Essays on wage inequality in developing countries

Doctoral Thesis

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Introduction

The study of economic inequalities is one of the most relevant issues in Economics. First, the distribution of income has important effects on key economic variables such as the allocation of resources, human capital, and economic growth. A large body of literature documents, for example, the important role of countries initial income distribution on their later economic development. In public debate, most of the economic policies are controversial precisely due to their redistributive effects on the population. In low-income countries, high levels of income inequality are also consistent with high levels of job informality and poverty, constraining even more the possibility of improving the quality of life in such economies. So, the roots of economic inequalities and their implications on development are broad motivations to focus on the study of changes in income distribution in developing countries.

A more narrowed concern deals with the determinants of the changes in income inequality. Why has income concentration increased or decreased? What is the role of labour supply and labour demand? How much economic policy can improve inequality levels? These are some of the key questions to be addressed, theoretically and empirically. The factors affecting income inequality come from different sources. For example, household income inequality varies as economic conditions change because of employment, wages, and returns to skills that are modified. All economic shocks coming from the external sector or domestic factors are included here. Inequality in labour income can also be affected by the strength of labour market institutions, such as minimum wages and unions. Likewise, fiscal policy in general and both tax policy and cash transfer programs in particular, seem to be relevant in accounting for changes in income concentration.

This thesis is a compilation of three essays that explores some of these issues in a region with high levels of income inequality in the world. By the beginning of the 2000s, 15 of 18 countries in Latin America exhibited Gini indexes above 0.50. The region has experienced two different inequality patterns in the past several years. For most of the countries, inequality rose during the 1990s and decreased during the 2000s. The increasing inequality after the implementation of structural reforms in several markets and countries in the 1990s has motivated much research in the field. The reversal in the inequality trend in the last decade, however, has been studied less. The three chapters that composed this document try to contribute to the understanding of such a declining pattern. We focus on the analysis of a representative sample of countries -Argentina, Brazil, Colombia, and, Mexico - in terms of GDP and population in which micro data is available.

Latin America has faced different shocks with potential distributive effects in the last decade. In an international context, the boom in commodity prices, capital flows, and remittances have been linked to increasing demand for unskilled workers, lower interest rates, and higher non-labour incomes into household budgets. In the same way, higher economic growth rates for most of the economies are also related to improvements in household income distribution due to greater probabilities of employment and higher

labour incomes. Additionally, domestic policy in terms of macroeconomic stability, educational coverage, increasing minimum wages, higher social assistance expenditure, and tax reforms in some economies appear also as relevant factors that would explain the reversal trend in the region s inequality.

We contribute to the literature by surveying and discussing the empirical evidence about the strength of some of these factors in our sample of countries. In particular, we study the recent effects of the business cycle, inequality in education, and minimum wages on income inequality. Our contributions, however, deal not only with providing updated evidence of these kinds of effects extensively considered in international literature, but also with the analysis of the distributional effects of more specific features of these labour markets. That is, despite high levels of job informality in the region, few studies are concerned about the impact of the changes in the composition of formal-informal employment on income distribution. Similarly, little attention has received theoretical frameworks that model the demand for skills and the distributional effects of technological change in a more complex way. Given this general picture, we will now explain in more detail the contribution of each chapter.

In the first chapter, we document the evolution and the determinants of the changes in income inequality in Latin America during the 2000s. First, we test the robustness of the drops in inequality by estimating confidence intervals for inequality measures. Then we decompose inequality indices both by income sources and by population subgroups. Therefore, we provide evidence of the role played by labour and non-labour income into the household budget. Second, we survey the literature and discuss evidence about the distributional effects of economic growth, labour market changes, labour market institutions, international trade, and cash transfer programs. We identify three gaps in the literature to consider further. Based on this discussion, we finally study the recent distributional effects of the business cycle in the region. In particular, we provide empirical evidence of the effect of the unemployment rate on labour income inequality, first by our four country sample and then for ten more economies.

In the second chapter, we estimate the distributional effects of schooling and job informality upon wage inequality. During the 2000s, both an educational upgrading for all countries and lower measures of job informality among wage earners for Argentina, Brazil, and Colombia were reported. By means of semi-parametric techniques, we study the marginal effects of schooling at different parts of the wage distribution, and decompose changes in inequality into composition and price effects. We use the methodology proposed by Machado and Mata (2005) to estimate marginal (and counterfactual) densities. Our main contribution deals with the study of the changes in the composition of workforce in terms of education, written contract, and health coverage on wage inequality. This is novel particularly since little evidence is provided about the relationship between inequality and job informality despite there being high levels of both in these economies.

In the final chapter, we consider a task-based approach to study the demand for skills in the region. We analyse employment patterns in high-skilled, middle-skilled, and low-skilled jobs in urban labour markets in Brazil, Colombia, and Mexico. Have job opportunities polarised in Latin America? We address this question by looking at the employment growth across skill distribution during the 2000s. To what extent does technological

change explain an employment shifts for middle-skilled occupations? Based on Autor, Leavy and Murnaney (2003) and Acemoglu and Autor (2012) we classify occupations into routine and non-routine jobs, and then into cognitive and manual jobs. By decomposing changes in employment across industries into a between and within component, we test in the extensive margin the routinization hypothesis. The main contribution of the chapter is to document employment patterns in the region and provide evidence of the recent role of technological change.

Chapter I

Changes in income inequality in Latin America: An overview

Abstract

In this paper we document the evolution and the determinants of the recent changes in income inequality in Argentina, Brazil, Colombia, and Mexico. First, we test the robustness of the decline in inequality and decompose inequality indices both by income sources and by population subgroups. Second, we review the main explanations of the falling inequality and identify three gaps in literature. Third, we estimate the effect of business cycle on income inequality. Results suggest that labour earnings became more important into household budgets. According to our estimates the marginal effect of the unemployment rate on income inequality is positive, robust to different specifications, and explains more than 30% of the total variation in Argentina, Brazil, and Colombia. Inequality in education and minimum wages also played a relevant role in the declining inequality pattern.

Key words: Income inequality, decomposition methods, business cycle
Journal of Economic Literature Classification: J31, I24, E32.

1. Introduction

Recent evidence from Latin America suggests that income inequality has declined in the last decade (Gasparini et al., 2011a; Cornia, 2014a). Since the region has enormous levels of economic inequalities, understanding the determinants of such changes in income distribution is a relevant issue not only in terms of economic research, but also in terms of public policy. Putting the region into an international context, we plot in Figure 1 household per capita inequality levels by GDP per capita for a sample of 89 countries in 2000. It is clear from the graph that Latin American and Caribbean countries exhibit higher levels of income concentration in relation to the other economies. The pattern is also observed from low-income to higher-income countries within the region.

Unlike the 1990s, when income inequality rose for most of the countries, there is limited literature that deals with the decreasing trend from the 2000s. According to Lusting et al. (2013) the recent declining inequality was observed in countries with different inequality levels, in countries governed by left and non-leftist regimes, and in countries with fast and slow economic growth. In Table 1 we report the recent changes in income inequality. In 17 of 18 countries in the region, income inequality declined. Argentina, Bolivia, Nicaragua, and Peru exhibited the greater drops in income inequality (the variation was from -0.09 to -0.12). This is great for all countries but in particular for those with the highest level of concentration such as Bolivia, Nicaragua, and even for Brazil and Ecuador with variation in their Gini coefficients of about -0.06.

In this paper we focus on the determinant factors of such recent decline. We study the potential mechanisms through which inequality can be affected by labour and non-labour

market forces, and provide empirical evidence of the effect of some of them. In particular, we test the impact of the business cycle, inequality in education, and minimum wages on the Gini coefficient during the 2000s. We consider a representative sample of countries in Latin America in terms of population and GDP: Argentina, Brazil, Colombia, and Mexico.[1] In Table 2 we present basic statistics of these countries regarding population, GDP per capita, income inequality, years of schooling, unemployment rate, and economic growth. More than 70% of the labour force in the region is concentrated in these economies.

We contribute to the literature in three ways. First, we document and test the statistical significance of the income inequality changes from 2002 to 2012. We estimate confidence intervals for inequality measures by wages and by household incomes. We also decompose inequality indices by income sources as well as by population subgroups. Such decompositions allow us to know what happens with inequality within and between groups and also other sources of incomes that are significant in households. At the individual level we consider population subgroups drawn from employment status. At the household level, we consider income sources coming from earnings as well as income coming from pensions, renting, interests, and cash helps.

Second, we review the main explanations stated to account for the recent changes in income inequality. We present the conclusions drawn from studies analysing the role of economic activity, changes in the labour market, international trade, as well as results of the role of labour market institutions and cash transfers programs. We identified three gaps in literature to consider further. In particular, we highlight the distributional effects of the business cycle and the potential impacts of relevant changes in labour markets in terms of schooling, industrial structure, and job informality. A new theoretical approach to analyse changes in the demand for skills is also suggested.

Finally, based on the first point of literature review, we study the recent effect of the macroeconomic conditions on income inequality. During the 2000s, most of the countries in the region experienced important economic growth rates with potential effects on employment and incomes. So, in that part of the paper we estimate the effect of the unemployment rate on Gini coefficient of labour income using panel data methods controlling for other factors such as inequality in education and minimum wages. Our hypothesis is that the changes in household incomes driven by labour market incomes are mainly explained by better macroeconomic conditions. At the end, we provide evidence of the percentage of the total change in inequality explained by the business cycle.

The paper is structured as follows. Additional to this introduction, in section 2 we document the changes in income inequality. In section 3 we present the results of the decomposition of indices. We review the explanations proposed to account for the declining pattern and comment on the gaps in literature in section 4. Following that, we explain in section 5 the empirical strategy to estimate the effect of the business cycle on inequality. The econometric estimations are presented and discussed in section 6. Finally, we provide some concluding remarks in section 7.

[1]The sample is also determined by the availability of microdata.

2. Recent trends in income inequality in Latin America

For the last two decades there have been two income inequality patterns in the region. During the 1990s inequality increased while from the 2000s inequality declined.[2] Gasparini et al. (2011a) were the first to document the declining trend in inequality during the 2000s. They found that the drop in inequality until 2010 was robust to both income definition and measures of inequality including zero-income observations and nonresponse. They reported that the Gini fell by around one and a half points between the 1990 and the mid-2000s in twelve of the seventeen continental Latin American countries. By decomposing the Theil index, they found that the declining inequality was mainly explained by the fall in the within country inequality.

Other studies have also reported the decline in inequality. Lustig et al. (2013) suggest that the drop in inequality was observed in countries with low and high inequality levels (Argentina and Brazil), in countries governed by left and non-leftist regimes (Brazil-Chile, Mexico-Peru), and in countries with fast and slow economic growth (Chile-Peru, Brazil-Mexico). A recent study of the determinants of the changes in income inequality in the region during the period from 1990 to 2010 can be found in Cornia (2014a). He provides empirical evidence of the role of changes in macroeconomics, foreign trade, labour markets, education, taxation, and social assistance. In the first part of this paper we extend the period of analysis until 2012 and test whether the declining pattern in income inequality remains.

2.1 Testing the statistical significance of inequality changes

In this section we test the robustness of inequality changes by using the Gini coefficient and the interdecile gap. The data is derived from household surveys in each country from 2001-2012. More details of data can be found in the data appendix. We estimate inequality measures for both wage distribution and total household income distribution. The Gini coefficient is given by equation (1) where y_i refers to income (individual or household) and n refers in this case to sample size. The interdecile wage gap is the difference between income at the 90th percentile and income at the 10th percentile. We estimate these two inequality measures and construct confidence intervals at 95% for each one. This allows us to evaluate how strong the changes in inequality are.

$$Gini = \frac{1}{n}\Big[n + 1 - 2\Big[\frac{(\Sigma_{i=1}^{n}(n+1-i)y_i)}{\Sigma_{i=1}^{n} y_i}\Big]\Big], \quad \text{where} \quad y_i \leq y_{i+1} \tag{1}$$

We estimate the standard errors of the Gini coefficient by bootstrapping. In appendix A we present the do file built in Stata for this purpose. We take a sample of 1,000 observations 100 times in the case of the Gini coefficient, and a sample of 100 observations 100 times for the interdecile wage gap. In Tables 3 and 4 we present the results by country, year, and inequality measure.

[2]Despite the region's exhibited high levels of income concentration, analysing and comparing their trends and determinants as a whole have been quite hard for a long time. For example, the online access to microdata of household surveys in each country was a fact until recently. Moreover, in most countries the improvements in household surveys since the 1980s implied huge methodological changes that made comparisons not possible even within them. From the 2000s the scenario is much better, and at least in the main economies (Argentina, Brazil, Colombia, and Mexico) the household surveys are comprehensive, allowing an in-depth analysis of the inequality.

According to the estimations, the decline in wage and household income inequality are statistically significant for all countries. Although the size of the changes is different among measures and countries, the pattern reported in previous studies until 2010 remains by 2012. Considering the Gini coefficient, wage inequality declines by around 0.090 in Argentina, 0.076 in Brazil, 0.036 in Colombia, and 0.043 in Mexico. Income inequality at the household level is higher than inequality at the individual level, and in some cases their changes are also greater. The results in Table 3 do not change so much when we consider labour income from wage earners and self-employees. Next we move to a more detailed study of the changes.

3. Decomposing of inequality indices

To determine which groups contribute more to total inequality and how important the different income sources are to households inequality, we decompose Generalized Entropy (GE) family indices both by population subgroups and by factor components. For household per capita income we decompose half the square Coefficient of Variation GE (2). The components are earnings, rents, interests, pensions, and cash helps. For population subgroups we decompose the Theil index GE (1). In this case, the criterion of partition is the employment status with categories such as wage earners, self-employed, domestic service, and employers. Next we present an overview of the two procedures.

3.1 Decomposing by factor components

Since households receive income from a variety of sources (employment, capital, pensions) it is particularly relevant to analyse the contribution of each component to income inequality. In this case, the key point highlighted in the literature is the choice of the appropriate decomposition rule.[3] This is important because the inequality contribution of each factor can vary arbitrarily with the choice of the decomposition rule.

