Vol.8 Issue.1 April 2023

RSEP Review of Socio - Economic Perspectives
ISSN: 2149 - 9276
E-ISSN: 2547-9385

Labor income gap in Ecuador due to discrimination, pre and post pandemic: Correction of error due to selection bias

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Article History

Received: 3 January 2023 Revised: 24 March 2023 Accepted: 26 March 2023 Available Online: 1 April 2023

Keywords: labor income, labor gap, discriminatory factors, pandemic, youth, ethnic minorities.
JEL classification: A19, C01, C53.

Citation: Varela Enríquez, M. & Salazar Espinoza, G. (2023). Labor income gap in Ecuador due to discrimination, pre and post pandemic: Correction of error due to selection bias, *Review of Socio-Economic Perspectives*, 8(1), 11-30.

Abstract

The objective of this research is to analyze the labor gap in Ecuador, correcting the session period by sample selection to show if the differences in labor income are due to observable or discriminatory situations, and if they changed after the pandemic. To achieve this objective, the annual employment databases for the years 2018, 2019 and 202 were analyzed, and a model described by Jones (2007) and Adkins and Hill (2011) was initiated, who conclude in the application of the model of Heckman and the failure of the Oaxaca-Blinder method was estimated to correct errors and show possible discrimination in labor income. The results obtained show that it is more difficult for women, young people and ethnic minorities to find work, and when they are in employment their income is lower, even the labor gap between men and women increases after the pandemic. Income gaps are explained by discriminatory factors and observable factors in the case of women and ethnic minorities; while for young people it is due to observable factors.

1. Introduction

The search for equal pay has been going on for more than 103 years when Convention No. 100 on Equal Remuneration was defined in 1919, since its constitution already determined the fundamental principle "equal pay for work of equal value". As stated by the International Labour Organization (ILO, 2019):

"*This principle implies a questioning of wage discrimination, and in particular, gender roles and the sexual division of labor, from which the jobs of women and men are evaluated, resulting in some skills and competences being more valued than others (SNMT, 2010: 30). Thus, the Convention not only assumes that if two people perform the same work they are entitled to receive the same income; It also states that different jobs can have the same value. The establishment of the value of each job requires the evaluation of the capabilities expected of the worker, the efforts that are expected of the worker.*"

And although great progress has been made in the recognition of equal rights between men and women, significant signs of the wage gap still appear, even though Article 23 of the Universal Declaration of Human Rights (1948) states that:

> "*1. Everyone has the right to work, to free choice of work, fair and favourable conditions of work and protection against unemployment.*
>
> *2. Everyone has the right, without any discrimination, to equal pay for equal work.*

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DOI: https://doi.org/10.19275/RSEP145
Article Type: Original Paper

> *3. Every working person has the right to just and favourable remuneration which will ensure him and his family an existence in conformity with human dignity and which shall be supplemented, if necessary, by any other means of social protection.*
>
> *4. Everyone has the right to form trade unions and to join trade unions for the defence of his interests*".

In addition, Article 7 of the International Covenant on Economic, Social and Cultural Rights (1966) states that:

> "*The States Parties to the present Covenant recognize the right of everyone to the enjoyment of just and favourable conditions of work which ensure in particular: (a) Remuneration which provides at least all workers: (i) Equitable and equal pay for work of equal value, without distinction of any kind; in particular, women should be guaranteed working conditions not inferior to those of men, with equal pay for equal work; (ii) Decent living conditions for themselves and their families in accordance with the provisions of the present Covenant; (b) Safety and health at work; (c) Equal opportunity for all to be promoted, within their work, to the appropriate higher level, without consideration other than the factors of length of service and capacity; d) Rest, enjoyment of leisure time, reasonable limitation of working hours and periodic holidays with pay, as well as remuneration for public holidays*"

The Political Constitution of Ecuador (2008) states that remuneration must be fair, that young people have the right to be active subjects in production, there is a right to work in communities, peoples and nationalities, and shall guarantee women equality in access to employment, to training and promotion to work and professional, to equitable remuneration, and all forms of discrimination are prohibited, as indicated in the following articles:

> "*Article 328.- The remuneration shall be fair, with a living wage that covers at least the basic needs of the worker, as well as those of his family; It shall be unattachable, except for the payment of maintenance pensions. Article 329.- Young men and women shall have the right to be active subjects in production, as well as in the work of self-employment. For the realization of the right to work of communities, peoples and nationalities, the State shall adopt specific measures to eliminate discrimination affecting them, recognize and support their forms of work organization, and guarantee access to employment under equal conditions. The selection, hiring and promotion processes will be based on requirements of skills, abilities, training, merits and abilities. The use of discriminatory criteria and instruments that affect the privacy, dignity and integrity of persons is prohibited. Article 331.- The State shall guarantee women equal access to employment, to training and promotion to employment and professional, to equitable remuneration, and to the initiative of self-employment. All necessary measures will be taken to eliminate inequalities. Any form of discrimination, harassment or act of violence of any kind, whether direct or indirect, affecting women in the work*".

However, the wage gap between men and women, in the case of Ecuador, widened further in the two years prior to the pandemic (2018-2019) as the following graph shows. The impact of the pandemic on the wage gap is more noticeable in young people, with an increase of 7 percentage points. Finally, in the case of ethnic minorities, the gap is greater compared to the other analysis groups, however, in the post-pandemic period, it did not show notable growth.

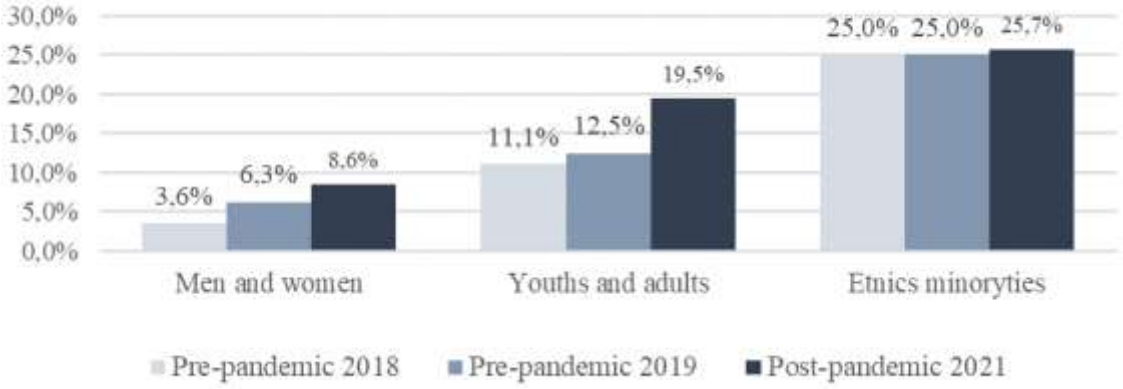


Figure 1. Wage gap in Ecuador, pre and post pandemic, 2018-2021 (percentage)

Notes: For young people, people between the ages of 18 and 24 are considered; ethnic minorities include indigenous, Afro-Ecuadorian, black, mulatto and montubio; Therefore, the analysis is regarding mestizos and whites. Expansion factors are used.

Source: National Institute of Statistics and Censuses -INEC-, National Survey of Employment, Unemployment and Underemployment -ENEMDU- quarterly series 2018-2019-2021. **Elaboration**: Authors.

