higher labor income than those with a high school academic level (Cheng et al., 2021). Thus, one of the main causes of inequality is poor fiscal policies, due to the fact that these deal with taxes and living wages (Deng, 2019). With respect to the Dominican Republic, the presence of disparity among young people aged 15 to 24 years in issues related to education and the labor market have presented strong evolutionary features (Baez & Sousa, 2017). Equally important, in Mexico, living in a marginalized geographic area does not reduce the possibility of the population to have a job, but it does reduce the possibility of formal employment, with this decrease being between 18 and 19% approximately (Daverio, 2021). It is worth mentioning that the existence of a sticky floor and glass ceiling is more latent in professional women in the health area; on the other hand, in the construction area women are more valued (Rodríguez & Limas, 2017).

Also, in the formal sector they determine that there has been an evolution of minimum wages; since, for the nineties the average salary was above the minimum wage approximately 13% higher in Mexico (Bell, 1997). Likewise, Colombians show signs of discrimination towards women; since, when they apply for jobs in which they can participate as administrative, they are generally not granted such positions (Chávez & Ríos, 2014). On the other hand, in Peru, wage discrimination between 2003 and 2009 shows a difference of 15% and 25% (Castillo, 2011).

Concerning Argentina, the characteristics of the population whose households are the poorest show that the household and childcare responsibilities are mostly carried out by women with approximately 85%; likewise, 43% of men tend to help in household tasks (Marchionni et al., 2018). In addition, a factor for the existence of socio-economic inequalities is alcohol consumption due to the fact that in the population between 18 and 24 years of age there is excessive alcohol consumption (Carrazana & De-Santis, 2021). In Brazil, since 2004, there has been an educational inclusion program focused on university education, which has had a positive impact on health, engineering and technology careers, with a return on education ranging from 21 to 18.5% (Lima, 2021). On the other hand, in 2008, the female gender, compared to the male gender, received 54% less of the total salary (Araújo, 2015).

Thus, wage gaps in Brazil tend to undergo changes due to the production of final goods, where tariff taxes were reduced in large proportion, causing a reduction in racial wage disparity (Hirata & Soares, 2020). Thus, in Santiago, Chile, wage dis- crimination is 6% using the ordinary least squares model (Troncoso et al., 2021). Likewise, in Chile, the factors involved in wage disparity are associated with cyclical unemployment, which means that jobs are linked to fluctuations in the economic market (Cowan et al., 2003). In this context, discrimination in 2003 showed a considerable decrease compared to previous years, although there is still a wage gap between men and women, which corresponds to a disparity of 27.5% (Fuentes et al., 2005).

In Paraguay, the percentage of adults with completed secondary education

is around 10%; likewise, older persons with disabilities is 17%, which means that 25% of the adult population is participating in the labor market (Hessela et al., 2019). On the other hand, in Cuba, women with parents who have a high level of education present educational opportunities of 76%, with parents with medium and low levels of education (Rosales et al., 2017). On the other hand, in Bolivia there is wage discrimination by gender in the central part of the country, where this disparity gives us a reference of 17% inequality (Cadena, 2020).

Similarly, in Nicaragua, discrimination increased from 30% in the last decade to 39% in the current decade, which means that women are positioning themselves in the labor market (Monroy, 2008). As for wage inequality in Uruguay, between the periods 2008-2013 there were strong decreases, but in recent years there have been no significant decreases in wage inequality (Burdín et al., 2021). Therefore, in Uruguay, the largest number of people in employment are men.

With regard to Ecuador, wage inequalities are established specifically by wage policies; thus, the population that has a minuscule salary is the one that is most affected by the establishment of minimum wages (Wong, 2019). Thus, one of the possible causes of wage disparity in Ecuador may be due to the level of education that people have; since, at the time of presenting an increase in schooling their income tends to increase by an average of 8.91%; likewise, with the years of experience, since if this presents an additional increase people will perceive 3.94% more in their income (Jumbo & Granda, 2014). Therefore, although it is true that labor discrimination against women has tended to decline in recent presidential terms (Llano, 2021). Similarly, for the year 2019, the wage gap showed reductions of approximately 46%, which means that the difference in labor income between men and women was approximately 52 US dollars in favor of men (Sánchez et al., 2021). Thus, inequality in Latin America is rooted in capital and income; where, countercyclical income inequality causes an increase in aggregate demand, because agents who are restricted tend to react to fluctuations in the economic market (Bilbiie et al., 2021).

