

Measuring Changes in Poverty in Colombia: the 2000s

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2016

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Measuring Changes in Poverty in Colombia: the 2000s

Nataly Obando Rozo and Leandro G. Andrián¹

Abstract

This paper analyzes the change in poverty between 2002 and 2013 in Colombia. We find that more than 90 percent of the reduction in poverty is explained by economic growth, and that wages are the main household income contributing to poverty reduction. In particular, 71% and 85% of poverty reduction comes from labor income in urban and rural areas, respectively. Cash transfers also played an important role in reducing poverty and inequality. Our estimates suggest that without cash transfers, poverty would have been 4 percentage points higher in 2013 and the income distribution would have been worse. The paper also finds that increases in labor income have been driven by a growing proportion of population acquiring skills at technical and professional level. However, when we focus on the poor population, increases in their labor incomes are not explained by higher educational levels, but by higher market wage levels.

Key words: income effect, distribution effect, Poverty, cash transfers, labor income.

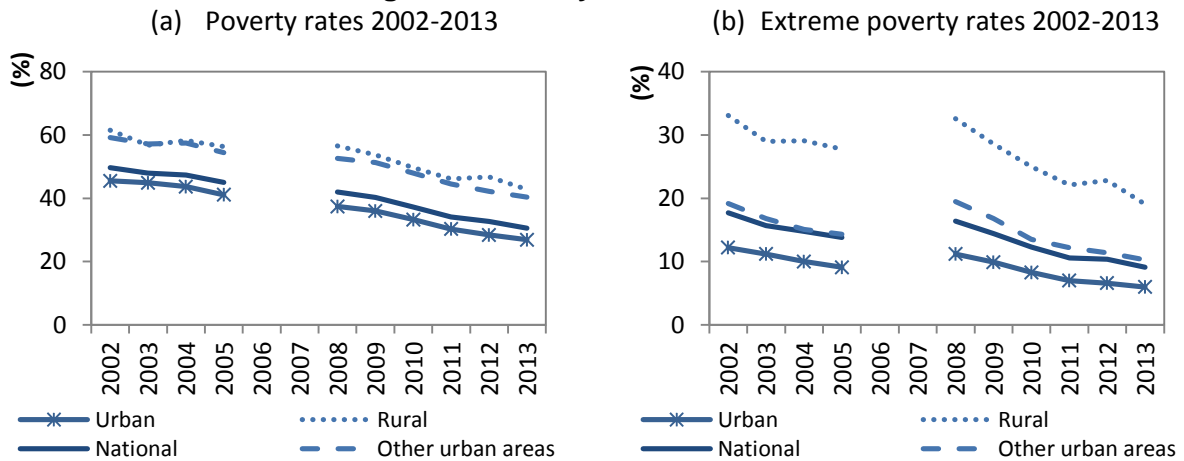
JEL codes: I30, I32, I38, J31 and O11

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1. Introduction

The sharp decrease in poverty rates in Colombia post crisis in the early 2000s is a stylized fact in Latin America and the Caribbean (LAC) as documented by Cruces and Gasparini (2013), Banco Mundial (2014) and Azevedo, *et al* (2013), among others. The combination of high economic growth and income distribution improvement, through cash transfer programs, sped up poverty reduction in LAC. Colombia has grown at average annual rates of 4.6% over the past ten years and implemented several social programs targeted to poor households. Thus, from 2002 to 2013 at national level, the poverty² rate decreased from 49.6% to 30.6%, while extreme poverty decreased from 17.7% to 9.1% (Figure 1)³. In the rural area, the poverty rate decreased from 61.5% in 2002 to 42.8% in 2013.

Figure 1. Poverty rates in Colombia



Source: ECH, GEIH.

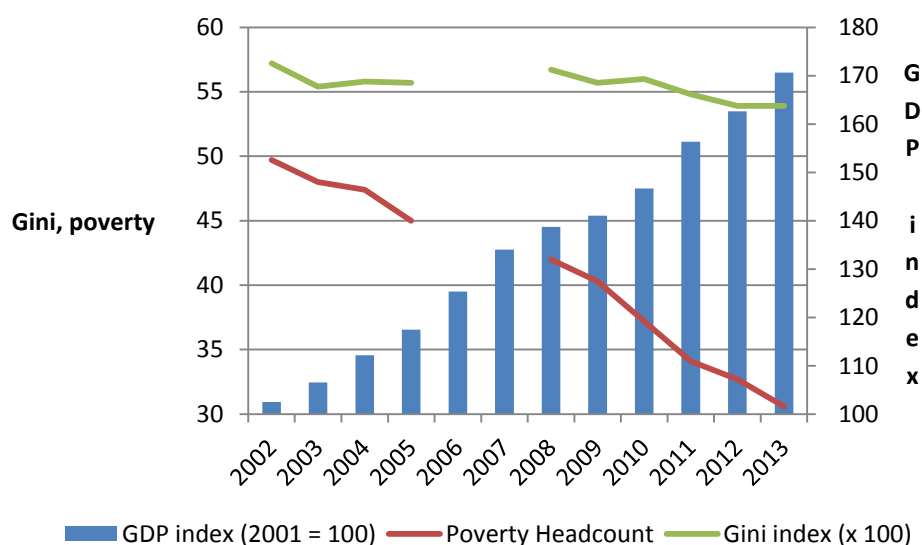
The relationship between poverty, growth and inequality can be seen in Figure 3. Between 2002 and 2013, poverty rate fell from 49.7% to 30.6% (a 38% drop) and GDP's grew up to 66%. These two facts contrast with a moderate decrease in inequality. In the same period the Gini coefficient fell from 0.572 to 0.539, a -6% variation. These facts are commonplace in LAC. However, inequality in Colombia in this period remains as one of the highest in the region and the drop in inequality was lower than observed in the rest of the region⁴. According to Cruces and Gasparini (2013), the turn of the century was a turbulent period in which poverty increased as a result of macroeconomic crises in several LAC countries. Later, during the 2000s, poverty decreased in LAC due to two facts: economic growth and better income redistribution. Moreover, although changes in income distribution were important in order to reduce poverty, the economic growth was the dominant factor.

² There are several definitions of poverty. Monetary poverty by individual (household) is defined as the headcount ratio between those individuals (households) whose per-capita income is below the poverty line over total population (total number of households). Also there is the concept of multidimensional poverty where unsatisfied basic needs; monetary poverty, health and level of education of the members of the households are taken into account. In this study we analyze the headcount poverty rate.

³ Because of changes of methodology in survey households, there is not data of poverty indicators between 2007 and 2008.

⁴ For countries with available information in the region; the average drop in Gini was 0.059, while in Colombia it was just 0.033. These countries are: Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru and Uruguay.

Figure 2. Poverty, GDP and inequality



Source: DANE.

