Imagining Education: Educational Policy and the
Labor Earnings Distribution

Diego Amador

Universidad de
los Andes
Facultad de Economía

CEDE
Centro de Estudios
sobre Desarrollo Económico

Universidad de
los Andes
Facultad de Economía

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Diego Amador [*]
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Abstract

This paper simulates, within a partial equilibrium framework, the scenarios resulting form the implementation of several educational policies. Then, policies are compared according to their hypothetical results in terms of labor earnings inequality, as measured by the Gini coefficient. Results suggest that educational policies which attempt to guarantee medium qualification produce the lowest inequality even if dispersion in schooling years is high. Policies which attempt to raise tertiary education coverage but do not raise high school coverage as well, lead to rising inequality.

Key words: Educational policy, economic inequality, schooling.

JEL classification: I28, J24, J38.

[*] Universidad de los Andes. di-amado@uniandes.edu.co . I would like to specially thank Raquel Bernal for all of her comments, suggestions, ideas and support; and to Ximena Peña for her uninterested help, encouragement and patience. I'm grateful to Juan Camilo Cárdenas and José Leibovich for their suggestions and to the three Ms and E for their unconditional support.

EDUCACIÓN IMAGINADA:
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Resumen

En este trabajo se simulan, dentro de un marco de equilibrio parcial, los escenarios que resultarían de la implementación de una serie de políticas educativas. Dichas políticas son comparadas a partir de sus efectos hipotéticos sobre la desigualdad en los ingresos laborales, medidos a partir del coeficiente Gini. Los resultados indican que las políticas educativas que garantizan educación media universal producen la menor desigualdad. Políticas educativas en las que se aumenta la cobertura en educación terciaria sin garantizar primero un nivel medio llevan a una mayor desigualdad.

Palabras clave: Política educativa, desigualdad económica, escolaridad.

Clasificación JEL: I28, J24, J 38.

1 Introduction

Educational policy affects the schooling years of individuals in a given society. Thus, it potentially has an effect on the distribution of labor earnings throughout the population. Nevertheless, Economic literature does not provide policy makers with means to predict these effects. This paper compares the results of a series of empirical exercises in which the scenarios, in terms of labor earnings inequality, that would emerge after the implementation of a set of plausible educational policies are predicted. All of the above is developed within a partial equilibrium framework, in which only labor earnings are affected by the educational policies.

In order to simulate the effects of the different educational policies on the distribution of earnings, a methodology that has been widely used in decompositions of changes in earnings inequality (Bourgignon & Ferreira 2005) is applied. The educational policies are represented by the objective distribution of schooling years across the population associated with each one of them. The main advantage of this methodology is that it allows identifying and isolating the effect of each distribution of schooling years on the distribution of earnings, conditional on the distribution of other individual characteristics correlated with earnings and the prices of those characteristics. The estimated prices for 2004 are used.

Several conclusions arise from the described exercises. First, guaranteeing medium qualification (high school) appears to be a powerful and necessary way of achieving lower inequality. Educational policies which attempt to raise average schooling years or tertiary educational coverage but do not start with full high school coverage are not efficient at lowering labor earnings inequality. Also, composition of the schooling distribution, and not only its variance, proves to be of great importance when relating it to the labor earnings distribution. Thus, the results suggest the possibility of achieving scenarios in which a high variability in schooling years coexists with low earnings inequality. In particular, an ambitious schooling distribution[1] in which high school is guaranteed and half of the labor force has a college education, generates good results in terms of earnings inequality without making sacrifices in terms of earnings level, at the same time that it is has a relatively high dispersion of schooling years. Finally, since some of the educational policies included are nested within other of these policies, a very general analysis can be made about two different paths towards a schooling distribution with a higher proportion of high skilled labor.

2 Labor Earnings Inequality and the Educational Expansion

Figure 1 shows the evolution of labor earnings inequality, measured by the Gini coefficient, during the period 1980-2003 in Colombia. Just as it has been widely documented by economic literature, inequality rose systematically since the end of the 1980's. At the same time, average years of schooling went from about 6.5 in 1982 to slightly above 8 in 2000 (Figure 2). During this same period, the standard deviation increased as well. The coefficient of variation fell to about 0.52, though (almost 0.05 less than it was ten years before). Nevertheless, these changes cannot fully acknowledge relevant variations in the composition of the schooling distribution. As Figure 3 shows,

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[1] This distribution is based on the goals included in the Colombian "*Plan Decenal de Educación 2006-2015*" (Decennial Educational Plan 2006-2015)

the outstanding growth in the proportion of people with high school or more was mainly driven by the increase in the percentage of the population who completed high school but has no tertiary education, and complemented, although not so strongly, by those with some tertiary education and the decrease of the relative size of those with no schooling.