Data and methodology

Data processing

The main objective of this research is to evaluate the impact of academic level on gender wage gaps, based on the ENEMDU survey data source, which is carried out by INEC (2021). The ENEMDU uses a probabilistic sampling with its respective expansion factors, which help to approximate the provincial population. The research is framed in the 24 provinces of Ecuador and additionally, the non-delimited areas are added during the periods from 2010 to 2020. It is worth mentioning that the database corresponding to the year 2020, due to mobility restrictions and health emergency in Ecuador derived from the COVID-19 global pandemic, the INEC carried out the surveys of the population of the provinces of the country.

This information is usually collected by telephone, since it is usually collected in person throughout Ecuador.

On the other hand, both dependent, independent and control variables were implemented; thus, the dependent variable used was the population's salary income, measured in US dollars; likewise, the independent variables were gender, measured numerically with 2 for females and 1 for males; academic level, which is measured in years; and work experience, which is measured in years of work; and work experience, which is measured by years of work; also, as control variables we have the province, which is measured by numbers ranging from 1 to 25 that correspond to each province of Ecuador, including the non-delimited zones; poverty is another variable which is measured with 0 for the non-poor and the poor; the branch of activity is measured between 1 and 22, which are the work activities of the persons. Thus, the description of the variables is presented in Table 1.

Table 1.
Description of variables

Variable	Símbolo	Unidad de medida	Descripción
Dependiente			
Ingresos salariales	ling	Dólares estadounidenses actuales Se estima con logaritmos	Mide la cantidad de renta que percibe mensualmente el jefe de hogar por retribución de las actividades laborales.
Independiente			
Género	gen	Numérico Valores de 2 femenino y 1 masculino	Indica las características de las personas, asociada al sexo biológico.
Nivel académico	edu	Años promedio	Mide el nivel de instrucción promedio educativa que ha cursado la población.
Experiencia laboral	exp	Años promedio	Mide los años de prácticas laborales, en los cuales las personas han adquirido nuevas habilidades.
Control			
Provincia	prov	Numérico	Lista que indica el lugar geográfico de residencia de las personas.
Pobreza	pob	Numérica Con valores de 0 no pobres y 1 pobres	Mide el nivel económico de las personas, en la cual no pueden satisfacer sus necesidades básicas y cuyo estatus económico se encuentra bajo la línea de pobreza.
Rama de actividad	act	Numérico	Indica el sector laboral en el cual las personas realizan sus actividades de trabajo.

Note: Adapted with information from INEC (2021).

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Econometric strategy

Oaxaca-Blinder Method (1973)

The Oaxaca-Blinder (1973) decomposition model was used to determine the wage gaps between men and women, according to their level of education. Thus, the dependent variable will be the wage income of individuals and the independent variables will be the level of education, with the gender dummy variable. Therefore, this model is represented in equation (1):

$$Ln(w_m) - Ln(w_f) = X'_m b_m + X'_f b_f \qquad (1)$$

Where, $Ln(w_m)$ - $Ln(w_f)$ represent natural logarithms of the wage of w_m(men) and w_f (women); likewise, X_m and X_f show the vectors of the means of the variables for men and women respectively; additionally, b_m and b_f indicate the estimated coefficients of men and women respectively.