Therefore, to determine the conditions of labor inequality, the existing gap in labor income between men and women, young people and ethnic self-identification, the present work shows whether the differences in labor income are due to observable or discriminatory situations, and if they changed after the pandemic. The methodology applied uses econometric models for the correction of sample selection bias, this problem is due to the fact that in the conventional income analysis people with employment are considered and the characteristics of those who are not working are omitted. There is a large amount of research in the field of gap analysis, which has not considered the bias described, resulting in the possibility of errors, especially in inference. In addition, the present research includes analyses of two other groups generally violated: young people and ethnic minorities; contributing to the explanation of wage differentials in these groups.

The structure of the research begins with an introduction where the beginnings of the understanding of labor inequalities between men and women from international regulations are briefly reviewed, and then briefly review Ecuadorian regulations. The second section addresses the evidence, from the methodological construction carried out in Ecuador by the National Institute of Statistics and Censuses (INEC) under the guidance of the International Labor Organization (ILO), as well as the studies carried out in this regard both in Ecuador and in the region. The third section reviews the methodology, for which a two-stage Heckman model described by Jones (2007) and Adkins and Hill (2011) was developed, and the decomposition of the Oaxaca-Blinder method was estimated to correct selection errors and evidence possible discrimination in labor income. The fourth section analyzes the results obtained, which determines that the employment gap between men and women increases after the pandemic, and income gaps are explained by discriminatory factors and observable factors in the case of women and ethnic minorities; while for young people it is due to observable factors. The research paper ends with the conclusions.

2. Literature Review and Evidence

2.1. Literature Review

In the determination of wage gaps between men and women, two methodological visions have been manifested. The first has to do with the theory of human capital, which explains the differences in human capital (seen as educational level achieved) that determines the difference between the salaries of men and women, therefore, it is pointed out that women receive lower salaries because they accumulate less human capital than men. But it must be considered that at present women have been acquiring greater human capital, and despite this, the

differences in income remain, as is the case of immigrant women in the United States where they have greater human capital than male immigrants (Anker, 1997).

The second, which considers other unobservable factors such as discrimination, which has not only led to women having less human capital, but access to work is restricted by this gender condition, as well as access to training and quality at work. Therefore, the literature begins to distinguish the difference in income between men and women due to "individual characteristics and endowment of human capital, from that unexplained and mostly related to gender prejudice and / or discrimination" (Atal et al., 2009), aspects that are considered in the model of Oaxaca (1973) and Blinder (1973), in which from Minas Cerian salary equations, divide two groups to differentiate wage income, a first group to explain group differences and productive characteristics such as experience or level of education, and a second group considered an unexplained residual component, to understand existing discrimination (Jann, 2008).

To this methodology of Oaxaca-Blinder decomposition, we can add the so-called "dimension curse" carried out by Ñopo (2010, 2012) to correct specific limitations: "First, because the pairing is constructed with discrete variables, the probability of finding a person with the same characteristics and endowments for each man or woman decreases as the number of variables included increases, which reduces the common support if the analysis is performed with a significant number of observable characteristics" (Enamorado et al., 2009), which has led to new evidence showing that attitudes and preferences towards work are not necessarily similar between men and women (Chioda, 2011). Speaking of discrimination and not only of differences in human capital, Becker (1971) points out that "discrimination against a particular group may depend on the social and physical distance between socioeconomic status, demographic characteristic, geographical location or personality" (p.137).

Meanwhile, the income gap between men and women can be considered as a condition of less work experience or because there are fewer working hours in women, but in reality this does not happen, moreover, when these two factors are not considered in models, the wage gap persists despite the fact that the greater experience or educational level was greater in women than in men. (Fortin, Bell & Böhm, 2017; Fields et al, 1998; Ñopo, 2012).

Occupational and economic sector segregation is also another form of wage discrimination (Hegewisch, 2010; European Commission, 2015), both because occupations considered "male" and covered by greater participation of women are considered less prestigious or of lesser value (Goldin, 2013¸ Pan, 2015), and because characteristics that can be classified as "feminine" are undervalued (ILO, 2019). In addition, in developing countries, administrative work, trade or services carried out by women are low paid (ILO, 2019).

With this broadening in the understanding of wage gaps between men and women, the gender and ethnicity approach begins to be incorporated, as Gallardo & Ñopo (2009), Ñopo (2012), and García-Aracil & Winter (2006) did. All these authors find that the characteristics of human capital allow to better explain the existing gaps between ethnicities, and to a lesser extent the gender gap.

Larger studies such as those carried out by Anglade, Useche and Deere (2017) show the gender gap in the wealth dimension, finding that "the gap in favor of men in the lowest quantiles is explained by differences in the returns of characteristics, while in the middle and upper part of the distribution it is mainly explained because men have better characteristics than women" (Benítez & Espinoza, 2018: 3).

Psacharopoulos and Zafiris (1992) with a study carried out in the 80s of the last century, for 15 countries in Latin America and the Caribbean in the late 80's find that:

> "*Women earned labor income that represents 65% of what a man receives, explained by differences in the level of education and human capital, which represented only a third of the total difference, leaving a large portion (about 43%) of the difference unexplained and possibly associated with discrimination*."

While Ñopo and Hoyos (2010) show that "the income gap narrowed from 16% to 9% between 1992 and 2007, however, the unexplained gap represented 34% in 1992 and 30% in 2007", which determines that the reduction

in the gap in recent years is due to greater investment in education, which led to an increase in women's educational level, allowing them to penetrate more into the labor market (Chioda, 2011; Gasparini and Marchionni, 2015).

Finally, the International Labor Organization (ILO, 2019) in a study for 17 countries, using the nonparametric decomposition of Ñopo, finds that the gap is greater in self-employed workers and more accentuated in low-income workers, while in the period 2012-2017, the unexplained income gap is reduced between 2 and 3 percent..

2.2. Evidence

The National Institute of Statistics and Censuses of Ecuador (INEC, 2012: 1) defines the labor income gap between men and women as the "Existing percentage difference between the hourly labor wage between men and women, expressed as a percentage of the male salary. It also corresponds to the exact rate of percentage change between the wages of men and women." In the same way, the calculation formula is defined as:

$$BYL(h-m) = \frac{(YLh - YLm)}{YLh} * 100$$

Where:

$BYL(h-m)$ = Gap in labor income between men and women

YLh = Hourly earnings men

YLm = Hourly earnings women

For the calculation of the indicator, INEC considers hourly labor income, for which the monthly labor income is divided for the monthly hours worked, since people are consulted about the hours they work in the week.

In the same vein, INEC (2012: 1) defines labor income as:

> *"any remuneration for productive activities in the form of payments in money, in kind or in services. For self-employed workers, net monetary income (both from the main and secondary activity) is considered, that is, discounting the expenses for the operation of the business. For salaried workers, monetary income includes disposable income, the amount on account of direct taxes and social security contributions."*

While, for Eurostat (2020), the wage gap between men and women, in its unadjusted form, is defined as "the difference between the gross hourly earnings of male and female employees, expressed as a percentage of the average gross hourly earnings of salaried workers".