The goal of this document is to analyze the determinants of the drop in poverty in the 2000s in Colombia prior to the fall of the shock to the terms of trade. Therefore, we analyze the period between 2002 and 2013⁵ to identify which were the changes between these two years that led to a reduction in poverty. First, we look at what share of the reduction in poverty was driven by the increase in income and changes in inequality. For this purpose we use the growth-inequality decomposition introduced by Datt and Ravallion (1992). This method decomposes the relative contribution to changes in poverty into three components: i) growth, ii) redistribution, and iii) a residual⁶. The growth component (or income or growth effect) represents the change in poverty attributable to changes in mean welfare (i.e. economic growth). In turn, the redistribution component (i.e. redistribution effect) represents the change in poverty attributable to changes in the distribution curve. Second, we use the method of Azevedo et al (2013) in order to decompose how each source of household income contributes to the total poverty reduction. Finally, we adapt the method of Ñopo (2008), to identify which observable characteristics of the population between 2002 and 2013 explain the change in wage income between these two years. This methodology has been used to identify which observable characteristics between men and women explain the wage gap between these two groups.

We use data from the Continuous Household Survey for 2002 and the Great Integrated Household Survey for 2013 for the analysis. We find that economic growth, rather than changes in income distribution, is the main factor explaining the drop in poverty between 2002 and 2013. Likewise, we observe that transfers explain 15% of the reduction in poverty in urban areas and 19% in rural areas. This income transfer especially helped children, youth and the elderly to cross the poverty line. Also, we show how the elderly (people 65 years and over) are more likely to fall into poverty, which leaves them in extreme vulnerability, due to the fact that the elderly leave the labor

⁵ We choose 2013 as the end point, because is the year before to the shock to the terms of trade suffered by Colombia, due to the fall of the oil prices that started in 2014.

⁶ The residual, sometimes referred to as the interaction term, represents the effect of simultaneous changes in mean income and distribution on poverty that is not accounted for by the other two components.

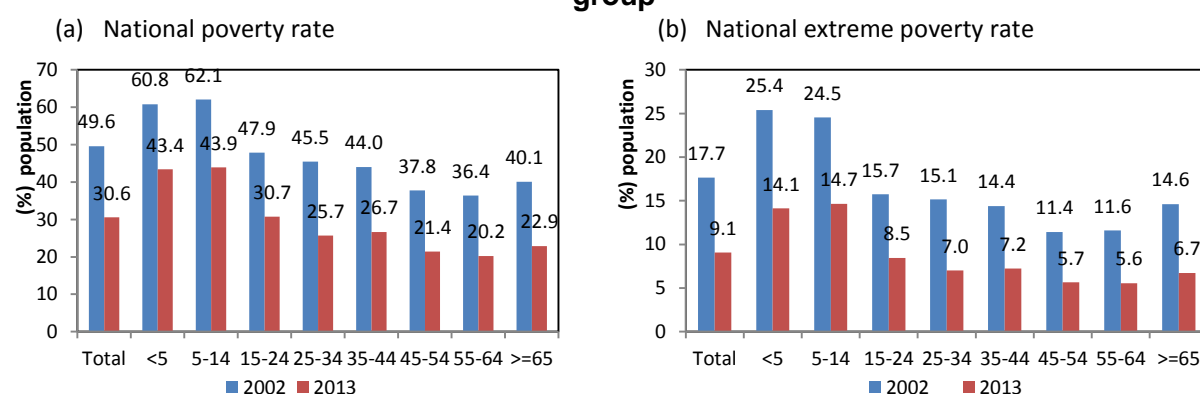
market and most of them lack a pension income. The latter is in line with the study of Bosch et al (2015) that finds that the pension system in Colombia shows low coverage levels. Finally, using Ñopo's methodology, we show that people who achieve education at technical and/or professional levels are the ones who achieve higher increases in labor incomes. Our results go in line with the findings in Cruces and Gasparini (2013), Banco Mundial (2014) and among others, in the sense that income effects, rather than distributional effects, explain the bulk of poverty reduction during this period. In addition, as in Azevedo, *et al* (2013), we find that wages is the main source of household income followed by cash transfers.

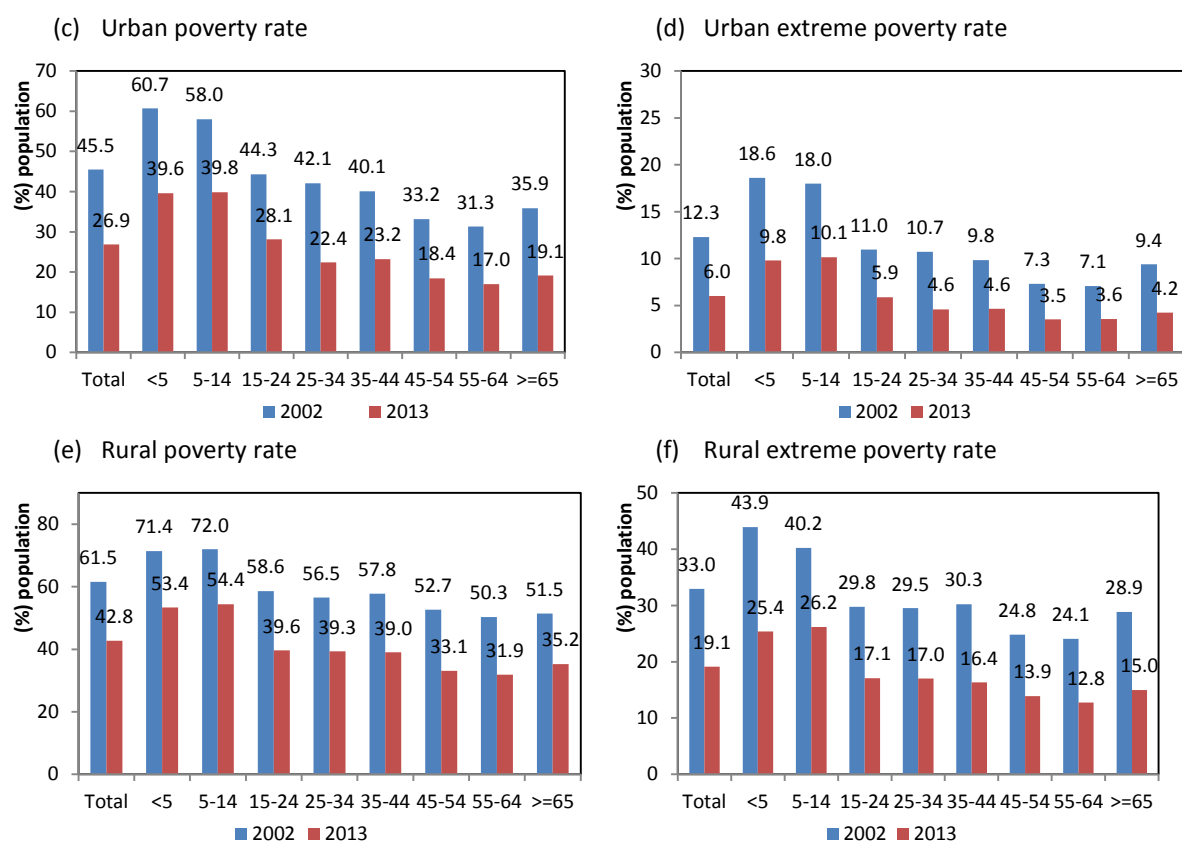
2. Characterizing poverty in Colombia

The decline in poverty has been heterogeneous among ages. As Figure 3 shows, poverty and extreme poverty rates are different between age groups. The groups of population with the highest poverty and extreme poverty rates are the younger ones. While in 2002 the poverty rate was 49.6% for the entire population (See Figure 4, panel a), for the age group of less than 5 years old and the group between 5 and 14 years old, poverty rates were 60.8% and 62.1%, respectively. The differences between poverty rates and extreme poverty rates of these groups compared to the total population persist until 2013. At urban and rural levels we can see a behavior similar to the national level.