On the other hand, the natural logarithm of income can be decomposed in two ways, and is represented in equation (2).

$$Ln(w_m) - Ln(w_f) = \Delta X' b_m + X'_f \Delta b \qquad (2)$$

Thus, the first part represents the difference in the logarithm of income between men and women; likewise, the second part of the equation represents the difference that exists, due to the coefficients. To determine the dichotomous variable, which in this case represents men and women, so to create it, it must be applied by means of equation (3) and equation (4):

$$Y_i = 1 \; \acute{o} \; Y_i = 0 \qquad (3)$$

Yes:

$$Z_i \alpha + \mu_i < 0 \qquad (4)$$

Thus, Z are the explanatory variables of the probability of participating or not; therefore, the wage equation for both men and women is represented in equation (5):

$$lnW_i = X'_i \beta + \mu_i \qquad (5)$$

In effect, lnW represents the natural logarithm of the wage of the people who participate or not, X shows us the vectors of the explanatory variables, β means the parameter vectors and μ shows us the residuals.

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Propensity Score Matching Method (PSM)

The Propensity Score Matching PSM model, which attempts to make observations comparable. Through this method, the impact of academic level on income gaps by gender could be obtained.

Likewise, the Propensity Score Matching (PSM) method allowed us to perform a Matching, which meant to match each of the observations of the sample with each other, with some observed qualities. Where these qualities diminish some type of matching distortion; being thus, a help at the moment of predicting probabilities; which, helped us to determine if the gender is or not part of the problem. In this sense, the PSM method performed a comparability between the variables, where it determined the participation in the treatment (T) with the observed qualities (X); thus, this pairing is explained algebraically in equation (6).

$$P(X)=Pr(T=1|X) \qquad (6)$$

In this sense, as identification assumption we have (a) conditional independence and (b) common support; therefore, literal (a) states that the set of observable covariates (X) which will not be affected by the treatment (T), likewise, literal (b) helped us with the potential results (Y) will be independent of the given result (T). Therefore, the first assumption is described in equation (7).

$$(Y_i^T, Y_i^C) \perp T_i|Y_i \qquad (7)$$

Thus, Y_i^T indicated the results of the treated and Y_i^C meant the results of the untreated. On the other hand, the second assumption was implemented by equation (8).

$$0<P(T_i=1|X_i)<1 \qquad (8)$$

Thus, through this assumption, the comparability of the observations can have a certainty in the propensity distribution.

DISCUSSION OF RESULTS

By implementing an evolution analysis in this research, we are trying to visually determine the existing degree of the effect that academic level has on the wage income of individuals according to gender; Thus, Figure 1 shows that as the levels of education increase, the logarithmic lines of wage income by male and female gender show an increase on average, so that this growth indicates that the higher the academic level, the higher the average wage income of individuals; likewise, we can see that there is a very marked increase in the male logarithmic line,

as the female between the intervals corresponding to the years 2014 to 2016; therefore, in 2014, Ecuador was among the 4 Latin American countries with the highest economic growth.

In that sense, such economic growth played a fundamental role for the increases in labor income of the Ecuadorian population; on the other hand, the decrease in the logarithm of promised income, would be due to the fact that for later years and until the beginning of 2019 the economy was in crisis, since the fall in the price of oil seriously affected Ecuadorians; in addition, it can be observed that in 2020 there was a decrease in labor income in both genders; This means that the COVID-19 pandemic was a negative factor for the decrease, due to restrictions in mobility, employment and other causes that played against the Ecuadorian economy; although, it should be noted that people with literacy as an academic level, specifically males presented a growth in that year, since a percentage of this population is dedicated to agriculture and this sector of the economy was not largely affected by the restrictions of the pandemic. Here we can also observe an interesting fact. When we look at higher education at the university level, we see that there is a gap between men and women, but it has been closing in recent years. That is to say, only in university higher education is there a convergence towards wage equality.