Shorrocks in 1982 demonstrated that when an inequality index $I(\mathbf{Y})$ is written as a weighted sum of incomes, the decomposition contribution of factor k, $S(\mathbf{Y}^k, \mathbf{Y})$ is the same weighted sum applied to factor k incomes.[4] So, it can be applied to all inequality measures conventionally written in the quasi-separable form of equation such as GE family. The GE family of indices is given by

$$I_c(\mathbf{y}) = \frac{1}{n}\frac{1}{c(c-1)}\sum_i \left[\left(\frac{y_i}{\mu}\right)^c - 1\right], c \neq 0, 1 \tag{2}$$

$$I_0(\mathbf{y}) = \tfrac{1}{n}\sum log\left[\tfrac{\mu}{y_i}\right], c = 0$$

$$I_1(\mathbf{y}) = \tfrac{1}{n}\sum \tfrac{y_i}{\mu} log \tfrac{y_i}{\mu}, c = 1$$

[3]Let $I(\mathbf{Y})$ be an inequality measure of the distribution of total incomes $\mathbf{Y}$ and S_k be the contribution of factor k to overall income inequality. If we represent S_k as a fraction of total inequality, we obtain the proportional factor contributions $s_k = S_k/I(\mathbf{Y})$. According to Shorrocks (1983) any function that generates suitable values of s_k (with property $\Sigma_k s_k = 1$) will be called decomposition rule.

[4]More formally $I(\mathbf{Y}) = \mathbf{a}(\mathbf{Y})\mathbf{Y} = \Sigma_i a_i(\mathbf{Y})Y_i$ Where $S(\mathbf{Y}^k, \mathbf{Y}) = \mathbf{a}(\mathbf{Y})Y^k = \Sigma_i a_i(\mathbf{Y})Y_i^k$

Where $\mathbf{y}$ is the income distribution vector for a population of n individuals. In this case, c=1 corresponds to the Theil index and c=2 is half the square of the coefficient of variation.[5] For simplicity, we take the square of the coefficient of variation (I_2) to decompose it. In this case the natural decomposition rule is given by

$$s_k(I_2) = \frac{S_k(I_2)}{I_2(Y)} = \frac{cov(Y^k,Y)}{\sigma^2(Y)}$$

Jenkins in 1999 showed that total inequality can be written in terms of factor correlations with total income, factor shares in total income, and factor inequalities as follows

$$s_f = \rho_f \Big[\frac{m(factor\_f)}{m(totvar)}\Big][(I_2)(factor\_f)(I_2)(totvar)] \tag{3}$$

Where s_f is the proportionate contribution of factor f to total inequality, ρ_f is the correlation between $factor\_f$ and $totvar$, m is the mean, $totvar = \Sigma_{f=1}^{1} factor\_f$, and (I_2) is half the squared coefficient of variation. We run the Stata command ineqfac to obtain the terms of this formula. We present results for the contribution of each factor to total income, the (I_2) of each factor, and the proportional contribution of each factor to total inequality.

3.2 Decomposing by population subgroups

One relevant property of an inequality index is that it can be expressed as a function of the subgroup inequality levels. It is desirable since we are interested in analysing inequalities in population features such as age, level of education or employment status. However, not all inequality indices can be exactly decomposed into within-group and between-group components. Shorrocks in 1980 demonstrated that when the decomposition (or aggregation) is additive, the inequality measure I of an income distribution vector y for a population of n individuals, can be written as

$$\mathrm{I}(\mathbf{y}; n) = \mathrm{I}(\mathbf{y}^1, ..,\mathbf{y}^G; n) = \Sigma_g w_g^G(\boldsymbol{\mu}, \mathbf{n})\mathrm{I}(\mathbf{y}^G; n_g) + I(\mu_1\boldsymbol{\mu}_{n1}, .., \mu_G\boldsymbol{\mu}_{nG}; n) \; for \; all \; \mathbf{y}^1, .., \mathbf{y}^G \tag{4}$$

Where w_g^G is the weighted attached to subgroup g in a decomposition into G subgroups, $\boldsymbol{\mu}$ is the vector of subgroup means and n is the vector of subgroup populations. The first term of the right side of the equation is the within-group component while the second term is the between-group component.[6] Shorrocks demonstrates that the additively decomposable indices satisfying mean independence (income homogeneity) and population replication are given by the GE Family of indices (Shorrocks, 1980, 622).

In our case, we consider the Theil index to decompose. As a criterion of partition we use the employment status of the occupied. So we analyse changes in inequality among wage earners, domestic service, self-employees, employers, and others. We think that it is an intuitive way to account for changes in labour earnings. Empirically, we perform the

[5] This family of indices also satisfies the principle of transfers as long as incomes are positives. The key parameter c indicates the sensitiveness of index to transfers in the tails. As c declines, the index requires larger transfers at the top end to compensate for a given transfer lower down in the distribution.

[6] In 1984 Shorrocks relaxed the additively decomposable constraint by considering a very weak aggregation condition requiring only that the overall inequality is some general function of the subgroup means, population sizes, and inequality values. He demonstrated that such decomposable inequality measures must be monotonic transformation of additively decomposable indices.

decomposition by using the ineqdeco command in Stata developed by Jenkins (1999).

3.3 Decomposition results of half the squared coefficient of variation

In Table 5 we present the results for the decomposition of the (I_2) by contributing factors for the Argentina, Brazil, and Colombia. The income distribution considered is the per capita household income. Column (1) displays the contribution of each factor to total income; column (2) shows half the squared coefficient of variation, and column (3) presents the proportional contribution of each factor to total inequality. Columns from (4) to (6) show changes of previous components during the period.

According to the results, labour income is by far the largest component of the household income package. It comprises more than 67% of total per capita household income for the three countries (column 1). The second larger component is income from pensions. For Colombia this source represents about 12% of household per capita income while for Brazil and Argentina it represents more than 20%. The third important component varies across countries. For Argentina it is income from cash transfers (4.8%), for Brazil it is income coming from renting (2%), and for Colombia it is both incomes from renting (5%) and cash transfers (5%).

The distribution of each source is quite different within countries. Income from other sources and interests are very concentrated in contrast to labour incomes and pensions, which have lower levels of inequality (column 2). This is in part because capital ownership is concentrated on the top of income distribution. However, to know exactly what the factor contribution is to total inequality we should look at the information in column 3. According to that, at least 65% of total inequality in the three countries is explained by the labour income and more than 13% is explained by pensions in the beginning of the 2000s. The results for labour income are much higher for Brazil and Colombia while results for pensions are higher for Argentina and Brazil.

Regarding the changes in the components of inequality for Argentina and Brazil, labour income is reinforced as the main factor in explaining income inequality within households (column 6). For Colombia, it remains as the main factor but its share decreases slightly. Two important patterns are also observed. Pensions lost weight in the three countries while renting and interest became more important for Argentina and Colombia. We also found that the contribution of cash helps is even lower than at the beginning of the 2000s for Argentina and Brazil.

3.4 Decomposition results of the Theil index

Once we have analysed household income inequality, we will turn to the study of labour income inequality at the individual level. As we see previously, labour income is by far the main factor in the household budget so it is relevant to study further. In this case, we consider the employment population and we split it according to the employment status. In Table 6 we present some features of the subgroups such as relative mean, income share, and Theil coefficient by country and year. Table 7 displays the results from the decomposition of the Theil index into between-group inequality and within-group inequality.

According to Table 6, wage earners have the average income while self-employees obtain on average an income 20 percent below the mean (column 1). Domestic service earns as much as 0.6 percent of the average income. Employers earn more than 2 times the worker average income. The ratio is higher in the case of Brazil. In terms of income share, results show that wage earners contribute more than 60 percent to total labour income, followed by self-employees and employers with more than 14 percent and 9 percent, respectively (column 2). Here the sharing by groups varies more among countries. Finally, the concentration is higher for self-employees and employers with regard to the concentration for wage earners (column 3).

The relevant change in terms of relative mean across countries was that mean income for employers falls (column 4). The changes in income share were however more dynamic. In all countries except Colombia, the share of wage earners in total income grew, while simultaneously, the share of self-employees and employers drops (column 5). Such trend together with a lower income inequality in the main groups had enormous consequences on overall income inequality. It implied less inequality both from a higher weight of wage earners and from a lower inequality into subgroups. The case of Colombia is especially interesting since the share of the self-employed sector in total income is high and increasing over time.

Results from the decomposition by population subgroups suggest that the main component is the within-group inequality (Table 7). In fact, more than 85 percent of the Theil index is due to differences in income inside groups.[7] The heterogeneity in some groups is too high. For example, in the self-employed group there are workers with different skills earning different incomes. In this group we can find a range of workers with such jobs as street sales persons to workers with highly skilled independent professional jobs. In the case of wage earners there are also heterogeneous workers. One feature of the economies under analysis is the high rate of job informality. There are wage earners without written contract and without social security affiliation who pressure inequality levels to go up. In terms of the changes in between and within component, we see that both decrease over the period. In fact, the fall in the within component is larger than in the between component suggesting an important role of lower income differences among wage earners, self-employees, and employers as we previously documented.

4. Determinants of income inequality changes: A survey

In this section we explain the determinants of the changes in income inequality and we comment on the evidence suggested by previous literature. From a macroeconomic point of view, the business cycle affects income inequality due to its impact on employment probabilities and earnings in the labour market. Changes in labour income distribution are related particularly with the strength of supply and demand factors in shaping the returns to skills. The aggregate growth off course is not the only relevant factor affecting labour markets. Trade, financial and labour reforms as well as labour market institutions such as minimum wages and unions have important distributional effects. The tax system and the social spending (cash transfers programs in low-income countries) are also relevant.

[7] For Brazil in 2001 we have 0.57/0.67=0.85.

4.1 Macroeconomic conditions and income inequality

There is a large body of theoretical and empirical literature that deals with the relationship between macroeconomic conditions and changes in income inequality and poverty. Some of the earlier studies are Metcalf (1969), Blank and Blinder (1985), Cutler and Katz (1991), and Blank and Card (1993). The general conclusion is that higher economic growth and lower unemployment rate reduce income inequality and poverty. The effect however, depends on the extent such better macroeconomic conditions improve household incomes through labour market changes. So, the specific effect on households varies according to the features of economic growth, and to the composition of families and head of family characteristics.

Due to the recent worldwide recession, there is a growing body of literature that is concerned with the distributional effects of such economic crisis. Some studies for developed countries can be found in Immervoll et al. (2011), Jenkins et al. (2011) and Atkinson and Morelli (2011). Results for the OECD suggest differentiated effects of worsening economic conditions on income, poverty, and inequality always mitigated by the tax and benefit system. The long-term effect of this recession is however unknown due to the period of time. Some evidence for Spain suggests that the effect of unemployment on poverty is larger during the period of economic recession than during a period of expansion (Ayala et al., 2011).

For Latin America, there is not much literature that deals with the recent distributional effects of economic activity on income inequality. The average economic growth from 2001-2012 for the four countries considered was 4.14 percentage points while the average change in unemployment rate was about -4.5 percentage points. Starting with this macroeconomic scenario the first natural question would be to what extent the decline in income inequality is explained by change in the unemployment rate. Given the relevancy of the question and the scarce evidence of recent periods, the study of this relationship becomes the first gap in literature that we try to address later in this document.

4.2 Trade openness

International trade is another likely candidate to explain changes in wage structure. In fact, most of the research in the 90s focused on the role of international trade and foreign direct investment. Since most of the countries reduced tariffs unilaterally and deregulated other markets, it was an ideal scenario to assess the effect of these reforms on wage structure. According to the Heckscher-Ohlin model, the economic integration would lead to an increase in the price of the factor relatively abundant in the country. By that time it was assumed that Latin American economies were abundant in unskilled labour, so an increase was expected in the price of this factor. However, as much of the evidence suggests, the returns to skilled labour increased propelling higher levels of income inequality.[8]

[8]Some researchers argue that considering all Latin American countries as abundantly unskilled is a strong assumption. Later studies suggest that not only international trade but also Foreign Direct Investment and Skill Biased Technological Change should be considered. Some studies are in Harrison and Hanson (1999), Feenstra and Hanson (1997), and Acosta and Montes-Rojas (2008).

More in general, the literature of how globalisation has affected income inequality in developing countries is surveyed in Goldberg and Pavcnik (2007). They reported both an increase in the exposure to international markets of developing countries, and a rise in the level of income inequality in these countries. They argue that the understanding of the channels through globalisation and their effect on inequality has improved as the theoretical framework used in empirical work expanded to include factors such as trade in intermediate products, capital flows, skilled-bias technological change, short-run factor immobility, and firm heterogeneity. The main conclusion is that since countries experienced globalisation in different ways and at different times, the relevant mechanisms through income inequality effects are case-specific.

Despite lengthy discussion, the literature is inconclusive about the strength and the direction of the relationship between trade openness and inequality. In a recent study Szkely and Sámano (2012) found that greater trade openness is associated with contemporaneous increases in inequality in the region. According to their results, trade openness contributed to the increase in inequality in the 1980s and 1990s, but once fully implemented, it did not lead to further rises in inequality. Since during the 2000s big trade reforms were not implemented as in the previous decade, we are in principle not overly concerned about relevant changes in income distribution as a direct result of trade shocks.[9] Due to that some literature suggest a strong relationship between openness and the adoption of new technologies, the distributive effect of technological changes constitutes a relevant issue to study further.

4.3 Supply, demand, and wage differentials

Analysing trends in the supply, demand, and returns to skills is one way to study changes in inequality. The interaction between labour market forces determines the level and the evolution of the returns to skills. Since relative returns measure the dispersion between two groups of workers, they have a direct effect on wage inequality. In empirical work, the skill level of a group of workers is equivalent to the educational level. Usually it is the case when there are two groups of workers, those with tertiary education considered as skilled while those with a lower level of education considered as unskilled. Next, we present the evidence of the effect of such market factors in the region.