Other stylized fact to highlight is the behavior of poverty trough age groups in a moment in time. For example, in 2002 (Figure 4, panel a) 60.8% of people with less than 5 years of age are poor, such rate slightly decreases in childhood, and in the age group between 15-24 years the probability of being poor starts to decrease. It is possible that such changes are related to the entrance of individuals in the labor market. However, when a person is 65 years old or older the poverty rate increases. This fact holds true in both poverty and extreme poverty rates given a moment of time.

Figure 4. Evolution of poverty and indigence rates between 2002 and 2013 by age group

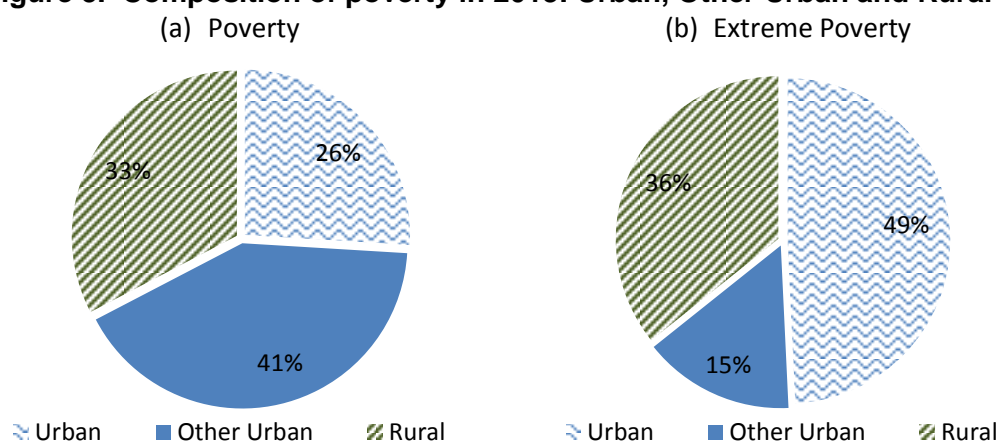




Source: ECH, GEIH, MESEP. Authors' calculations.

Finally, figure 5 decomposes the poor population at urban, other urban, and rural⁷ areas. Thus, in 2013 around one third of poor households lived in rural areas (33%), 26% of the poor population resided in urban areas, and the remaining 41% in other urban areas.

Figure 5. Composition of poverty in 2013: Urban, Other Urban and Rural



Source: ECH, GEIH.

⁷ Urban correspond to the main 13 areas: Barranquilla AM, Bogotá, Bucaramanga AM, Cali AM, Cartagena, Cúcuta AM, Ibagué, Manizales AM, Medellín AM, Montería, Pasto, Pereira AM y Villavicencio. Other Urban areas correspond to all the urban areas without the mean 13 areas.

3. Empirical framework

In order to analyze the change in poverty and income between 2002 and 2013, three methodologies will be implemented. As there are no panel data surveys, the individuals observed in 2002 are not the ones observed in 2013, then each methodology (see Annex 1 for more details of each approach) creates different counterfactuals in order to compare individuals in 2002 with their contrafactuals in 2013.

We start the analysis with Datt and Ravallion (1992) methodology, which allows to identify if changes in poverty between two periods are mainly the result of two factors: i) a change in income distribution (distribution effect), which explains the part of the population that crosses the poverty line because of an improvement in income distribution; and ii) income effect, which explains the amount of the population that crosses the poverty line due to an average increase in income without any change in income distribution. Additionally, the methodology generates a residual which is generated when it is not possible to separate the effects; the residual is known as the interaction of the effects.

Then, we look at the main sources of household income. In this sense, changes in poverty rates are mainly due to changes in incomes of household members. People generate income from different sources (labor market, cash transfers, pensions, etc.) With this in mind, Azevedo *et al* (2012) presents a methodology to identify how these sources contribute to explain decreases in poverty. Thus, Azevedo's methodology allows to identify how different sources of income made it possible for households to cross the poverty line. The methodology creates income quantiles of population in the two periods 2002 and 2013. For each quantile in both periods this procedure calculates the contribution of each source of income. Then, the methodology replaces the observed levels of such source of income in the first period and assigns it in the second period. Then, the poverty that would have prevailed in the absence of such source of income can be calculated. With the calculation of such contrafactuals it is possible to know the contribution of each source of income in the changes to poverty rates.

Finally, we adopt the Ñopo (2008) match methodology in order to know which of the characteristics of the persons (level of education, marital status, age gender and economic activity, among others) are driving income increases. We focus on labor income because this component explains the largest proportion of poverty reduction. There are several methodologies in the literature that explain the gap in labor incomes between two groups -in this case, the change in income between two periods-. Some simple approaches compare the Mincer equation for both groups, but there are also more complex methodologies. We adopt the Ñopo Match because it matches individual by individual in both groups with their most similar peer, given a vector of observable characteristics. When individuals in both groups share similar characteristics, they are called individuals in the common support, but individuals out of the common support -the ones with observables characteristics different between two groups- also explain a portion of the gap of incomes between 2002 and 2013.

The data comes from the Continuous Household Survey (ECH, for its acronym in Spanish) for the 2002-2006 period, and the Comprehensive Household Survey (GEIH, for its acronym in Spanish) for the period 2007 to 2013. Both surveys of the Colombian Department of Statistics (DANE, for its acronym in Spanish) are nationally representative of urban and rural areas. These surveys are used

for official poverty and inequality reports in Colombia. Due to a problem related to the comparability of data given methodological changes between ECH and GEIH, DANE created the mission for splicing employment, poverty and inequality in the series (MESEP) in order to splice the series. Data from this work took the adjustments of MESEP.

3.1 Income and redistribution effects: Datt-Ravallion (1992)

With 2002 as base period and 2013 as end period, the Datt and Ravallion decomposition is used to analyze poverty changes in Colombia. The poverty rate reduction was 19.1 percent points, from 49.6% in 2002 to 30.6% in 2013. As we explained above, the income effect is the part explained because the population benefits from higher incomes of the economy, while the redistribution effect is the part that explains how the poverty decreases as a result of improvements in income distribution. As two effects are not additively separable, the methodology also presents an interaction effect. The results of this methodology are presented at national, rural and urban level and by age groups.