Figure 1.
Evolution of the logarithm of labor income by gender, according to their academic level, period 2010-2020.
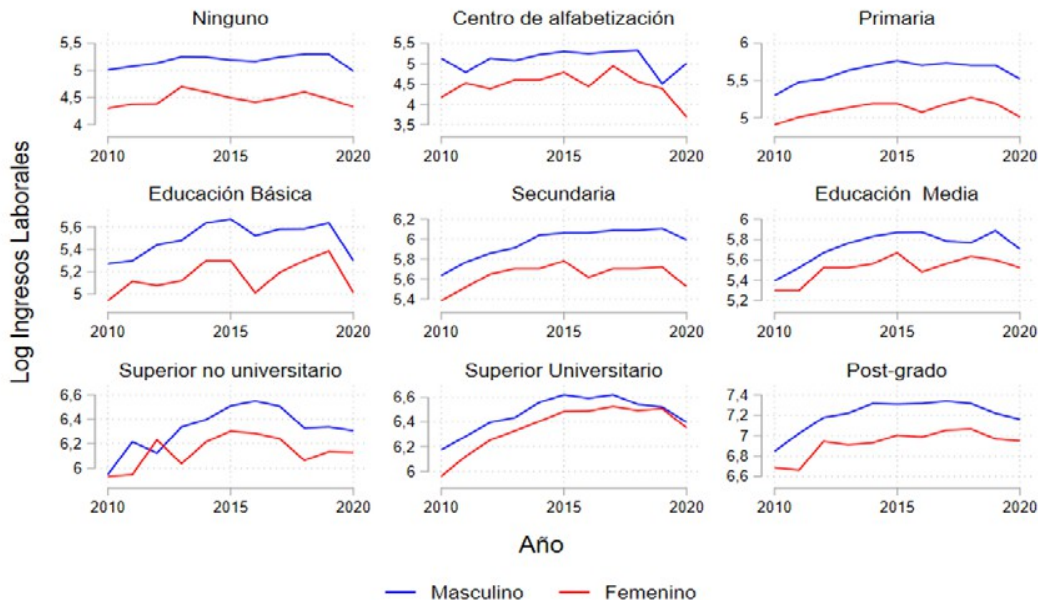

Table 2 shows the results of the correlation between all the study variables; in this sense, when analyzing these correlations, we obtain that the logarithm of income and gender have a negative correlation of 0.14, which implies that, when there is an increase in income, the negative relationship indicates that the increase will depend on gender, which translates into

On the other hand, the positive correlations between the logarithm of income and the other variables only occur with the academic level and the geographic location, which in this case belongs to the cities of Ecuador; thus, the positivity with the academic level is due to the fact that as the years of educational instruction increase, people tend to earn a higher salary. With respect to the negative correlations, we have the experience, the situation of poverty and the activities of the people in relation to the logarithm of the salaries; where, these correlations explain to us that, before a possible increase of one of the variables, the income will present a slight decrease, according to its level of incidence; On the other hand, there is a correlation of zero between experience and provinces, since this is due to the fact that the location of the people in this research does not significantly affect the experience that people have, on the other hand, the negative correlation that stands out the most is poverty and the logarithm of income, since as the population falls into poverty, salaries will decrease, which means that due to the lack of employment people do not receive a salary and therefore their poverty situation increases.

Table 2.
Correlation matrix of the study variables

Variables	ling	gen	edu	exp	prov	pob	act
ling	1,00						
gen	-0,14	1,00					
edu	0,42	0,11	1,00				
exp	-0,15	-0,10	-0,32	1,00			
prov	0,06	-0,03	0,03	-0,08	1,00		
pob	-0,39	-0,06	-0,26	0,13	-0,01	1,00	
act	-0,15	-0,09	-0,26	0,00	-0,01	0,08	1,00

In this context, it can be seen that, on average, men's salaries are higher than women's, since, logarithmically, men earn 5.79 and women 5.49, with a gap against women of 0.30; it should also be noted that in this model there is significance in both variables; On the other hand, when performing a decomposition analysis, the endowments express the productive characteristics of men to women, expressing the average increase in salaries, being in this case -0.15; in this sense, when adjusting the endowments of men to women, these cause women to earn 14% less in their salaries. The coefficients are calculated as the variation that occurs in women's salaries, where the change in the coefficients or remunerations of men is applied to the characteristics of women; therefore, this change is positive, bordering 0.42. Likewise, the interactions measure the simultaneous effect that exists between the endowments and coefficients.