Figure 1.
Labor earnings. Gini coefficient.
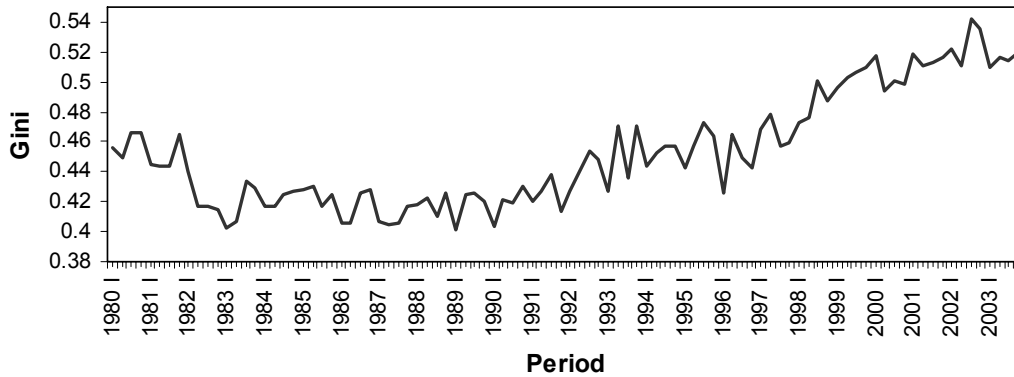
Figure 2.
Average schooling years 1982 - 2000
(WAP)
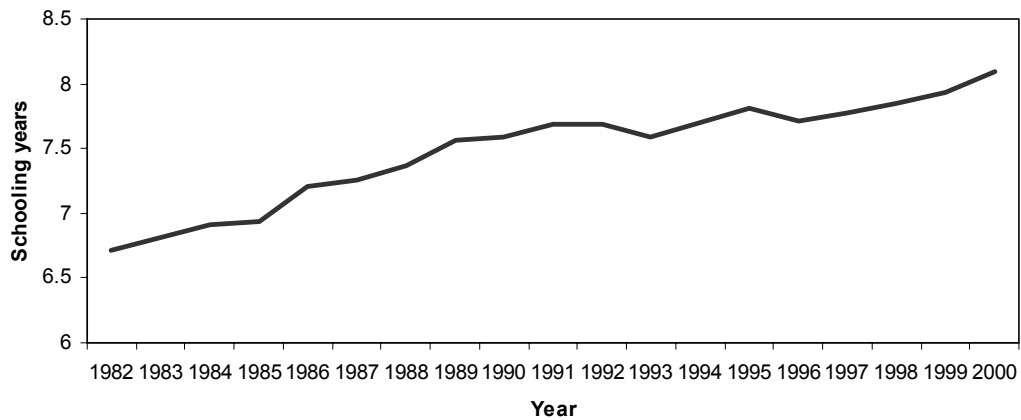
Figure 3.
Schooling levels 1982 - 2000
WAP
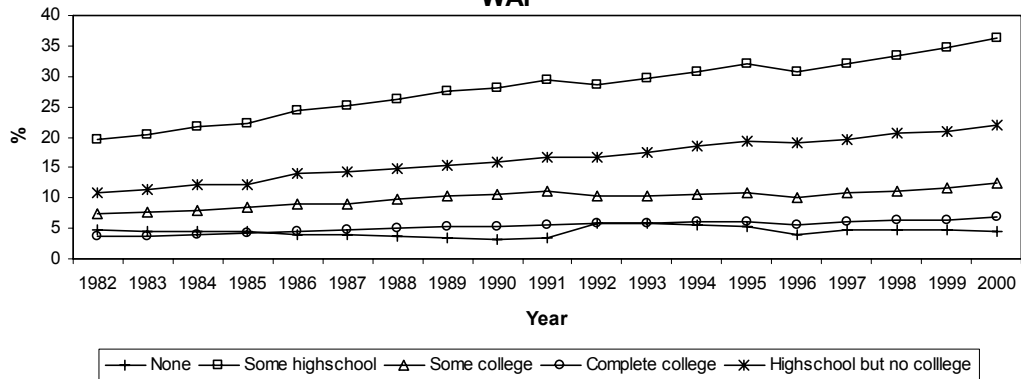
Thus, one could expect that the particular composition of the schooling distribution would affect the earnings distribution. In other words, it is definitively important to take into account the exact way in which schooling is distributed, and not only the variance of this distribution, in order to understand the relationship between education and economic inequality. Clearly, the observed changes in the Gini coefficient ought not to be explained only by the changes in the schooling distribution. Nevertheless, a great deal of the variation in labor earnings seems to be determined by the dispersion in the schooling of individuals. Cárdenas and Bernal (1999) have shown that, in 1996, 36% of the earnings inequality could be explained by schooling alone[2]. Furthermore, in a hypothetical scenario in which all individuals had identical observed characteristics and, therefore, the variance in their labor earnings was solely due to unobserved characteristics and stochastic shocks, the estimated Gini coefficient would be 0.173. If schooling was allowed to vary too, the Gini coefficient would climb to 0.346, accounting for approximately 35% of observed inequality. Compared to this, potential experience (the other individual characteristic measuring human capital accumulation) would account for just 10% of inequality.

Thus, understanding the connection that has been discussed becomes fundamental for the analysis of the determinants of the behavior of earnings inequality during the last decades, as well as in the attempt of designing equality enhancing public policies. The former has been developed through different empirical strategies (Núñez and Sánchez, 1998b; Cárdenas and Bernal, 1999; Santa María, 2004; Vélez, Leibovich, Kugler, Bouillon and Núñez, 2005). This work intends to contribute in the latter.

3 Labor Earnings Distribution, Educational Policy, and the Schooling Distribution.

Educational policy can be a very ambiguous term and, so far, it has been used in this paper without giving any clear and precise definition. Even though educational policy includes a great variety of actions, goals, perspectives, etc., it will be used here to refer, exclusively, to the precise goals in terms of enrollment in the different schooling levels and the means for achieving those goals. Therefore, it will make no reference to any

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[2] The proportion was 27% only 8 years before.

other dimensions of educational policy, such as quality, ideology, curriculum, or any other element that may be included in a broader definition. Thus, it is a conceptual and terminological simplification.

Within this particular and narrowed dimension of educational policy, it is reasonable to think about the goals of policy makers in terms of an objective schooling distribution within the relevant age range. For example, when someone talks about universal coverage in *basic education* (Colombian 9th grade), she might be thinking about a schooling distribution in which all of the individuals have, at least, 9 years of schooling. Based on the above, one of the main assumptions supporting the work developed in this paper is that different educational policies can be represented by their corresponding objective schooling distribution, which is, according to what has been stated, a plausible assumption.

Thus, the basic concern underlying this paper is that of the relationship between schooling and labor earnings distributions, understanding the former as the plausible representation of the goals of given educational policies. In particular, it is worth asking oneself about what kind of schooling distributions would be associated with less unequal earnings distributions. If there exists at least a partial answer to this question, a connection between the schooling distributions and the particular educational policies they attempt to represent could be posed. Based on this connection, useful criteria for educational policy design could be created, in terms of its effect on labor earnings inequality.

4 Data

All of the estimations in this paper are based on the *Encuesta Nacional de Hogares* and the *Encuesta Continua de Hogares* (Household survey)[3] for the stages corresponding to the third quarter of 1985, 1995 and 2004. Information on individual years of schooling (used also for the construction of level premia); age (used in the construction of potential experience[4]); occupation (construction workers, employees, domestic service employees, self employed, business owners and other earners); metropolitan area of residence (Bogotá, Barranquilla, Bucaramanga, Medellín, Manizales, Cali and Pasto); marital status (cohabiting, married, widowed, single, separated/divorced); household size (in terms of household members and household members under 10); relationship with the head of household; and individual labor earnings is used..

The sample has been restricted based on several criteria. First, only data from people living in the 7 largest cities is included. This is done to assure comparability between samples for the different stages of the survey. People reporting more than 84 hours worked during the previous week are excluded[5] too, in order to reduce probable measurement error. Finally, with that same purpose, observations in the top and bottom 1% of the labor earnings distribution are excluded as well. As a result of all of the above, the sample size for the estimation of the earnings functions is 47,179, where 23,199 of those observations are reported earners (2004 sample) [6].

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[3] DANE.
[4]Potential experience =Age-schooling – 6.
[5] Note that 84 hours a week is 12 hours a day x 7 days a week.
[6]This numbers are 12,001,999 and 6,120,098, respectively, when observations are properly weighted.

5 Literature Review: a Selection

The following literature review is focused on three subjects: work attempting to explain the rise in inequality during the 1980's and 1990's in countries other than Colombia (mainly U.S.A.); in Colombia; and research that includes some prediction of the effects of educational policy. This kind of literature is, to say the least, abundant. Thus, this review is not intended to be exhaustive. Quite the opposite, the idea is to set some relevant examples, as well as to introduce fundamental findings and conclusions of some seminal papers.