Gasparini et al. (2011b) studied the role of labour market forces in the evolution of wage differentials for 16 Latin American countries between 1990 and 2009. They estimate the relative contribution of supply and demand factors to the trends in skill premium for tertiary and secondary educated workers. They find that the demand side accounts for most of the changes through the period. According to them, supply factors would have been relevant only in explaining the fall in skill premia for high school graduates. Although they attribute the reversal in the demand for skills in the 2000s to the boom in commodity prices (that would favour the unskilled workforce), they do not discard other forces that have been important within sectors.

Lustig et al. (2013) focused on the case of Argentina, Brazil, and Mexico during 2000-

[9] In any case we are aware of the effect of international trade on wage structure. The world market has changed dramatically in the last years with new players from emerging economies such as China.

2010. They documented that the relative supply of skilled workers rose while the relative returns declined. They attributed the decreasing pattern in returns to skills to supply-side factors in the case of Brazil and Mexico (unskilled labour became relatively less abundant), and to demand-side factors in the case of Argentina (the relative demand for skilled workers declined). Labour market institutions in Argentina and Brazil would also have played an important role. The explanation why demand for skilled workers declined or grew slowly remains weak according to empirical evidence.

Two conclusions can be drawn. First, the fall in the wage gap in the region is consistent with a decreasing pattern in returns to education in a context of educational upgrading. However, focusing only on the role of education could relegate other significant labour market factors with potential distributional impacts. In particular, we know little about the effect of industrial composition, and changes in job informality on income inequality. This is the second gap in literature that we address in the next chapter of the thesis. Second, theoretical models with two inputs (skilled and unskilled labour) are very general to disentangle the driven forces behind labour supply and labour demand. This is why the analysis of the changes in income distribution needs a more nuanced approach to understand patterns in the demand for skills. This is the third gap that we try to fill by using a task-based approach in chapter 3.

4.4 Labour market institutions

The most important labour market institution in Latin America has been the minimum wage. Unlike the US and Europe, unions are concentrated in just certain sectors and are not strong enough to influence the distribution of earnings in a relevant way. Lustig et al. (2013) suggest that unions in the last decade could have been important in countries like Argentina, but it is very difficult to determine to what extent. Empirically, the main drawback in the study is the lack of pertinent data. In this section we concentrate on minimum wages as one of the main forces in shaping the distribution for the countries under study.

4.4.1 Minimum wages

The effect of minimum wages in formal and informal sectors in Latin American economies is tested in Cunningham (2007). Results suggest that minimum wage has a positive effect in both sectors. According to this study, the impact is higher for workers who earn near the minimum in formal and informal salaried and self-employed workers across the region. She also suggests the role of minimum wage as a numeraire. Since the minimum wage may be used as a benchmark for other wages it has important implications on the earnings distribution. Whether the minimum wage can increase or decrease wage inequality depends on its level.

For the case of Mexico, Bosh and Manacorda (2010) studied the contribution of minimum wages to earnings inequality during late 1980s and the early 2000s. By using municipalities as a unit of analysis, they account for permanent unobserved differences in wages across municipalities, unrestricted time-varying state-specific effects, and municipalities time-varying characteristics (trade openness). They found that a substantial part of the growth in inequality, and in particular all of the growth in inequality in the bottom end

of the distribution, is due to the steep decline in the real value of the minimum wage.[10]

To study the evolution of minimum wages, we compute and compare by country monthly minimum wages in US dollars using PPP from World Economic Outlook. The results are presented in Table 8. According to the information, the level of minimum wages has been increased largely for Argentina and steadily for Brazil and Colombia. For Mexico the real value has just gone up. These results are in line with previous evidence and suggest that minimum wages would have influenced even more the earnings distribution. Given its increasing trend and its potential effects on inequality, we later calculate how much minimum wages explain income distributional changes.

As an additional exercise, we estimate earnings densities and graph together with the real value of minimum wages. We use wage data from household surveys in each country. Figure 2 presents the results. The minimum wages seem to shape the distribution in a relevant way. In particular, they have a significant effect in the wage density for Argentina, Brazil, and Colombia. The graphs show peaks in the lower part of the distribution around the minimum wages. The extent to which the rise in the minimum wage can influence negatively employment generation is a recursive point of discussion in these economies.

4.4.2 Unions

Empirical evidence on the role of unions in the regions is scarce. In 2005 Kuhn and Marquez compiled some studies of unions in Latin America. They present evidence of the determinants of the union density in Canada, Ecuador, Mexico, Nicaragua, and the US. According to the results a higher likelihood of union membership is found by workers in manufacturing and utility transportation industries, workers in professional, administrative or manual occupations, workers aged 45-54, workers in larger firms, and public sector workers. One interesting result is that unionisation is concentrated among less-educated workers in the case of North America, but among better-educated workers in Latin America. Due to the lack of practical information we are not able to test the importance here.

4.5 Fiscal redistribution

The tax policy is one of the most important tools for redistributing incomes. Designing an optimal tax policy however is not a simple task due to the trade-off between equity and efficiency. The progressiveness of the tax rate and its corresponding amount of tax revenue are always sources of debate. In Latin America recent progressive changes in the tax system have been applied in Uruguay (2007), Ecuador (2008), Mexico (2008), and Peru (2009). According to Cornia et al, (2014b), taxation seems to have played a modest (or even negative) redistributive role in most of the countries in the region during the 1990s and a more positive redistributive role from the mid-2000s. By comparing Gini coefficients from income distributions pre and post taxation, they found that such policies had a positive distributive effect in the last decade.

[10] They stated that the minimum wage declined by about 50 percent relative to the median earnings from 1989 to 2001. They reported that by 2001 only between 3 and 5 percent of workers (depending on the area), are paid at or below the minimum wage.

So, given this evidence and the fact that total tax revenue as a percentage of the GDP has increased in the region during the 2000s, the study of the redistributive implications of tax reforms constitutes a growing area of research. In particular, detailed analysis of tax system features in specific countries appears as a highly relevant topic in the field. At a more aggregate level, the study of the evolution of tax ratios coming from different sources provided useful insights about structural changes. By using the ratio between revenues from direct taxes to indirect taxes into regression analysis, researchers test the distributive implications of changes in the tax system in a comprehensive manner. The main advantage is the availability of data for several countries and periods when panel data techniques are used.

On the other hand, several programs of cash transfers have been applied in most of the countries since 2000. Some examples are Bolsa Familia (Brazil) and Progresa/Oportunidades (Mexico). The goal of these programs is to reduced poverty and inequality. Evidence for Mexico suggests that the increase in the disposable income into households has had a positive effect on poverty and inequality (Esquivel et al., 2010). Despite our finding in the decomposition of household inequality that income from transfers played a minor role during the period, we are aware of the limitations of our measure. Since we do not exactly know what part is due to these kinds of programs, our conclusion should be taken with caution. In any case, we cannot test the role of these types of programs directly.

4.6 Summarizing the gaps in literature

4.6.1 Unemployment, households and income inequality

The first gap identified is the lack of evidence of the distributional effects of the recent macroeconomic conditions on income inequality in the region. In this paper we contribute to the literature by providing new evidence of this relationship once we have controlled for other factors with potential distributional effects such as the distribution of education and the level of minimum wages. In the same way, we also contribute by decomposing changes in inequality at individual and household levels by population subgroups and income sources, respectively. We think it is an especially intuitive way to study inequality since as we previously reported, the stronger role of labour income in explaining inequality changes would be related to the higher economic activity.

4.6.2 Labour market changes: educational upgrading and job informality

Despite evidence of the significant role of earnings in explaining the declining inequality, there is not a comprehensive analysis of the distributive implications of recent labour market changes. The labour markets in the economies considered have faced important changes in the last decade. There has been not only an educational upgrading, but also the industrial composition, the size of the public sector, and the proportion of long-term employment have changed substantially. Since they may have strong effects in wage structure we focus on them in the next chapter. Our hypothesis suggests that changes towards better labour conditions (more workers employed in larger firms, higher proportion of workers with long-term contracts and affiliated to social security) reduce wage inequality.

4.6.3 Skills, tasks, and jobs

There is also an important gap in the literature in terms of a detailed analysis of the patterns in labour demand. As the level of skill is proxy by the level of education, conclusions are drawn from a general setting of only two types of inputs: skilled and unskilled labour. Recent theoretical developments have proposed models where labour demand is linked more to tasks than to years of schooling. Different tasks require different skills, so by analysing task changes we are able to go a step further and study the kinds of skills (and types of jobs) for which labour demand has grown. We use this theoretical framework in chapter 3 and provide evidence of the employment changes in the distribution of skills. In particular, we assess whether such employment patterns can be explained by the routinization hypothesis suggested by Autor, Leavy and Murnane (2003).

5. Empirical strategy

5.1 Econometric specification

In this part of the paper we study the relationship between business cycle and income inequality. In particular, we estimate the marginal effect of unemployment rate on labour income inequality using panel data methods. So we consider a static econometric model where we study the effect of unemployment on the Gini coefficient for our four-country sample. After including different controls in our regression, we add more countries to the sample to test the robustness of the main results.

In panel data models, the individual-specific-effects model for a dependent variable y_{it} is given by equation (5). In this case, the time variant individual outcome is a function of three components: a random individual-specific effect α_i, a set of regressors X_{it}, and a idiosyncratic error ϵ_{it}.

$$y_{it} = \alpha_i + X_{it}^{'}\beta + \epsilon_{it} \tag{5}$$

The distinction between fixed-effects (FE) and random-effects (RE) models is important in panel data models because the RE estimator is consistent if the RE model is appropriate, and is inconsistent if the FE model is appropriate (Cameron and Trivedi, 2010). So, in equation (5), the FE model assumes that α_i is correlated with regressors while the RE model assumes that α_i is purely random. In the empirical part, we estimate an FE model and test the model specification using a Hausman test.

In our base estimation we have as a dependent variable the Gini coefficient of labour income, and as regressors we have the unemployment rate, the Gini coefficient of years of schooling, the minimum wage, the government expenditure as a percentage of the GDP, and the Foreign Direct Investment. These variables represent a set of the factors that would have played the most relevant role for our country sample (Argentina, Brazil, Colombia, and Mexico) as we have discussed in the previous section. So our benchmark model is given by equation (6)

$$Gini_{it} = \alpha_i + \beta_1 Unemp_{it} + \beta_2 GiniEdu_{it} + \beta_3 Min.wage_{it} + \beta_4 Gov.Exp_{it} + \beta_5 FDI_{it} + \epsilon_{it} \tag{6}$$

Where i refers to country (i=1,2,3,4) and t refers to time (t=2001, 2002,...2012).[11] We estimate an FE model of equation (6) by using the within estimator provided by Stata. The estimator actually fits the following equation

$$(y_{it} - \overline{y_i} + \overline{\overline{y}}) = \alpha + (X_{it} - \overline{X_i} + \overline{\overline{X}})'\beta + (\epsilon_{it} - \overline{\epsilon_i} + \overline{\overline{\epsilon}}) \quad (7)$$

Where an intercept (average of the individual effects) is estimated. The description of the variables is presented in Table 9. The measures of income and education inequality are calculated from household surveys while the other variables are obtained from international databases.

As robustness checks, we estimate the benchmark model considering other inequality measures. In particular we display marginal effects for the Mean Log Deviation of labour income. We also extend our country sample to 10 more economies. The entrance of countries to the sample is constrained by the availability of the consistent time series for our variables of interest. Thus, we include Bolivia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Honduras, Panama, Paraguay, Peru, and Uruguay. First, we obtain estimations from this specification and then we add more controls. In this case, we include the terms of trade, the real interest rate, the ratio of direct-indirect taxes, the real exchange rate, and the life expectancy.

For this enlarged sample, we use the Gini coefficient for household per capita income and the Gini coefficient of years of schooling from the SEDLAC database. The unemployment rate and the real exchange rate come from the World Bank indicators. The minimum wages, the terms of trade, the real interest rate, the direct/indirect tax ratio, and the life expectancy are obtained from CEPALSTAT. We include such variables to control for the other factors surveyed in the literature review.

6. Results

6.1 Unemployment, inequality in education, and minimum wage

Some descriptive statistics of the variables considered are shown in Table 10. The decreasing inequality was consistent with lower unemployment rates, lower inequality in education, and higher minimum wages. The results for the within estimation of equation (6) are presented in Table 11.[12] The effect of the unemployment rate on income inequality is presented in the first row of the table. Columns refer to marginal effect after controlling for other factors in two inequality measures of labour income. According to the results, the marginal effect of unemployment is positive and statistically significant. Income inequality increases as the labour market conditions worsen to find a job. A decrease in 5 percentage points in unemployment rate reduces the Gini on average by 0.02.

The results also show that inequality in education has a positive relationship with income inequality while the level of minimum wage has a negative effect. Results for the Gini of

[11] The period of our base model goes from 2001 to 2012 with 3 missing values. We do not observe Brazil in 2010 because it is a census year, and we do not observe Argentina in 2001 and 2002 because the new household survey started in 2003. So our panel is composed of 45 observations.

[12] We perform the Hausman test and reject the null hypothesis that RE provides consistent estimations.

years of schooling are consistent with the evidence provided by Cruces et al. (2014) for more countries from 1980 to 2010. The government expenditure and the Foreign Direct Investment did not have any effect on income inequality.

In Table 12 we present the percentage of total change explained by covariates. According to that, unemployment rate accounts for more than 30% of the total change in inequality in Argentina, Brazil, and Colombia. In fact, this is the main factor in Argentina and Colombia (45% and 40%, respectively). For Brazil and Mexico inequality in education played a more relevant role explaining half of the total variation in income inequality. Minimum wages appear to have a relevant role in Argentina and a lesser one in Colombia (21% and 12%, respectively).