Tabla 3.
Descomposición Oaxaca-Blinder por género.

ling	Coeficiente	Std. err.	t	P>t	[95% conf. Interval]	
Diferencia						
Predicción Masculina	5,79	0,00	2729,89	0,00	5,79	5,80
Predicción Femenina	5,49	0,00	1670,62	0,00	5,49	5,50
Diferencia	0,30	0,00	76,47	0,00	0,29	0,31
Descomposición						
Dotaciones	-0,15	0,00	-59,49	0,00	-0,15	-0,14
Coeficientes	0,42	0,00	126,81	0,00	0,42	0,43
Interacción	0,02	0,00	19,68	0,00	0,02	0,03

Note: The information corresponds to all research analysis periods.

Table 3 presents the decomposition by the Oaxaca Blinder method; therefore, the results indicate the difference, specifically in prediction 1 which belongs to men and prediction 2 belongs to women; in this case, for the years 2010-2020, these predictions are statistically significant at 0.1% in all predictions. In this sense, we can determine that, as the years go by, it can be observed that the logarithm of men's salary income has presented increases with the exception of the year 2020 where these salaries were closer on average to those of 2013; likewise, women's salaries measured on a logarithmic scale show that, like men, they have increased throughout the years with the exception of the year 2020, where said logarithmic salary is closer to those of the year 2016.

Additionally, the wage gaps between both genders throughout the years of research have had variations; so, in 2010 the wage gap represented 28% and until 2016 it was 44%; so, for the following years this wage gap presented decreases, so that by the year 2020 it was 28%. In that sense, we can give a brief explanation for which, from 2017 onwards, the wage gaps presented progressive decreases, as this is born as a result of the boom in entrepreneurship, where most of these are occupied by women with a percentage of 51.1% of the total number of entrepreneurs, where the most recurrent age is between 36 years old; In this sense, new ventures are becoming a main source in the economy of Ecuadorian women, because the Global Entrepreneurship Monitor (GEM) indicates that 54% of women report a desire to be micro-entrepreneurs (Jimenez, 2018).

On the other hand, in the second section of the evolution of the decomposition of wage gaps, the endowments, which represent the average wage increase of women as they change with the productive characteristics of men, where by applying this decomposition for 2010 women's wages decreased by 15%; Likewise , until 2016 that this decrease represented 19%; however, from 2017 this decrease declined by 17% until 2019, but this percentage increased to 19% in 2020 due to COVID-19 causes who represented decreases in world economies. Furthermore, in the same section, in the coefficients section or the unexplained part, since by 2010 it represented 45% until 2016 when it represented 69%, as in the previous explanations from there on the decrease until 2020 represented 53% of the discri- mination in the labor sector.

The Oaxaca-Blinder (1973) decomposition matrix, disaggregated by years, which can be found in Table 4, shows the evolution of the average salaries of the male and female genders and the gap between them, This means that as there are modifications or increases in the tables of basic unified salaries in Ecuador, the average labor salaries of individuals tend to increase regardless of gender; Likewise, wage gaps tend to undergo changes, meaning that the greatest increase in wage gaps occurred in 2016, reaching 44.24% without applying the SMP model; in this sense, this increase in wage gaps can be explained by the economic crisis that existed in Ecuador in that year, accompanied by the earthquake that occurred in that year, which further aggravated the situation in which the country found itself.

On the other hand, this table shows that when applying the PSM model, in all cases the wage gaps by gender are against men, meaning that women tend to earn higher incomes than men, as long as a comparison is made within the samples in which the analysis is being carried out; likewise, when adjusting the decomposition model, it can be determined that for the data with PSM there are no significant changes in the wage gaps; However, those gaps to which the adjustment is applied and present greater modifications are those that do not have the SMP model; additionally, we must highlight that the lowest percentage of wage gaps occurs in 2020, although for the SMP model the lowest wage gap for that year presented decreases in its percentage of inequality, meaning that before any economic expansion or contraction, the wage gaps tend to undergo changes.

Table 4.
Oaxaca Blinder decomposition matrix with and without PSM disaggregated by year.