The observed rise in inequality during the 1980's and 1990's triggered, in many countries, a proliferation of economic literature which tried to explain the determinants of such a change in the trend. For example, Juhn, Murphy and Pierce (1993) found that a great deal of this phenomenon could be explained by changes in the unobserved components (attributed to unobserved ability) of wages, and by the different timing of these and the changes in observables. The American rise in inequality of the 1980's would be owed to an increase in the wages of high skilled workers (returns to observed ability), as well as an increase in the returns to unobserved ability.

Katz and Murphy (1992) argued that, besides the growing demand for skilled workers, unobserved ability and female labor, one of the main determinants of the changes in the American wage structure between 1963 and 1987 was the dynamics in the relative supply of skilled labor. DiNardo, Fortin and Lemieux (1996) added institutional and normative components to the explanation (i.e. changes in the union structure) and proposed the behavior of the minimum wage as another basic determinant. Mincer (1996) found that the within educational group inequality was the largest contributor to overall inequality, once other variables are controlled for. Following Juhn et. al. (1993), he identifies these changes with rising returns to unobserved ability, which would be due to technological dynamics.

Murphy, Riddell and Romer (1998) analyze the changes in earnings inequality in the U. S and Canada, and attempt to relate them with technological change. They find that the behavior of inequality can be explained by changes in relative supply of skilled labor and changes in technology which raise the demand for unobserved ability. According to them, the rise in inequality would have been stronger in the Canadian case if there had not been a progressive equalization in the supply of differently skilled kinds of labor. Beaudry and Green (2000) try to explain the Canadian case with a totally different set of arguments, based on the hypothesis of a systematic deterioration of labor market conditions. They conclude that younger cohorts face a lower earnings profile than older ones throughout their entire lifetime.

Finally, Johnson (1997) finds that the relative demand for skilled worked has followed a rising trend since the 1940's, which experienced an important acceleration starting at the beginning of the 1980's. The same did not happen with the relative supply, which lagged during this last period. From this point of view, the rise in earnings inequality comes from these different dynamics in relative supply and demand. Although several explanations could be posed, the rise in unobserved ability due to technological change seems to be the most reasonable to the author.

Colombia was not an exception to the rising inequality trend (as it was shown in Figure 1) and a vast economic literature has been produced on the subject. Núñez and Sánchez have exhaustively documented changes in the Colombian wage structure

(1998a), the determinants of changes in labor earnings inequality (1998b) and the changes in the decisions of Colombian households (2002) during the 1990's. Generally speaking, they find robust and consistent evidence of the importance of education in all of these processes, especially through the observed changes in relative prices and supply. According to them (1998b), schooling alone can explain 20% to 30% of the variation in inequality. They observe differential dynamics between male and female labor prices too. Besides that, within sector mobility and the deterioration of overall labor market conditions are found to be powerful and fundamental components of the observed changes in inequality.

According to Santa María (2004), the recent Colombian labor market conditions can be characterized by decreasing returns to intermediate skilled workers and increasing relative wages of women and skilled workers. He rejects the hypothesis of a relationship of these and the structural reforms that took place in Colombia at the beginning of the 1990's (openness and trade liberalization). The explanation could be found, he concludes, in the variations of the skill composition of the labor force and skilled bias technological change.

Vélez et al. (2005) make a decomposition of the observed changes in inequality, based on the same methodology used later on this paper (Bourguignon & Ferreira, 2005). Based on their estimations, they classify determinants as persistent and fluctuating forces. The first group includes, on the one hand, socio-demographic conditions such as the schooling distribution, which are the result of long term trends. The fluctuating determinants include, on the other hand, some of the most important determinants (i.e. the rising returns to skill) which, nonetheless, obey to transitory conditions. Generally speaking, their results agree with what had been found by Núñez and Sánchez (1998a, 1998b, 2002). But besides all of these, and contrary to their expectations, they find that the equalization of educational endowments led to a deterioration of the income distribution in urban areas (Vélez et. al. 2005:127).

Taking a different methodological perspective, in recent years, technological innovation has allowed the full estimation of structural models in diverse fields including labor economics. These estimations include, in many cases, the simulation of the effects of particular public policies in a specific framework. There is no intention here to survey this literature. On the contrary, just a couple of examples of public policy simulations are set. They are completely different in nature to the ones developed later on, though.

Keane and Wolpin (1997) estimate a model of schooling, labor force participation and occupational choices. Based on it, they evaluate, for example, the consequences of introducing college subsidies. Keane and Wolpin (2001) ask themselves about the effects of liquidity constraints and parental transfers on the decisions of human capital investments and labor market choices. They simulate scenarios which include subsidies, relaxing the constraints and equalizing parental transfers. They find, among other things, that liquidity constrains are not as important as parental transfers in the determination of the decisions mentioned above. Both of these works, as most of the literature does, evaluate only partial equilibrium effects of the public policies.

Opposite to this literature, this paper develops some empirical exercises based on reduced form models instead of structural models. The data available in Colombia does not allow doing something of that type. Despite this restriction, the greatest advantage of the methodology used here is that it allows the evaluation, in a rigorous manner, of the partial equilibrium effects and consequences of educational policies which cannot be observed in historical data, isolating the effects of the particular variable of interest.

6 Methodology

6.1 Baseline Methodology

The methodology proposed by Bourguignon and Ferreira (2005) is basically one designed for decompositions of changes in earnings distributions between two periods. The first step[7] is to estimate a conditional earnings function for different moments in time. The assumption here is that individual earnings are correlated with other observed characteristics such as schooling, experience, gender, marital status, etc.; the market prices of those characteristics; and an error term including unobserved characteristics and stochastic shocks. Thus, the following can be written:

$$\{y_i\}^t = D(\chi_t, \Pi_t, \theta_t) \tag{1}$$

where $\{y_i\}^t$ are the observed labor earnings in time t, and χ_t, θ_t, Π_t are the distribution of the observed characteristics, the prices of those characteristics and the distribution of the error term in time *t*. In the particular case of individual labor earnings, the distribution $D(\chi_t, \Pi_t, \theta_t)$ can be easily estimated through a Mincer equation, which can be expressed this way:

$$\ln y_i = \alpha + X_i \theta + \varepsilon_i .$$

Accordingly, the function generating distribution D( ) would be:

$$F(X, \theta, \varepsilon) = R \exp(X\theta + \varepsilon) \ .^8 \tag{2}$$

The next step is to define the counterfactuals in the way Bourguignon and Ferreira do. The changes needed in order to simulate the effects of educational policies will be shown later.