Concerning robustness checks we present in Table 13 econometric estimations after including more countries. In the first column we only consider as explanatory variables the unemployment rate and the inequality in education. According to the results, the sign and the statistical significance of the effects remain. In this case, the effect of unemployment in inequality is a little bit lower while the effect of inequality in education is higher in regard to the benchmark model. In column 2 we present the results after including other controls. According to the estimations, general results do not change. The marginal effect of unemployment remains about 0.30 while real interest rate and terms of trade have a statistically significant negative effect on inequality. Government expenditure, FDI, and minimum wages do not appear to have any effect on inequality. [13]

The final robustness check deals with the estimation of marginal effect on unemployment by using a different database for a broader period. In particular we consider the database of Income Distribution in Latin America (IDLA) developed by Martorano and Cornia (2011). They studied changes in inequality in 18 countries from 1990 to 2008. The database is composed of several economic, political, and social variables. In this case, we keep only our variables of interest and run the previous model. By considering just the unemployment rate and the Gini of education, we obtain an estimate of β_1 about 0.34 with 0.08 of standard error (e.e.) and 4.11 as t-statistic. By including all variables as in Table 13 we obtain an estimation of 0.20 with 0.08 of e.e. and 2.20 as t-statistic. So, despite the lower effect of estimated unemployment, the relevant result is that the effect remains even when we consider a greater period.

7. Concluding remarks

In this essay we study the declining trend in income inequality in Brazil, Mexico, Colombia, and Argentina. We test the statistical significance of the inequality changes and decompose inequality indexes by income sources and by population subgroups. In particular, we construct confidence intervals for Gini coefficients and decompose the Theil Index by employment status and the half coefficient of Variation by income sources. After reviewing the literature, we suggest two additional issues to develop further. We also present empirical evidence of the effect of the business cycle on income inequality.

Results suggest that the fall in wage inequality is robust and statistically significant for

[13] The tax ratio and the life expectancy were also not statistically significant.

all countries during the period. Both income from labour in households and income from wage earners are reinforced as the main contributors to household and personal income inequality. One of the most suitable explanations for this higher share is related with the better macroeconomic conditions experienced for these economies. In fact, according to our estimations, the effect of unemployment on the Gini coefficient is positive, significant, and robust once we control for other factors.

Our results also suggest that changes in the Gini in education and minimum wages were relevant in accounting for changes in labour income inequality. For countries like Brazil and Mexico, changes in the inequality in the years of schooling explain more than 50% of the changes in the Gini coefficient. We also found that in Argentina, minimum wages accounts for the 21% of variation in labour income inequality. The main drawback of the estimations presented here is of course the level of aggregation of the analysis and the short time period used in the estimation.

In terms of labour market factors, the role of changes in industrial structure and labour informality in accounting for changes in inequality remains undetermined. The educational upgrading and the fall in returns to education are not the only relevant changes in the region. Likewise a further study of the demand of labour in the region constitutes another challenge in literature. New theoretical approaches can be considered to analyse more in detail changes in demand for skills and patterns in employment growth.

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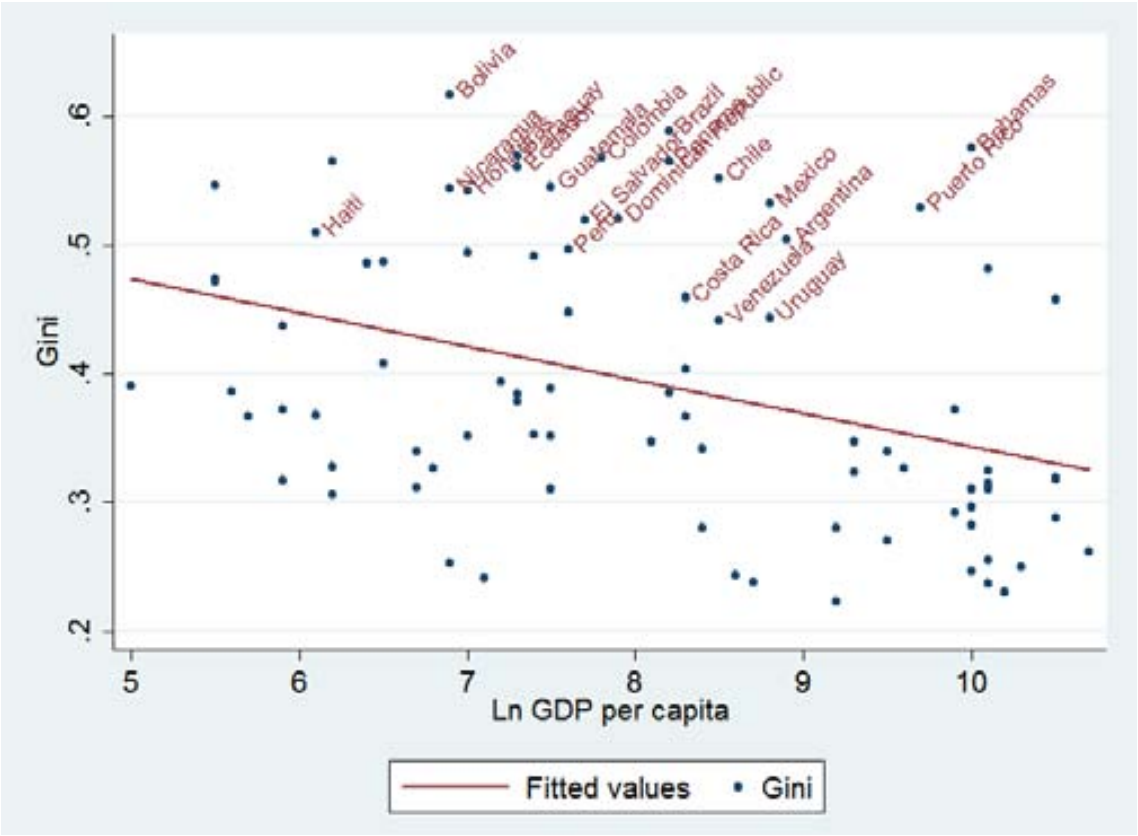

Figure 1. Gini coefficient and GDP per capita in 2000.

Source: Gini coefficients are obtained from the World Institute for Development Economics Research WIDER database. GDP per capita is obtained from World Bank indicators. We use the inequality measures nearest to 2000 where information was not available in that year. The sample is composed by the following countries: Argentina, Armenia, Australia, Austria, Bahamas, Bangladesh, Belarus, Belgium, Bolivia, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Cyprus, Czech Republic, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Finland, France, Georgia, Germany, Greece, Guatemala, Guinea, Haiti, Honduras, Hungary, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Lithuania, Luxembourg, Macedonia, Madagascar, Malaysia, Malta, Mexico, Moldova, Mongolia, Morocco, Nepal, Netherlands, New Zealand, Nicaragua, Nigeria, Norway, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Puerto Rico, Romania, Russia, Serbia, Sierra Leone, Singapore, Slovak Republic, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Tanzania, Thailand, Turkey, Uganda, Ukraine, United Kingdom, United States, Uruguay, and Venezuela.

Table 1. Changes in Gini coefficients in Latin America

Country	Period	Initial year	Final year	Gini variation
Argentina	2003-2010	0.54	0.44	-0.10
Bolivia	2001-2011	0.59	0.46	-0.12
Brazil	2001-2011	0.59	0.53	-0.06
Chile	2000-2011	0.55	0.51	-0.04
Colombia	2001-2011	0.56	0.54	-0.02
Costa Rica	2001-2010	0.50	0.50	0.00
Dominican Rep.	2000-2010	0.52	0.47	-0.05
Ecuador	2003-2010	0.54	0.49	-0.06
El Salvador	2004-2010	0.47	0.45	-0.03
Guatemala	2000-2011	0.55	0.52	-0.03
Honduras	2001-2010	0.54	0.53	-0.01
Mexico	2002-2010	0.51	0.47	-0.04
Nicaragua	2001-2009	0.58	0.46	-0.12
Panama	2001-2009	0.56	0.52	-0.04
Paraguay	2001-2010	0.55	0.52	-0.03
Peru	2003-2010	0.54	0.45	-0.09
Uruguay	2001-2010	0.46	0.45	-0.01
Venezuela	2001-2006	0.46	0.43	-0.03

Source: Author's calculations based on the Socio-Economic Database for Latin America and the Caribbean SEDLAC (CEDLAS and The World Bank). Indices are estimated from household equivalized labour monetary income in urban areas

Table 2. Some statistics for the sample of countries in 2012

Country	Argentina	Brazil	Colombia	Mexico
Population	41,086,927	198,656,019	47,704,427	120,847,477
GDP per capita, PPP (Current international dollar)	18,112	11,875	10,791	15,311
Gini coefficient	0.39	0.49	0.46	0.38
Average years of schooling	9.3	7.5	7.7	9.1
Average growth rate 2001-2012	7.1	2.9	4.3	2.1
Unemployment rate 2001-2012	7.2	6.9	10.4	4.9

Source: Population and unemployment are from The World Bank indicators. GDP per capita is from International Monetary Fund. Gini coefficient is calculated based on household surveys. Schooling is for 2010 from Barro and Lee (2013).

Table 3. Wage inequality in Latin America

	Gini	Std. Err.	[95% C.I.]		90/10	Std. Err.	[95% C.I.]		n
Argentina									
2003	0.433	0.001	0.431	0.435	2.052	0.014	2.023	2.081	9,870
2010	0.342	0.003	0.337	0.348	1.726	0.020	1.686	1.767	14,902
Brazil									
2001	0.513	0.002	0.510	0.517	1.986	0.022	1.942	2.030	85,243
2010	0.437	0.005	0.427	0.448	1.547	0.017	1.513	1.581	99,769
Colombia									
2002	0.408	0.002	0.405	0.412	1.678	0.022	1.634	1.722	17,507
2010	0.372	0.005	0.362	0.383	1.514	0.024	1.467	1.561	18,735
Mexico									
2001	0.386	0.001	0.383	0.389	1.607	0.019	1.569	1.644	81,081
2010	0.343	0.004	0.335	0.350	1.478	0.017	1.443	1.512	52,822

Source: Author's calculations based on microdata from household surveys. Standard Errors obtained by bootstrapping with 100 replicates

Table 4. Household income inequality in Latin America

	Gini	Std. Err.	[95% C.I.]		90/10	Std. Err.	[95% C.I.]		n
Argentina									
2003	0.450	0.001	0.448	0.452	2.24	0.02	2.20	2.27	9,572
2010	0.367	0.001	0.365	0.369	1.74	0.02	1.71	1.77	13,414
Brazil									
2001	0.555	0.002	0.552	0.558	2.49	0.02	2.44	2.54	85,460
2010	0.494	0.003	0.489	0.499	2.15	0.02	2.11	2.20	91,175
Colombia									
2002	0.490	0.002	0.487	0.494	2.23	0.02	2.19	2.27	20,461
2010	0.463	0.002	0.460	0.467	2.01	0.02	1.97	2.05	22,063

Source: Author's calculations based on microdata from household surveys. We do not include Mexico because the household survey considered does not have information about non-labour incomes. Standard Errors obtained by bootstrapping with 100 replicates.

Table 5. Decomposition of income inequality by factors and changes during period. Per capita household income

	Argentina						Brazil						Colombia					
	2003			2003-2012			2001			2001-2011			2002			2002-2012		
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Labour Income	67.5	1.4	65.6	4.0	-0.5	11.7	73.5	2.3	72.3	-0.2	-0.2	5.1	76.3	1.5	75.5	1.8	-0.2	-2.0
Renting	1.8	44.2	2.6	-0.5	5.4	0.7	2.3	76.6	3.9	-1.0	16.4	-1.9	5.4	15.9	6.2	-0.9	16.0	2.2
Pensions	24.9	4.0	22.4	-2.8	-1.8	-10.9	22.1	6.8	20.1	1.0	-1.6	-0.9	11.9	10.8	13.7	-0.9	-0.3	-1.2
Interests	0.6	320	1.9	-0.0	172.3	2.3	1.1	26.3	3.5	0.7	-231	-2.4	0.5	189	0.9	0.4	36.4	2.0
Cash helps	4.8	23.2	4.8	-0.3	-6.8	-1.2	0.9	64.0	0.2	-0.5	128	-0.1	5.0	10.7	2.0	0.1	-0.7	0.1
Other	0.3	3000	2.8	-0.3	-1874	-2.7	0.1	454	0.0	0.0	707	0.1	0.9	178	1.7	0.5	-82.3	-1.2
Total		0.89			-0.54			1.83			-0.4			1.30			-0.2	

Source: Author's calculations based on microdata from household surveys. Results are obtained from ineqfac program in Stata. Column (1) is the contribution of each factor to total income (100*m_f/m). Column (2) is half the square of Coefficient of Variation (I2_f). Column (3) is the proportional contribution of each factor to total inequality (100*s_f). Column (4) is the variation in the contribution to total income. Column (5) is the variation in inequality index. Column (6) is the variation in the proportional contribution to total inequality.

Table 6. Decomposition of income inequality by employment status. Labour income

	Argentina						Brazil					
	2003			2003-2012			2001			2001-2012		
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Wage earners	1.0	70.0	0.34	0.1	7.9	-0.13	1.0	61.5	0.55	0.0	4.7	-0.10
Domestic Service	0.4	2.9	0.28	-0.1	-0.4	-0.06	0.3	2.9	0.19	0.1	-0.1	-0.02
Self-employees	0.8	18.0	0.51	-0.1	-4.9	-0.15	0.8	20.6	0.67	0.1	-0.8	-0.11
Employers	2.3	9.0	0.49	-0.9	-2.7	-0.20	3.3	15.0	0.55	-0.1	-4.0	0.03
Other	0.2	0.0	0.50	0.2	0.0	-0.16	0.2	0.0	0.84	0.1	0.0	-0.27
	Colombia						**Mexico**					
	2002			2001-2011			2001			2001-2012		
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Wage earners	1.2	59.4	0.37	-0.1	-2.7	-0.05	1.0	72.2	0.30	0.0	3.2	-0.07
Domestic Service	0.6	4.6	0.20	0.0	-1.7	-0.03	0.4	1.5	0.16	0.1	1.3	0.02
Self-employees	0.7	24.1	0.50	0.0	6.3	0.00	0.8	14.7	0.40	0.0	-1.0	-0.05
Employers	2.4	11.7	0.58	-0.2	-1.9	-0.12	2.3	11.6	0.41	-0.3	-3.7	-0.05
Other	0.4	0.2	0.30	0.0	-0.2	-0.01	2.1	0.0	0.32	-2.1	0.0	-0.32

Source: Author's calculations based on microdata from household surveys. Results are obtained from ineqdeco program in Stata. Column (1) is the relative mean, column (2) is the income share, column (3) is the Theil index, column (4) is the variation in the relative mean, column (5) is the variation in the income share, and column (6) is the variation in the Theil index.

