

# Differences by gender in the marginal rate of return to undergraduate and graduate studies in Mexico

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## *Abstract*

This research is aimed at estimating the marginal rate of return to Undergraduate and Graduate Education (UGE) in Mexico with a gender approach. To that end, the impacts of the UGE on the earnings of men and women who have completed an undergraduate or a graduate program are assessed. The estimation of the wage earning rate is carried out by using the procedure proposed by Heckman, Tobias and Vytlačil (2000) and (2001). The information used for the estimates is based on a sample from the National Household Income and Expenditure Survey (ENIGH for its acronym in Spanish) 2012. The proposed estimation procedure addresses the problems associated with heterogeneity and self-selection of individuals. The main empirical result of this research is that UGE has a positive impact on wage income in both genders, but the impact is lower for women.

*Keywords:* Returns, higher education, self-selection, gender, Mexico.

## *Resumen*

Esta investigación estima la ganancia salarial marginal de la Educación Superior y el Posgrado (ESP) en México con un enfoque de género. Para ello se evalúa el impacto de la ESP sobre los salarios de hombres y mujeres que concluyeron una carrera profesional o un posgrado. La estimación de la tasa de ganancia salarial se realiza mediante el procedimiento propuesto por Heckman, Tobias and Vytlačil (2000) and (2001). La información utilizada para las estimaciones se basa en una muestra de la Encuesta Nacional de Ingresos y Gastos de los Hogares (ENIGH) 2012. El procedimiento de estimación propuesto corrige los problemas asociados con la heterogeneidad y la autoselección de los individuos. El principal resultado, soportado por la evidencia empírica, es que la ESP tiene un impacto positivo sobre los ingresos salariales en ambos géneros, pero el impacto es menor para las mujeres.

*Palabras clave:* Tasa de ganancia salarial de la educación superior, autoselección, género, México.

## INTRODUCTION

**T**he wage differential in the population is a subject of continuous debate and concern. This differential in individuals who have concluded a professional career or a postgraduate degree should be reduced regardless of gender. The present research finds empirical evidence that academic training does have a positive impact on the rate of wage gain (return) of men and women with higher education or postgraduate studies (masters or doctorate), but the impact is, unfortunately, lower in the case of women. In this way, not only there are differences in job opportunities for women, but also in their salaries.

Based on information from the National Council for the Evaluation of Social Development Policy (CONEVAL), in Mexico in 2012, there were 53.3 million people living in poverty, of which 41.8 million are moderate poor and the remaining 11.5 million are in a situation of extreme poverty. Of the 53.3 million Mexicans, 52% (27.6 million<sup>1</sup>) were women, of whom about half are under 30 years of age and with average families of 4.14 members (higher than the national average<sup>2</sup>) and are concentrated mostly in urban areas.<sup>3</sup>

In contrast to the above, as shown in Table 1 (lines 4, 5 and 6), the indicators referring to the vulnerable population due to social deprivation<sup>4</sup> point out to a greater extent in men than in women in both urban and rural areas; while the vulnerable population by income<sup>5</sup> is to a greater extent that of women. In the case of people who are not poor or vulnerable,<sup>6</sup> the situation is maintained in the same proportions when the information is disaggregated by gender, but not by size of the locality, since the majority of the population in these conditions is in the urban area.

<sup>1</sup> Of this total, 19 million are in the urban area and 8.6 million in the rural area.

<sup>2</sup> The national average, according to the INEGI, is 3.7 members at home.

<sup>3</sup> Information about other indicators can be found in Wagstaff (2002).

<sup>4</sup> Vulnerability due to social deprivation refers to that population that presents one or more social deficiencies, but whose income is higher than that of the welfare line.

<sup>5</sup> Vulnerability by income refers to that population that does not have social deficiencies and whose income is less than or equal to that of the welfare line.

<sup>6</sup> It refers to that population whose income is higher than the welfare line and has no social deficiency.

Table 1 : Deprivation and welfare lines by poverty indicator and gender 2012  
(millions of people)

Indicators	Urban		Rural		Total
	Men	Women	Men	Women	
<i>Poverty</i>					
Population in a situation of poverty	17.6	19	8.2	8.6	53.3
Population in a situation of moderate poverty	14.8	16.1	5.3	5.6	41.8
Population in extreme poverty	2.8	2.9	2.8	3	11.5
Vulnerable population due to social deprivation	12.7	12.1	4.4	4.3	33.5
Vulnerable population by income	3.1	3.7	0.2	0.2	7.2
Population not poor and not vulnerable	10.3	11.5	0.7	0.7	23.2
<i>Social deprivation</i>					
Population with at least one social need	30.3	21.1	12.5	12.9	86.9
Population with at least three social needs	7.8	7.4	6.4	6.5	28.1
<i>Indicators of social deprivation</i>					
Educational lag	6.3	7.4	4.2	4.6	22.6
Deficiency of access to health services	10.6	9	3.1	2.5	25.3
Deficiency of access to social security	25.2	24.5	11	11.2	71.8
Deficiency of quality and spaces in housing	4.7	4.8	3.1	3.2	15.9
Deficiency of access to basic services in housing	4.6	4.7	7.7	7.9	24.9
Deficiency of access to food	9.2	9.8	4.1	4.3	27.4
<i>Welfare</i>					
Population with income below the minimum welfare line	6.9	7.7	4.3	4.6	23.5
Population with income below the welfare line	20.7	22.8	8.3	8.8	60.6

At Module of Socioeconomic Conditions 2012.

Source: own elaboration based on estimates of CONEVAL.

In Table 1, a greater number of women is observed in both urban and rural areas with educational lag, which shows evidence of the existing differences in development opportunities between men and women; situation contrary to health services, since men are those who least attend these services. With regard to the minimum welfare lines<sup>7</sup> and welfare,<sup>8</sup> it is observed, as expected, a greater number of people in a situation of income below these lines of welfare are again women, which shows that in Mexico there are still pending tasks on gender equity in health, education, and food, as well as job opportunities.

On the other hand, Schultz (1961) considers that the creation of human capital is based on the approach that people increase their capacities as producers by investing in themselves increasing the level of schooling. It is important to mention the work of Parker and Pederzini (2000) in which it is emphasized that school attendance of girls is reduced after 12 years of age, which has a negative impact on the formation of human capital by gender. Taking into account the existent inequality<sup>9</sup> in Mexico, the issue of human capital is relevant because it allows to explain to a large extent the development of individuals, particularly the benefits they receive from education; being the rate of wage gain an important indicator, since it directly impacts the lines of welfare of men and women.

The main contribution of this research is to provide empirical evidence that education has a positive impact on the wage income (earnings) of individuals in a differentiated way between men and women based on various observable and underlying factors related to the family and economic environment that significantly impact the probability that individuals decide to study an UGE program. This allows obtaining a rate of wage gain (marginal rate of return) according to the intensity with which these factors are presented by gender.

The objective of this research is to estimate the impact of UGE on the earnings of bachelor or graduate studies throughout their life cycle considering their gender. The theoretical framework for analyzing the differences in wage income by gender is based on Mincer's (1974) human capital model. This model provides the theoretical basis for the study of earnings based on variables that increase the productivity of individuals. Since the work of Schultz (1961) and Becker (1962, 1964), an important number of contributions have been developed in the estimation of investment returns

<sup>7</sup> Equivalent to the cost of the food basket.

<sup>8</sup> Equivalent to the sum of the costs of the food and non-food basket.