For the International Labour Organization (ILO, 2019: 17) the wage gap between men and women is:

> *"which considers the difference between the average monthly income per work of women and that of men. In this regard, the ILO notes that wage inequality is often understood as the gap resulting from the difference between the average earnings of women and men as a percentage of men's income, if women's average monthly earnings account for 70 per cent of men's average monthly earnings, The gender pay gap is 30 percentage points".*

Also, the ILO (2019) considers that the data on the income gap between men and women considers income by salary, excluding self-employed people, which generates restrictions:

> *"Such indicators have so far proved useful for estimating in general terms the wage disadvantage faced by women. However, they do not allow us to know the wage inequality in different contexts or measure its impact on different groups of women and limit the possibility of designing effective public policies that protect those who need it most."* (p. 17).

In this regard, on the gender pay gap, when the ILO (2019) analyzes four countries (Mexico, Costa Rica, Peru and Uruguay) it finds something very important, which is considered in this study:

> *"Gaps in monthly wages are not the best indicator for estimating wage discrimination based on gender, since differences in monthly earnings by women and men are partly due to the fact that women on average work fewer hours than men work fewer hours on average. It is, considering the two reference years, about 15% less per week in Mexico, 17% in Costa Rica, 10% in Peru and 20% in Uruguay. Except in the latter country, these differences have increased slightly between 2010 and 2016"* (p. 36).

Studies on wage discrimination in Ecuador refer to the traditional methodology of the Mincer model (1978) that collects the gaps in access to education (human capital), and others delve into modeling that shows if wage differences are due to discriminatory factors, which in the present study is used, such as the well-known Oaxaca-Blinder decomposition.

In the study by Benítez and Espinoza (2018), wage discrimination between men and women in Ecuador is analyzed by branch of activity and company size, differentiating wage bias, and they point out:

> *"To differentiate the proportion of wage bias attributable to the characteristics of workers from that attributable to discrimination, the Oaxaca-Blinder decomposition is used. It is found that there is wage discrimination by gender in almost all branches of activity, but with different levels in each of them."* (p. 1).

Regarding the criticisms that exist about the application of the Oaxaca-Blinder decomposition model, Benitez and Espinoza (2018) explain the existence of several methodologies that use parametric and non-parametric methods, such as the quantile regression of the Oaxaca-Blinder model, by pointing out the following:

> *"Despite the criticisms made of the latter, mainly related to the existence of omitted variables and the fact that it does not measure gaps in access to human capital (such as education), the Oaxaca-Blinder decomposition is still widely used due to the ease with which wage differences can be expressed in components that account for the difference in characteristics (human capital). on the one hand; and from one unexplained part attributable to discrimination, on the other"* (p. 6).

Concluding these authors, Benítez and Espinoza (2018) with the following: "the data of administrative records about formal employment in Ecuador shows evidence that there is discrimination against women, despite the fact that there is no wage gap in this regard", which shows the benefit of using the Oaxaca-Blinder method to understand labor discrimination, as used in this investigation.

In another study for Ecuador, García (2022) analyzes the evolution of the wage gap and its relationship with the supply of skills related to higher education motivated by changes in income distribution, and points out that the explanation for the decrease in income inequality is due to "the unprecedented increase in a more educated workforce" (p. 11), That is to say, it is human capital that reduced the gaps and wage inequality, embracing the Mincerian model, the results show that:

> *"The improvement in the educational composition of the Ecuadorian labor market is evident. An interesting fact is that the positive scale used for women tells us that the participation of women with tertiary education exceeds the participation of those without this education, while, for men, although the participation of the former with respect to the latter has increased, the male labor force is still intensive in workers without higher education. Another important feature is that the improvement in educational composition grows rapidly only after 2015 for both men and women. Perhaps this is the reflection of the higher education reforms of 2008, whose main axis was free access to higher education, and the increase in investment in this type of education during the period of economic growth 2009-2014 that materializes only after 2015. It could also be due to the displacement of less productive, in this case less educated, workers out of the labor*

> *market during the period of economic contraction, something that is reaffirmed with the significant increase in the indicator in the 2020 pandemic year"* (pp. 12-13).

Puebla (2018) in a study for Ecuador, on wage gaps by gender with a focus on occupation and company size, uses the selection bias methodology, that is, it applies the Oaxaca-Blinder decomposition model to perform a decomposition of the gender wage gap to explain how much is due to gender differences. As noted in the study, three specifications were used.:

> "*i) Model 1: age (level and square), education and marital status; (ii) Model 2: model 1 and type of occupation; (iii) Model 3: model 2, size of enterprise and economic sector. However, the results shown refer mainly to Model 3, although in the case of decompositions a robustness test is carried out considering also the other models*" (p. 86).

In addition, this author, when analyzing the dimensions by company size and type of occupation, finds the following results:

> "*Women have a significant share in the top income quintiles, which occurs regardless of the size of the company in which they work ... The widest average wage gaps between men and women are among those who: have higher education, are over 45, are married, and who work in White Collar occupations ... Gaps typically show nonlinear patterns along the distribution, calling into question the scope of the average wage gap analysis.... Finally, when performing the analysis of wage decomposition, it was found that, in general, men have higher returns than women when compared to pairs of equal characteristics. Therefore, this becomes evidence that women face significant wage discrimination, despite the fact that in a global sense they have better characteristics than men, mainly in terms of educational level.*" (pp.104-105).

At the regional level, we have studies to determine wage inequality such as the study of the Inter-American Development Bank (IDB, 2020) when analyzing the labor income gap by gender in Bolivia uses the decomposition of the Oaxaca-Blinder model and the Ñopo model, and finds the following results.:

> "*The Blinder-Oaxaca Decomposition shows us a reduction from 32% of the income gap in 1993 to 7% in 2018 and the Ñopo Decomposition shows us a reduction in the gap from 43% to 7% in the same period. This reduction is explained by the reduction of both components, the first explainable by the reduction of differences in observable characteristics, especially that related to improvements in women's education and the impact of family characteristics.. The second component that explains the reduction of the gap is due to the reduction of the unexplained component, assumed as discrimination ... Considering formality, we find an absence of gap not explained by gender in the formal sector, while in the informal sector it is almost 7% of the average income ... These results have important implications for the possibility of implementing public policies. It is necessary to continue with the reduction of the income gap, for that it is necessary to promote equal access of women to sectors and occupations that generate higher remuneration. This can be achieved through the training and labor insertion of women in non-traditional occupations and sectors, which allows them to improve their labor productivity and consequently their labor income.*" (p. 18).

Arpi and Arpi (2018) in a study for Peru on labor income inequality between ethnic groups, use the decomposition of the Oaxaca-Blinder model to measure differences in educational level and experience between different ethnic groups, finding the following results:

> "*The explanatory scope by observable characteristics, mainly, difference in educational level, increased from 54% in 2006 to 77% in 2016; Meanwhile, the influence of unobservable characteristics (discrimination) on access to the Peruvian labor market decreased from 46% to 23% between the years of analysis. It is concluded that the inequality of labor income of ethnic groups, between 2006 and 2016, remains unchanged, and there is also a tendency for indigenous Peruvians to decrease over time*." (p1.).

A study by Colacce (2018) for 4 Latin American countries estimates how the elimination of gender differences in labor income can affect poverty and inequality in Bolivia, Brazil, Peru and Uruguay using Rubin's (1957) multiple imputation technique of missing data, and finds the following results:

> "*Brazil and Uruguay have similar participation gaps, but in which income gaps are smaller, and in Bolivia and Peru, the income gap is very large, maintaining high levels in the participation gap. Additionally, the differentials between men and women in the variables of interest along the income distribution are different between the two pairs of countries analyzed (p.8). While the effects of eliminating gender differences in the labor market on poverty are unequivocal and always positive, the effects on labor income and household income inequality cannot be widespread, they will depend on the country and the scenario. This is because, depending on the starting situation, changes are generated in different parts of the income distribution, reflecting how gender inequalities are concentrated in the labor market of each country.* (p. 1)".