Knowing X for two given moments in time *t* and *s*, F( ) can be estimated for these two cross sections. In this paper, this estimation includes the correction of selection bias by using the Heckman MLE process. Consequently, there will be

$$\widetilde{F}_t(X_t, \widetilde{\theta}_t, \widetilde{\varepsilon}_t) \quad \text{and} \quad \widetilde{F}_s(X_s, \widetilde{\theta}_s, \widetilde{\varepsilon}_s) \tag{3a ,3b}$$

The counterfactuals are obtained by simply simulating the earnings distribution after substituting the elements of F( ) from *t* to *s* or *vice versa*. For example, the counterfactual

$$\{y_i\}^{t\to s} = D(\chi_t, \widetilde{\Pi}_t, \widetilde{\theta}_s) \tag{4}$$

could be created, in which an earnings distribution is simulated using the observed characteristics in *t*, the estimated distribution of residuals for that same period, but the prices of *s*. This counterfactual can be interpreted as the earnings that individuals with the characteristics of *t* would have had if the prices would have been those of *s*. Since what it is generated through the simulation process is a distribution, inequality measures can be estimated on the counterfactual.

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[7] Even though the methodology is proposed and applied in more general terms, it is introduced in the specific way that it operates on this paper.

[8] This specification comes from a standard income equation $y_i = R.H_i$, in which R is the rental price of Human Capital and H_i is the individual stock of HC. In particular, $H_i = \exp(X_i \theta + \varepsilon)$ and $\alpha = \ln R$.

A possible extension of this process is to do these exercises with hypothetical X distributions which do not necessarily come from observed data. This procedure is different form the one proposed by Bourguignon and Ferreira because it does not intend to decompose changes in the distribution into changes in the elements of F ( ). Nevertheless, this methodological variation allows the prediction of the consequences of educational policies which can be represented through those hypothetical X distributions, even if these policies cannot be observed or proxied through actually observed data.

6.2 Educational Policy Counterfactuals

According to what was mentioned in the previous section, a counterfactual in which the distribution of X is created arbitrarily could be thought of. Specifically, artificial variations could be generated on the data included in X_t (the observed distribution of X in t). Since X_t is really a matrix in which each column is a particular variable or characteristic, the arbitrary Xs would leave all of those columns (variables) unaltered except the one containing the data on schooling (thus its distribution). Schooling data is changed in order to represent a specific educational policy. In this way, the counterfactual

$$\{y_i\}^{c \to t} = D(\chi_c, \hat{\Pi}_t, \hat{\theta}_t) \tag{5}$$

Is obtained, where χ_c is the counterfactual distribution of X (only different from X_t in the schooling data), $\hat{\Pi}_t$ is the estimated distribution of the random term estimated in t, and $\hat{\theta}_t$ are the parameters estimated in that same year.

Therefore, the comparative analysis is established on the different counterfactual distributions of labor earnings $\{y_i\}^{c \to t}$ which come from the different χ_c distributions (the schooling distributions included in them) and their interaction with parameters $\tilde{\theta}_t$:

$$\{y_i\}^{c \to t} = D(\chi_c, \hat{\Pi}_t, \hat{\theta}_t)$$
$$\text{Vs.}$$
$$\{y_i\}^{h \to t} = D(\chi_h, \hat{\Pi}_t, \hat{\theta}_t)$$

The comparison between two distributions $\{y_i\}^{c \to t}$ and $\{y_i\}^{h \to t}$ is based on any inequality measure (Gini coefficient, Theil's entropy measure), which allows the distributions, and their corresponding educational policies, to be ranked according to the level of inequality they produce, taking the distribution of other characteristics, the estimated prices and the distribution of the error term as given. Formally, an earnings distribution c will be considered to be better than another distribution h in terms of inequality if

$$I[\{y_i\}^{c \to t}] \ < \ I[\{y_i\}^{h \to t}].$$

I could be any inequality measure. In this paper, it will be the Gini coefficient, although Theil's entropy measure is also reported in the results.

Since the only thing that makes $\{y_i\}^{c \to t}$ different from $\{y_i\}^{h \to t}$ is the schooling distribution in the generating process (other observed characteristics are identical, as well as the residuals), the above allows to conclude that if c is better than h, then X_c is

better than X_h. This really means that schooling in X_c is better than X_h. Under the assumption that schooling in c and h are the representations of educational policies c and h, educational policy c is considered to be better than policy h.

Finally, it is worth noting that any effect of the educational policies on the labor income distribution is conditioned on the other observed characteristics and their prices. About the former, the ones observed in 2004, which are the most recent ones available, are used. About the latter, the results are robust to the year in which they are estimated.

6.3 Earnings and Participation Functions

As it was mentioned on the previous section, the distribution of earnings, conditional on other characteristics can be easily estimated through a Mincer equation. Off course, there are other more sophisticated ways of estimating some of the elements included in a Mincer equation. Heckman, Lochner and Todd (2006) have shown that the coefficients of schooling in this type of models cannot be interpreted as the internal return rate to schooling. Nevertheless, there is no interest here in estimating such thing. Human capital investments of individuals are not being modeled. Quite the opposite, the distribution of schooling is taken as exogenous, since it is the representation of some particular objectives in a given educational policy. Thus, the Mincer equation is just used as the conditional distribution of log labor earnings or, as it is stated by Peracchi (2006), the statistical function of labor earnings.

According to this, the particular specification of the Mincer equation is:

$$\ln y_i = \alpha + \beta_1 schooling_i + \beta_2 \exp er_i + \beta_3 \exp er_1^2 + \sum_{k=1}^{2} \rho_k levelpremia_{ki} + \sum_{j=1}^{6} \delta_j city_{ji}$$

$$+ \sum_{l=1}^{5} \gamma_l occupation_{li} + \sum_{m=1}^{4} \varphi_m maritalstatus_{mi} + \varepsilon_i \qquad (6)$$

which includes the individual's schooling years, potential experience (in linear and quadratic forms), high school and college premia, and city, occupation and marital status fixed effects.

The choice of the particular form for schooling in this equation (linear term plus two level premia) is owed to the assumption of discrete changes in earnings at these specific points of the schooling distribution. It is a standard specification in economic literature and a widely used one in Colombia (i.e. Núñez and Sánchez 1998a y 1998b).

This estimation has to be corrected for possible selection bias. This process is done through the Heckman method, where the Mincer equation is jointly estimated with the selection equation, in which the probability of participating is determined as follows:

$$Part_i = household\_members_i + members\_under10_i + schooling_i + d\_complete\_college_i +$$

$$\sum_{m=1}^{4} \varphi_m maritalstatus_{mi} + female\_householdhead_i + householdhead_i +$$

$$hhincome\_spouse_i + hhincome\_parent_i + \varepsilon_i \qquad (7)$$

where *female_householdhead* is 1 if the household head for the individual's household is a woman and 0 otherwise; householdhead is 1 if the individual is the head of his household and 0 otherwise; *hhincome_spouse* and *hhincome_parent* are the head of household's income in case he/she is the spouse or the parent of the individual, respectively.

Since this selection equation is, in fact, a raw modeling of the decision of participating in the labor market, the effects of educational policies on it could be taken into account too. However, this would require assuming that all of the possible rises in participation rates due to higher overall schooling can be absorbed perfectly by the labor market. No need to be said, this is a very strong assumption and an unlikely thing to happen. As it is shown in Table 1, the difference in predicted occupation rates between some of the policies would be of more than 20 percentage points in some cases. This rules out this option almost automatically. Thus, baseline results are based on another assumption which is just as strong but less unlikely than this one. Participation decisions are assumed to remain unaltered by educational policies.