<sup>9</sup> Term used in the gender perspective to refer to the differences in opportunities between women and men.

in human capital, whose results consistently demonstrate that the educational level is a determinant of the level of income.<sup>10</sup>

There is a large number of studies in many countries on the returns to education, among which are: Hansen (1963), Hanoch (1967), McMahon (1991), Psacharopoulos (1993), Ashenfelter y Krueger (1994), Altonji (1993), Altonji y Dunn (1996), Harmon y Walter (1995), Alba-Ramírez y San Segundo (1995), Cohn y Addison (1998), Card y Ashenfelter (1999), Asplund y Pereira (1999), Card (2000), Harmon, Walter y Westergaard-Nielsen (1991), Walter y Nielsen (2001), Carneiro *et al.* (2001), Psacharopoulos y Patrinos (2002), San Segundo y Valiente (2003), Harmon *et al.* (2003), Carneiro *et al.* (2003), Arrazola *et al.* (2003) y Moffitt (2007). In the case of Mexico, there are several estimates of the returns to education, for example: Austria y Venegas-Martínez (2011), Carnoy (1967), Bracho y Zamudio (1994), Rojas, Angulo y Velásquez (2000), Barceinas (2001), Sarimaña (2002), Del Razo (2003), Rodríguez-Oreggia (2004), López-Acevedo (2004) y Ordaz (2007). With regard to the literature related to gender studies, it is worth mentioning : Katrin *et al.* (2013), Coneval (2012), García (2008), Cabo y Garzón (2007), García y Oliveira (2007), Ariza (2006), Arriagada (2005), CEPAL (2004), CEPAL-UNI FEM. (2004), Raczynski (2003), Gómez (2002), Salles y Tuirán (2002), Parker y Pederzini (2000), Gerstenfeld y León (1999), Faúndez (1996), Goldschmidt-Clermont (1995), CEPAL/OREALC (1992) y García de Fanelli (1989), among many others.

With regard to estimation methods, Card (1999) finds in his measurement of educational returns finds that the OLS estimator, resulting from Mincer's (1974) wage equation, presents two important biases: one attributed to the correlation between schooling and the slope of the income function and the other related to the skills of individuals, whose effect is captured in the intercept of the regression that correlates with schooling. This author incorporates in his econometric methodology instrumental variables<sup>11</sup> to partially deal with both biases. However, this problem is not completely resolved. To address this limitation, in this study, the two-stage process suggested by Heckman *et al.* (2000) and (2001), which considers the problems of bias related to self-selection and the heterogeneity of individuals.

<sup>10</sup> For Becker (1964), spending on education or training means capital investments that are in full agreement with the traditional definition of the concept of capital Skipper, 2006).

<sup>11</sup> Barceinas (2001) mentions that to avoid biases in the OLS estimates in the analysis between schooling and income, Instrumental Variables (IV) can be used where the necessary condition for the method to provide consistent estimators is that the instruments used are not correlated with the ability of the individual, which avoids the problem of endogeneity.

According to the above, Diez de Medina (1992) mentions in his research that the problem of self-selection bias is common in the evaluation of the impact of programs, particularly in the case of quasi-experimental methods and arises when the extraction of a sample is performed with the same probability of selection for all its elements either by the form of extraction of the sample or by the characteristics of the individuals under study, or by both. In random sampling, it is always available the information of the *prior* probability of extraction of each individual in the sample, so if there is an equal probability, a larger sample will provide better estimates. This implies that if the sample is not random it is only possible to describe characteristics of the sample but not of the population. Diez de Medina (1992) also suggests that unlike the experimental design where the control group is made up of eligible people who voluntarily apply to receive a program or treatment, both groups should be randomly assigned avoiding<sup>12</sup> with it the problem of self-selection bias; the quasi-experimental design seeks to form a control group based on econometric techniques with external data<sup>13</sup> to the same program. Given that there is no type of random assignment in the conformation of both groups in the experimental design, it is not possible to ensure the initial equivalence of the treatment and control groups, which obviously leads to the problem of bias by self-selection and the presence of possible problems of both internal<sup>14</sup> and external<sup>15</sup> validity of the used design.

It is important to point out that in this research there is no alternative design method for the target population since the design of the ENIGH is probabilistic, stratified, one-stage and by conglomerates. In this way, from the ENIGH only the extraction of the population of interest was carried out. Likewise, the ENIGH aims to obtain statistical information on the distribution and structure of household income and expenditure, as well as economic activities carried out by household members in Mexico. Thus, the characteristics of the population are also included in the representativeness of the ENIGH, so that all the individuals in the sample have the same

<sup>12</sup> The observed and unobserved characteristics in the control and treatment group are assumed to be equally distributed.

<sup>13</sup> This is due to the fact that in its design there are existing data that possibly its original conception was not intended to evaluate.

<sup>14</sup> In this regard, Campbell and Stanley (1973) report that the quasi-experimental design has internal validity when all possible explanations are controlled by the design.

<sup>15</sup> According to Campbell and Stanley (1973) this validity refers to the need for representativeness of the sampling units, looking for the possibility of extrapolating or generalizing the effects of the results obtained to other contexts such as: populations, treatment variables and measurement variables.

probability of being selected. Next, the steps followed by this research are summarized below:

1. It will start from the ENIGH.
2. The target population is extracted from the ENIGH.
3. The extracted information contains economic variables and underlying characteristics of the target population.
4. Estimation of the marginal rate of return by gender via the comparison of the treatment and control groups.
5. Identification of the determinants that affect the educational level and wage income (result) by gender.

In order to estimate the wage gain rate (returns) of UGE in Mexico by gender, the quasi-experimental<sup>16</sup> method will be used, which compares the treatment and control<sup>17</sup> groups, making it possible to isolate the observable characteristics of both groups and evaluate to what extent differences can be attributed between the educational level (treatment) and the wage income (result) observed without incurring in problems of bias. The counterfactual scenario will be estimated simulating what would have happened if the project had never been carried out; being necessary to separate the effect of the interventions from other factors. In the present investigation four effects of interest are estimated, namely: 1) average treatment effect (ATE), 2) marginal treatment effect (MTE), 3) Treatment on the Treated (TT), and 4) local average treatment effect (LATE), as proposed in Heckman, Tobias and Vytlačil (2000) and (2001) for the correction of the self-selection bias.

It is necessary to emphasize that in the specialized literature the impact of the return to education is evaluated mainly from a perspective of private returns. This is due to the fact that the Mincer's (1974) earnings equation estimates private income, which is the traditional way of estimating the rate of return (RR) of investment in education. The main limitation of this procedure is to leave aside the estimation of the social returns associated with the expenses (investment) and other external factors associated with the public sector that have a significant impact on the returns to education.

This investigation is organized as follows: section 2 describes the method for estimating the rate of return to higher and graduate education; in the course of section 3, the sample to be used is described and the results

<sup>16</sup> The advantage of these designs is the existence of data, representing lower cost and promptness in its implementation once the program has been developed.

<sup>17</sup> The treatment group represents those individuals who receive the intervention; while the control group represents those who do not participate in a program or receive benefits (Baker, 2000).

of the econometric estimations are explained; finally, in section 4, the conclusions are presented.

### ESTIMATION METHOD

According to Baker (2000), in the impact evaluation of programs it is common to use econometric techniques to infer about the behavior of populations that are of interest. It is also common for samples to have certain qualities, which if not considered, may lead to the assumption that individuals do not decide to carry out the program voluntarily, but rather because of their characteristics. Considering this, the problem of bias and heterogeneity will be addressed with the methodology described in Heckman *et al.* (2000) and (2001), which is described below.