	2010		2011		2012		2013		2014		2015	
	Sin PSM	*PSM*	*Sin PSM*	*PSM*	*Sin PSM*	*PSM*	*Sin PSM*	*PSM*	*Sin PSM*	*PSM*	*Sin PSM*	*PSM*
					Diferencia							
Predicción 1	235,73	175,64	271,20	177,53	304,27	177,89	315,71	180,43	353,36	188,09	365,72	194,84
Predicción 2	183,97	321,54	206,51	324,83	233,44	323,34	238,95	334,70	253,69	344,15	264,22	351,45
Diferencia	1,28	0,55	1,31	0,55	1,30	0,55	1,32	0,54	1,39	0,55	1,38	0,55
Ajustada	1,35	0,55	1,40	0,55	1,39	0,54	1,42	0,55	1,48	0,55	1,47	0,56
					Descomposición							
Dotaciones	0,85	0,87	0,86	0,88	0,87	0,89	0,81	0,83	0,82	0,84	0,81	0,85
Coeficientes	1,51	0,64	1,56	0,63	1,54	0,63	1,67	0,66	1,71	0,66	1,72	0,66
Interacción	1,05	0,99	1,04	0,98	1,04	0,98	1,05	1,01	1,06	1,01	1,05	0,99

|	2016		2017		2018		2019		2020	
	Sin PSM	*PSM*	*Sin PSM*	*PSM*	*Sin PSM*	*PSM*	*Sin PSM*	*PSM*	*Sin PSM*	*PSM*
					Diferencia					
Predicción 1	347,02	188,62	362,12	192,21	363,61	196,33	361,78	196,29	323,93	199,96
Predicción 2	240,59	347,45	258,98	355,23	268,80	359,50	269,66	369,72	253,49	365,23
Diferencia	1,44	0,54	1,40	0,54	1,35	0,55	1,34	0,53	1,28	0,55
Ajustada	1,54	0,55	1,51	0,55	1,46	0,56	1,44	0,55	1,37	0,56
					Descomposición					
Dotaciones	0,81	0,84	0,83	0,87	0,83	0,85	0,83	0,85	0,81	0,84
Coeficientes	1,78	0,65	1,73	0,64	1,69	0,66	1,66	0,65	1,62	0,66
Interacción	1,06	1,00	1,05	0,99	1,04	1,00	1,05	1,01	1,04	1,01

Note: Prediction 1 represents male gender and prediction 2 represents female gender.

As we can observe the salary gaps by provinces reflect a variation when comparing two consecutive years of comparison; because in 2019, although it is true that the Ecuadorian economy presented some problems, for 2020 this situation worsened due to the arrival of COVID-2019 to the country, in the first quarter of that year; so, we have proceeded to make the graph of the salary gaps for each of the provinces of Ecuador; so, in the provinces of Galapagos, Carchi, Sto. Domingo and Cañar, in 2019 were very high compared to the other provinces, even assuming that in Galapagos salaries are high compared to the average for mainland Ecuador, so these high salary gaps are due to the existence of low academic levels, where people with non-professional education predominate.

In this regard, it should be noted that in 2020, specifically in Galapagos, the wage gaps occurred against men, where, unlike women, they earned less, one of the explanations is that the number of surveys conducted by INEC in the islands for that year decreased; Also, it may be explained that due to the pandemic and the restrictions on tourist travel to the islands, tourist activity declined, which left only jobs related to agriculture, and it is precisely for these jobs that the wage gap for men may be explained; According to the International Service portal of the Swiss Broadcasting and Television Society [Swissinfo] (2021), approximately 75% of the properties belong to men, but most of them are worked by women; in this sense, the pandemic affected the sector where men work the most.