Off course, the *real* scenario must be somewhere in between these two situations. Fortunately, relative results are identical when participation effects are and are not included in the simulations. Magnitudes are quite different, though. Therefore, results under both assumptions could be interpreted as lower and upper bounds for the size of the *real* results.

Table 1
Predicted Occupation Rates

Schooling Distribution	Predicted Occupation Rate
Egalitarian	37.92%
College subsidy	43.85%
Un focalized	50.45%
Universal primary	42.81%
Universal highschool	47.87%
Decennial	60.06%

There are several limitations to the kind of analysis described, which are owed to the characteristics of the methodology. First, it does not take into account any of the general equilibrium effects that could arise from the implementation of the educational policies evaluated. For instance, exogenously introduced changes in the schooling distribution could affect its price (therefore the coefficient in the Mincer equation). An educational policy in which, for example, the amount of qualified labor rises more than proportionally, should lead to a lower price of this type of labor in a general equilibrium framework, which would create other effects on participation and labor earnings which are unaccounted for.

Nevertheless, there are some reasons to think that these effects are not as important as it could be expected. On the one hand, the work that has attempted to include GE effects has shown that the results in this framework are not that different from the ones obtained in a partial equilibrium one[9]. On the other, to predict GE effects, a very complex structural modeling should be developed, which requires more complete data than what is available for Colombia, as well as a very robust specification, since full structural models are strongly dependent on the assumptions made on the agents' behavior and expectations. All of these given, in the case of this paper, an attempt on doing so would diminish the predictive power of the model and, therefore, the credibility of the results.

Finally, there could be some doubts about the dependence of the results on the specification of the earnings equation or the data (year) used to estimate it. Thus, robustness checks including these kinds of variations are presented.

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[9] See, for example, Lee (2004) and Lee & Wolpin (2006).

7 Public Policy Experiments

7.1 Schooling Distributions and Equation Estimations

7.1.1 Educational Policies

According to what has been stated so far, 6 schooling distributions are built in order to represent as many educational policies. One of them (*egalitarian*) does not represent a feasible educational policy. It is relevant, though, as a comparison and purely theoretical scenario. The remaining five share a basic characteristic, beside their feasibility: compared to the observed schooling distribution for 2004[10], all of them are strictly better in a Pareto sense.[11] Since the schooling distributions are built from the observed one, no individual is allowed to "loose" schooling years. Table 2 presents the educational policies and their corresponding schooling distributions. The column named *distribution* includes a brief description of each one and the way it was built. Figure 4 shows histograms of all of the schooling distributions.

Table 2
Description of policies and distributions.

Name	Educational Policy	Schooling distribution
Egalitarian	D.N.A. (Theoretical and comparative purpose)	All observations have 9 years.
College subsidy	Full tuition subsidies until receiving a bachelor's degree, randomly assigned among those with schooling prerequisites (at least highschool).	20% of the observations with complete high school or incomplete college will now have complete college. Random assignment.
Un focalized	To rise average schooling without any specific focalization.	All observations have their observed schooling plus 2 with an upper bound set at 16 years (complete college).
Universal primary	To guarantee primary education (Colombian 5th grade) to all of the population.	Observations 12 or older with less than 5 years of schooling will now have 5. Others remain unaltered.
Universal high school	To guarantee high school (Colombian 11th grade) to all of the population.	Observations 18 or older with less than 11 years of schooling will now have 11. Others remain unaltered.
Decennial	The Decennial Education Plan (Plan Decenal de Educación) 2007 poses the following goals: Universal coverage until 11th grade, 50% coverage in tertiary education adn 205 coverage in post graduate education.	Observations are randomly selected to fill in the empty places in the coverage goals. They are selected from the sample of observations which do not have the corresponding schooling.

7.1.2 Descriptive Statistics

The selection of these policies attempts to include a wide range of possibilities, based broadly on their variance and the section of the density where most of the changes occur. Thus, *egalitarian* has no variance. *College subsidy*, on the other hand, has a very large one. *Unfocalized* makes the same (absolute) changes throughout the distribution. *Universal primary* focuses on the lower section, *universal high school* on the center and *decennial* on the upper section.

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[10] The schooling distributions are built from the observed one for 2004.
[11] Under the assumption that more schooling is always preferred to less schooling or, in other words, that the marginal utility for an additional year of schooling is always positive within the relevant range.

Table 3 presents some descriptive statistics of the counterfactual schooling distributions. All of the distributions but egalitarian have a higher mean than the observed one, which goes from 9 (*egalitarian*) to 13.7 (*decennial*). Standard deviation has a broader range, going from 0 (*egalitarian*) to 4.57 (*college subsidy*).

Figure 4
Histograms of the schooling distributions
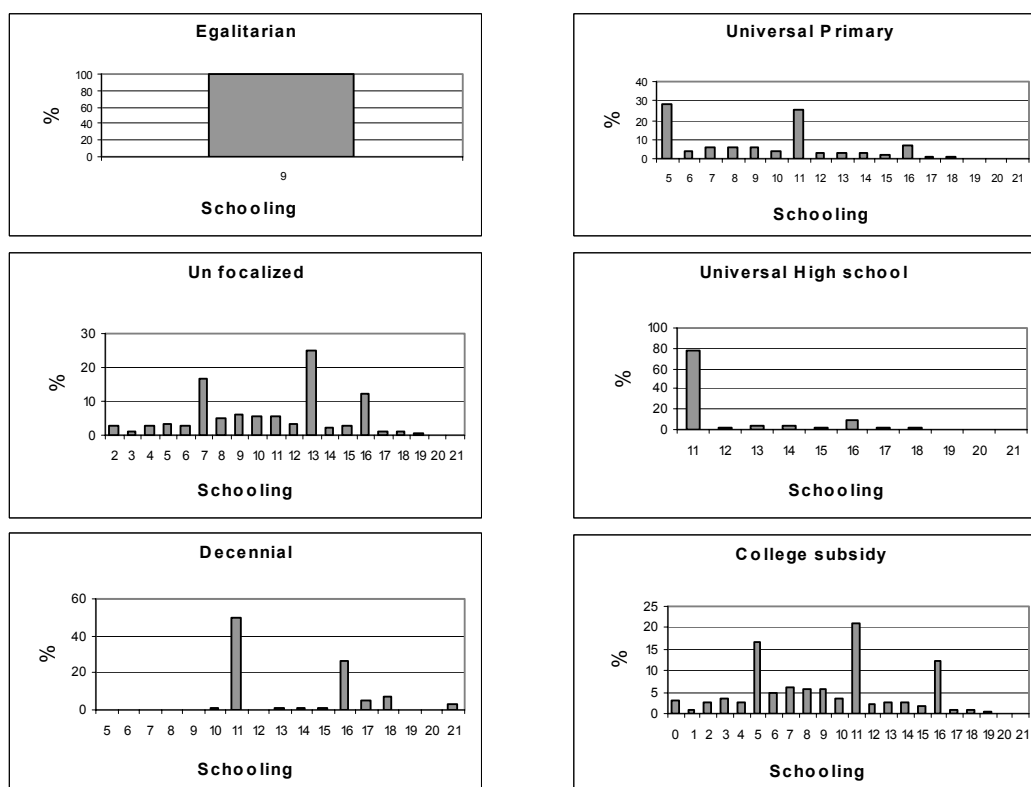
Table 3
Descriptive statistics