It is assumed that an individual obtains a result (hourly wage) with or without treatment (Higher and Graduate Studies). To do that, let  $Y_1$  be the result with treatment and let  $Y_0$  be the result without treatment, hence only one of these two variables is observed for each individual. To evaluate the effect of the treatment, the unobservable variable must be measured, which is obtained from the difference of means  $Y_1 - Y_0$  according to the following equations:

$$D = Z\theta + U_D \quad (1)$$

$$Y_1 = X\beta_1 + U_1 \quad (2)$$

$$Y_0 = X\beta_0 + U_0 \quad (3)$$

$$\begin{pmatrix} U_D \\ U_1 \\ U_0 \end{pmatrix} \sim N \left( 0, \begin{bmatrix} 1 & \sigma_{1D} & \sigma_{0D} \\ \sigma_{1D} & \sigma_1^2 & \sigma_{10} \\ \sigma_{0D} & \sigma_{10} & \sigma_2^2 \end{bmatrix} \right)$$

where:

Equation (1) stands for a latent variable<sup>18</sup> of exposure to treatment, and since the latent variable,  $D$ , is a function of the set of independent variables contained in  $Z$ , a restriction of exclusion appears naturally for the set of independent variables in  $X$  that determine  $Y_1$  and  $Y_0$ . Under this constraint, the mechanism of choice must include at least one element in  $Z$  that is not

<sup>18</sup> The characteristic of this type of variables is that they can not be measured directly, but they allow defining a pattern of responses to a group of indicators (Willms, 2006), such is the case of Probit models.

in the set  $X$ ; see, in this regard, Heckman y Vytlacil (2001).<sup>19</sup> With respect to equations (2) and (3), the variables  $Y_1$  and  $Y_0$  represent the natural logarithm of the hourly wage with and without the UGE program, respectively. These variables depend, in turn, on a set of variables contained in  $X$ , the determinants of the dependent variable that is observed only in two possible states.<sup>20</sup>

Because the impact of a program is different according to the individuals in the sample, certain assumptions will condition the type of characteristics that will be evaluated in them. The first assumption, in this study, is that the effect of the program is not the same for all individuals. The second is that the effect is different between the treatment and control group, being impossible to determine *a priori* the magnitude of the effects, and the third is that the effect among those who decide to carry out the program is also different, so that the decision to carry out the program will depend on the intensity with which its observed and underlying characteristics are presented. This last assumption has important implications in the design of public policies, since the efficient targeting of individuals with certain characteristics will contribute to the impact of the programs on the target population; see Heckman and Vytlacil (2001). In order to estimate the UGE return through the expected log-wage gain (or expected wage gain rate), four parameters proposed in Heckman *et al.* (2000) and (2001) will be estimated: ATE, MTE, TT, and LATE. These are commonly used to evaluate the impact of programs and their scope is briefly explained below.

The ATE effect is defined as the expected return of the program when an individual is randomly chosen from within the eligible population.<sup>21</sup> This parameter estimates the expected gain for any given person a set of observable variables contained in  $X = x$ . For its estimation the following equation is used:

$$\text{ATE}(x) = E(Y_1 - Y_0 \mid X = x) = x(\beta_1 - \beta_0) \quad (4)$$

This effect is useful if instead of eliminating or reducing a program it required to extend the program to the entire eligible population and make it mandatory for all people who meet certain characteristics.<sup>22</sup> For example, in terms of social development programs, it has been shown that these

<sup>19</sup> These authors refer that the mechanism of choice is the result of the restriction between the wage equations (2) and (3) and equation (1) that contains the latent variable.

<sup>20</sup> The possible states make reference to that an individual must belong to one and only to a group in the selected sample.

<sup>21</sup> In this work, the eligible population is constituted by the treatment and control group.

<sup>22</sup> Heckman (2000) and (2001) affirm that it is not useful to consider the entire population where individuals that should not be targeted by the program are included, for which it is possible to

have brought benefits to the target population, guaranteeing targeting the proportion of the population subject to receiving the benefit.

With regard to the MTE, in addition to estimating the preferences of the objects under study, the expected return of the program for those individuals that are in the limit of participating in it<sup>23</sup> constrained to the set of observable variables contained  $X = x$  in and underlying variables contained in  $U_D = u_D$ . In this context, it is necessary to investigate whether individuals have underlying variables that influence the choice to receive treatment, registering lower returns. The estimation of this parameter is formally given by:

$$\text{MTE}(x, u_D) = E(Y_1 - Y_0 | X = x, U_D = u_D) = x(\beta_1 - \beta_0) + (\rho_1\sigma_1 - \rho_0\sigma_0)u_D \quad (5)$$

The usefulness of the MTE is derived from the dependency it keeps with the values of  $u_D$ <sup>24</sup>, in such a way that if the MTE effect is evaluated with high values of  $u_D$ , the average wage gain will be calculated for those individuals whose unobservable factors make their participation in the treatment less likely, and the contrary for low values of  $u_D$ . Thus, if  $u_D = 0$ , then MTE is equal to ATE.<sup>25</sup> Although the MTE effect turns out to be the limiting form of the LATE effect, this effect is usually a useful tool to demonstrate the existence of externalities that tend to affect the probability that individuals decide to carry the program or not; hence the expected negative sign and that in the case of social programs can mean its success or failure.

With respect to the TT effect, this is defined as the expected return of the program for those individuals who chose to participate and who actually received the treatment voluntarily. So the expected gain of those who have actually received the treatment ( $D = 1$ ) subject to the set of observable variables contained in  $X = x$  and  $Z = z$  is given by:

$$\text{TT}(x, z, D = 1) = E(Y1 - Y0 | X = x, Z = z, D = 1) = x(\beta_1 - \beta_0) + (\rho_1\sigma_1 - \rho_0\sigma_0) (\varphi(z\theta/\Phi(z\theta)) \quad (6)$$

restrict the ATE average and take into account only segments of the population on which it is important to influence through some public policy

<sup>23</sup> It was introduced by Björklund and Moffitt (1987), and is the limiting form of the LATE parameter where individuals who have not received treatment have a slightly lower return than they can if they decide to participate in the program.

<sup>24</sup> This component captures all those unobservable factors that significantly affect the latent variable and that are linearly independent of the explanatory variables contained in  $Z$ .

<sup>25</sup> As  $u_D$  approaches zero, individuals are more likely to decide to carry out the program, since there are no underlying factors that prevent carrying out an UGE program.

Where  $f(\cdot)$  represents the density function of a standard normal random variable,  $F(\cdot)$  denotes its cumulative distribution function,  $r_1$  and  $r_0$  are the correlation coefficients between  $U_1$  and  $U_D$ , and  $U_0$  and  $U_D$ , respectively. The relevance of this effect is to demonstrate that the program records the expected impact on the income of individuals that voluntarily decided to carry out the program and is also higher compared with those with a lower educational level.

The effect LATE<sup>26</sup> is defined as the expected performance of the program due to changes in the observable factors contained in  $Z_k$ , which induce the individuals to receive the program. This effect is defined by a change from  $Zq = z$  to  $Zq = z'q$  with  $zq < z'q$ , being  $z$  and  $z'$  the same in everything, except in the  $k$ -th element. To estimate this parameter, formally, it is written:

$$\text{LATE}(D(z) = 0, D(z') = 1, X = x) = E(Y_1 - Y_0 \mid D(z) = 0, D(z') = 1, X = x) \\ = x(\beta_1 - \beta_0) + (\rho_1\sigma_1 - \rho_0\sigma_0) (\varphi(z'\theta) - \varphi(z\theta)/\Phi(z'\theta) - \Phi(z\theta)) \quad (7)$$

The relevance of this effect is that it allows to simulate expected impacts (local effects) of the program, product of variations in the values of variables of interest, which, when compared directly with the results of the ATE effect, allow the formulation and definition of strategies that contribute to the achievement of the objectives of the program efficiently.<sup>27</sup> In this research, the LATE effect help to simulate the expected returns of individuals when parents' education and the size of the family are changed, being useful to estimate the magnitude of the impact of the strategies of interest.