Caicedo (2009) in a study of wage inequality in the United States for Mexican, Cuban and Central American immigrants, uses the method of decomposition of wage gaps developed by Oaxaca - Blinder, to establish how much of the gap is due to differences in human capital among workers, and how much to the differential treatment exercised by the market on some workers, and find the following results:

> "*There are great differences in human capital among workers, but also, the unequal treatment of the market exercised mainly towards some groups of Latin American workers (p.1). Stereotypes around different nationalities and sex operate strongly in societies as rich and developed as the United States, where there have supposedly been efforts to eliminate unequal treatment among workers. The symbolic constructions around sex and nationality, are especially affecting women, this means that, in most cases, although on average they have a set of productive characteristics superior to those of men, they are in a worse situation than they do in the market.* (p.17)".

3. Methodology

The methodology applied is based on the possible existence of error due to sample selection bias, since, when analyzing the income of the respondents, the characteristics of those who do not participate in the labor market are omitted. To identify the existence of this error, and the steps to follow, the process described by Jones (2007) and Adkins and Hill (2011) was used as a reference, who conclude in the application of Heckman's model to solve it. The estimates of Heckman's model allow to obtain reliable sign, magnitude and inference results. Subsequently, the Oaxaca-Blinder method was carried out, to show if the differences in income are due to discriminatory situations.

Based on the sample selection problem, according to Adkins and Hill (2011) the model to be estimated is made up of two equations. On the one hand, the regressors that determine if a variable has values greater than or equal to zero, or if it has lost values, that is, if the variable can be observed or not, this is described in equation number 1. It should be noted that the population analyzed is made up of $1, \dots, N$ people, $whereas, the\ population\ actually\ observed, without\ lost\ values, is\ made\ up\ of\ 1, \dots, n$ people; and, besides, n < N.

$$w_i = \alpha_0 + \beta x_i + \varepsilon_i\,, \qquad i = 1, \dots, N, \qquad w_i = \begin{cases} 1 & w_i \geq 0 \\ 0 & other\ cases \end{cases} (Equation\ 1)$$

On the other hand, the linear equation whose regressors are the objective of the research is estimated, in this case they contain the determinants of labor income, in general terms it is expressed in the equation 2.

$$y_j = \theta_0 + \delta z_j + \mu_j\,, \quad j = 1, \dots, n\ (Equation\ 2)$$

For Adkins and Hill (2011) there is a sample selection problem when the equation of w_i is equal to 1, that is, the variable is observed, and the errors between ε_i and μ_i are related, this is expressed by equation 3.

$$E[y_j/w_j = 1] = \theta_0 + \delta z_j + \delta_\lambda \theta_j \ , j = 1, \dots, n \ \ (Equation\ 3)$$

In the development of this model, it is important to analyze θ_j, which is called "Inverse Mills Ratio" and results from dividing the density functions of both the standard and cumulative random variable. If incorporating the "Inverse Mills Ratio" into equation 2 turns out to be significant, the inference of the model is not efficient, because there is a problem in the selection bias. This is solved from Heckman's model where standard errors are corrected, in general terms it is expressed in equation 4, where the "Inverse Mills Ratio" is estimated. $\bar{\lambda}_i$.

$$y_i = \theta_0 + \delta z_i + \delta_\lambda \bar{\lambda}_i + \mu_i \ (Equation\ 4)$$

In the case of identifying that the regressors are significant, it is pertinent to distinguish if there are differences due to discrimination, for the case of the present study discrimination by sex, age or ethnic self-identification of the people. The procedure described by Neuman and Oaxaca (2004), starts from Equation 4, and compares two groups (either men and women; young and non-young; etc.), which are identified with subscripts 1 and 2 in the following equations.

$$\bar{y}_1 - \bar{y}_2 = \bar{Z}'_2(\hat{\delta}_1 - \hat{\delta}_2) + (\bar{Z}_1 - \bar{Z}_2)'\hat{\delta}_2 + (\hat{\delta}_{\lambda 1}\hat{\lambda}_1 - \hat{\delta}_{\lambda 2}\hat{\lambda}_2) \ (Equation\ 5)$$

Within the framework of the approach described, the models being analysed are described in equations 6 and 7. The first model analyzes the determinants of the natural logarithm of people's labor income; Unlike the Mincerian models that consider experience measured in years, or age as a proxy for experience, the present model by incorporating dummies to identify young people implicitly includes experience. While the second model analyzes the probability of people participating in the labor market. The estimation of the second model responds to Heckman's two-stage methodology and the estimators allow us to understand what factors affect the employability of people.

Model of labor income:

$$y = \theta_0 + \delta_1 mujer + \delta_2 etnia + \delta_3 jefe + \delta_4 titulo + \delta_5 edad\_18\_24 + \delta_6 edad\_25\_30 + \delta_7 afiliacion + \delta_8 estab + \delta_9 sector + \delta_{10} grupo + \delta_{11} horas + \delta_\lambda IMR + \mu \ (Equation\ 6)$$

Where:

$y =$	Natural logarithm of labor income.
$\theta_0 =$	Coefficient representing a constant magnitude for the model.
$\delta_j, j = 1, \dots, 11$	Coefficients of each of the model-dependent variables
$mujer =$	Dummy, women=1.
$etnia =$	Dummy, ethnicity other than mestizo, white, or other =1.
jefe =	Dummy, Head of household =1.
titulo =	Dummy, whether the person has a third or fourth level degree =1.
$edad\_18\_24 =$	Dummy, if the person is between 18 and 24 years old =1.
$edad\_25\_30 =$	Dummy, if the person is between 25 and 30 years old =1.
$afiliacion =$	Dummy, whether the person has any kind of social affiliation (IESS, ISFA,

ISSPOL) =1.

$estab =$ Dummy, If the person works in an establishment with more than 100 people =1.

$sector =$ Dummy, whether the person works in the branch of the sector concerned with electricity supply, financial activities and administration =1.

$grupo =$ Dummy, whether the person works as managerial, scientific, technical and mid-level professional =1.

$horas =$ Natural logarithm of working hours, in both primary and secondary work.

$IMR =$ Inverse of Mills Ratio.

$\mu =$ Model error.

Model probability of participating in the labor market:

$$pml = \alpha_0 + \beta_1 women + age_{18_{24}} + \beta_3 age_{25_{30}} + \beta_4\, head of\ household + \beta_5 etnicity + \beta_6\, level\ degree + \beta_7\, studie + \varepsilon\ (Equation\ 7)$$

Where:

$pml =$ Dummy, the person participates in the labour market =1.

$\alpha_0 =$ Coefficient representing a constant magnitude for the model.

$\beta_j, j = 1, \ldots, 7$ Coefficient representing a constant magnitude for the model.

$mujer =$ Dummy, women=1.

$edad\_18\_24 =$ Dummy, if the person is between 18 and 24 years old =1.

$edad\_25\_30 =$ Dummy, if the person is between 25 and 30 years old =1.

jefe = Dummy, Head of household =1.