The dotted lines in Figure 4 show the changes in poverty in percentage points between 2002 and 2013 for the total population and by age group. The bars decompose those changes in income, distributional and residual/interaction effects. As we can see, Income effect (blue bar) explains most of the decrease in both poverty and extreme poverty rates at urban and rural areas. In the panel (a) of figure 6, income effect explains the 18.4 percentage points decrease of the total 19.1 percentage points of poverty reduction. Thus, income effect explains 95% of the decrease in poverty in urban areas, while redistribution effect explains only 4% of the changes in poverty⁸. The small result of the redistribution effect suggests a marginal improvement in the distribution of incomes, except in higher ages groups (55-64 and >65), where the distribution effect played a role in reducing poverty rates⁹. Similar results are obtained when looking at poverty and extreme poverty rates in urban and rural areas.

What are the effects of cash transfers? On the one hand, cash transfers have an impact shaping income distribution, as long as these are targeted at low income households. On the other hand, cash transfers represent an important component of poor household's income (see next section). In order to look at the contribution of cash transfers to each effect, we build a counterfactual distribution for 2013. In this fictitious income distribution we remove income from transfers to all households and we calculate again the Datt and Ravallion decomposition¹⁰. We find two things. First, without cash transfers, the poverty rate would have been 4 percentage points higher in 2013 than it was. Second, the income effect increases from 96% to 109%, while the redistribution effect has a negative impact on poverty reduction (from 2% to -2%)¹¹. In other words, in a world without cash transfers poverty is higher and the income distribution worsens in the lower tail.

⁸ These results slightly differ from World Bank (2014) where distribution effect is 16% for total population. However is in line with the results of IMF (2015) and Cord, Genoni, and Rodríguez-Castelán (2015).

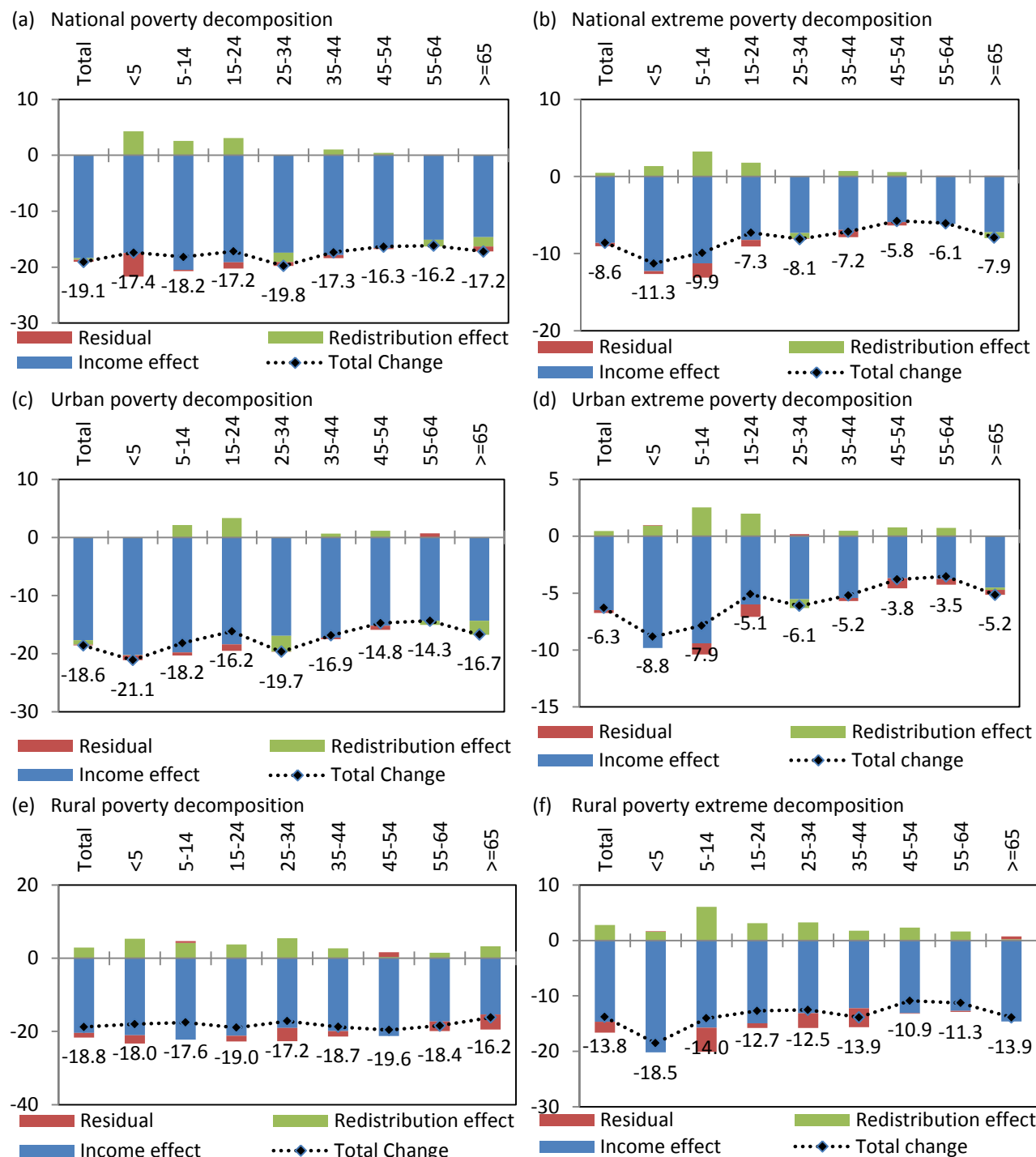
⁹ As we will see in the next sections, this improvements of the distribution can be explained because the transfer programs directed to this age groups.

¹⁰ This exercise does not consider the possible incentives that produce cash transfers in the labor market. However, several studies find that there is no negative effect (o a little one) on both employment and hours worked (see Alzúa, et al (2012) and Bosch and Manacorda (2012)).

¹¹ The residual component goes from 2% to -7%.

Finally, from the Datt and Ravallion decomposition we can conclude that the main force behind poverty reduction is growth in income, and not changes in distribution. Thus, the fact that the redistribution effect does not significantly decrease poverty can be explained because of the small changes observed in the income distribution of Colombia during the last decade.