The results obtained with the four parameters of interest are presented below using the two-stage process proposed in Heckman (2000) and (2001). In the first stage a Probit model is estimated where the auxiliary variable  $l$  is calculated, which captures the effect of the self-selection bias in the latent variable  $D$ . In the second stage, Mincer's wage equations are estimated using the auxiliary variable  $l$  to correct the bias caused by the truncation of the variables  $Y_1$  and  $Y_0$ , allowing to obtain reliable parameters with emphasis on the gender approach.

<sup>26</sup> As a version of the MTE, the LATE effect was introduced by Imbens and Angrist (1994). The limiting form of the LATE is due to Heckman (1997) and Angrist *et al.* (2000).

<sup>27</sup> This parameter is estimated, generally on the determining variables in the decision that the individuals carry out the program or not.

## ESTIMATION Y EMPIRICAL RESULTS

Below are the estimates obtained from equations (1) to (3), first describing the characteristics of the sample used.

### The Sample

For the econometric analysis, information is used from the National Household Income and Expenditure Survey (ENIGH) 2012, which contains information on different socioeconomic characteristics of individuals.<sup>28</sup> The most important restriction in relation to the information available in the survey is that it does not include all the information about all the family characteristics used in this study. For example, it does not include data on the size of the household, level of family income and experience that are important to explain the choice of individuals (children) to take on or not a program of UGE, being necessary to build variables in the traditional way from the information available. The construction of the sample<sup>29</sup> was made under the following considerations:<sup>30</sup>

1. Men and women who lived with their parents were included, having thus the educational level and income of the head of the family.<sup>31</sup>
2. Those individuals whose income from the head of the household was not specified (missing values) were left out, including children who had a positive salary.
3. The age of the individuals was limited in the range from 22 to 65 years.<sup>32</sup>
4. Salaried employees were considered to work more than 20 hours a week.<sup>33</sup>

<sup>28</sup> Stata Software (version 12) was used.

<sup>29</sup> It is important to notice that no additional sampling design method was used to define the target population. This is derived from the fact that the design of the ENIGH is probabilistic, stratified, one staged and by conglomerates. In this sense, only an extraction of the population of interest was carried out from the ENIGH.

<sup>30</sup> It is the objective of the ENIGH that the statistical information of the distribution, volume and structure of family income and expenditure, as well as the economic characteristics of households in Mexico. The characteristics of the target population are also included in the ENIGH, so that the elements of the sample have all the same probability of being selected.

<sup>31</sup> It is possible to infer about the role of parents, both socially and economically, in the decision that the family members (sons and daughters) carry out an ESP program and that this affects the income of the family members.

<sup>32</sup> Individuals in the ages from 0 to 12 years who have registered income for main work were eliminated from the sample. In addition, from the age of 22, on average, individuals graduate from the university.

<sup>33</sup> Income associated with any income other than salary is discarded, for example, a scholarship.

5. No distinction was made between individuals who studied in public and/or private schools.
6. Income from activities different from the previous month and activities carried out before six months were not considered in the surveyed.<sup>34</sup>

Under the previous assumptions, a sample of 7,150 individuals was obtained. The following variables to estimate the return to the education program were used:

1. Treatment: treatment variable that takes the value of 1 when the individual has an UGE program and 0 any other case.<sup>35</sup>
2. Lsalario: Natural logarithm of the hourly wage of the children.
3. Tam\_hogar: number of members in the household (includes total members, guests and domestic workers).<sup>36</sup>
4. Educación\_padre: number of accumulated years of education of the father of the family.<sup>37</sup>
5. Educación\_madre: number of accumulated years of education of the mother of the family.
6. Lsalario\_jefe): natural logarithm of the hourly wage of the head of the household.
7. Edad: number of years completed by the children at the time of the interview.
8. Exper: number of years of work experience.<sup>38</sup>
9. Exper2: square of the variable experience.<sup>39</sup>
10. Género: binary variable where 1 is a woman and 0 is a man.

<sup>34</sup> The objective is to have the income related to the labor activities at the time of the survey, having equitable and comparable analysis conditions.

<sup>35</sup> For accumulated years of formal education reported, "1" was assigned to the treatment group when the number of years of education was in the following levels: Normal (16 years), Technical or Commercial Career (15 years), Professional (18 years), Master and Doctorate (20 to 23 years, respectively). "0" was assigned to those individuals whose number of years of education was in the following levels: no education (0 years), preschool (1 year), primary (6 years), high school (3 years), high school or high school (3 years).

<sup>36</sup> The evidence shows that large households have a negative impact on the level of welfare of their members, since income tends to be redistributed among a greater number of members (Alonzo, 2004).

<sup>37</sup> With the level of instruction reported in the ENIGH, the number of accumulated years that the parents had, which are between 0 and up to 23 years of school education, was specified.

<sup>38</sup> Because the ENIGH does not contain information on work experience, it was constructed in the usual way: Experience = Age —years of formal education— 6.

<sup>39</sup> It is desired to show the existence of diminishing returns. In view of the fact that human capital is related to productivity, a constant marginal productivity contradicts the assumption underlying the law of diminishing returns. Diez de Medina (1992) estimates salary equations, finding the expected signs, positive for the Experience variable and negative for the Experience Squared variable.

Based on the assumptions and variables considered, the estimates of the return to UGE are shown below using the four previously defined parameters.

### **Empirical Results**

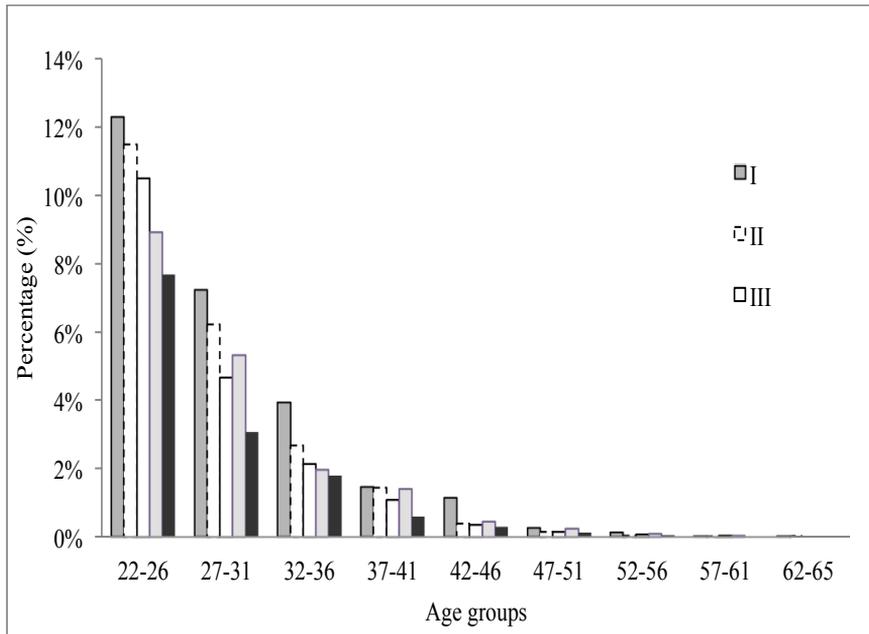
To analyze the composition of the population in the sample used by age groups, in Figure 1, it is observed that 51% of the total of the individuals in the sample are concentrated in the age range of 22 to 26 years of age and in the first three quintiles. As it is expected, in the treatment group, as age increases, so do the income gradually and begin to reduce as they overcome the barrier of the age range that goes from 47 to 51 years of age. In the case of the control group, such a fall in income started from the age range of 37 to 41 years of age, which shows that individuals who do not decide to enter an UGE program throughout their life cycle are more likely to present social deprivation in a shorter period of time, or some kind of vulnerability, either social or from income, may even present some kind of poverty situation.