Table 7. Decomposition of Theil index. Labour income

	Argentina		Brazil		Colombia		Mexico	
	2003	**2012**	**2001**	**2012**	**2002**	**2012**	**2001**	**2012**
Theil coefficient	0.43	0.27	0.67	0.54	0.49	0.44	0.37	0.28
Between-group	0.05	0.04	0.11	0.07	0.07	0.05	0.04	0.03
Within-group	0.38	0.23	0.57	0.47	0.42	0.39	0.33	0.25
n	15,845	22,599	146,516	151,556	34,975	38,856	117,887	80,027

Source: Author's calculations based on microdata from household surveys. Results are obtained from ineqdeco program in Stata.

Table 8. Minimum wages in PPP-adjusted US$

	2001	**2012**	**Variation**
Argentina	288.5	884.6	596.2
Brazil	176.5	329.1	152.6
Colombia	311.1	426.7	115.6
Mexico	183.3	210.6	27.3

Source: Authors calculations. We use the PPP from World Economic Outlook (WEO).

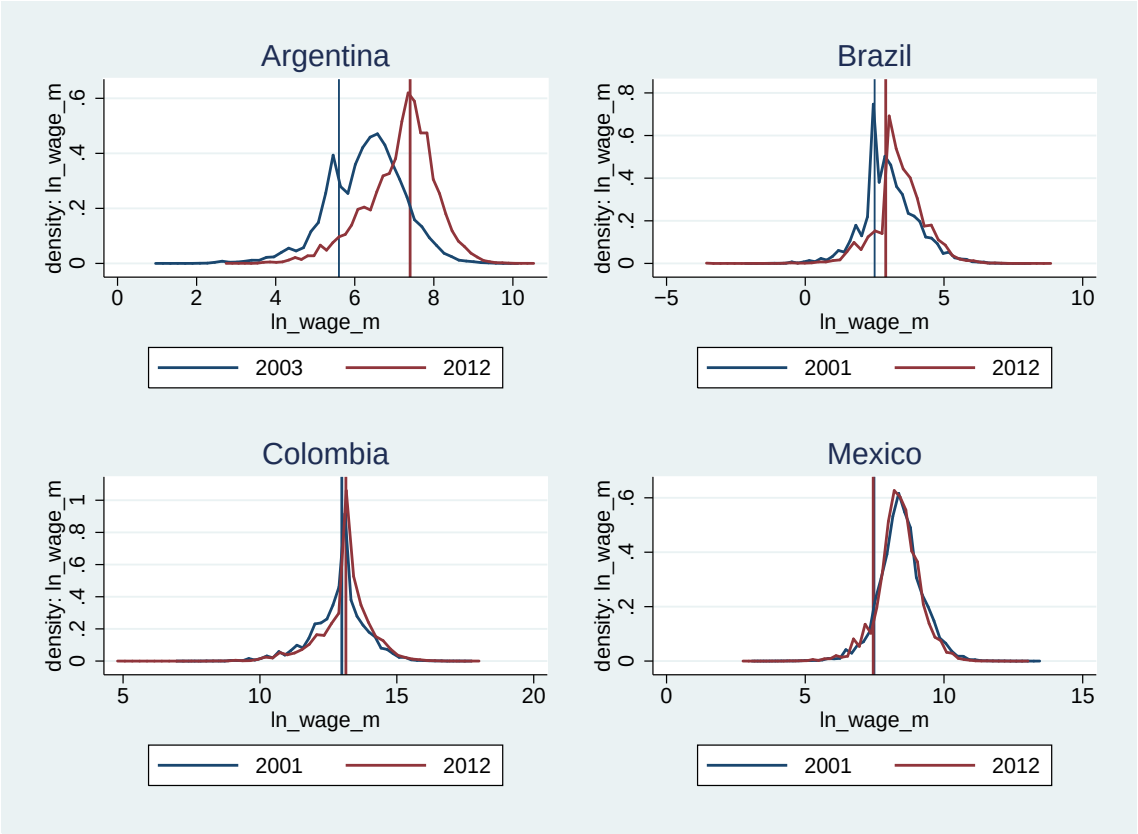

Figure 2. Minimum wage and earnings distribution in Latin America

Table 9. Variables description

Name	Description	Source
Gini income	Gini coefficient of labour income from the main job	Author's calculations based on household surveys
Mean Log Deviation GE(0)	Mean Log Deviation of labour income from the main job	Author's calculations based on household surveys
Unemployment	Unemployment rate	World Economic Outlook (WEO) online database
Gini education	Gini coefficient of years of schooling	Author's calculations based on household surveys
Minimum wage	Minimum wage in PPP	Different sources. See data appendix. We use the Purchasing-Power-Parity (PPP) from World Economic Outlook (WEO) online database
Gov. expenditure	Government spending / GDP	World Economic Outlook (WEO) online database
FDI	Foreign Direct Investment	Data indicators The World Bank

Table 10. Summary statistics 2001-2012

	Mean	Std. Dev.	Min	Max	Variation
Gini Labour income					
Argentina	0.431	0.028	0.394	0.477	-0.083
Brazil	0.530	0.022	0.494	0.559	-0.066
Colombia	0.486	0.015	0.457	0.509	-0.030
Mexico	0.406	0.013	0.387	0.432	-0.043
Unemployment rate					
Argentina	9.98	3.30	7.15	17.25	-10.05
Brazil	9.39	2.30	5.50	12.30	-5.765
Colombia	12.47	1.69	10.38	15.58	-4.592
Mexico	4.08	0.94	2.77	5.46	2.186
Gini education					
Argentina	0.245	0.004	0.240	0.252	-0.010
Brazil	0.308	0.015	0.283	0.332	-0.050
Colombia	0.261	0.004	0.254	0.268	-0.012
Mexico	0.235	0.015	0.219	0.258	-0.035
Minimum wage (US Dollars)					
Argentina	652.0	223.8	288.5	884.6	596.2
Brazil	242.5	51.2	176.5	329.1	152.6
Colombia	369.8	38.2	311.1	426.7	104.6
Mexico	194.9	8.7	183.3	210.6	27.3
Government expenditure (% GDP)					
Argentina	0.35	0.05	0.30	0.44	0.14
Brazil	0.38	0.01	0.36	0.40	0.04
Colombia	0.28	0.01	0.26	0.30	0.00
Mexico	0.24	0.03	0.20	0.27	0.06
FDI (US Millions)					
Argentina	6,690	3,582	1,433	12.736	11.302
Brazil	33,586	25,035	8,799	79,922	61.111
Colombia	7,284	4,815	1,492	16.433	14.304
Mexico	21,956	4,567	16,096	30.712	-8.786

Note: Variation is the difference between the final and the first year. See variables description for details.

Table 11. Income inequality and unemployment rate in Latin America. Fixed-Effects (within) regression

	Gini coefficient			Mean Log Deviation GE(0)		
	(1)	(2)	(3)	(4)	(5)	(6)
Unemployment	0.654**	0.492**	0.371**	1.136**	0.882**	1.141***
	0.168	0.143	0.044	0.300	0.158	0.206
	3.89	3.44	8.52	3.78	5.58	5.55
Gini education		0.884**	0.709**		1.382**	1.249*
		0.083	0.195		0.26	0.468
		10.59	3.65		5.34	2.67
Minimum wage			-0.003**			0.003
			0.001			0.002
			-3.21			2.03
Gov. expenditure			-0.166*			-0.255*
			0.056			0.094
			-2.95			-2.72
FDI			0.002			0.009
			0.003			0.009
			0.66			1.03
Constant	0.405***	0.188**	0.287**	0.308***	-0.031	-0.035
	0.015	0.020	0.090	0.027	0.065	0.218
	27.02	9.58	3.19	11.51	-0.48	-0.16
R2	0.40	0.91	0.81	0.51	0.92	0.90
Observations	45	45	45	45	45	45

Note: Unbalanced panel for Argentina, Brazil, Colombia, and Mexico from 2001 to 2012. The missing values are for Brazil in 2010 (census year) and for Argentina 2001-2002 (Previous household survey). Estimations obtained from a fixed-effects model. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Robust standard errors are shown in second row follow by t-statistics. Both inequality measures of dependent variables are for labour income from the main job. See more details in variables description.

Table 12. Marginal effects and contribution to inequality changes

		Unemployment	**Gini education**	**Minimum wage**
Marginal effect		0.371	0.709	-0.003
Total change	**ΔGini**	**ΔUnempl**	**ΔGini educ**	**ΔMin. wage**
Argentina	-0.083	-0.101	-0.010	5.96
Brazil	-0.066	-0.058	-0.050	1.52
Colombia	-0.030	-0.032	-0.012	1.15
Mexico	-0.043	0.022	-0.035	0.27
Contribution	**ΔGini**	**Unempl**	**Gini educ**	**Min. wage**
Argentina	100%	45%	9%	21%
Brazil	100%	33%	54%	7%
Colombia	100%	40%	29%	12%
Mexico	100%	-19%	58%	2%

Note: Marginal effects obtained from fixed-effect estimation. Total change refers to changes between 2001-2012.

Table 13. Income inequality, unemployment, and inequality in education. Robustness checks

	(1)	(2)
Unemployment	0.309**	0.304**
	0.12	0.09
	2.6	3.4
Gini education	0.956***	0.767***
	0.17	0.10
	5.4	7.5
Gov. expenditure		-0.002
		0.000
		-1.6
FDI		0.00
		0.00
		1.08
Min. wage		-0.00
		0.00
		-0.77
Real interest rate		-0.027**
		0.001
		-2.48
Terms of trade		0.0005
		0.0002
		-2.05
Constant	0.166***	0.226***
	0.05	0.05
	3.09	4.43
R2	0.38	0.91
Observations	141	130
Countries	14	13

Note: Dependet variable is Gini coefficient of household per capita income. See empirical strategy for details.

Appendix A. Estimation of the Gini coefficient and interdecile range by bootstrapping

```
*************************************************************************
************************   Gini coefficient ******************************
clear
use "d:\gini\Brazil_II_2001.dta"
cd "d:\gini"
/*1. Sampling with replacement. We generate 100 samples of 1000
observations*/
forvalues i=1(1)100 {
      clear
      use Brazil_II_2001.dta, clear
                  keep r_wage
                  bsample 1000
                        ineqdeco r_wage
                        display $S_gini
                        gen Gini_2001=$S_gini
                        keep Gini_2001
                        collapse (median) Gini_2001
      save gini_Brazil _2001_`i'.dta, replace
                        }
/*2. Appending 100 samples*/
      use gini_Brazil_2001_1.dta, clear
                  forvalues i=2(1)100 {
                  append gini sample_ Brazil_2001_`i'.dta
                  }
      save gini_Brazil_2001.dta, replace
/*3. Summary statistics */
sum Gini_2001
/*4. We replace n, mean, and sd in the following command*/
cii n mean sd, level(95)

************************** Interdecile range ******************************
clear
use "d:\ic\Brazil_II_2001.dta"
cd "d:\ic"
/*1. Sampling with replacement.  We generate 100 samples of 100
observations*/
forvalues i=1(1)100 {
      clear
      use Brazil_II_2001.dta, clear
                  keep lnrealwage
                  bsample 100
                        sort lnrealwage
                        gen n=_n
                        keep if n==90 | n==10
                        egen max=max(lnrealwage)
                        egen min=min(lnrealwage)
                        gen gap=max-min
                        keep gap
                        drop if _n==2
      save sample_Brazil _2001_`i'.dta, replace
                        }
/*2. Appending 100 samples*/
      use sample_Brazil_2001_1.dta, clear
                  forvalues i=2(1)100 {
                  append using sample_ Brazil_2001_`i'.dta
                  }
      save sample_Brazil_2001.dta, replace
/*3. Summary statistics*/
sum gap
/* 4. We replace n, mean, and sd in the following command*/
cii n mean sd, level (95)
```

Chapter II

Distributional effects of labour market changes on wage inequality. Evidence for Argentina, Brazil, Colombia, and Mexico[14]

Abstract

In this paper we study the distributional impacts of schooling and changes in broad measures of job informality on wage inequality for Argentina, Brazil, Colombia, and Mexico during the 2000s. By means of quantile regressions, we estimate counterfactual densities and decompose the drop in wage inequality into composition and price effects. According to our findings, not only the educational upgrading but also changes in formal contracting and health coverage account for the recent decline in wage inequality. Higher levels of workers with written contracts and covered by a health system are associated with lower inequality measures in Argentina, Brazil, and Colombia. Results from the decomposition exercise suggest that a coefficient effect - rather than a composition effect - played the most relevant role.

Key words: Wage inequality, education, quantile regression
Journal of Economic Literature Classification: J31, I24, C14

1. Introduction

Incomes from labour markets account for most of the recent changes in total income inequality in Latin America. The percentage of household income inequality explained by labour income in 2012 was about 76% for Argentina, 77% for Brazil, and 73% for Colombia. The drop in wage inequality, in turn, explains most of the decline inside labour income concentration. During the 2000s, the Theil index among wage earners fell by around 0.13 in Argentina, 0.10 in Brazil, 0.05 in Colombia, and 0.07 in Mexico. In this paper we study this decline by looking at the composition and price effects of two of the main labour market changes experienced by these economies: an educational upgrading and lower levels of broad measures of job informality among wage earners.