Figure 6. Poverty changes 2002 – 2013: Income and distribution effects



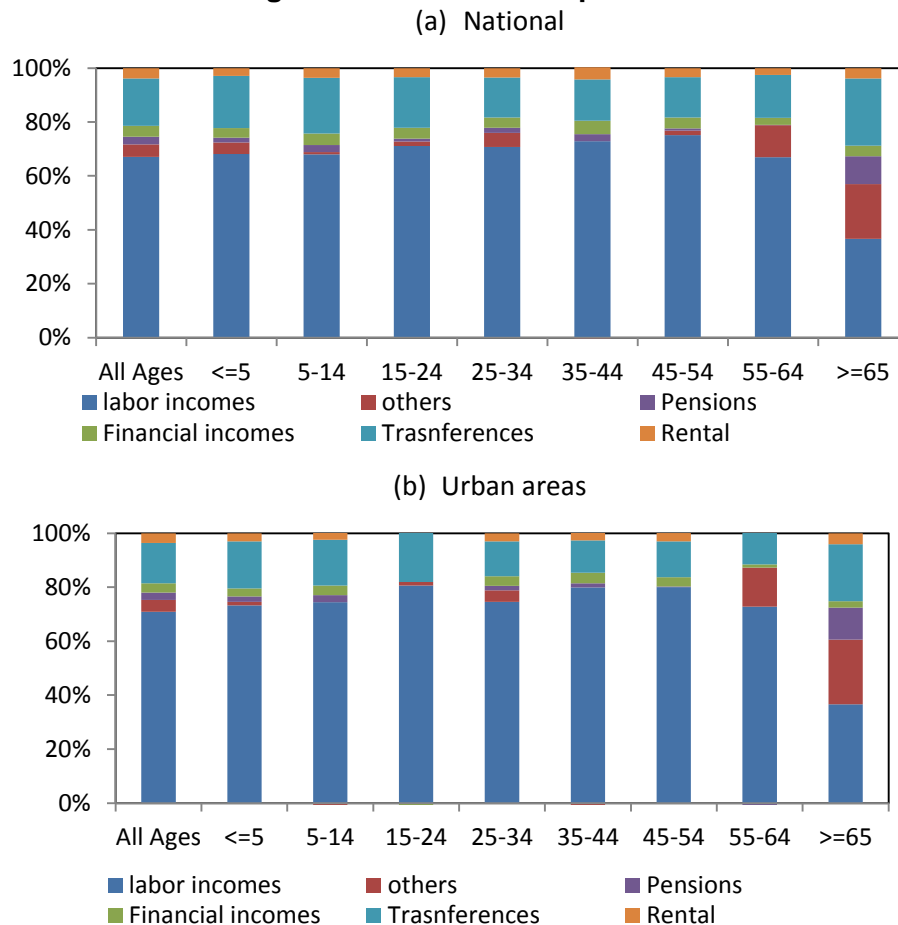
Source: own calculations.

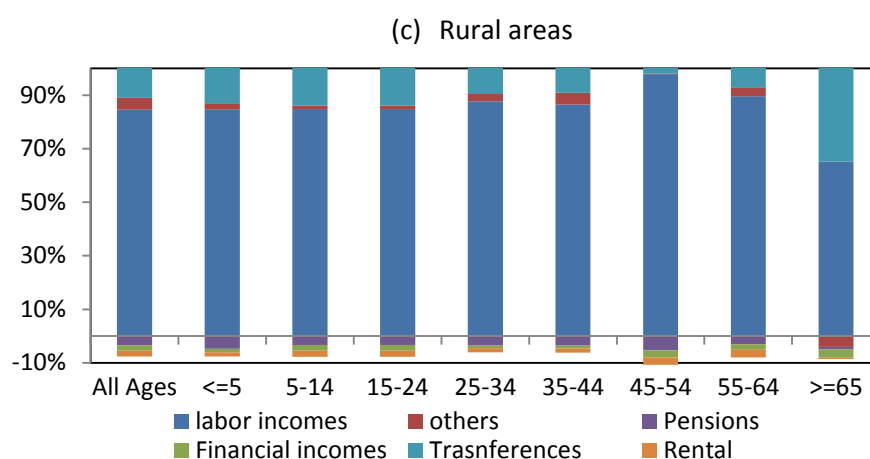
3.2 Income decomposition: Azevedo, et al (2012)

To cross the poverty monetary line, people need enough income to pass from the state of poor to not poor. From the 100% of household incomes, this methodology allows identifying in which proportion does each source of income (labor, non-labor, transfer, pensions, others) contributes to cross the poverty line. In other words, how the different sources of income helped to stimulate poverty reduction.

Figure 7 shows the contribution of each component of incomes to poverty reduction. As we can see, 71% of poverty reduction comes from labor income in urban areas and 85% in rural areas. Thus, we can conclude that the labor market is the main source for poverty reduction. The second source of income that aids in poverty reduction is cash transfers (15% in urban areas and 19% in rural areas). Other sources of incomes (Financial, pensions, rental and others) account for 14% of poverty reduction in urban areas. Instead, in rural areas, those other sources of incomes do not contribute to poverty reduction. This reflects the fact that people in rural areas do not have access to financial or rental incomes.

Figure 7. Income Decomposition





As monetary poverty is measured taking the total amount of incomes in a household, it is natural that all age groups are beneficiaries of the total incomes in the households. Therefore, children are beneficiaries of labor incomes, in the same way that adults are beneficiaries of transfers.

Regarding ages, there is an age group where income decomposition strongly differs from the other groups. At a national level, in people who are 65 years or older, labor incomes account for 37% reduction in poverty, pensions 10% and transfers 25% (panel a Figure 5).

In urban and rural areas people close to 65 years of age have a high probability of being poor (see Figure 2) because they exit the labor market and pensions do not compensate 100% of the labor income. This small effect of pensions in poverty reduction reflects that elderly people are not receiving a pension (see Bosch et al, 2015). In fact, in 2013 the rate of pension is 7.6% in urban areas and 2.7% in rural areas.

In Figure 5 we can see that transfers account for 18% of poverty reduction at a national level, 15% at urban level and 19% at rural level. This reflects the fact that in 2013 almost 1.5 million households were receiving conditional transfers (IDB (2015a)). Transfers reduce poverty in all age groups, but especially in childhood and old age. In urban areas, for the age group of 65 years and older, transfers explain 21% of poverty reduction, while in rural areas 43% (Figure 5). These outcomes are the result of the transfer programs directed at this age group, through Colombia Mayor, which currently covers 1.258.000 people, almost 25% of those in pension age.

Reduction in poverty generated by conditional cash transfers has been widely documented in the literature. Stampini and Tornarolli (2012) find that conditional transfers reduce current poverty while developing the human capital of the next generation. Thus, the program provides a large and reliable source of income, contributing to making economic growth more inclusive. In the same line, Attanasio, *et al* (2005) shows how the conditional cash transfer programs implemented by the Colombian government to reduce poverty and foster human capital accumulation has considerably increased household consumption, particularly consumption of protein-rich food, as well as of children's clothing and footwear and substantially increased school attendance of 12- to 17-year-olds. The present document complements the literature of conditional transfer programs, but in

addition, we show how programs such as *Colombia Mayor* are currently decreasing poverty rates in elderly people.

3.3 Ñopo (2008)

The Ñopo match is implemented in order to know which observable characteristics of people explain the increases or the gap of labor incomes between 2002 and 2013. In this section, we focus on labor income because it is the component that explains the largest proportion of poverty reduction.

In the Ñopo match, the gap of labor income between the two periods is explained by observable characteristics: Δ_X , Δ_{2002} and Δ_{2013} . As explained in Annex 1, Δ_X is the part of the gap explained by the observable characteristics of individuals in the common support, in other words it is the portion of the gap of incomes explained by observable common characteristics between both groups. Δ_{2002} and Δ_{2013} are the portion of the gap explained by the characteristics of people in 2002 and 2013 out of the common support, in other words, the amount of the gap of incomes explained because individuals in 2002 and 2013 have different observable characteristics. Finally, Δ_0 explains the portion of the gap that shares characteristics in the common support but their remuneration changes from 2002 to 2013, what we refer in this document as a price effect.