Table 2 shows the descriptive statistics for the treatment and control group, respectively. The data suggests the existence of significant salary differences between groups, even when the average age is similar. It is also possible to observe that the average schooling of the parents is higher in the treatment group; while the size of the household and the proportion of women is greater in the control group. It is also observed that women have lower income in both groups, which shows inequity gaps in the distribution of income even though women have the same educational level as men but with low-paid jobs. In this sense, the information suggests that the econometric specifications require an adequate treatment that avoids incurring possible biases in the estimators.

Once the heterogeneity between the two groups is identified, the return to UGE of children's salaries is estimated. It is necessary to correct the self-selection bias by means of a two-stage technique, which requires a Probit model in the first stage and Mincer's wage equation in the second. Derived from the above, Table 3 shows the estimation of the Probit model, whose dependent variable is made up of 2,546 individuals with UGE and 4,604 with a lower educational level. The variables used as the mechanism of choice<sup>40</sup> are the income of the head of the family and the size of the household.

<sup>40</sup> There may be other factors that affect the decision of the children to adopt or not the program; however, these mechanisms were chosen because they could impact the decision to adopt or not a program.

Figure 1: Distribution of individuals by age group and quintile



Source: Own elaboration with data of the ENIGH 2012.

In the econometric model, it is observed that children are more likely to go in UGE to the extent that their parents have a higher educational level,<sup>41</sup> higher income<sup>42</sup> and where the size of the household<sup>43</sup> tends to be reduced. The sign of the coefficient of the gender variable<sup>44</sup> must be highlighted showing that women are more likely to go in an UGE program, despite the fact that they are the ones with the most social deficiencies in education, housing and food, as well as the situation of poverty (see Table 1).

<sup>41</sup> Given that the educational level allows individuals to develop more and better skills that impact their quality of life, parents with a relatively high level of education will encourage their children to have more years of formal education with the objective that these enjoy greater social welfare; equal and even better to that of the parents throughout the life cycle of the individuals.

<sup>42</sup> When income poverty exists, it has been shown that it increases the probability that an important sector of the population cannot acquire the basket of non-food goods such as education.

<sup>43</sup> In households with high levels of marginalization, it has been observed that the number of members is usually higher compared to those with a lower level of marginalization (Alonzo, 2004).

<sup>44</sup> This situation may be due in large part to the fact that in the treatment group there is a higher proportion of women; however, in terms of perceived income the situation changes radically.

Table 2: Descriptive statistics from the treatment and control groups

Variables	Observations	Average	Standard deviation	Minimum	Maximum
<i>Treatment Group</i>					
Tam_Hog_2	2,546	4.71	1.72	2	14
Educación_padre	2,546	9.86	6.6	0	23
Educación_madre	2,546	10.84	4.94	0	23
Edad	2,546	27.87	5.47	22	59
Exper	2,546	4.45	5.4	0	38
Lsalario	2,546	3.35	0.87	-0.72	6.25
Lsalario Mujeres	1,283	3.31	0.88	-0.72	5.57
Lsalarios Hombres	1,283	3.38	0.87	-0.62	6.25
<i>Control Group</i>					
Tam_Hog_2	4,604	5.56	2.4	2	21
Educación_padre	4,604	5.98	4.7	0	20
Educación_madre	4,604	6.93	4.12	0	23
Edad	4,604	27.27	6.36	22	64
Exper	4,604	11.89	7.35	3	54
Lsalario	4,604	2.68	0.85	-3.33	5.51
Lsalario Mujeres	1,583	2.61	0.86	-3.33	5.05
Lsalarios Hombres	3,021	2.72	0.86	-3.10	5.51

Source: Own elaboration with data of the ENIGH 2012.

Table 3. Probit Model for UGE<sup>a</sup>

Variables	Coefficients	P > (z)
Constant	-0.260	(0.00)*
Educación_madre	0.047	(0.00)*
Educación_padre	0.037	(0.00)*
Exper	-0.211	(0.00)*
Exper2	0.005	(0.00)*
Lsalario_jefe	0.217	(0.00)*
Tam_Hogar	-0.098	(0.00)*
Género	0.452	(0.01)*

<sup>a</sup> Dependent variable: treatment (treatment and control)

\* P(z) significant at 5%.

Source: Own elaboration with data of the ENIGH 2012.

From the results of the Probit model, the auxiliary variable,  $l$  was estimated measuring the effect by self-selection, and correcting the bias that is incurred when estimating the salary equations by OLS. In this sense, Table 4 shows Mincer's wage equation for the treatment and control groups. The purpose of using both groups in the estimation is to highlight the role of the variable  $l$ . Given its statistical significance, it is possible to deduce that heterogeneity and self-selection have an important influence on the wage difference between both groups. Table 4 shows the value of the coefficient of the gender variable, which shows that women tend to have lower income on average than men. Therefore, there is sufficient evidence at this stage of the study to demonstrate that gender inequality is a real fact in terms of the income that women receive even when they even have the same level of education as men.

Additionally, in Table 5, the wage equations for the treatment and control group are estimated, respectively, considering the effect of self-selection bias by using the auxiliary variable  $l$ . In this case, the income equations measure the effect that the independent variables have on the wage income of children. In both estimations, the auxiliary variable is statistically significant, which means that there is sufficient evidence to affirm that heterogeneity and self-selection cannot be controlled; the estimates by OLS would be biased. Table 5 also highlights the expected sign of the estimated coefficients; positive for the experience variable and negative for the experience squared variable. On the other hand, it is observed that only the education of the mother in the control group was statistically significant, showing that while she has a higher educational level, the probability that the children choose to carry out an UGE program will increase. In the approach of the Mincer model, the education of the fathers in the treatment group was not significant, suggesting that this is not enough to see how their education impacts on the level of income of the children. Nonetheless, it may be assume that if the educational level of the fathers is increased through various public policy strategies, a greater proportion of individuals (children) who are in the limit could adopt the program, thus enhancing their capabilities and abilities

Table 5 highlights the negative sign of the gender variable, which shows that there is sufficient evidence about the inequality between men and women, since the latter perceive, on average, a lower level of income in both groups.

Table 5: Wage equation for the treatment and control groups<sup>c</sup>

Variables	Multiple Regression	P > (t)
<i>Treatment Group</i>		
Exper	0.171	(0.00)*
Exper2	-0.004	(0.00)*
Educación_padre	-0.001	(0.71)
Educación_madre	0.000	(0.94)
Género	-0.227	(0.00)*
Lambda	-2.979	(0.00)*
Constante	4.256	(0.00)*
<i>Control Group</i>		
Exper	0.082	(0.00)*
Exper2	-0.002	(0.00)*
Educación_padre	-0.004	(0.16)
Educación_madre	0.014	(0.00)*
Género	-0.233	(0.00)*
Lambda	-2.464	(0.00)*
Constant	3.760	(0.00)*

<sup>c</sup> Dependent variable: Lsalario (Natural logarithm of salary).

\* P(t) significant at 5%.

Source: Own elaboration with data of the ENIGH 2012.