The average years of schooling and the proportion of workers with some tertiary education has increased steadily in the region since the 1990s. Governments in most countries have made important efforts in terms of coverage and the quality of the educational system (See Barros et al., (2011) for Brazil, Esquivel et al. (2011) for Mexico, and Jaramillo and Saavedra (2011) for Peru). Likewise, in countries such as Brazil, Colombia, and Argentina, the sharing of workers with a written contract and covered by a health system (paid by their employers) also increased during the 2000s. Some literature suggests that this is a result of the implementation of programs towards better labour conditions in some countries (Berg (2010), ILO (2011, 2013) and

[14]Previous version of this paper was presented at the Annual Conference of European Association of Labour Economists (EALE) in Turin-Italy in 2013.

Maurizio (2014)).[15]

From a supply-demand framework, the net effect of an educational upgrading of labour force upon wage inequality is conditioned to the trends in labour demand (in particular, demand for more educated workers). If return to skills spreads as people become more educated, the race between education and technology - in terms of Golding and Katz (2008) - is led by technology. Theoretical models that relate changes in the size of the informal sector and changes in earnings concentration are less common. In general, we expect that lower levels of informality lead to lower levels of inequality due to income improvements in the lower tail of the wage distribution.

Evidence of the recent trends in returns to education in the region suggests a declining pattern in the average return for most of the countries (Gasparini et al., 2011 and Lustig et al., 2013). During the 1990s, educational upgrading was consistent with both decreasing returns to secondary education and increasing returns to tertiary education. Such higher returns to skilled workers were interpreted as evidence of the Skill-Biased Technological Change (SBTC) propelled by several market-oriented reforms implemented in most of the countries at the beginning of the decade. The reversal of the trend in returns to highly educated workers during the 2000s has been linked to the boom of commodities that would have increased labour demand towards less skilled workers.

But what about the distributional impacts of education beyond average effect? Since few literature deals with the returns to education at different parts of the wage distribution and their changes over time, we explore this issue in this chapter. This is a relevant question as long as we do not know to what extent the drop in the average returns to schooling has been equally distributed through wage distribution. In the same way, as the distributional effects of labour informality has also received little attention, our second goal is concerned with the study of such a relationship. To analyse the job informality we consider two broad measures: having a written contract and having health coverage paid by their employer.[16]

Thus, the paper contributes to the literature in two ways. On the one hand, we document the recent evolution of returns to schooling for a representative sample of countries not only at mean (as much of the literature does) but also at median, and at lower and at higher deciles of the wage distribution using Quantile Regression (QR) techniques. On the other hand, we explore the distributional effects of both the educational upgrading and changes in the size of job informality. Do better labour conditions imply improvements in wage inequality? By using the methodology proposed by Machado and Mata (2005), we decompose changes in inequality into the shifts in the distribution of covariates and into the changes in the distribution of returns.

The paper is organized as follows. Additional to this introduction, in section 2 we present the literature review. In section 3 we explain the empirical strategy to estimate the marginal effects and counterfactual densities. The data are described in section 4. The results of econometric estimations and the decomposition exercise are presented in section 5. Finally, in section 6 we provide some concluding remarks.

[15]Specific programs include: "Plan nacional de regularizacin del trabajo" (Argentina, 2004); "Regimen Simples" (Brazil, 2006); "Programa Colombia trabaja formal" (Colombia, 2010), and "Programa para la formalizacin del empleo" (Mexico, 2013).

[16]We study informal employment according to the "legal" approach stated by the ILO. We only consider wage earners. In this case, the ILO defines that "employees are considered to have informal jobs if their employment relationship is, in law or in practice, not subject to national labor legislation, income taxation, social protection, or entitlement to certain employment benefits for specific reasons" (ILO, 2004).

2. Literature review

A central issue in labour economics is the relationship between schooling and earnings. Higher levels of schooling are associated in general with greater incomes for individuals.[17] Different from the average (or average marginal) return to education, there is growing literature that explores the effect of schooling at different parts on the earnings distribution. By using QR techniques, researchers obtain conditional wage distributions and analyse changes within-group wage inequality. Buckinsky (1994) was the first to examine changes in returns to skills (education and experience) by applying QR techniques. Results for the US suggest a differentiated effect of returns to schooling and experience across quantiles of the wage distribution. In general, returns to education were higher at higher quantiles.

More recent evidence for other countries supports this idea. From a sample of 16 Western countries in the mid-1990s, Martins and Pereira (2004) find that schooling has a positive impact upon within-levels wage inequality. Results differ off course across countries. For example, in the case of Sweden, the returns to education both at the first decile and the ninth decile were about 2% and 6%, respectively. For Portugal returns at the same deciles were 6% and 15%, respectively. As explanations for the spread of returns for higher educational levels, they suggest three sources: over-education, ability-schooling interactions, and school quality or different fields of study.

The QR framework has also been used to decompose changes in inequality on the basis of the Oaxaca-Blinder concept. Machado and Mata (2005) and Melly (2005) proposed techniques to disentangle the effect of the changes of the distribution of the covariates from the effect of changes in the distribution of coefficients - or returns- in accounting for inequality changes. The methods are based on the estimation of marginal wage distributions that are consistent with conditional distributions estimated by quantile regression with hypothesized distributions of covariates. The possibility of obtaining counterfactual conditional densities (and inequality measures) is one of its main advantages in studying, for example, changes in education and inequality over time.

In Latin America there are few studies that deal with the recent evolution of returns to education. Based on a supply-demand framework, Manacorda et al. (2007) proposed a model with three production inputs to account for changes in skill premia in Argentina, Brazil, Chile, Colombia, and Mexico during the 1980s and the 1990s. The three inputs correspond to workers with primary, secondary, and university levels of education. According to their results, the rise in the supply of workers who completed secondary education depressed their wages relative to the workers with primary-level educations. They suggest that the supply shift was exacerbated by a shift in the demand for workers with tertiary education.

Likewise, Gasparini et al. (2011) provided evidence of the evolution of returns to skills for most recent years. They documented that during the 2000s the supply of more educated workers increased, but their returns did not, as in the 1990s. By considering 16 Latin American countries

[17] Beyond correlations, researchers have been interested in the causality issue. Some of the most relevant studies concerning endogeneity and omitting variable bias can be found in Griliches (1977), Becker (1964), and Card (1999). All in all, the evidence provided by Card (1999), once he accounts for some sources of endogeneity, suggest that the average return to education is not much below the estimate from a standard human capital earnings function obtained by OLS.

they estimate the relative contribution of supply and demand factors to skill premia for tertiary and secondary educated workers. They state that the main role in explaining trends in returns education has been played by labour demand. For the reversal trend in returns to skills during the 2000s they partially attribute this to the recent boom in commodity prices that could favour the unskilled workforce. They suggest that supply-side factors were only relevant in the fall of wage premia for high-school graduates.

Studies that deal with the distributional impacts of informality levels on earnings inequality are also scarce in the region. Most of the studies focus on the determinants and dynamics of informality (Maloney, 2004; Maurizio, 2012). Some evidence suggest that job informality has declined recently in Argentina and Brazil (ILO, 2011; Berg, 2010). These studies remark on the important progress in improving labour conditions as the result of programs to job formalization. Empirical evidence of the specific relationship between job informality and wage inequality for Argentina and Brazil is provided in Maurizio (2014). By decomposing the Theil index, they found a positive composition effect in both countries, suggesting that the rising trend in labour formality had equalizing income effects.

In this paper we analyse trends in returns to skills not only at the mean but also at the median and at the interdecile gap for a representative sample of Latin American countries. We also go a step further and study the role played not only by formally contracts but also the role of higher levels of health coverage on changes in wage inequality. We contribute to the literature by providing evidence of the distributional effects of such employment patterns. In particular, we estimate counterfactual densities that would have prevailed in 2010 if the distribution of either education, written contracts, or health coverage had remained the same as at the beginning of the decade and were paid as in 2010. The topic is quite relevant since they are some of the most important concerns in public policy in the region.

3. Empirical strategy

Methods that complement the exclusively focus on standard linear regression on the conditional mean have recently received a lot of attention, both theoretically and empirically. One such development is the semi-parametric technique of Quantile Regression (QR). The QR model provides information about how covariates influence not only the location, but also the scale and shape of the entire response distribution (Koenker, 2005). Next, we explain how this semi-parametric technique allows us to study the effect of the covariates both along wage distribution and on inequality measures. Likewise, we present how, based on counterfactual densities obtained by QR, we can decompose the changes in wage inequality by isolating the effect of the different factors in which we are interested.

3.1 Quantile regression

Consider a wage setting model where the (log) hourly real wages are a function of a set of covariates X and an error term μ. Then, the linear QR can be written as

$$lnw_{\theta i} = X_i\beta_\theta + \mu_{\theta i} \quad \text{with} \quad Q_\theta(lnw_{\theta i}|X_i) = \beta_\theta X_i \tag{1}$$

Where the θth conditional quantile function of w given X is $Q_\theta(lnw_{\theta i}|X_i)$. In our case, X is composed by worker, industry, and firm characteristics. So, additional to the years of schooling, we include in our regressions as explanatory variables age, potential experience, gender, indus-

try, firm type, firm size, contract type, health coverage, and cities. The marginal effect for the jth regressor is

$$\beta_{\theta j} = \delta Q_\theta(lnw_{\theta i}|X_i)/\delta x_j \tag{2}$$

We refer to this marginal effect as return or price to the observable characteristics.[18] As empirical literature suggests, we expect to find differences in such marginal effect as we move from the lower part to the higher part of the wage distribution. Our first analysis focuses on the returns to education. To study the effect of schooling and other covariates on inequality measures we consider the inter-quantile regression framework IQR. By defining the percentile wage gap, we estimate the impact of a marginal change on this broad inequality measure. By far, we expect that formal contracting for example, has stronger effects at the lowest part of the distribution. We run QR and IQR in Stata software specifying 100 replicates to ensure a large enough number of bootstrap samples for stable estimates of the standard errors and 95% confidence intervals.

3.2 Composition and price effects

We decompose changes in inequality by using the methodology proposed by Machado and Mata (2005). The method is based on the estimation of marginal wage distributions consistent with a conditional distribution estimated by QR and with hypothesized distributions for the covariates.[19] The procedure is explained in appendix B. So, we estimate marginal densities by year and country as well as their counterfactual marginal densities. To obtain the counterfactual marginal density, we estimate the wage density that would have prevailed in 2010 if all of the covariates had been distributed as in the first year and were paid the same as in 2010.[20]

Equation (3) shows the wage gap decomposition. The terms $f(w)$ and $f^*(w)$ refer to estimators of the marginal density of wages from the observed and generated samples, while α represents the inequality measure to decompose. So, the total change in inequality measure breaks down into the part due to changes in the characteristics of the working population (first term), the part due to changes in the returns to these characteristics (second term), and into the part due to changes in both unobserved quantities and prices (residual).

$$\begin{aligned}\alpha(f(w(2010)) - \alpha(f(w(2001))) = \alpha(f^*(w(2010))) - \alpha(f^{**}(w(2010); X(2001)))\\ + \alpha(f^{**}(w(2010); X(2001))) - \alpha(f^*(w(2001)))\\ + \text{residual}\end{aligned} \tag{3}$$

We define two scenarios in which we perform the decomposition presented in equation (3). The first one is described above. Following the same idea, in the second scenario we keep only the distribution of one variable of interest as in the first year and assume that the others are distributed

[18] The interpretation of the slope coefficient for discrete changes requires considerable care. Given the assumption that the individual remains in the same quantile of the distribution after the change, for non-infinitesimal changes this assumption is very weak. Conversely, in this paper we are in line with Buchinskys's (1994) approach since interpreting the causal effect of the coefficients is beyond the scope of this study. Similarly, we are aware that the slope coefficients could differ across quantiles due to the presence of heteroskedastic errors (Koenker, 2005) and not because of heterogeneity, as much of the empirical work assumes.

[19] Theoretically this marginal density is obtained based on both the probability integral transformation theorem and the consistency property of the estimated conditional quantile function developed in Bassett and Koenker (1982, 1986).

[20] The first year varies for countries. For Argentina it is 2003 while for Brazil, Colombia, and Mexico it is 2002. The final year is 2010 for all except for Brazil, which is 2011.

and paid as in the final year. This counterfactual density is given by $(f^{**}(w(2010); z(2001)))$. Doing this I can isolate, for example, the effect of education or written contracts upon wage inequality. Furthermore, in order to make robustness checks we invert the order of the year in the decomposition exercise for all scenarios.

The methodology proposed by Machado and Mata (2005) has been extended to account for other issues. For example, Albrecht et al. (2009) demonstrated the asymptotic properties of the technique and proposed a procedure to account for sample selection in this framework. Techniques with the same objective can be found in Dinardo et al. (1996), Melly (2005), and Autor et al. (2005). We chose this algorithm because we found it more intuitive and better explained in the paper.

4. Data

The results in this paper are based on wage data from household surveys for Argentina, Brazil, Colombia, and Mexico. See the data appendix for more details. We use these household surveys to create several variables. From the composition of the labour force side, we take into account age, potential experience, and educational attainment. Our data do not contain direct information for all countries of the individuals experience in the labor market. As is common in literature, we construct a proxy variable (potential experience) by subtracting the years of education and 6 from the age of the individual.

Educational attainment corresponds to levels of formal education. We take the educational levels from the educational categories reports in all household surveys. That is, incomplete primary, primary, high school dropouts, high school, some college, and college or more. We also know that in Mexico and Argentina, complete primary is composed of 6 years of education, while in Colombia it is composed of 5 years. In all three countries high school is composed of 6 years of education and college is composed of 5 years.