$etnia =$ Dummy, ethnicity other than mestizo, white, or other =1.

titulo = Dummy, whether the person has a third or fourth level degree =1.

$estudia =$ Dummy, if the person is in education =1.

$\varepsilon =$ Model error.

4. Results

The INEC databases called the National Survey of Employment, Unemployment and Underemployment -ENEMDU-, accumulated (annual) for the years 2018, 2019 and 2021, were used. The year 2020 does not contain an accumulated base, this because, during the first months of the pandemic, ENEMDU surveys were not carried out periodically and in person. In the stage of greatest risk due to COVID contagion, telephone ENEMDU was carried out, which due to its design is not strictly comparable to face-to-face surveys. For this reason, the year 2021 is considered as the post-pandemic period, which has information comparable to previous years.

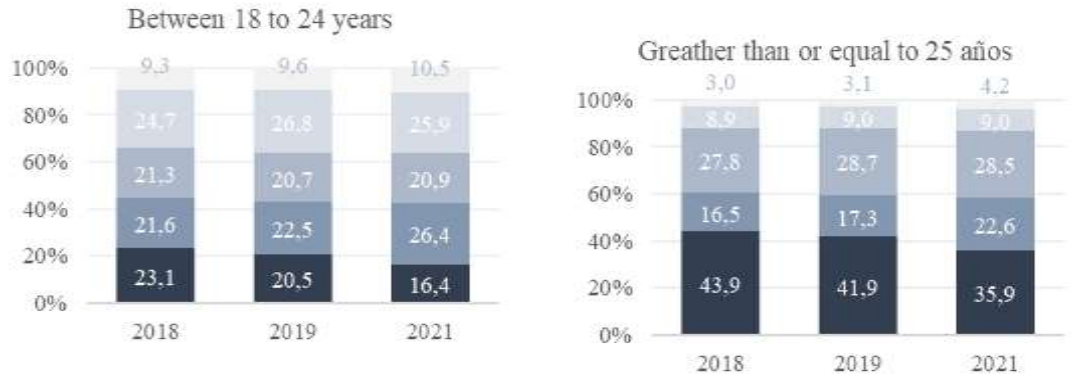
The domains of study of the annual ENEMDU are: national, urban and rural, 5 self-represented cities (Quito, Guayaquil, Cuenca, Machala and Ambato), as well as the 24 provinces of Ecuador. This database is built by INEC from monthly surveys, which are aggregated under a broken panel design that allows for greater representative domains at an adequate level of representativeness. It should be noted that INEC recalculates and calibrates the expansion factors to be annual. The databases, tabulations and technical documents are published on the official INEC website.

According to the information from the databases used, gross employment, which results from the division between employed population and working-age population, went from 64.3% in 2018 to 62.5% in 2021. The following figure shows the prevalence of activity status according to sex, youth and ethnicity; It can be observed that in all cases the percentage of people with full employment decreased, while the percentage of people with unemployment increased; taking into account that the percentage is calculated with respect to the economically active population -EAP-. Relative to the focus groups, the prevalence of women engaged in unpaid and unclassified work is at least 2.5 times higher than that of men. It is also noteworthy that the prevalence of adequate employment does not exceed 25% in people between 18 and 24 years old, or with indigenous ethnic self-identification, Afro-Ecuadorian, black, mulatto and montubio.

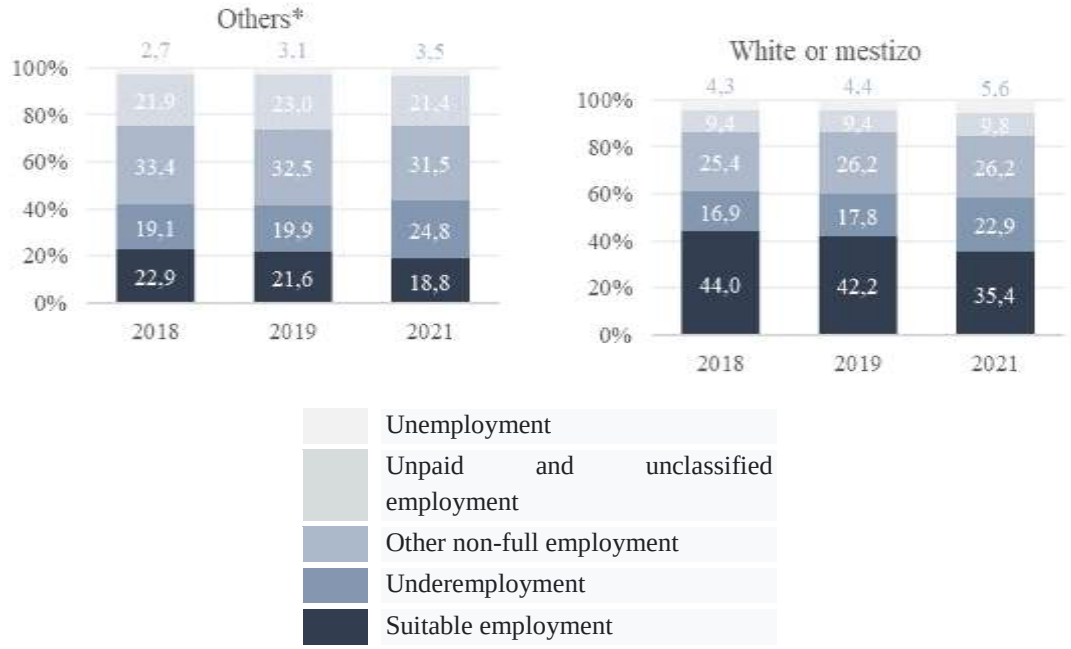
Figure 2. Activity status by sex, youth and ethnicity (% of EAP)

Panel A: Sex

Panel B: Youths



Panel C: Ethnic self-identification



Note: the percentages were calculated with respect to the Economically Active Population of each group and each year, considering the respective expansion factors. In ethnic self-identification others include: indigenous, Afro-Ecuadorian, black, mulatto and montubio.
Source: INEC, ENEMDU Annual 2018, 2019 and 2021. **Elaboration:** Authors.

Due to the variability of the data both in labor income and in hours worked in primary and secondary work, the following figure presents information on the median disaggregated by the different analysis groups, being a more appropriate measure compared to the mean. The value of labor income is presented in constant dollars with base year of 2007 to capture the effect of inflation, it should be noted that in current dollars the value of the highest median was 400 USD.

For women, for both 2018 and 2019, although the median hours of work were the same as for men, the median real labor income was lower. In 2021, both men's and women's incomes decreased, in this case the gender gap was greater than the other two years, although the median working hours were lower for women.

People aged 18 to 24 worked fewer hours per week and had a lower median labor income than people with more or equal to 25 years. It is observed that in the group of young people the reduction in working hours is less than the reduction in their real labor income. In another order of ideas, people with self-identification other than white or mestizo had a lower median income compared to other groups, although the hours of work are similar.