On the other hand, to calculate the average return to UGE in Mexico on the used sample, based on the salary equations and their difference in means, the ATE was calculated. To estimate the MTE, the differential between the auxiliary variables was used  $l$ . For the TT effect, the results obtained from the ATE and the MTE were used in a combined manner; while for the LATE, the ATE and MTE effects, as well as the marginal changes of the election mechanisms defined in section 3.2 of this research.

Table 6 shows the estimated effects of the treatment for the group of individuals considered in the sample, making a special distinction between genders. This table shows that the average return (ATE) to an additional year<sup>45</sup> of UGE is approximately 11.20% for an individual that is taken randomly from the population, while the return for an individual who has actually received the treatment (TT) is equivalent to 9.53%. Both results

<sup>45</sup> Percentage effects are calculated by scaling the total effect between the average difference of years of school that exists between the treatment and control group (7.27 years).

suggest that the implementation of an UGE program brings positive and on average higher returns in comparison to those individuals with a lower educational level. Regarding the effect by gender, the program's returns are always higher for men in both ATE and TT; but also the returns for men are above the ATE (11.2%) and the TT (9.53%), while the return for women is below these averages, respectively.

Table 6: Effects of an UGE program on individuals' wage income in Mexico

Effects	Value (%)
Average Treatment Effect (ATE)	11.20
Women	11.12
Men	11.25
<i>Marginal Treatment Effect (MTE)</i>	-0.064
Treatment on the Treated	9.53
Women	9.50
Men	9.54

Source: Own elaboration with data of the ENIGH 2012.

The negative sign of the marginal effect of treatment (MTE) shows that the individuals in the sample have unobservable variables (externalities) contained in  $u_D$  that weigh significantly on the choice of receiving the treatment, registering lower returns as a result of not participating in the program; see in this regard Heckman (2005). For example, in the particular case of women, who have the greatest educational backwardness, it is desirable to identify in other studies those externalities that can significantly explain the inequality between men and women in education, health and income, among other aspects related to social development.

In order to complement the analysis, Table 7 shows the expected return of the program as a result of changes in the observable factors contained in  $Z_k$ .<sup>46</sup> The magnitude of the impact on the average effect (ATE) was determined when there was a marginal change in the number of years of formal education of the parents and in the size of the household. This table also shows that if the mother's education increased marginally, in addition to increasing the likelihood that the child decides to participate in an UGE program, it would positively impact the marginal income of the children's salary by 0.04 percentage points more, going from 11.2% of the ATE effect to 11.235% in the local effect.

<sup>46</sup> These results are obtained from the Probit model.

Table 7: Local Average Treatment Effect (LATE)

Effects	Value (%)
Mother's education	11.235
Father's education	11.227
Family size	11.114

Source: Own elaboration with data of the ENIGH 2012.

In the case of the father's education, one more year in the school education of the latter would reflect a positive marginal return to the program on the children's salary by 0.03 percentage points, going from 11.2% of the ATE effect to 11.227% of the local effect. As expected, the impact of the mother's education turned out to be slightly greater than that of the father.<sup>47</sup> Another local effect that is interesting to assess is the one related to the family size. From the Probit model, it was deduced that the probability that an individual decides to participate in an UGE program is conditioned, among other variables, to the number of members in the family, so that as this number increases, it will have a negative impact on the UGE income from the children's salaries. In this sense, when the size of the household increases marginally, it impacts negatively on the UGE return by 0.08 percentage points less, going from 11.2% of the ATE effect to 11.11% of the local effect.

## CONCLUSIONS

Based on Heckman *et al.* (2000) and (2001) and the developed gender analysis, four relevant effects have been estimated to measure the return to UGE in Mexico and its effect on the income of individuals through a Heckit model. The estimated effects consider persistent heterogeneity and self-selection bias in the sample obtained from the 2012 ENIGH.

The descriptive data showed the heterogeneity between the treatment and control group, such as significant salary differences, higher education in the parents of the treatment group and larger household size in the control group. It was also found in this analysis that women have a lower wage

<sup>47</sup> Despite the fact that women have the greatest number of social deprivations and situations of poverty, they are the ones who have the greatest influence over the income of their children. In this regard Villacis (2008) mentions that women have been assigned culturally diverse roles to develop in society, whose social forms are aligned to their role as mothers, wives, housewives, nurses and educators, among others. Other roles have been attributed to women as the biological one that results in the responsibility of giving affection to the children based on the functional characteristics such as motherhood and household tasks related to the children's activities, which has allowed her to have closer cultural and manifestations of affect, which influence their behavior, motivation and attitudes in the school environment.

income in both groups, evidencing inequality in the distribution of income in Mexico in those cases in which women had the same educational level as men. Likewise, the results obtained indicate that the return to UGE for an individual in Mexico is positive and higher than for those with a lower educational level. It was shown that if an individual is taken randomly from the eligible population, the achieved performance (ATE) is higher in comparison to those who actually received the Higher Education (TT) program.

With respect to the ATE parameter, an average return per additional year of UGE of 11.2% was estimated for an individual that is taken randomly from the population; while for the TT effect, a return of 9.53% was estimated for an individual who actually received the treatment voluntarily. Both results show that the implementation of an UGE program brings positive and on average higher returns in comparison to those individuals with a lower educational level. Regarding the effect by gender, the return of the program were always higher for men in both the ATE and the TT, but also these returns for men were above the ATE (11.20%) and the TT (9.53% ), while the performance for women was below these averages, respectively. This extends the results found in the studies of García de Fanelli (1989) and Ariza (2006) on wage discrimination by gender. The results suggest that it is feasible to expand the eligible population of an UGE program instead of reducing it, because there are individuals with sufficient characteristics to be incorporated, which would allow their income to be incentivized throughout the life cycle and thus expand the range of possibilities in the expenditure of the food and non-food basket; and particularly in women, who have a lower return.

Regarding the marginal effect of the treatment (MTE), an effect of -0.064% was estimated. The negative sign allows demonstrating that there are unobservable factors (externalities) that reduce the probability of participating in the program of certain individuals, who generally have a lower return on their income compared to those who decided to carry out an UGE program.

In the LATE effect estimates it was found that when compared directly with the results of the ATE effect, the mother's education increased marginally. This also increases the likelihood that the child decides to participate in an UGE program. In this case, the impact on the child's salary increases by 0.04 percentage points, from 11.2% of the ATE effect to 11.235% in the local effect. This result suggests that the implementation of public policies that encourage the participation of a greater number of women in education

and/or training, in addition to the cultural patterns already cited by Villacís (2008) in this study, could be a trigger in the generation of greater wealth and human capital in Mexico, particularly for women. It was also found that a marginal increase in the education of the father generates a positive return to UGE on the child's salary by 0.03 percentage points, going from 11.20% of the ATE effect to 11.227% in the local effect. Regarding the local effect of the size of the household, it was found that, in the face of a marginal increase in the household, there was a negative impact on the return to UGE of the children's wages by 0.08 percentage points less, from 11.2% of the ATE effect at 11,114% in the local effect, representing an expected reduction given that this variable inhibits the probability that children decide to go in an UGE program.

In general, the empirical results obtained in this research suggest that the income of the head of the household, work experience, and variables related to the number of family members, among other factors, such as the education of parents, have a decisive influence on the choice individuals to participate in an UGE program, expecting with this to access higher future income throughout the productive life cycle and get greater social welfare. However, this situation is not equal between men and women as shown by the empirical findings, since women would always have to wait for a lower return throughout their life cycle if persist those underlying factors that tip the balance towards certain groups of the population. This result is consistent with that found by García (2008) in Latin America.