It is important to know that all components Δ_{2013} , Δ_{2002} , Δ_X and Δ_0 add up to 100% of the change in labor incomes between 2002 and 2013. Thus, when the methodology does not control enough by the observable characteristics, the price effect gathers most of the changes in income.

Table 1 presents descriptive statistics of some of the population's observable characteristics in 2002 and 2013 which are included in the Ñopo match methodology. Table 2 shows the results of the Ñopo match for the total population (panel A) and poor population (panel B). *Percent 2013* and *Percent 2002* show the population of 2013 and 2002 that is in the common support, respectively. As we can see in table 2, the increase in income of the total population was 35.92%, while those incomes of poor population increased by 15.02%.

Table 1. Characteristics of population

	2002	2013
Marital Status (%Population)		
Cohabitation	22.2%	27.15%
Married	27.0%	21.37%
Widowed	4.7%	4.57%
Divorced	7.6%	11.1%
Single	38.2%	34.78%
Occupational position (% Occupation)		
Private sector	33%	36%
Public sector	6.41%	4.05%
Domestic	5.6%	3.37%
Self-employment	32.86%	42.82%
Unpaid family worker	4.13%	5.01%
Others	18%	9.25%
Education (% Population)		
Primary	27%	33.8%

Secondary	22%	45.8%
Technical	0.08%	10.56%
Professional	0.00%	9.63%
Economic Activities (% Occupation)		
Agriculture	20.3%	16.7%
Mining	0.9%	0.9%
Manufacturing	13.3%	12.03%
Electricity	0.4%	0.51%
Construction	4.7%	5.8%
Wholesale and retail trade	24.44%	27.4%
Transportation	6.65%	8.2%
Financial	1.15%	1.38%
Inmob	4.2%	7.08%
Services	0.16%	0.17%
Others	0.00%	1.32%

Column 1 of table 2 shows the Ñopo decomposition when the common support is compounded by age, gender, marital status and number of households members. As we can see, under specification of column 1, observable characteristics (Δ_{2013} , Δ_{2002} and Δ_X) do not explain the change of income and therefore, what we refer to as price effect (Δ_0) explains most of the change. In other words, labor incomes are not increasing because of the population characteristics, but because the market is paying higher wages in 2013 than in 2002. It is evident that Δ_X is positive for the total population and negative for the poor. This means that those observable characteristics in column 1 are pushing incomes to increase in the total population, while decreasing for the poor. Thus, the poor population, over the past 10 years, is resulting in a combination of age, gender, marital status and number of household members that put them in the lower part of income distribution.

Column 2 is controlled by the same characteristics as column 1, plus their occupation (private sector, public sector, self-employment, etc.). Under this specification, common support starts to decrease given the more characteristics in the common support, the harder it is to match a person in 2002 and 2013. When we control by positional occupation (columns 2, 4, 6, 8 and 10) it generates a negative value for component Δ_X . This means that the population composition between private sector, public sector and self-employment is generating decreases in incomes rather than increases. As we can see in table 1, self-employment has been increasing from 32% in 2002 to 42% in 2013. In this occupational position there is a high component of informal workers, who drive down salaries. Then, we can attribute to this component 15% decrease in incomes in the total population and 11% for the poor between 2002 and 2013.

Columns 7 and 8, controlled by primary and secondary education, according to table 1 these characteristics have increased between 2002 and 2013. However, as we can see in table 2, such increases captured by Δ_X do not drive increases in salary distribution. It is important to distinguish that the methodology explains change of income, not the levels. Thus, although primary and secondary education can positively affect income levels¹², what the methodology shows is that

¹² This positive effect can be captured in a Mincer equation.

people in 2013 with only primary or secondary education are driving income distribution downward, compared to income distribution in 2002.

The most interesting results in Table 2 are in columns 9 and 10. These columns show that Δ_0 decreases only when technical and professional education are accounted for in the analysis. In these cases (panel A) the populations of 2013 who are in the common support are 74% (columns 7) and 69% (column 8). The 2013 population in the common support decreases given that the increase in education at technical and/or professional levels limits the number of people in 2013 with whom they can be matched in 2002 (see Table 1), reducing the common support. Likewise, we can see that Δ_{2013} is the part explaining the biggest change in labor incomes, which means that those characteristics of population of 2013, mainly education at technical and/or professional, explain the increases of labor incomes between 2002 and 2013.

Other matters such as positional occupation (column 2), region or municipality (Column 3 and 4), and sector of economic activity (columns 5 and 6) -although can affect the levels of labor income- are not affecting the change in incomes. Further, as poor population is not achieving those education levels, it seems that *price effects* (Δ_0) explain the change of incomes between 2002 and 2013 (panel B, Table 2). In order words, higher wages drive change in poverty and we reach the same conclusion as in Datt-Ravallion (1992), but those higher wages can be explained by observables characteristic listed in Table 1.

Table 2. Ñopo's income decomposition

Decomposition	(1). Age, gender, marital status, number of household members	(2). (1) + Occupational position	(3). (1) + Municipality	(4). (2) + Municipality	(5). (1) + Economic activities	(6). (2) + Economic activities	(7). (1) + Primary, Secondary	(8). (2) + Primary, Secondary	(9). (1) + Technical and Professional	(10). (2) + Technical and Professional
A. All population										
ΔY	35.92%	35.92%	35.92%	35.92%	35.92%	35.92%	35.92%	35.92%	35.92%	35.92%
Δ_0	33.68%	50.38%	37.52%	48%	34.58%	42.86%	65.74%	70.46%	-10.00%	7.48%
Δ_{2013}	-0.36%	-1.95%	-8.17%	-9.91%	-0.6%	-3.39%	-1.33%	-3.56%	43.02%	44.81%
Δ_{2002}	0.38%	2.76%	4.54%	7.4%	1.25%	3.83%	2.57%	4.9%	0.41%	1.25%
Δ_X	2.22%	-15.26%	2.02%	-9.5%	0.67%	-7.38%	-31.0%	-35.8%	2.55%	-17.62%
Percent 2013	99%	94%	79%	61%	93%	84%	97%	88%	74%	69%
Percent 2002	99%	93%	88%	66%	95%	85%	95%	82%	99%	90%
B. Poor population										
ΔY	15.02%	15.02%	15.02%	15.02%	15.02%	15.02%	15.02%	15.02%	15.02%	15.02%
Δ_0	22.2%	23.45%	25.50%	24.18%	19.79%	20.08%	21.60%	24.76%	18.73%	23.18%
Δ_{2013}	-0.29%	-1.94%	-6.56%	-10.21%	-1.69%	-2.89%	-0.05%	-0.08%	1.39%	1.51%
Δ_{2002}	0.01%	3.08%	1.75%	12.30%	0.62%	5.38%	1.68%	7.19%	0.03%	3.27%
Δ_X	-6.9%	-11.32%	-5.67%	-11.24%	-3.70%	-7.54%	-7.68%	-16.1%	-5.14%	-12.95%
Percent 2013	98%	94%	73%	54%	92%	82%	96%	87%	94%	89%
Percent 2002	98%	90%	84%	59%	93%	80%	92%	77%	98%	88%

4. Conclusions

Economic growth is the main factor explaining poverty reduction in the 2000s in Colombia. Thus, in line with the literature, we found that poverty fell due to income effect rather than distribution effect. Conditional transfer programs in Colombia, as a source of income, contributed to decrease poverty rates between 2002 and 2013. Even more, without cash transfers, poverty would have been 4 percentage points higher in 2013 than it was and the income distribution would have been worse in the lower tail. In this sense, improving the targeting of CCTs programs would generate gains in poverty reduction and equality in Colombia (see IADB (2015b)). In addition to the effects on lowering poverty and reducing inequality, the main conditional cash transfer, *Familias en Acción*, has proved to have positive long run impacts in education and health (Aguilar and Siza (2010)).