Panel A: Sex

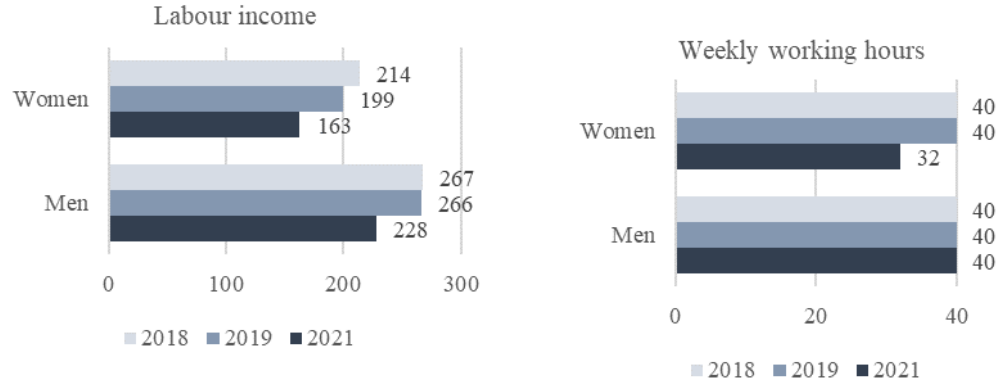
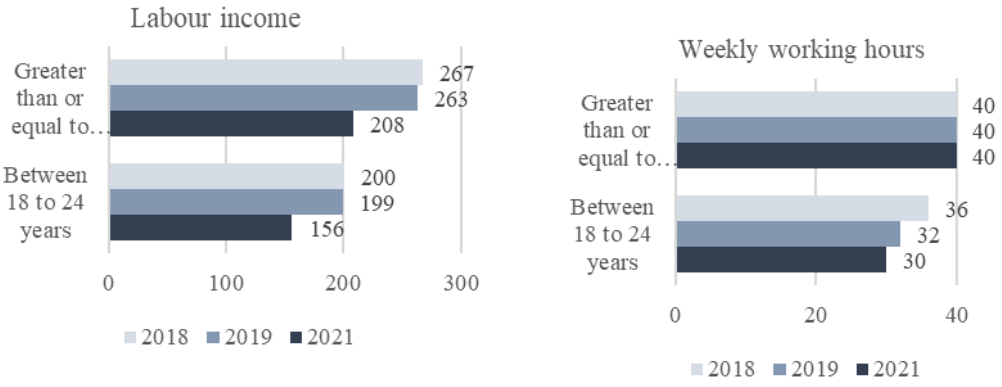
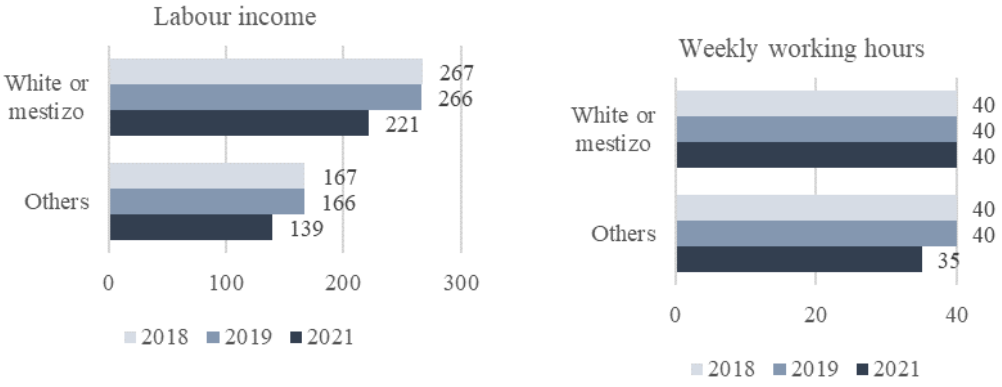


Figure 3. Median labor income (constant 2007 dollars) and weekly work hours

Panel B: Youths



Panel C: Ethnic self-identification



Note: Real labor income was calculated from the implicit deflator of the Gross Domestic Product, with base year of 2007, the expansion factors of the surveys were used. In ethnic self-identification others include: indigenous, Afro-Ecuadorian, black, mulatto and montubio.

Sources: INEC, ENEMDU Annual 2018, 2019 and 2021. Central Bank of Ecuador, Quarterly National Accounts of Ecuador No.119. **Elaboration:** Authors.

In percentage terms, the decrease in income between the pre- and post-pandemic period was greater in women, where labor income decreased 18.4%, about 4 percentage points more than in men. In the case of young people between 18 and 24 years old, the decrease in pre- and post-pandemic income was 21.7%, being a reduction of 1 percentage point greater compared to people with 25 years or more. On the other hand, white and mestizo people had a somewhat greater decrease (16.8%), compared to the decrease of people who self-identify in ethnic minorities (16.2%).

The following table indicates the median labor income according to sex and ethnicity in each year of study, in current dollars the highest value was 441 dollars, however, to compare considering the effect of inflation, the values with base year 2007 were deflated. Note that in all ethnic groups income decreased in 2021. In the case of women, the group with the greatest reduction in median income were mestizo women (20.5%), followed by Afro-Ecuadorians and blacks (19.1%) and mulatto women (18.7%). While, in the case of men, those who presented a greater percentage reduction in income, were Afro-Ecuadorians and blacks (21.4%), followed by montubios (20.5%) and mulattos (16.1%).

The median income of women is lower than that of men in all groups and years; This difference was more pronounced in absolute terms in the group of Afro-Ecuadorians or blacks in 2018; On the other hand, the difference was greater in the group of mestizos for the year 2021. Finally, it is observed that the groups with the lowest median real labor income are the indigenous and montubios; who earn about half the income of people with mestizo or white self-identification.

Table 1. Median real labor income (2007) by sex and ethnicity

	Men			**Women**		
	2018	**2019**	**2021**	**2018**	**2019**	**2021**
Indigenous	167	166	148	100	100	91
Afroecuadorian and black	267	253	198	197	203	164
Mulato	257	233	195	194	173	141
Montubio	174	180	143	134	100	91
Mestizo	281	271	254	234	213	169
White	295	279	260	253	253	215

Note: Real labor income was calculated from the implicit deflator of the Gross Domestic Product, with base year of 2007, the expansion factors of the surveys were used.
Sources: INEC, ENEMDU Annual 2018, 2019 and 2021. Central Bank of Ecuador, Quarterly National Accounts of Ecuador No.119. **Elaboration:** Authors.

For the econometric model, at first it was considered to analyze the wage differences taking into account both the public and private sectors, however, the results were not consistent, so it was decided to focus the analysis on the private sector. In turn, this choice is argued in the sense that people working in the public sector should not face discrimination based on gender or ethnicity when being hired by the contracting mechanisms that exist in that sector. Merit and competitive examinations consider these factors to promote inclusion.

In order to have groups that can be comparable with their labor income, a process similar to that carried out by Carrillo et. Al (2018), building various filters in databases. Thus, people under 18 and over 65 years of age were excluded, as well as those who worked less than 20 hours in the week. Two sectors and one occupation group that had only 1 observation in the three years of study were also eliminated. It should be mentioned that,to make the estimates and construction of filters to the databases, the econometric package Stata was used.

The process carried out by Jones (2007) and Adkins & Hill (2011) to identify if there are problems by sample selection consists of estimating the "Inverse Mills Ratio" which results from the quotient between the standard normal function of equation 1, and the equal cumulative normal distribution function from equation 1. This is

done from the probit model, which in each year had a pseudo R2 adjustment greater than 0.22. By incorporating the "Inverse Mills Ratio" in the MCO model of equation 4, it was identified that it is significant, therefore, the model must be estimated using what Heckman proposed.