The obtained results leave open the possibility of additional lines of research on the generation of public policies in Mexico regarding gender equity. An example of this is the expected returns on women's income, since these were lower, even though women more likely to carry out the program and had similar educational levels in both groups. In this way, it is ideal to quantify the impact of those externalities on the educational performance of certain population groups, but given the limitations of information available in the ENIGH, it was not possible in this study, apart from not being the main objective of it.

In order to contrast the robustness (internal and external validity) of the results obtained, Tables 8 and 9 show the private return to Higher (Undergraduate and Graduate) Education on the income of individuals from a subsample.

Considering the results shown in Tables 7 to 9, the main implication of comparing the two samples is that the methodology used and the results obtained could be generalized according to the estimated parameters of

interest (ATE, MTE, TT and LATE), These estimates differed only in magnitude due to the size of the samples, but not in the implications demonstrated in the economic literature in this type of studies.

Table 8: Effects of the Higher Education program on the income of individuals

Parameters	Value (%)
Average Treatment Effect (ATE)	10.29
Marginal Treatment Effect (MTE)	-0.078
Treatment on the Treated (TT)	8.79

Source: Own elaboration with data from ENIGH 2012.

Table 9: Average local effect of Higher Education treatment

Local Average Treatment Effect (LATE)	Valor (%)
Mother's education	10.351
Father's education	10.352
Family size	10.179

Source: Own elaboration with data from ENIGH 2012

## BIBLIOGRAPHICAL REFERENCES

Alba-Ramírez, A. and San Segundo, M. J., 1995, "The returns to education in Spain", in *Economics of Education Review*, vol. 14, núm. 2. pp. 155-166.

Alonzo, R., Balisacan, A., Canlas, D., 2004, *Population and poverty: the real score*. Discussion Paper, núm. 0415. University of Philippines.

Altonji, J. G., 1993, "The demand for and return to education when education outcomes are uncertain", in *Journal of Labor Economics*, vol. 11, núm. 1, pp. 48-83.

Altonji, J. G. and Dunn, T. A., 1996, "The effects of family characteristics on the return to education", in *Review of Economics and Statistics*, vol. 78, núm. 4. pp. 692-704.

Angrist, J. D., Graddy, K., and Imbens, G. W., 2000, "The Interpretation of instrumental variables estimators in simultaneous equations models with an application to the demand for fish", in *Review of Economic Studies*, vol. 67, núm. 3, pp. 499-527.

Ariza, M., 2006, "Mercados de trabajo urbanos y desigualdad de género en México a principios del siglo XXI", en De la Garza y Salas (coords.), *La situación del trabajo en México*, UNAM, IET, AFL-CIO, Plaza y Valdés, pp. 377-412.

- Arrazola, M., De Hevia, J., Risueño, M. and Sanz, J. F., 2003, "Returns to education in Spain: some evidence on the endogeneity of schooling", in *Education Economics*, vol. 11, núm. 2, pp. 293–304.
- Arriagada, I., 2005, *Dimensiones de la pobreza y políticas desde una perspectiva de género*, Santiago de Chile, División de Desarrollo Social. Comisión Económica para América Latina y el Caribe (CEPAL), pp. 101-113.
- Ashenfelter, O. and Krueger, A., 1994, "Estimates of the Economic Return to Schooling", in *American Economic Review*, vol. 84, núm. 5, pp. 1157-1173.
- Asplund, R. and Pereira, P. T., 1999, *Returns to human capital in Europe. A literature review*, Helsinki: ETLA.
- Austria, C. M. y Venegas-Martínez, F., 2010, "Rendimientos privados de la Educación Superior en México en 2006 un modelo de corrección del sesgo por autoselección", in *El Trimestre Económico*, vol. 78(2), núm. 310, pp. 441-468.
- Baker, J. L., 2000, "Evaluación del impacto de los proyectos de desarrollo en la pobreza", en *Manual para Profesionales*. Banco Mundial. Washington, D. C.
- Barceinas, F., 2001, *Capital humano y rendimientos de la educación en México*, Tesis Doctoral, Universidad Autónoma de Barcelona.
- Becker, G. S., 1962, "Investment in human capital: a theoretical analysis", in *Journal of Political Economy*, vol. 70, núm. 5, pp. 9-49.
- Becker, G. S., 1964, *Human capital: a theoretical and empirical analysis, with special reference to education*, National Bureau of Economic Research, New York.
- Bracho, T. y Zamudio, A., 1994a, *Rendimientos económicos a la escolaridad I: discusión teórica y métodos de estimación*. Documento de Trabajo 30. CIDE. México.
- Bracho, T. y Zamudio, A., 1994b, *Rendimientos económicos a la escolaridad II: estimaciones para el caso mexicano*. Documento de Trabajo 31. CIDE. México
- Campbell, D. T. y Stanley, J. C., 1973, *Diseños experimentales y cuasi-experimentales en la investigación social*. Buenos Aires: Amorrortu.
- Cabo, S. G. y Garzón, M. J., 2007, *Diferencia y discriminación salarial por razón de sexo*. Instituto de la Mujer (MTAS). Centro de Estudios Económicos Tomillo, S. L. Madrid.
- Card, D., 1999, "The causal effect of education on earnings", en Ashenfelter, O. y Card, D. (eds.), *Handbook of Labor Economics*, vol. 3, North-Holland, Amsterdam.
- Card, D., 2000, *Estimating the return to schooling: progress on some persistent econometric problems*. Working Paper 7769, NBER.
- Carneiro, P., J. Heckman and Vytlacil, E., 2001, *Estimating the returns to education when it varies among individuals*, Working Paper. University of Chicago.
- Carneiro, P., K. Hansen and Heckman, J., 2003, *Estimating distributions of treatment effects with an application to the returns to schooling and measurement of the effects of uncertainty of college choice*. NBER Working Paper, N° 9546.

Carnoy, M., 1967, "Earnings and Schooling in Mexico", in *Economic Development and Cultural Change*, vol. 15, núm. 4. pp. 408-418.

Cohn, E., and Addison, J. T., 1998, "The economics returns to lifelong learning in OECD countries", in *Education Economics*, vol. 6, núm. 3, pp. 253-307.

CEPAL, 2004, *Caminos hacia la equidad de género en América Latina y el Caribe*, documento presentado a la 9ª Conferencia Regional sobre la Mujer de América Latina y el Caribe, México, D. F., 10 al 12/06/2004.

CEPAL/OREALC, 1992, *Educación y conocimiento: eje de la transformación productiva con equidad*, Comisión Económica para América Latina y el Caribe/ Oficina Regional de Educación de la UNESCO para América Latina y el Caribe. Santiago de Chile. Publicación de las Naciones Unidas.

CEPAL-UNI FEM, 2004, *Entender la pobreza desde la perspectiva de género*. Serie mujer y desarrollo, (52). Chile.

Consejo Nacional de Evaluación de la Política de Desarrollo Social, 2012, *Pobreza y Género en México: Hacia un sistema de indicadores información 2008-2012*.

Del Razo, L. M., 2003, *Estudio de la brecha salarial entre hombres y mujeres 1994-2001*. Serie Documentos de Investigación. Secretaría de Desarrollo Social. 2003.

Diez de Medina, R., 1992, "El sesgo de selección en la actividad de jóvenes y mujeres", in *Suma*. vol. 7, núm. 13, pp. 69-85.

ENIGH, 2012, *Encuesta Nacional de Ingresos y Gastos de los Hogares de 2012*. Instituto Nacional de Estadística Geografía e Informática (INEGI). Disponible en <http://www.beta.inegi.org.mx/proyectos/enchogares/regulares/enigh/tradicional/2012/>

Faúndez, A., 1996, *Género, salud y políticas públicas: del binomio madre-hijo a la mujer integral*. Memoria para optar al título de Magister en Gestión y Políticas Públicas, Santiago de Chile. Universidad de Chile.