Schooling Distribution	Mean	Standard Deviation	Coefficient of Variation	Median	Min	Max
Egalitarian	9.000	0.000	0.000	9	9	9
College subsidy	9.564	4.569	0.478	10	0	21
Un focalized	11.064	3.947	0.357	12	2	21
Universal primary	9.640	3.848	0.399	10	5	21
Universal highschool	12.095	2.062	0.170	11	11	21
Decennial	13.745	3.091	0.225	12	6	21

7.1.3 Labor Earnings Function

Table 4 shows the most important coefficients of the Mincer equations, estimated with the 2004 data. These estimations have a purely statistical relevance in this paper. Thus, the only interpretation for these parameters is as marginal effects on the simulated

labor earnings. Since potential experience remains unaltered throughout the different distributions, the corresponding coefficients are irrelevant at this point.

Each additional year of schooling will generate 7% more labor earnings, if the individual is a woman, and 5%, if he is a man. If that additional year takes the individual to "finish" high school, earnings would rise approximately 15% (for both genders). If he/she "finishes" college, labor earnings would be 52% larger (exp 0.048+0.37) in the case of men, and 73% (exp. 0.07+0.48) in the case of women.

Although the results are not reported, the Mincer equations are estimated with the 1985 and 1995 data, too. The schooling coefficient is close to the one reported in papers with similar data and specifications (i.e. Núñez and Sánchez, 1998a)

Table 4

Labor earnings functions. 2004. (corrected for selection bias) Dependent variable is log labor earnings		
Variable	Men	Women
Schooling (years)	0.04876 ***	0.07044 ***
	(0.0048)	(0.0065)
College premia	0.37246 ***	0.48162 ***
	(0.0396)	(0.0442)
High school premia	0.10327 ***	0.07032 *
	(0.0292)	(0.0417)
Potential experience	0.03499 ***	0.03352 ***
	(0.0021)	(0.0031)
Potential experience (squared)	-0.00048 ***	-0.00047 ***
	(0.0000)	(0.0001)
Total observations	21334	25845
Uncensored observations	12676	10523

Source: Author's calculations based on ECH 2004 III

Standard errors in parenthesis

* Significant at the 10% level

*** Significant at the 1 % level

Occupation, marital status and city fixed effects included but not reported.

Selection bias is corrected with Heckman ML procedure.

7.2 Results

Table 5 shows mean labor earnings, Gini coefficient and Theil index for each of the counterfactual earnings distributions. Table 6 ranks the distributions according to these criteria. A lower number in this ranking means a lower value in the results in Table 5. Figure 5 shows the results in terms of inequality (Gini and Theil).

Even though the fit of the labor earnings function is good (the adjusted R –squared is somewhere near 50% in both cases), it is responsible to focus the analysis on comparative rather than absolute results. Thus, the main, but not only, element of analysis is the comparison between the counterfactual scenarios in terms of inequality, which, according to what has been stated in previous sections, is equivalent to establishing a comparison between the educational policies in this particular dimension.

As it could have been expected, the distribution with the lower inequality is the one that comes from the simulation of the *egalitarian* distribution. It is also illustrative, though expected, to see that *egalitarian* has the worst results in terms of mean earnings. Even if it is beyond the scope of this paper, it is important to underline the existing trade off between the reduction of inequality and the level of labor earnings.

U*niversal high school* is the best plausible policy in terms of inequality. Since this is a very similar policy, though a more ambitious one, to what was observed in Colombia during the last years (Figure 3), an optimist interpretation would be that what has been done would yield good results in the long run[12]. On the other hand, the earnings distribution resulting from the *college subsidy* policy is the most unequal one. Thus, it could be concluded that investing in high qualification *alone* would lead to higher inequality, while doing so in medium qualification lead towards the opposite.

Table 5
Counterfactual labor earnings distributions

Schooling distribution	Labor Earnings		
	Mean	Gini	Theil
Egalitarian	437188	0.28450	0.13011
College subsidy	620727	0.37855	0.23629
Un focalized	650563	0.35260	0.20439
Universal primary	585622	0.36229	0.21916
Universal highschool	657746	0.32625	0.17635
Decennial	848623	0.33881	0.18423

Table 6
Counterfactual labor earnings distributions ranking

| Schooling distribution	Labor earnings		
	Mean*	Gini**	Theil**
Egalitarian	6	1	1
College subsidy	4	6	6
Un focalized	3	4	4
Universal primary	5	5	5
Universal highschool	2	2	2
Decennial	1	3	3

* 1= highest value
** 1=lowest value

One of the most interesting results is the relative position of *decennial*. Right behind *universal high school,* it is the second best of the plausible policies. This is relevant for several reasons. First, *decennial* is a quite disperse schooling distribution. Second, the mean of the resulting earnings distribution is the highest, contradicting the trade off between level and inequality in labor earnings. Thus, by equalizing opportunities and high levels of investment in generating skilled labor, *decennial* achieves good results in terms if labor earnings inequality without any sacrifice in their level. Given the large earnings differential between skilled and unskilled labor, the ambitious goals in terms of tertiary education coverage lead to interesting results in term of inequality. It is straightforward to see why this raises mean earnings as well.

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[12] This result seems to be sensitive to how perfectly the objective is accomplished. For instance, when 1% desertion is allowed between high school grades, the Gini coefficient jumps to 0.34596.

Figure 5
Counterfactual Distributions' Inequality
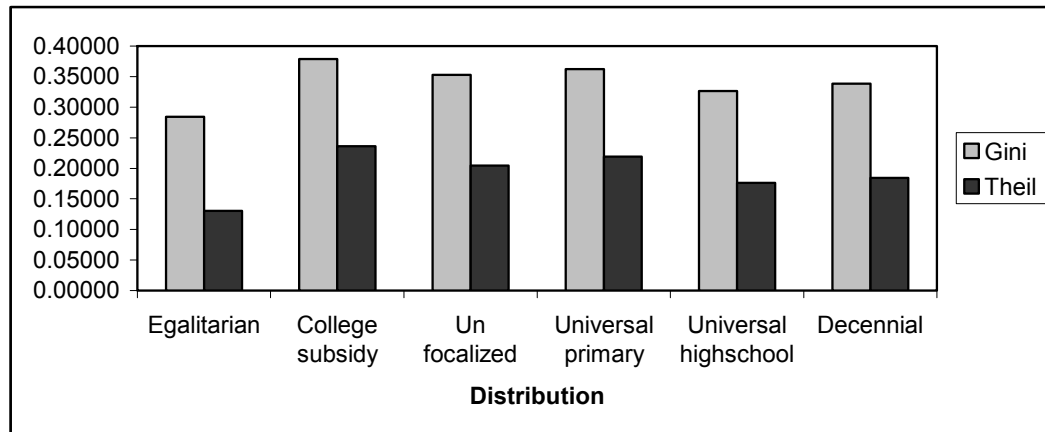
Comparing this last result to the opposition between college subsidy and universal high school leads to a very important policy implication. Since *decennial* implies a large investment in high skilled labor, full coverage in high school and just a small rise in inequality compared to *universal high school*, the results suggest that investments in tertiary education could be made without large increases in inequality if high school coverage is previously guaranteed.