The following table presents the results of the estimation performed by the two-stage method. For the years 2018 and 2019, the total number of people analyzed is around 140 thousand; figure that is lower in 2021 because in that year there are fewer observations (122 thousand less compared to the other two years). Both model 1 and model 2 have a significance of at least 1% in all variables, these results are also consistent when estimating for maximum likelihood. Also, the sign is expected in all study variables.

The likelihood of participating in the private sector labour market is reduced for women, ethnic self-identification other than mestizo or white, and young people aged 18-24. In the case of age, when people are between 25 and 30 years old, the probability of being hired is higher, but the income is lower compared to other age groups (note the sign in model 1). People who are heads of household are more likely to participate in the labour market. Also, having a third or fourth level degree implies greater chances of being hired. Conversely, an adult studying during the analysis period is less likely to be working.

In the model that estimates the determinants of the natural logarithm of labor income, it indicates that being female, being young and belonging to an ethnicity other than mestizo or white, is associated with lower levels of income. Among these groups, being young between 18 and 24 years old has the greatest negative impact on income, in part this is explained by the experience of people. For both women and young people, the magnitudes of the estimated coefficients are higher in 2021, which implies that after the pandemic people from these groups who are working in the private sector have lower incomes.

Being head of household, being affiliated to social security, possessing a third or fourth level degree, working in a company with more than 100 workers, and working more hours, is associated with higher levels of labor income. Likewise, if people work in the sectors of electricity supply, financial activities and administration they have higher incomes. Finally, those who have an occupation group such as managerial staff, scientific, technical and mid-level professionals, have higher incomes compared to other groups.

Table 2. Results of Heckman's two-stage estimate

Variable	Model 2018	Model 2019	Model 2021
Model 1 (Natural logarithm of labor income)			
Woman	-0.16330049***	-0.1513297***	-0.16962075***
Ethnic group	-0.07849197***	-0.05938861***	-0.07937906***
Head of household	0.15208747***	0.13355206***	0.16116545***
Title	0.26410141***	0.26490815***	0.24526755***
Age_18_24	-0.24233939***	-0.25798138***	-0.27514489***
Age_25_30	-0.08931765***	-0.09789604***	-0.0749259***
Afiliation	0.53089588***	0.59265603***	0.68675892***
Establishment	0.12509908***	0.07821153***	0.08651153***
Sector	0.15869448***	0.14766466***	0.18998879***
Group	0.34076641***	0.31185967***	0.28429824***
Hours	0.53592827***	0.52806696***	0.67144674***
Constant	3.6021688***	3.6535275***	2.9174497***
Model 2 (Probability of participating in the labor market)			
Woman	-0.9294368***	-0.91978994***	-0.88788832***
Age_18_24	-0.07942333***	-0.10862323***	-0.12051932***
Age_25_30	0.4234776***	0.41714795***	0.39957167***
Head of household	0.57679227***	0.54913243***	0.57553387***
Ethnic group	-0.15373788***	-0.12725027***	-0.14439152***
Title	0.55870283***	0.57503674***	0.52750001***

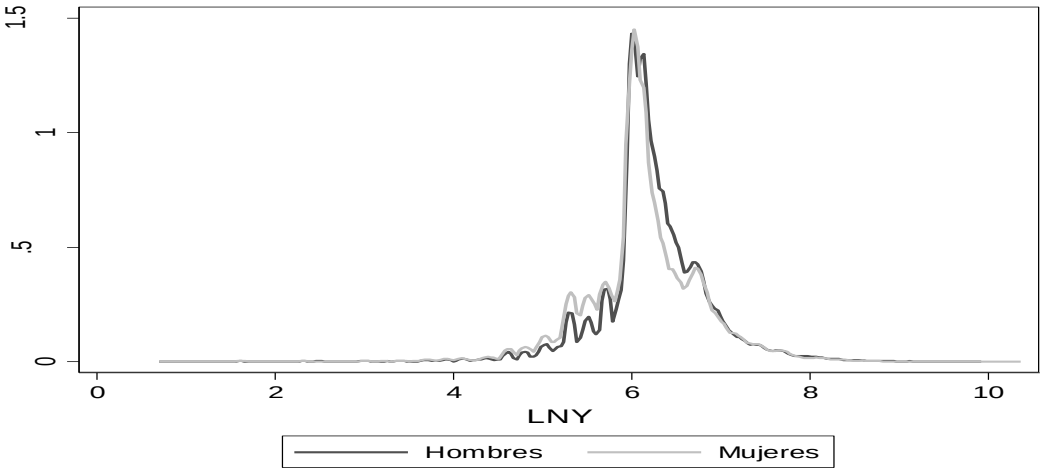
Variable	Model 2018	Model 2019	Model 2021
Studies	-0.93736056***	-0.94146612***	-0.72530989***
Constant	0.26357774***	0.26256444***	0.08585769***
Mills (Lambda)	0.0854325***	0.06222506***	0.116596***
N	140.830	141.088	104.466
N	77.670	78.442	63.210

*Significance: * p<0.10; **p<0.05; ***p<0.01.* **Source:** INEC, ENEMDU Annual 2018, 2019 and 2021. **Elaboration:** Authors.

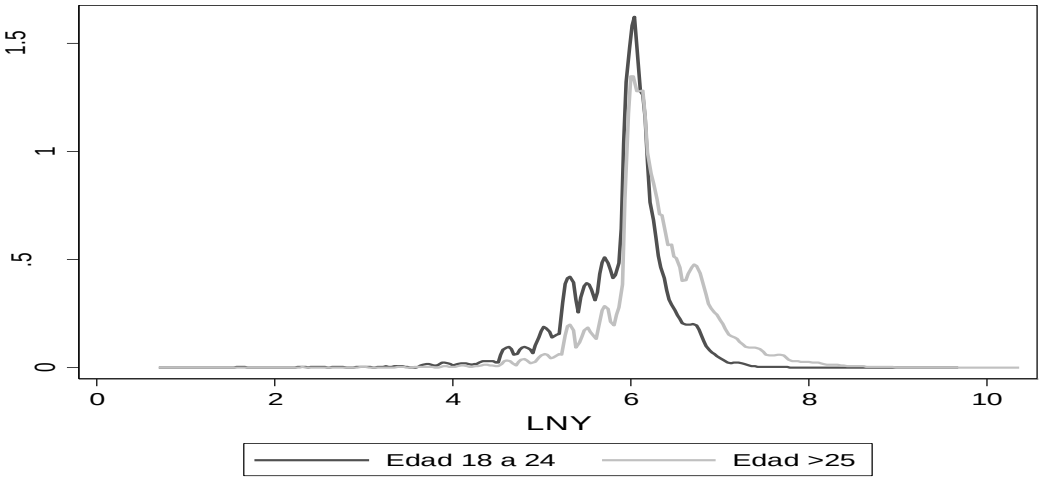
By plotting the Kernel density functions of the natural logarithm of labor income, it is evident in the following graphs that income distributions have a better fit (with more concentrated values up and right of the graph) for men, non-young people and people with mestizo or white self-identification. This implies that women, youth and people from ethnic minorities are more likely to have lower incomes, being consistent with descriptive and econometric analysis. The difference is most noticeable among people aged 18 to 24. The differences in distributions according to sex and ethnicity have some points in common, starting with the fact that women and people from ethnic minorities have a more pronounced distribution to the left; and less pronounced to the right.