García, E., 2008, "Políticas de igualdad, equidad y gender mainstreaming." Programa de las Naciones Unidas para el Desarrollo (PNUD). *América Latina Genera: Gestión del Conocimiento para la Equidad de Género en Latinoamérica y el Caribe*.

García, B. y de Oliveira, O., 2007, "Trabajo extradoméstico y relaciones de género: una nueva mirada", en *Género, familias y trabajo: rupturas y continuidades. Desafíos para la investigación política*. CLACSO, Buenos Aires.

García de Fanelli, A. M., 1989, "Patrones de desigualdad social en la sociedad moderna: una revisión de la literatura sobre discriminación ocupacional y salarial por género", in *Revista Desarrollo Económico*, Vol. 29, No. 114, pp. 239-264.

Gerstenfeld, P. y León, A., 1999, *Transmisión intergeneracional de la desigualdad*. Santiago de Chile, Comisión Económica para América Latina y el Caribe (CEPAL), inédito.

Goldschmidt-Clermont, L., 1995, "La valoración monetaria del trabajo no remunerado", in *Revista Política y Sociedad*, núm. 19, mayo-agosto, pp. 7-18.

Gómez, E., 2002, "Género, equidad y acceso a los servicios de salud: una aproximación empírica", en *Revista Panamericana de Salud Pública*, vol. 11 núm. 5/6, pp. 327-334.

Hanoch, G., 1967, "An economic analysis of earnings and schooling", in *Journal of Human Resources*, vol. 2, núm. 3, pp. 310-329.

Hansen, W. L., 1963, "Total and private rates of return to investment in schooling", in *Journal of Political Economy*, vol. 71, núm. 2, pp. 128-140.

Harmon, C., H. Oosterbeek, and Walter, I., 2003, "The returns to education: microeconomics", in *Journal of Economic Surveys*, vol. 17, núm. 2, pp. 115-155.

Harmon, C., I. Walker and Westergaard-Nielsen, N., 2001, *Education and earnings in Europe. A cross country analysis of the returns to education*, Cheltenham: Edward Elgar.

Harmon, C., and Walter, I., 1995, "Estimates of the economic return to schooling for the United Kingdom", in *American Economic Review*, vol. 85, núm. 5, pp. 1278-1286.

Heckman, J., 1997, "Instrumental variables: a study of the implicit assumptions underlying one widely used estimator for program evaluation", in *Journal of Human Resources*, vol. 32, núm. 3, pp. 441-462.

Heckman, J. and Vytlacil, E., 2000, *Identifying the role of cognitive ability in explaining the level of and change in the return to schooling*, Working Paper 7820, Cambridge, Mass. NBER.

Heckman, J., Tobias, J. L. and Vytlacil, E., 2000, *Simple estimators for treatment parameters in a latent variable framework with an application to estimating the returns to schooling*, Working Paper 7950, NBER.

Heckman, J., J. L. Tobias and E. Vytlacil, 2001, "Four parameters of interest in the evaluation of social programs", in *Southern Economic Journal*, vol. 68, núm. 2, pp. 210-223.

Heckman, J., Tobias, J. L. and Vytlacil, E., 2005, *Structural equations, treatment effects and econometric policy evaluation*, Working Paper 306, NBER.

Imbens, G. and Angrist, J., 1994, "Identification and estimation of local average treatment effects, in *Econometrica*", vol. 62, núm. 2, pp. 467-475.

Jiménez-Villacís, M., 2008, *Influencia de los padres en el rendimiento escolar de sus hijos*. Universidad del Mayab.

Katrin, E., Newiak, M., Kochhar, K., Fabrizio, S., Kpodar, K., Wingender, P. Clements, B. y Schwartz, G., 2013, *Las mujeres, el trabajo y la economía: Beneficios macroeconómicos de la equidad de género*. Departamento de Estrategia, Políticas y Evaluación y Departamento de Finanzas Públicas. Fondo Monetario Internacional.

- López-Acevedo, G., 2004, "Mexico: Evolution of earnings inequality and rates of returns to education (1988-2002)", in *Estudios Económicos*, vol. 19, núm. 2, pp. 211-284.
- McMahon, W. W. E., 1991, "Relative returns to human and physical capital in the U. S. and efficient investment strategies", in *Economics of Education Review*, vol. 10, núm. 4, pp. 283-296.
- Mincer, J., 1974, *Schooling, experience and earnings*, New York. National Bureau of Economic Research.
- Moffitt, R., 2007, *Estimating marginal returns to higher education in The UK*. National Bureau of Economic Research. NBER Working Paper No. 13534.
- Mroz, T. A., 1987, "The sensitivity of an empirical model of married women's hours of work to economic and statistical assumptions", in *Econometrica*, vol. 55, núm. pp. 765-799.
- Ordaz, J. L., 2007, *México: capital humano e ingresos. Retornos a la educación, 1994-2005*. CEPAL-Serie Estudios y Perspectivas, núm. 90, octubre, pp. 1-69.
- Parker, S. W. and Pederzini, C. 2000, "Género y educación en México", en *Estudios Demográficos y Urbanos*, vol. 15, núm. 1, pp. 97-122.
- Psacharopoulos, G., 1993, *Returns to investment in education: a global update*, Policy Research Working Paper, núm. 1067. Banco Mundial.
- Psacharopoulos, G. and Patrinos, H., 2002, *Returns to investment in education: a further update*, Policy Research Working Paper, núm. 2881, Banco Mundial.
- Raczynski, D., 2003, *Equidad, inversión social y pobreza. Innovar en cómo se concibe, diseña y gestiona las políticas y los programas sociales*. Documento presentado en el Seminario CEPAL/MIDEPLAN "Políticas innovativas de desarrollo social". Santiago de Chile, 23 y 24 de mayo.
- Rodríguez-Oreggia, E., 2004, *Institutions, geography and the regional evolution of returns to schooling in México*. Instituto de Investigaciones sobre Desarrollo Sustentable y Equidad Social, Universidad Iberoamericana-Santa Fe, México, inédito.
- Rojas M., H. Angulo, e I. Velásquez, 2000, "Rentabilidad de la inversión en capital humano en México", en *Economía Mexicana*, vol. 9, núm. 2, pp. 113-142.
- Salles, V. y Tuirán, R., 2002, *¿Cargan las mujeres con el peso de la pobreza? Puntos de vista de un debate*. Guatemala. Sistema de Naciones Unidas.
- San Segundo, M. J., and Valiente, A., 2003, "Family background and returns to schooling in Spain", in *Education Economics*, vol. 11, núm. 1, pp. 39-52.
- Sarimaña, J. E., 2002, "Rendimiento de la escolaridad en México: Una aplicación del método de variables instrumentales para 1998", en *Gaceta de Economía*, vol. 7, núm. 14, pp. 85-125.
- Schultz, T. W., 1961, "Investment in Human Capital", in *American Economic Review*, vol. 51, núm. 1, pp. 1-17.

Skipper, S., 2006, “Desarrollo del capital humano y reducción de la pobreza en el Salvador”, en *Comercio Exterior*, vol. 56, núm. 11, pp. 968-976.

Wagstaff, A., 2002, “Pobreza y desigualdades en el sector de la salud”, en *Revista Panamericana de Salud*, vol. 11, núm. 5/6, pp. 316-326.

Willms, J. D., 2006, *Learning divides: ten policy questions about the performance and equity of schools and schooling systems*. Montreal: UNESCO.

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Article received on 17 august 2015 and accepted on 4 september 2017.