Base on all of the above, a very preliminary comparison between two different paths towards a larger proportion of high skilled labor force can be posed. If *universal primary* is taken as a starting point, and a higher proportion of high skilled labor is taken as the final target, one path would be going straightly from one to the other (*college subsidy*). The other path would introduce an intermediate stage: full high school coverage. Thus, the resulting distribution would be *decennial.* Based on the already mentioned results in terms of Gini coefficient, the second "path" would be definitively better than the first one.

The un-focalized policy, as one could have expected, lands right in the middle of all of the rankings. This is quite interesting, though, since it highlights the importance of thinking about educational policy and the implications of the composition of the schooling distribution on the labor earnings distribution. It reinforces the assumption that *composition does matter*.

7.3 The Participation Effect

The results presented in the last section did not take into account the effect of the educational policies on labor force participation. As it was already mentioned, since schooling is involved in an individual's decision of whether or not she offers labor in the market, educational policies could affect those decisions. Nevertheless, these effects were not included because doing so would require the unlikely and strong assumption that all of the increases in participation, no matter their magnitude, could be perfectly absorbed by the labor market.

Results in Tables 5 and 6 rest on an equally strong assumption: participation remains unaltered by educational policies. Therefore, it is important and necessary, for comparison purposes, to present the results that are obtained when the participation

effect is included. These can be found in Tables 7 and 8, which are analogous to Tables 5 and 6.

Several points are worth noting. First, comparative results are identical. Nevertheless, the results are clearly weaker, in magnitude, when the participation effect is included. The distribution under which inequality is lower is still *egalitarian* with a Gini coefficient of 0.45, which strongly differs from the original 0.28 in Table 5. The range of the new Gini coefficients is also narrower.

All of these can be basically explained by the positive coefficient of schooling in the participation equation. Many individuals who do not participate in the historical data will end up participating in the counterfactual scenarios, and this will be more frequent in the lower part of the schooling distribution. Furthermore, since these individuals are also more likely to be in the lower part of the earnings distribution, inequality rises.

Thus, the inclusion of the participation effect generates less variation among the resulting labor earnings distributions and higher overall inequality. The relative results do not change, though. Since the two assumptions (perfect absorption and constant participation) can be interpreted as the two extreme situations among an infinite range of scenarios, the quantitative results in Tables 5 and 7 could be understood as upper and lower bounds of the changes in inequality that would result from the implementation of the educational policies.

Table 7
Counterfactual labor earnings distributions
Includes participation effect

Schooling distribution	Labor earnings		
	Mean	Gini	Theil
Egalitarian	323,588	0.45036	0.33677
College subsidy	529,970	0.50485	0.50485
Un focalized	505,120	0.50294	0.42346
Universal primary	487,371	0.50434	0.42811
Universal highschool	510,290	0.47736	0.38264
Decennial	640,050	0.48199	0.38383

Table 8
Counterfactual labor earnings distributions ranking
Includes participation effect

Schooling distribution	Labor earnings		
	Mean*	Gini**	Theil**
Egalitarian	6	1	1
College subsidy	2	6	6
Un focalized	4	4	4
Universal primary	5	5	5
Universal highschool	3	2	2
Decennial	1	3	3

* 1= highest value
** 1=lowest value

7.4 Robustness Checks

Table 9 summarizes the results of some robustness checks[13].One could think of the results being driven by two kinds of unwanted elements: the year of the data from which the earnings and participation equations are estimated and the particular specification of the Mincer equation. Thus, the whole estimation and simulation process was repeated with four different variations. First, the earnings function was estimated with 1985 and 1995 data. These years were selected in order to estimate the Mincer equation before (1985) and during (1995) the period of rising inequality in Colombia. The policy rankings, according to the Gini coefficient, are presented on columns 2 and 3 of Table 10. Column 4 shows the results when age is included instead of potential experience in the earnings function. Finally, the results after including schooling levels instead of the schooling years and level premia in that same equation can be found in column 5. In order to allow an easy comparison, original results (from Table 6) are included in column 1.

As it can be observed, comparative results are extremely robust. Not only they remain unaltered when the participation effect is included, but the same happens when the already mentioned changes are introduced in the estimation of the Mincer equation. The only case in which something different is obtained is when schooling levels are included instead of schooling years and premia in the Mincer equation. In this case, *universal primary* ranks 4th, moving *unfocalized* to he 5th position. This happens because all of the changes in *universal primary* lead to a change in schooling level, while most of the changes in *unfocalized* don't.

Table 9
Robustness checks
Distributions ranked by Gini coefficient

Baseline estimation	Variation			
	1985 Parameters	1995 Parameters	Age	Schooling levels
Egalitarian	Egalitarian	Egalitarian	Egalitarian	Egalitarian
Universal highschool	Universal highschool	Universal highschool	Universal highschool	Universal highschool
Decennial	Decennial	Decennial	Decennial	Decennial
Un focalized	Un focalized	Un focalized	Un focalized	Universal primary
Universal primary	Universal primary	Universal primary	Universal primary	Un focalized
College subsidy	College subsidy	College subsidy	College subsidy	College subsidy

It is absolutely necessary to make explicit some of the limitations of the methodology that has been used. First, it is an absolutely static one. The way in which the participation decision is modeled, as it was widely discussed, is extremely simple. These led to unrealistic changes in participation decisions under some of the policies evaluated. For these reason, the main results were presented without the participation effect.

Finally, all of the comparative analysis has not taken into account the different costs associated with each of the educational policies. Some of the best policies, according to the results, would probably represent a larger burden on public budget (i.e. *decennial*).

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[13] The participation effect is excluded in these exercises.

8 Conclusions

Counterfactual labor earnings distributions were simulated. The only difference between them comes from the generation process, in which the schooling of individuals (hence the schooling distribution) was changed in order to represent some educational policies. A comparative analysis was established in terms of the inequality of the resulting earnings distributions. This allowed for comparison between the educational policies in this particular dimension. All of the process happens inside a partial equilibrium environment in which labor earnings are endogenous but relative prices remain unaltered.