With regard to employer characteristics, we focus on variables such as economic activity, firm type, firm size, contract type, and health coverage. All three countries classified their economic activities mainly based on to the International Standard Industrial Classification ISIC (Rev. 3 to two digits). Thus, we can aggregate economic activities into broad groups. The firm type is either private or public; the firm size breaks down into firms that employ between two to ten workers or more than eleven. We also classify workers as those who do or do not have a written contract, as well as those who do or do not have health coverage paid by their employers.

Finally, we keep the main states (cities in Colombia) and add the small ones into a group by each country.[21] The sample of workers for econometric estimation is selected according to the following criteria: workers aged 18-65, work at least 20 hours per week in urban areas, are not be self-employed, and do not work in agricultural jobs.

5. Empirical results

5.1 Employment patterns

[21] For Brazil, we keep Sao Paulo and Rio de Janeiro. For Mexico we keep Mexico D.F., Guadalajara, Monterrey, and Puebla. For Colombia we keep Bogota, Medellin, Barranquilla, and Cali. For Argentina, we keep Buenos Aires, Cordoba, Rosario, Mendoza, and Tucuman.

Labour markets in Latin America have faced important changes coming from labour supply and labour demand. In Table 1 we present employment changes by educational attainment, industry composition, firm type, formal contracts, and health coverage during the 2000s. We present the employment share and their absolute variation by category and country. One of the most relevant changes in terms of the composition of the workforce is the higher levels of educational attainment for all countries. Workers with some college or more grew about 5 percentage points in Argentina, 6 percentage points in Brazil, 10 percentage points in Colombia, and 9 percentage points in Mexico.[22]

In terms of the composition of industrial employment, we report that during the 2000s the manufacturing sector was negatively affected in Brazil, Colombia, and Mexico. In particular, employment share from food, textiles, and wood industries fell by more than 3 percentage points in Colombia and Mexico, and by more than 2 percentage points in Brazil. Likewise, employment in education and health sectors reported lower weights. By contrast, sectors such as water, energy, construction, hotels, restaurants, and transportation increased their capacity as employers for all countries. The trade and communal and personal services remain as the sectors with the highest share in total employment without relevant changes.

Additional patterns with potential effects on wages are the employment size of the private sector and the share of workers with better labour conditions. According to the table, public employment fell in all countries. Argentina and Colombia exhibited higher variations. Then again, workers either with a formal contract or with health coverage increased their share in total employment for all countries except Mexico. The reasons for this in Mexico are beyond the aim of this chapter, but we could think about specific patterns of economic growth that worsen labour conditions.

5.2 Returns to schooling

Once we have identified the main changes in the labour markets, we move to study the returns to education. In Table 2 we present the OLS estimates of the marginal effect of a year of schooling on wages by country and year. According to the results, the average return to education at the beginning of the decade was about 6% for Argentina, 11% for Brazil, 10% for Colombia, and 7% for Mexico. To document how returns to education differ across quantiles, we plot the marginal effect of educational levels in Figure 1. Results indicate that schooling has an increasing effect along wage distribution. In Table 3 we present estimates and confidence intervals for particular percentiles. According to our sample, Argentina shows the lowest return at the 10th percentile with about 4.5%, while Brazil exhibits the highest at the 90th percentile with about 14% at the beginning of the decade.

In order to study how the marginal effect of covariates varies across distribution, we display in Table 4 the estimations of the marginal effects at median for others worker characteristics, firm characteristics, and job characteristics. In this case, we use educational levels instead of years of schooling. The category of reference for the marginal effects of education is the primary level. We present the median coefficient estimated from QR in columns by country and year. The results show that most of the coefficients are statistically significant and have the expected signs.

[22]Based on Barro and Lee (2012) database we found that the average years of schooling for population over 15 years old is 8.45 with and increased about 1.01 since 2000 for the countries selected. This is equal to the average and the variation for the 25 Latin American and Caribbean countries.

As a general pattern across countries, the marginal effects at median also increase as we go to higher categories in education, age, and by bigger firms, formal contracting, and health coverage in regards to the reference group. At the beginning of the decade, the manufacturing of chemical products and machinery appears with the highest wage gap in all countries. Likewise, workers in the private sector have lower wages than public employees and workers with written contracts earn more than 5 percentage points more than those without contracts. A remarkable result is the wage gap between workers covered and not covered by a health system. For Argentina, Brazil, and Colombia, the gap is more than 17 percentage points.

As previous literature has suggested, returns to education has declined on average and at median (Table 2 and 3). The drops are statistically significant. The decreasing in the returns to education in the presence of educational upgrading is not novel in literature. Bourguignon et al. (2005) documented the same pattern for Brazil, Taiwan, and China during the 1980s and late 1990s. They suggest the convexity of earnings function with respect to education as the explanation. In this case, the drop in returns would reflect a substantial equalization in the distribution of the years of schooling.

To test the statistical significance of differences in marginal effects we present in Table 5 the results of inter-quantile regression. Results are for the interdecile wage gap. According to Melly (2005), if the difference between the 90th percentile and the 10th percentile coefficient on a covariate is positive, a higher value of this variable increases within-group inequality. The results show that for the four countries education increases within-group wage inequality, while written contract and health coverage decreases it. For almost all countries the difference in marginal effects is bigger for the case of health coverage. This highlights the potential distributional effects of a policy of job formalization.

5.3 Changes in marginal effects overtime

The fall in inequality comes from two sources. On the one hand, inequality could decrease as between group inequality falls. That is, if the gap between marginal effects across categories goes down over time. We studied this trend by looking at the differences in median coefficients. On the other hand, inequality can also drop as within-group inequality declines. We study this effect by analysing the evolution of coefficients from inter-quantile regressions by factors. Next, we present the results in each case.

In Table 6 we show changes in the marginal effects at median during this period. According to the table, there was a statistically significant fall in marginal returns to education for almost all countries. In Argentina the drop was only significant for the most educated, while in Colombia the drop was not significant for this group. The drop is in line with evidence for the mean provided in the previous section and in related literature (Gasparini, 2011 and Lustig, 2013). Additionally, for Brazil and Colombia, the decline in returns at median for written contracts was also significant. The between gap by health coverage was only significant for Brazil.

Coming back to Table 3, we observe that returns at the 10th percentile fall for all countries from the beginning of the decade to 2010. Changes in the upper part exhibited different trends. Returns fell only for Brazil and Argentina, remained the same for Colombia, and increased for Mexico. In Table 7 we test whether changes in the interdecile regression coefficients are statistically significant. According to the previous results, the effect of education on within-group wage inequality decreased by the tertiary level in Brazil and Argentina, increased by Colombia,

and did not alter by Mexico.

5.4 Counterfactual distributions and inequality measures

In Table 8 we present results of the effect of schooling and job informality measures on wage inequality in counterfactual scenarios. The first two rows show Gini coefficients drawn from the conditional marginal density estimated by QR. The following rows relate Gini coefficients from conditional marginal densities obtained from hypothesized distributions of education, written contracts, and health coverage. Such densities were estimated by maintaining the distribution of the covariates as in the first year. The table also presents confidence intervals to test whether or not differences in Gini coefficients are statistically significant.

According to the results, wage inequality fell during the period with changes statistically significant for all countries. But what would have happened with inequality if the composition of the workforce by educational levels had not change? Our estimations suggest that the Gini coefficient among wage earners would have been lower than those observed in 2010 for Brazil, Mexico, and Argentina. This means that education upgrading for these countries had an unequalizing quantity effect on wage inequality. So, a greater share of workers with higher levels of education tends to increase inequality. In the case of Colombia, no change was observed.

An opposite composition effect on inequality was found in the case of written contract and health coverage. In fact, higher levels of inequality are reported for the two measures of job informality for all countries in their counterfactual scenarios. This means that both a higher proportion of workers with written contracts and with health coverage had equalizing effects on wage inequality in Argentina, Brazil, and Mexico.[23] The effect of formally contracting for Brazil appears to be a little bit stronger than the effect of health coverage, while the contrary happens for Argentina and Colombia.

However, the composition effect is just one component of the changes in inequality. To have a general picture, we plot in Figure 2 the results from the decomposition exercise based on the Machado and Mata (2005) methodology. The graph shows the wage gap drawing from estimated conditional densities. It also shows the part explained by changes in the distribution of covariates and the part due to changes in the distribution of coefficients through distribution. The general pattern across countries is that changes in wage inequality were mainly driven by changes in coefficients. This result links to the declining trend in marginal returns at the median reported in previous section.

In Table 9 we present the decomposition results in counterfactual scenarios. In the first column we display the total variation in wage inequality in the Gini coefficient. In columns (2) and (3) we present the part explained by changes in the distribution of covariates and the part explained by changes in the distribution of coefficients, respectively. Evidence for the inter-decile wage gap is presented from column (4) to column (6). According to this, patterns in the distribution of coefficients (or returns) led to changes in wage inequality. The differences in the part explained by coefficients across countries depends, in this case, on the direction and on the magnitude of the compositional changes.

Finally, in Figure 3 we plot the decomposition results for the case of education, written contract,

[23] Mexico is the only country where job informality increased during the period. So the result for this country is contrary to the expected. Both effects are, however, smaller than the effects for the other countries.

and health coverage. Two important patterns are found. First, the composition effect of education on wage gap is more important at higher percentiles of the wage distribution than at lower ones for all countries. Second, the effect of written contract and health coverage, in contrast, seems to be more relevant at lower percentiles than at higher percentiles. This supports some of the indirect evidence of the potential effect on wage distributions of programmes designed for formalised workers.

6. Concluding remarks

Important labour market changes with potential distributional effects have been observed in Latin America in the last decade. The increase, on average, of years of education (Barro and Lee, 2012) and the decrease in job informality in some economies (Berg, 2010; ILO, 2011; and Maurizio, 2014) are some of the main features reported. In this paper we study the distributional effects of changes in both years of schooling and job informality levels on wage inequality for Brazil, Mexico, Colombia, and Argentina from 2001 to 2010. We use semi-parametric techniques to estimate marginal effects of education, written contract, and health coverage in different parts of wage distribution. We use the algorithm proposed by Machado and Mata (2005) to decompose changes in wage gap into changes in the distribution of covariates and changes in the distribution of coefficients.

According to the results, the returns to schooling increase as we move from lower quantiles to higher quantiles, boosting wage inequality. During this period these returns fall not only at mean but also at the first and last decile. We found that having a written contract or being covered by a health system implies a positive wage gap at median in regards to the respective reference group. The decomposition results suggest that the changes in the distribution of coefficients explain more the fall in inequality rather than the changes in distribution of covariates. In this latter case, we found differentiated effects of schooling and job informality on wage inequality. While the more equal distribution of education had an un-equalizing (composition) effect on wage distribution, both the higher share of workers with written contracts and the greater proportion of workers covered by a health system were associated with lower levels of inequality in Argentina, Brazil, and Colombia.

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Table 1. Employment patterns in Latin America 2001-2010 (1)

	Argentina		Brazil		Colombia		Mexico	
	2003	Δ	2001	Δ	2002	Δ	2001	Δ
Education								
Primary or less	29.1	-8.3	19.6	-7.5	16.1	-3.8	22.1	-4.4
High school dropouts	18.5	-2.2	27.6	-6.3	19.4	-5.5	43.6	-7.5
High school	19.5	4.7	33.4	7.7	33.1	-1.4	12.2	2.2
Some college	13.8	2.4	7.2	2.2	13.1	9.7	4.6	8.8
College or more	19.1	3.3	12.2	3.8	18.3	1.0	17.6	0.8
Industry								
Manuf. food, textil	7.5	-0.3	10.3	-2.0	15.4	-3.3	13.3	-3.8
Manuf. chemical, machinery	7.4	0.6	10.5	-0.8	10.0	-1.1	13.4	-1.5
Water, energy, construction	5.2	1.1	8.0	0.7	6.0	0.7	6.7	2.7
Trade and repair	14.8	0.1	18.4	1.3	19.1	0.1	16.3	1.1
Hotel, rest., transport	10.3	1.7	10.2	2.2	12.8	2.6	13.0	1.6
Education, health	19.0	-3.6	17.1	-1.6	15.1	-0.2	13.1	-0.8
Other services	35.8	0.5	25.5	0.1	21.6	1.1	24.2	0.7
Type of firm								
Private	74.8	6.3	76.4	1.8	87.9	3.7	79.6	1.5
Contract								
Written contract	80.4	6.8	68.4	8.5	65.4	8.7	72.3	-4.0
Social security affiliation								
Health Coverage	62.0	13.6	67.3	8.5	77.2	5.6	69.3	-3.6

(1) Urban wage-earners workers who are between 18 and 65 years old not working in agricultural activities. Source: Household surveys. Δ refers to changes between initial year and the final year (2011 for Brazil and 2010 for the others). All calculations use sample weights.

Table 2. Returns to education. OLS estimation (1)

	2001(2)	95% C. I.		2010(3)	95% C. I.	
Argentina	0.065***	0.060	0.071	0.057***	0.052	0.061
	24.06			25.6		
Brazil	0.117***	0.115	0.118	0.088***	0.087	0.090
	169.4			125.4		
Colombia	0.101***	0.097	0.105	0.089***	0.085	0.092
	49.8			52.5		
Mexico	0.073***	0.071	0.075	0.068***	0.065	0.070
	74.3			51.0		

(1) Workers who are between 18 and 65 years old. Source: Household surveys. (2) For Argentina estimates are for 2003 while for Colombia and Mexico are for 2002. (3) Estimates for Brazil are for 2011. t-statistics below coefficients. *** p<0.05; ** p<0.10. Robust standard errors. Constant: Age 18-29, Experience 0-11, Primary or less, Commerce, Public sector, Firm with 2-5 employees, without contract, Sales, without health coverage, Rio de Janeiro, Mexico D.F., Bogota, and Buenos Aires respectively. We control by age and gender. All calculations use sample weights.