The life cycle of a person starts with a high probability of being poor, which slightly decreases with age up to 15 years. Then, probably associated with entering the labor market, the poverty rate starts to decrease for people between 15 and 64 years old. But when a person nears pension age, the poverty rate increases again. According to these facts, we find that labor income is the main factor contributing to poverty reduction in Colombia. In addition, transfers are the second source of income for poor households. Also, we find that pension incomes do not compensate the loss in labor incomes for this group of population, basically because pension coverage is relatively low in Colombia. In this sense it is advisable to ensure the solidarity pillar of the Colombian pension system (i.e. greater coverage and monetary benefit), based on Colombia Mayor¹³, for those workers without a contributory pension (see Bosch et al (2015) and IADB (2015a)).

According to our analysis, increases in labor income have been driven by a growing proportion of population acquiring skills at technical and professional level. However, when we focus the analysis on the poor population, although their labor incomes have increased, such increases are not explained by higher educational levels. Thus, we conclude that people who are acquiring high education levels are the ones who account for the bulk of increases in labor incomes. However, poor populations are not achieving those education levels. In other words, for the poor population, labor incomes are not increasing because of their characteristics (skills, education), but because the market is paying higher wages in 2013 than in 2002. Thus, public policies should focus on increasing the quality of education with emphasis on the lowest decils of income distribution, not only to improve human capital but also to increase the income of poor households (see IADB (2015b)).

¹³ Colombia Mayor is a program of non-contributory cash benefits targeted to the elderly living in vulnerable situation.

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Annex 1

1) Datt-Ravallion (1992)

According to Datt and Ravallion (Ibid) poverty rate measures can be fully described with the poverty line z^{14} , the mean distribution income, μ , and the Lorenz curve, L , representing the structure of relative income inequality. Then, if the poverty line does not change in real terms, changes in poverty, ΔP , are the result of changes in mean income and changes in the Lorenz curve as in the following equation:

$$\Delta P = P_{t+1} - P_t = P(\mu_{t+1}, L_{t+1}) - P(\mu_t, L_t)$$

$$\Delta P = [P(\mu_{t+1}, L_t) - P(\mu_t, L_t)] + [P(\mu_t, L_{t+1}) - P(\mu_t, L_t)] + \text{Residual}$$

$$\Delta P = \Delta_{\mu}^p + \Delta_L^p + \Delta_R^p$$

Where,

- *Income effect* is defined as $\Delta_{\mu}^p = P(\mu_{t+1}, L_t) - P(\mu_t, L_t)$, and it is the change in poverty resulting from a variation of the mean income, μ , while the Lorenz curve holds in the reference point t .
- *Redistribution effect* is defined as $\Delta_L^p = P(\mu_t, L_{t+1}) - P(\mu_t, L_t)$, and it is the change in poverty resulting from a change in the Lorenz curve, L , while mean income in real terms remains constant.
- *Residual*: $\Delta_R^p = [P(\mu_{t+1}, L_{t+1}) - P(\mu_{t+1}, L_t)] - [P(\mu_t, L_{t+1}) - P(\mu_t, L_t)]$ is interpreted as the *interaction effect*.¹⁵

Thus, to build the counterfactual distribution Datt-Ravallion (1992) calculates the rate of growth of incomes between 2002 and 2013. Then, for each individual in 2002, the methodology increases their incomes in such rate of growth. As a result, the new distribution of income is the counterfactual distribution.

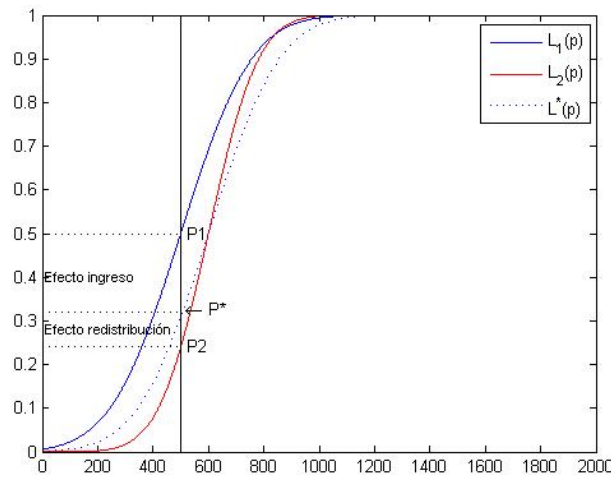
We can see graphic evidence of income and redistribution effects. Diagram 1, presents a cumulative distribution function of income in two periods, blue line for period 1 and red line for period 2. Let $P^* = P(\mu_2, L_1)$, the dotted line, be the counterfactual distribution where the mean incomes of period 1 are transformed to get the mean incomes of period 2, preserving the same Lorenz curve of period 1. The poverty rate changes from P_1 in period 1 to P_2 in period 2. The *income effect* is the change in poverty resulting from a variation of the mean income (the change from P_1 to P^*), while the Lorenz curve does not change. The *redistribution effect* is the change in poverty resulting from a change in the Lorenz curve, while the mean income remains constant. Diagram 1 shows the redistribution effect as the change from P^* to P_2 . In this particular case (Diagram 1) is assumed that

¹⁴ For simplicity we eliminate z from equations and formulas since it remains constant and does not affect the results.

¹⁵ Some extensions of the methodology attend to remove the residual component. For example, Mahmoudi (2001) calculate the income effect at the start period and the redistribution effect at the end period which is equivalent to allocate the residual in the redistribution component (see also Subbarao, 1990; Jain and Tendulkar, 1990; among others). However these procedures can give the false impression that income and redistribution are additively separable. There is a part of the distribution where it cannot be separated the income and redistribution effects. In fact, the residual can be seen as the joint effect.

income and redistribution effects are additively separable. As such assumption might not be true; there is a residual that can be seen as the interaction effect.