Figure 4. Kernel density function by analysis group

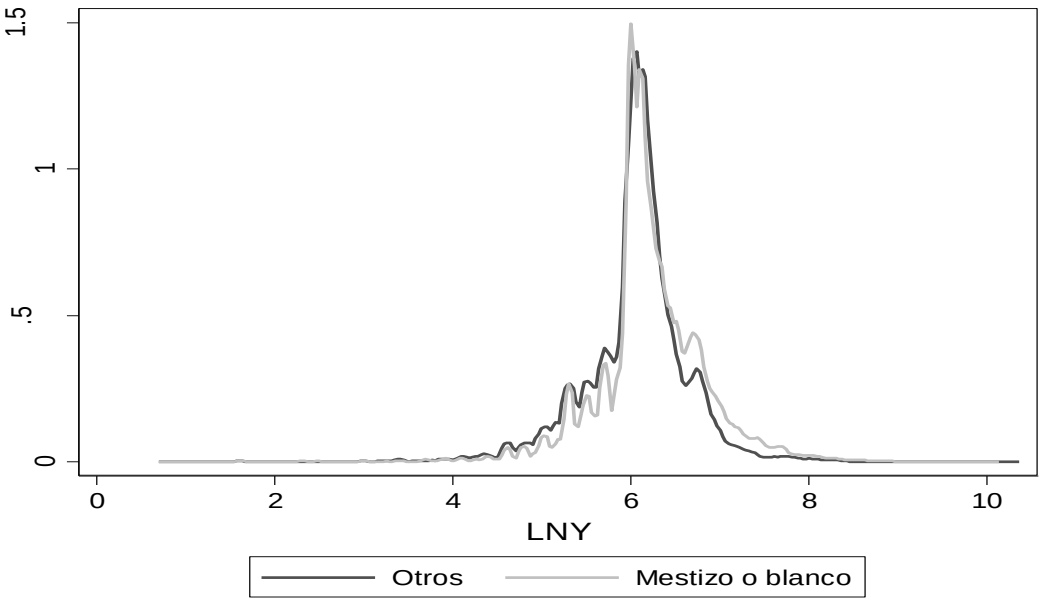
Panel A: Sex



Panel B: Youths



Panel C: Ethnic self-identification



Source: INEC, ENEMDU Annual 2018, 2019 and 2021. **Elaboration:** Authors.

The results obtained from the Oaxaca-Blinder decomposition show that the gap in the logarithm of labor income between men and women increased after the pandemic. This difference is significant at 1% in 2018, and 5% in 2019 and 2021. In 2019 the endowments component is significant, this value indicates that, if women had the same characteristics as men, they would have a lower value in their income. The component of coefficients is significant in all years, this indicates the change in the labor income of women when applying the coefficients of men in the characteristics of them. Finally, in the interaction component, the simultaneous effect of endowments and coefficients is low.

In the case of young people, it is observed that the gap in labor income estimates has decreased, however, the prediction of their income also turned out to be lower after the pandemic. From the decomposition, it is identified that only the endowment component is significant in all years. This implies that the differences in the labor income of young people between 18 and 24 years old with people older than or equal to 25 years are explained by the observable characteristics defined in the model, and is not necessarily due to discrimination. A similar case occurs when performing the analysis according to ethnic self-identification, although in the years 2018 and 2019 a high coefficient component was identified, which would indicate discrimination factors.

Table 3. Oaxaca-Blinder decomposition results

Panel A: Men and women

	Model 2018	**Model 2019**	**Model 2021**
Differences			
Prediction men	6.204476***	6.203155***	6.046913***
Women prediction	5.973049***	6.054828***	5.720907***
Difference	0.2314266***	0.1483266**	0.3260068**
Decomposition			
Endowments	/	-0.0163542**	/
Coefficients	0.2107407***	0.1369152**	0.3283549**
Interaction	0.0146403**	0.0277657***	/

Panel B: Age 18 to 24 years, and over 24 years

	Model 2018	**Model 2019**	**Model 2021**
Differences			
Prediction Y (age 18 to 24 years)	6.049493***	6.103572***	5.776379***

	Model 2018	Model 2019	Model 2021
Prediction Y (age over 24 years)	5.703227***	5.68642***	5.517362***
Difference	0.3462662***	0.4171518***	0.2590168**
Decomposition			
Endowments	0.3234264***	0.3395475***	0.4006005***
Coefficients	/	/	-0.1815022*
Interaction	/	/	/
Panel C: Ethnic self-identification			
	Model 2018	**Model 2019**	**Model 2021**
Differences			
Prediction Y (mongrel, white or other)	6.120413***	6.130945***	5.964014***
Prediction Y (indigenous, Afro-Ecuadorian, black, mulatto and montubio)	5.872636***	6.004644***	5.659964***
Difference	0.2477764***	0.1263006**	0.30405***
Decomposition			
Endowments	0.0924193***	0.1220632***	0.1500012***
Coefficients	0.1295437**	/	0.1464188
Interaction	0.0258135***	/	/

*Significance: * p<0.10; **p<0.05; ***p<0.01; / not significant. Note: The prediction was made with Heckman's estimation in two stages.* **Source:** INEC, ENEMDU Annual 2018, 2019 and 2021. **Elaboration:** Authors.

5. Conclusions

In the determination of wage gaps between men and women, two methodological visions have been manifested. The first, which has to do with the theory of human capital, which explains the differences in human capital (seen as educational level achieved) that determines the difference between the wages of men and women. The second, which considers other unobservable factors such as discrimination, which has not only led to women having less human capital, but access to work is restricted by this gender condition, as well as access to training and quality at work. The percentage of people with full employment decreased and the percentage of people with unemployment increased, between the pre- and post-pandemic periods. The prevalence of women engaged in unpaid and unskilled work is at least 2.5 times higher than the prevalence of men. It is also noteworthy that the prevalence of adequate employment does not exceed 25% in people between 18 and 24 years old, or with indigenous ethnic self-identification, Afro-Ecuadorian, black, mulatto and montubio.

In all ethnic groups, incomes decreased in 2021, and the probability of participating in the private sector labor market is reduced for women, ethnic self-identification other than mestizo or white, and young people between 18 and 24 years old. In the case of age, when people are between 25 and 30 years old, the probability of being hired is higher, but the income is lower compared to other age groups.

Being female, young, and belonging to an ethnicity other than mestizo or white is associated with lower income levels. For both women and young people, the magnitudes of the estimated coefficients are higher in 2021. This implies that after the pandemic, people in the analysis groups who are working in the private sector have lower incomes. There are conditions for having higher incomes, such as being affiliated to social security, having a third or fourth level degree, working more hours a week, and working in sectors and occupational groups that are generally more remunerated.

Finally, the gap in the logarithm of labor income between men and women increased after the pandemic. This difference is significant at 1% in 2018, and 5% in 2019 and 2021. Income gaps are explained by discriminatory factors and observable factors for women and ethnic minorities; while for young people it is due only to

observable factors. Only in 2019 the endowments component is significant in women, this value indicates that, if women had the same characteristics as men, they would have a lower value in their income. In the case of young people, it is highlighted that the gap in labor income estimates has decreased, although the prediction of their income also turned out to be lower after the pandemic.

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