Figure 2.
Evolution of wage gaps in the provinces of Ecuador in 2019 and 2020.
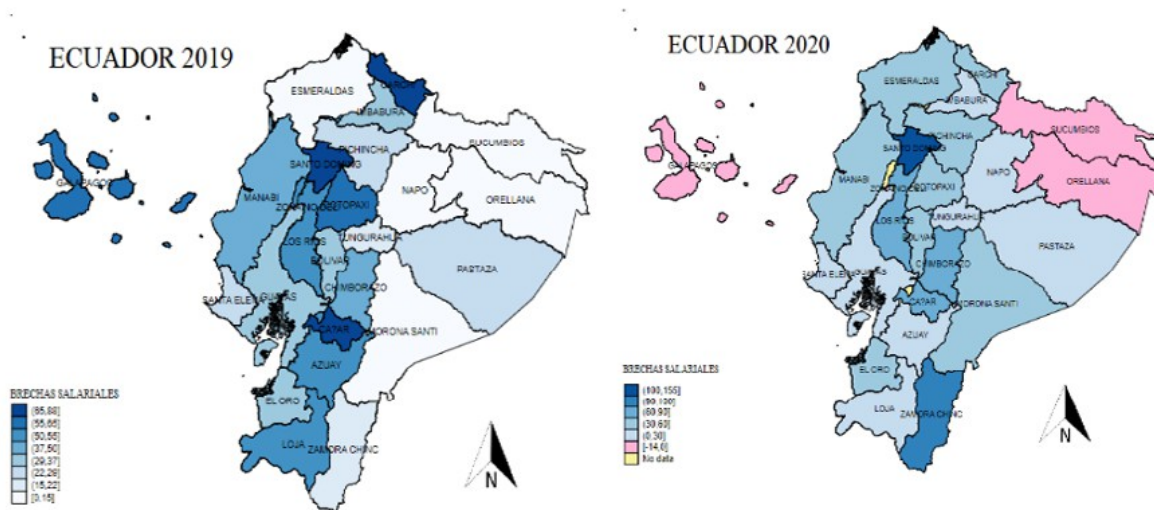
In addition, there are other provinces such as Sucumbíos and Orellana, where the wage gaps were presented against men by 2020, as some factors specifically related to tourism had a great impact in those places; in that sense, in a more generalized way for the year 2019, the region with more equality in Ecuador was the Amazon, where the continued work of

In addition, for the same year, in provinces such as Esmeraldas, which belongs to the coastal region of Ecuador, the wage gap is low; Also, for the same year in provinces such as Esmeraldas, which belongs to the coastal region of Ecuador, the wage gap is low, because initiatives of the Andalusian Fund of Municipalities for International Solidarity (FAMSI) and some other institutions that created the program called the local position, which focuses on eliminating discrimination against women and carry out activities of inclusion of women has allowed the wage gap to remain low in that province.

Conclusions

The evolutionary graphs of the labor income of the investigated population allowed us to determine the existence of an average wage inequality against the female gender in Ecuador during the period 2010 - 2020, where the largest wage gap is presented in those who do not have an academic level. On the other hand, the correlation analysis between the logarithm of income and academic level shows a strong positive correlation. Thus, we can evidence the existence of wage discrimination against women, which prevents women from accessing the labor sector and makes them work in unskilled jobs, thus underutilizing productive labor, and this discrimination is the cause of low performance and lower labor motivation. In this sense, it was possible to determine the rejection of the first hypothesis. In addition, we found that there is a schooling gap that is mostly explained by unobserved factors attributed to discrimination. Therefore, it is urgent for policy makers to intervene to mitigate the existing wage and education gaps in Ecuador.

On the other hand, the Oaxaca-Blinder model (1973) allowed us to determine the existence of implicit wage discrimination, since men are paid more than women, even when including the characteristics of women than men in Ecuador in the models. In this way, wage discrimination by gender is very evident in the country; thus, wage discrimination can be attributed as one of the factors causing some type of family violence and a condition of inferiority of this gender, since, as there is wage disparity against women, they are reluctant to enter the labor market, making them dependent on the salary income of men, leading in some cases to a type of machismo and authoritarianism by the economic status in which the man finds himself.

Likewise, by means of the Propensity Score Matching model it was possible to determine that, upon comparing the observations, we found that men earn more salary compared to women, which means that women are mostly qualified for the labor market, but receive less pay for it. In this way, we can identify that the academic level tends to reduce the salary gaps by gender, since it is a contributor so that people, and in this case women, can receive a fair and suitable salary according to their abilities and intellectual characteristics; in addition, the academic level can generate new job opportunities, high salaries, an adequate standard of living, as well as collaborating in the eradication of discrimination against women. In this sense, the third hypothesis is accepted.

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