Diagram 1. Datt and Ravallion decomposition of poverty



Note: In the horizontal axis the percentage of population, income in the vertical axis. Source: Authors' elaboration

2) Azevedo, et al (2012)

Azevedo, et al (2012) decomposes the different sources of income that affect the changes in poverty. Thus, poverty rate depends on household's per capita income, Y_{pc} , which in turn depends on labor incomes, y^l , non-labor incomes, y^{nl} , number of household members, n , number of adults in the family, n_A , and number of occupied adults, n_o , among others. Let $F(.)$ be the income cumulative density function. Then, the rate of poverty can be written as:

$$P = F\left(Y_{pc}\left(y^l, y^{nl}, \frac{n_A}{n}, \frac{n_o}{n_A}\right)\right) \quad (1)$$

Thus, given the cumulative density function in two periods, F_t and F_{t+1} and their corresponding poverty rates, P_t and P_{t+1} , Azevedo, et al (2012) propose the construction of a counterfactual distribution for period $t + 1$ by ordering households by their per capita household income in t and $t + 1$, and then taking the average value of each variable in eq. (1) for each quantile in period t and assigning it to each quantile in period $t + 1$. The authors compute cumulative counterfactuals distribution, F^* , by adding one variable in eq. (1) at a time and then computing the Shapley-Shorrocks estimations (see Azevedo, et al, 2012, for more details of the procedure).

In other words, the counterfactual distribution is created by substituting the observed levels of the variables in period t and assigning them to $t + 1$. The procedure adds one variable or component at a time and calculates the poverty that would have prevailed in the absence of a change in that variable, F^* . After computing the weights (or added value or shapely value) it is possible to compute the contribution of each variable to the decrease in poverty.

Thus, the counterfactual distribution Azevedo, et al (2012) goes further that Datt and Ravallion (1992) in the sense that instead of setting the same rate of incomes growth for all individuals, Azevedo, et al (2012) ranks individuals by quantiles and creates counterfactuals for each quantile.

This is an important distinction, because incomes for all individuals do not increase at the same rate. In fact, the average increase of labor income for the total population from 2002 to 2013 is 35%, while the average increase for poor population is 15% (see table 1). In addition, some poor households can increase their income more than the average value of the population for different reasons, for example: (i) when a household ceases to be in poverty due to a member entering the labor market after completion of studies; or (ii) when a household begins to qualify for a transfer program generating income growth at a higher rate than the average.

3) Ñopo (2008)

Ñopo (2008) presents matching comparisons as a tool for decomposition of wage gaps. The strategy has been mainly used to compare gender differences in wages. However, we use the methodology to decompose income gaps of a group in two periods, t and $t + 1$. Thus, the wage gap between two groups can be attributed to the existence of differences in individuals' characteristics ($\Delta_{t+1}, \Delta_X, \Delta_t$), and differences of unobservable characteristics (Δ_0). Using Ñopo's methodology, the change of incomes, ΔY , can be decomposed into the following components:

$$\Delta Y = \Delta_{t+1} + \Delta_X + \Delta_t + \Delta_0$$

Where Δ_X is the part of the gap that compares individuals in period t and $t + 1$ who share a vector of characteristics X (*Age, education, marital status, occupational position, etc.*) These individuals are called individuals in the common support. Therefore, it is the part of the gap explained due to the similar characteristics between individuals, but such characteristics are differently distributed over two periods of time. Under Blinder (1974)–Oaxaca (1973) decomposition, this part corresponds to $\hat{\beta}^{t+1}(\bar{X}_{t+1} - \bar{X}_t)^{16}$. This component is part of the *quantity effect*, in the sense that it accounts for the part of the person's characteristics that changed, while the payments or remuneration, $\hat{\beta}^{t+1}$, is the same.

Δ_{t+1} is the part of the gap explained by the difference between individuals in $t + 1$ who are in the common support and those who are not. It also can be seen as the increase of individual incomes in period t , if those individuals reach characteristics of individuals in period $t + 1$. Alternatively, the part of the gap that would disappear, $\Delta_{t+1} = 0$, if individuals in $t + 1$ were entirely matched with individuals in the common support.

Δ_t is the gap explained by the difference between the individuals in t who are in the common support and those who are not. It is the part of the gap that would disappear if all individuals in t reach at least one possible characteristic of the common support group.

It is important to see that the part of the gap of income explained by Δ_{t+1} and Δ_t is caused because there are individuals in $t + 1$ and t who are out of the common support but also influence the change in income. This means that for those individuals, it is not possible to create counterfactuals because they have characteristics which are not comparable between them. For example, it is possible that in period $t + 1$, more people achieve higher educational levels than in period t , which

¹⁶ $\hat{\beta}^{t+1}$ is the regression coefficient of a Mincer equation in $t+1$. Thus, Under Blinder (1974)–Oaxaca (1973) decomposition, $\hat{\beta}^{t+1}(\bar{X}_{t+1} - \bar{X}_t)$ is the wage of gap of individuals in t and $t+1$ explained by observable characteristics.

puts the former out of the common support. In this case, the distribution of characteristics plays in favor of individuals in $t + 1$. However, Δ_{t+1} and Δ_t can be seen as an *interactive effect*, in the sense that there is a part of the *quantity effect* and *price effect* from these components that are accounted by a change of characteristics, but also in prices.

Value Δ_0 is a component commonly attributed to discrimination as in Ñopo (2008). Under this analysis we attribute Δ_0 to a change in prices (*price effects*). Indeed, Δ_0 is the part of the gap explained by individuals who share the same vector of characteristics, X , in the two periods of time, but differ in their payments. Thus, Δ_0 is the part of the gap that cannot be attributed to differences in observables. This part accounts for individuals with the same distribution of characteristics but with different pay. Under Blinder-Oaxaca setup, this part corresponds to $\bar{X}_t(\hat{\beta}^{t+1} - \hat{\beta}^t)^{17}$, what we call *price effect*.

As discussed above, all previous methodologies make assumptions to create counterfactual contributions for individuals. Datt and Ravallion assume that the income of all individuals grows at the same average rate. Azevedo et al (2012) takes the average value of each characteristic quantile in period t and assigns it to each household in that same quantile in period $t + 1$. So, the procedure goes one step further compared to the one used by Datt and Ravallion (1992), because instead of assigning average values, they use a rank-preserving transformation by quantiles. However, as poor people are located in the first or second quantile there is not enough variation, and the information of those who change of quintile from a period to another will be missed in the procedure.

Ñopo's match methodology provides a better construction of counterfactual distributions. Given a set of characteristics X , the methodology matches individuals one by one in period t to someone with the same characteristics X in period $t + 1$. Therefore, Instead of matching individuals by their incomes as the previous methodologies do, this approach matches individuals one by one in period t with the most similar in $t + 1$ or with a synthetic individual in $t + 1$ (see Ñopo 2008).

¹⁷ $\hat{\beta}^{t+1}$ and $\hat{\beta}^t$ are the regression coefficients of mincer equations in $t+1$ and t , respectively. Under Blinder (1974)–Oaxaca (1973) decomposition $\bar{X}_t(\hat{\beta}^{t+1} - \hat{\beta}^t)$ captures the gap incomes due to individual characteristics are payed different trough the time - prices effect. When Blinder-Oaxaca methodology is used to decompose the income gap between two groups e.g. Male (M) and Female (F), $\bar{X}_F(\hat{\beta}^M - \hat{\beta}^F)$ is interpreted as the gap explained by discrimination, see Blinder (1974)–Oaxaca (1973) for details.