Guranteeing high school education to all of the population proves to be a really powerful tool in terms labor earnings inequality reduction. The results of this paper suggest that this should be done before attempting to do large investments in tertiary education coverage. When this happens, schooling distributions with relatively high variance can coexist with comparatively low levels of inequality and high mean earnings. On the other hand, failing to provide universal high school coverage before focusing on tertiary education leads to higher inequality.

There is some evidence that the magnitude of the changes in inequality produced by the educational policies seems to be strongly dependant on the characteristics of the labor market. Inequality reductions appear to be quite larger when the labor market is not able to absorb the changes in participation generated by the shifts in the schooling distribution. Although it is far beyond the reach of this paper, this could imply that educational policy has a larger effect, in terms of inequality reduction, in weaker economies (such as the ones in developing countries). Research on this is strongly encouraged by these preliminary results.

Are the results of this paper a precise prediction of the inequality that would arise from the execution of these educational policies? It would be irresponsible to say so. Nevertheless, they create useful elements for their comparison in this particular dimension, as well as clues on their interdependence with other elements. The main results are extremely robust to changes in equation specification and data used for the estimation. This allows rejecting the idea that they are driven by forces different from the educational policies. Thus, what has been presented in this paper must be interpreted as an initial step in the provision of decision elements for public policy, which has been produced through the use of a rigorous methodology. All of these should be complemented with research focusing on other dimensions of educational policy.

"The history of interest among economists in the distribution of income is as long as the history of modern economics itself" (Becker and Chiswick, 1966 p.358). As long as inequality levels remain as high as they actually are, that interest would still exist. Educational policy is still a powerful tool in this sense. The results of this paper suggest the possibility of achieving some inequality reduction without any sacrifice in mean earnings (though probably at a very large cost). Nevertheless, educational policy is just one of the possible means to achieving a less unequal income distribution. The problem requires creative initiatives integrating simultaneous and complementary actions supported on innovative academic research.

9 References

ASAMBLEA GENERAL POR LA EDUCACIÓN (2007). *Plan Decenal de Educación 2006-2015. Relatoría Tema 6 (Equidad: Acceso, permanencia y calidad)*. Plan Decenal de Educación website: http://www.plandecenal.edu.co

BEAUDRY, P. & D. GREEN. (2000). "Cohort Patterns in Canadian Earnings: Assessing the Role of Skill Premia in Inequality Trends." In: *The Canadian Journal of Economics* Vol. 33 No. 4, pp 907-936.

BECKER, G. S. & B.R. CHISWICK.(1966). "Education and the Distribution of Earnings" *The American Economic Review*, Vol. 56, No. 1. pp. 358-369.

BOURGIGNON, F. & F. FERREIRA. (2005)."Decomposing Changes in the Distribution of Household Incomes: Methodological Aspects" In Bourguignon et. al. editors *The Microeconomics of Income Distribution Dynamics in East Asia and Latin America*. World Bank and Oxford University Press.
CÁRDENAS, M. & R. BERNAL. (1999). *Changes in the Distribution of Income and the New Economic Model in Colombia*. Santiago: CEPAL Serie de reformas económicas. No. 36.

DINARDO J., L. FORTIN & T. LEMIEUX. (1996) "Labor Market Institutions and the Distribution of Wages, 1973-1992: A Semiparametric Approach" *Econometrica*, Vol. 64, No. 5. pp. 1001-1044.

HECKMAN J., L. LOCHNER & P. TODD. (2006). "Earnings Functions, Rates of Return and Treatment Effects: The Mincer Equation and Beyond" In Hanushek E. & F. Welch (Eds.) *Handbook of the Economics of Education.* Vol. 1. (Capítulo 7). Amsterdam ; New York : Elsevier.

JOHNSON, G. E. (1997) "Changes in Earnings Inequality: The Role of Demand Shifts" *The Journal of Economic Perspectives*, Vol. 11, No. 2. , pp. 41-54.

JUHN, C., K. MURPHY & B. PIERCE. (1993). "Wage Inequality and the Rise in Returns to Skill." In: *The Journal o Political Economy* Vol. 101 No. 3, pp 410-442.

KATZ L. & K. MURPHY. 1992. "Changes in Relative Wages, 1963-1987: Supply and Demand Factors" *The Quarterly Journal of Economics*, Vol. 107, No. 1 pp. 35-78.

KEANE, M. & K. WOLPIN. (1997) "The Career Decisions of Young Men" *The Journal of Political Economy*, Vol. 105, No. 3. pp. 473-522.

_____ (2001) "The Effect of Parental Transfers and Borrowing Constraints on Educational Attainment" en *International Economic Review*, Vol. 42, No. 4. pp. 1051-1103.

LEE, D. (2004) "An Estimable Dynamic General Equilibrium Model of Work, Schooling, and Occupational Choice" *International Economic Review*. Vol 46. No. 1. pp. 1-34.

LEE, D. & K. WOLPIN. (2006). "Intersectoral Labor Mobility and Growth of the Service Sector" *Econometrica*, Vol. 74, No. 1. 1–46

_____. (1996). "Changes in Wage Inequality, 1970-1990" NBER Working paper No. 5823.

MURPHY, K., W.C. RIDDELL & P. ROMER. (1998). "Wages, Skills, and Technology in the United States and Canada" NBER working paper No. 6638.

NÚÑEZ, J. & F. SÁNCHEZ. (1998a). *Educación y salarios relativos en Colombia, 1976-1995: determinantes, evolución e implicaciones para la distribución del ingreso.* Bogotá: Departamento Nacional de Planeación. Archivos de Macroeconomía No.74.

_____. (1998b). *Descomposición de la desigualdad del ingreso laboral urbano en Colombia:1976-1997.* Bogotá: Departamento Nacional de Planeación. Archivos de Macroeconomía No.86.

_____. (2002). *A dynamic analysis of household decision making in urban Colombia, 1976-1998.* Bogotá: Departamento Nacional de Planeación. Archivos de Macroeconomía No. 207.

PERACCHI, F. (2006). "Educational Wage Premia and the Distribution o f Earnings: An International Perspective" In Hanushek E. & F. Welch (Eds.) *Handbook of the Economics of Education.* Vol. 1. (Capítulo 5). Amsterdam ; New York : Elsevier.

SANTA MARÍA, M. (2004). "Income Inequality, Skills and Trade: Evidence from Colombia during the 80s and 90s". Documento CEDE 2004-02. Bogotá: Universidad de los Andes.

VÉLEZ, C.E., J. LEIBOVICH, A. KUGLER, C. BOUILLÓN & J. NÚÑEZ. (2005). "The Reversal of Inequality Trends in Colombia, 1978-1995: A Combination of Persistent and Fluctuating Forces." In Bourguignon, F., F. Ferreira & N. Lustig (Editors) *The Microeconomics of Income Distribution Dynamics in East Asia and Latin America*. World Bank and Oxford University Press.