Table 3. Quantile regression coefficients (1)

	2001(2)						2010(3)					
	10th	**95% C. I.**		**90th**	**95% C. I.**		**10th**	**95% C. I.**		**90th**	**95% C. I.**	
Argentina	0.045***	0.038	0.051	0.080***	0.074	0.085	0.054***	0.049	0.058	0.057***	0.052	0.062
	13.9			28.2			24.75			21.1		
Brazil	0.117***	0.075	0.080	0.149***	0.147	0.151	0.054***	0.052	0.056	0.111***	0.109	0.113
	63.4			137.1			50.4			104.8		
Colombia	0.071***	0.069	0.074	0.106***	0.103	0.109	0.066***	0.062	0.070	0.106***	0.102	0.110
	51.2			68.5			31.9			55.7		
Mexico	0.053***	0.051	0.055	0.082***	0.081	0.083	0.048***	0.046	0.050	0.086***	0.084	0.088
	52.2			125.7			43.8			72.78		

(1) Workers who are between 18 and 65 years old. Source: Household surveys. (2) For Argentina estimates are for 2003 while for Colombia and Mexico are for 2002. (3) Estimates for Brazil are for 2011. t-statistics below coefficients. *** p<0.05; ** p<0.10. Robust standard errors. Constant: Age 18-29, Experience 0-11, Primary or less, Commerce, Public sector, Firm with 2-5 employees, without contract, Sales, without health coverage, Rio de Janeiro, Mexico D.F., Bogota, and Buenos Aires respectively. We control by age and gender.

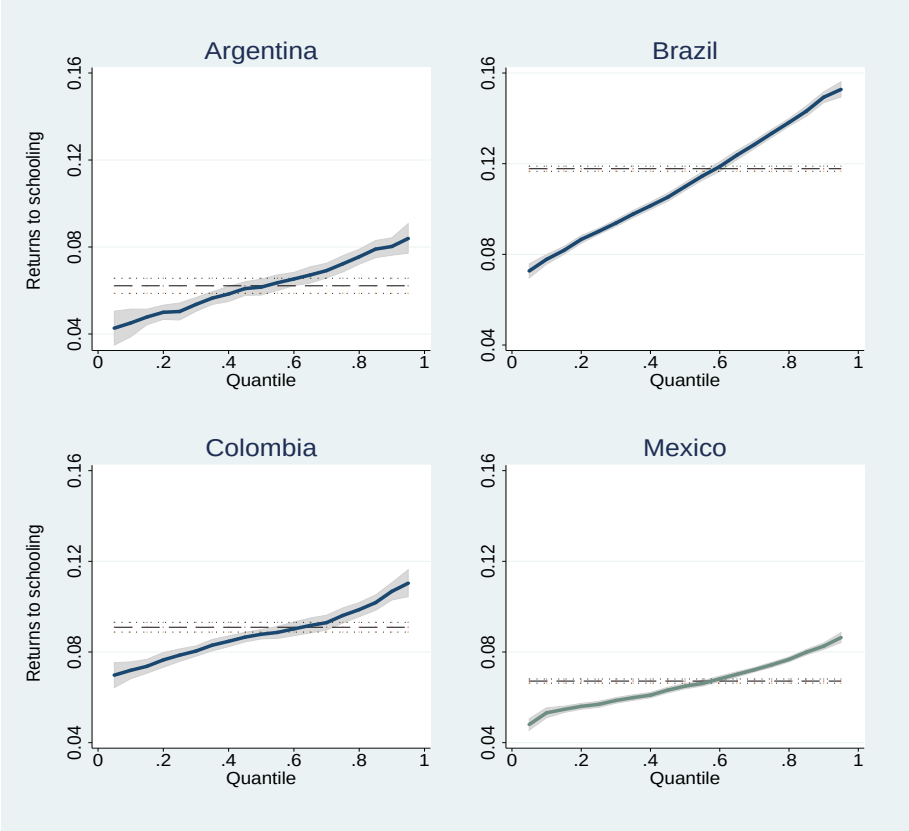

Figure 1. Returns to years of schooling along wage distribution.

Note: Estimations from workers who are between 18 and 65 years old. Source: Household surveys. Estimates for Argentina are for 2003, for Brazil for 2001, and for Mexico and Colombia are for 2002.Controls include age, gender, experience, industry, type of firm, size of firm, written contract, health coverage, and regions. The horizontal dashed black line indicates the average return to education.

Table 4. Median Regression Coefficients (1)

	Argentina		Brazil		Colombia		Mexico	
	2003	**2010**	**2001**	**2011**	**2001**	**2010**	**2002**	**2010**
High school drop.	0.03	0.07***	0.24***	0.15***	0.10***	0.05***	0.17***	0.11***
	1.2	2.3	34.1	24.6	9.8	5.0	26.6	13.3
High school	0.27***	0.21***	0.56***	0.34***	0.25***	0.16***	0.32***	0.23***
	10.3	8.4	66.7	46.3	23.3	15.5	35.3	23.3
Some college	0.50***	0.34***	1.07***	0.67***	0.49***	0.37***	0.48***	0.37***
	14.2	10.8	74.5	60.3	29.4	30.0	32.6	36.9
College or more	0.75***	0.62***	1.61***	1.21***	1.10***	1.09***	0.94***	0.75***
	20.0	22.0	108	84.0	49.0	63.0	88.0	63.0
Manuf food, text	0.10***	0.05	-0.02***	0.00	0.03***	0.01	0.10***	0.06***
	2.6	1.9	-2.1	0.7	3.4	1.7	11.0	5.3
Manuf chem, mach	0.18***	0.14***	0.14***	0.16***	0.10***	0.09***	0.21***	0.13***
	4.4	6.0	15.4	18.6	7.4	9.0	24.8	12.5
Water, ener, const	0.18***	0.12***	0.07**	0.11***	0.08***	0.15***	0.23***	0.30***
	3.2	3.2	7.9	14.1	3.8	13.5	23.9	26.4
Hotel, rest, transp	0.09***	-0.01	0.08***	0.06***	-0.06***	-0.02	0.07***	0.04***
	2.4	-0.5	9.5	8.1	-4.7	-1.7	8.2	4.4
Education,health	0.12***	0.12***	0.08***	0.05***	0.11***	0.08***	0.26***	0.25***
	3.1	4.7	8.8	5.5	7.2	5.5	24.5	26.6
Other services	0.15***	0.07***	0.11***	0.11***	0.07***	0.06***	0.09***	0.06***
	4.2	2.7	13.2	18.1	6.9	7.2	11.4	7.4
Private	-0.07***	-0.14***	-0.23***	-0.21***	-0.37***	-0.42***	-0.16***	-0.27***
	-2.5	-6.0	-21.2	-20.5	-23.0	-27.7	-19.0	-31.1
11 or more	0.17***	0.12***	0.16***	0.10***	0.10***	0.08***	0.11***	0.04***
	9.0	8.3	26.1	22.7	12.5	10.3	12.8	6.0
Written contract	0.11***	0.20***	0.06***	0.05***	0.13***	0.95***	0.08***	0.12***
	3.3	4.4	3.5	3.8	16.1	15.0	8.0	11.5
Health coverage	0.33***	0.35***	0.17***	0.12***	0.18***	0.15***	0.07***	0.08***
	12.9	16.8	10.9	9.5	14.7	12.0	8.3	8.9
Constant	2.09***	2.76***	-2.63***	-2.21***	7.60***	7.88***	2.62***	2.9***
	39.3	46.6	-210	-145	262	323	174	189
n	4,057	5,760	67,396	74,800	15,418	16,978	69,800	44,848

(1) Urban wage-earners who are between 18 and 65 years old working at least 20 hours weekly in non-agricultural and non-domestic services activities. Note: t statistics below coefficients. *** $p < 0.05$; ** $p < 0.10$. Standard Errors obtained by performing 100 bootstrap replications. Constant: Age 18-29, Experience 0-11, Primary or less, Commerce, Public sector, Firm with 2-5 employees, without contract, Sales, without health coverage, Rio de Janeiro, Mexico D.F., Bogota, and Buenos Aires respectively. We rule out domestic service and control by age and gender

Table 5. Interdecile Regression Coefficients (1)

	Argentina		Brazil		Colombia		Mexico	
	2003	**2010**	**2001**	**2011**	**2002**	**2010**	**2001**	**2010**
High school drop.	0.08	-0.01	0.14***	0.13***	0.01	0.05	0.13***	0.06***
	1.2	-0.2	10.8	12.0	0.5	1.6	10.8	3.0
High school	0.12	0.05	0.47***	0.36***	0.11***	0.11***	0.26***	0.18***
	1.6	1.0	25.4	27.5	3.5	4.4	15.1	8.4
Some college	0.20***	0.11	0.66***	0.67***	0.32***	0.32***	0.37***	0.31***
	2.6	1.6	21.7	37.1	7.5	10.2	14.4	14.2
College or more	0.48***	0.20***	1.21***	1.14***	0.57***	0.77***	0.46***	0.50***
	6.9	2.9	44.5	48.8	13.4	21.0	22.7	18.3
Manuf food, text	0.08	0.01	-0.05***	-0.10***	-0.04	-0.03	-0.10***	-0.13***
	0.9	0.2	-2.7	-4.0	-1.5	-1.2	-5.1	-6.0
Manuf chem, mach	0.03	0.01	-0.00	0.04***	-0.08**	0.05	-0.11***	-0.10***
	0.4	0.1	-0.3	3.0	-2.0	1.8	-5.7	-4.6
Water, ener, const	0.30***	-0.04	-0.08**	0.01	-0.05	0.01	-0.11***	-0.11***
	2.1	-0.6	-4.0	0.5	-1.0	0.2	-4.9	-5.1
Hotel, rest, transp	0.19***	0.13***	-0.01	0.01	0.07***	0.12***	0.09***	0.03
	2.0	2.4	-0.6	0.5	2.4	4.7	6.1	1.7
Education,health	-0.20***	-0.03	-0.10***	-0.05***	0.02***	-0.02	0.01	-0.02
	-2.5	-0.5	-5.4	-3.6	0.6	0.7	0.6	-0.8
Other services	0.08	0.12***	0.07***	0.08***	0.11***	0.10***	0.16***	0.11***
	1.0	2.2	3.9	6.9	3.4	3.4	7.9	6.2
Private	0.24***	-0.03	-0.10***	-0.19***	0.08***	0.06***	0.23***	0.08***
	4.4	-0.5	-5.6	-9.9	3.4	2.2	14.3	3.9
11 or more	0.06***	-0.07	-0.10***	0.08***	0.03	-0.03	0.15***	0.04***
	-1.5	-2.8	4.8	8.0	1.2	-1.1	8.1	2.9
Written contract	-0.06	-0.18	-0.09***	-0.08***	-0.23***	-0.24***	0.01	-0.08***
	-0.6	-1.7	-3.4	4.4	-7.6	-7.4	0.4	-4.4
Health coverage	-0.05	-0.25***	-0.24***	-0.24***	-0.36***	-0.21***	-0.19***	-0.07***
	-1.2	-4.6	-8.6	-11.1	10.1	-6.9	-9.6	-3.7
Constant	0.94***	1.46***	1.17***	1.06***	1.34***	1.07***	0.86***	0.97***
	6.2	11.1	35.2	39	21.6	18.3	25.6	21.1
n	4,057	5,760	67,396	74,800	15,418	16,978	69,800	44,848

(1) Urban wage-earners who are between 18 and 65 years old working at least 20 hours weekly in non-agricultural and non-domestic services activities. Note: t statistics below coefficients. *** $p < 0.05$; ** $p < 0.10$. Standard Errors obtained by performing 100 bootstrap replications. Constant: Age 18-29, Experience 0-11, Primary or less, Commerce, Public sector, Firm with 2-5 employees, without contract, Sales, without health coverage, Rio de Janeiro, Mexico D.F., Bogota, and Buenos Aires respectively. We rule out domestic service and control by age and gender

Table 6. Changes in marginal effects. Median regression coefficients

	Argentina	**Brazil**	**Colombia**	**Mexico**
	$\Delta\beta_{0.5}$	$\Delta\beta_{0.5}$	$\Delta\beta_{0.5}$	$\Delta\beta_{0.5}$
High school dropouts	0.03	-0.09***	-0.09***	-0.07***
High school	-0.06	-0.22***	-0.24***	-0.09***
Some college	-0.16***	-0.41***	-0.48***	-0.11***
College or more	-0.13***	-0.40***	-1.07	-0.19***
Private	-0.07	0.02	0.39	-0.12***
11 or more	-0.05	-0.01	-0.10	-0.07***
Written contract	-0.09	-0.06***	-0.12***	0.03
Health Coverage	-0.03	-0.05***	0.17	0.00

Note: Δ refers to change in coefficients during period. *** $p < 0.05$

Table 7. Changes in marginal effects. Interdecile regression coefficients

	Argentina	**Brazil**	**Colombia**	**Mexico**
	$\Delta\beta_{(0.9-0.1)}$	$\Delta\beta_{(0.9-0.1)}$	$\Delta\beta_{(0.9-0.1)}$	$\Delta\beta_{(0.9-0.1)}$
High school dropouts	-0.10	0.00	0.03	-0.07***
High school	-0.07	-0.11***	0.00	-0.07***
Some college	-0.09	0.01	0.00	-0.05
College or more	-0.29***	-0.07***	0.20***	0.04
Private	-0.27	-0.09***	-0.02	-0.14***
11 or more	-0.03	0.02	-0.05***	-0.11***
Written contract	-0.11	0.01	-0.01	-0.09
Health Coverage	-0.20	0.00	0.15***	0.11

Note: Δ refers to change in coefficients during period. *** $p < 0.05$

Table 8. Gini coefficients obtained by counterfactual distributions (1)

	Argentina				Brazil				Colombia				Mexico			
	Gini	**S.E.**	**[95% C.I.]**		**Gini**	**S.E.**	**[95% C.I.]**		**Gini**	**S.E.**	**[95% C.I.]**		**Gini**	**S.E.**	**[95% C.I.]**	
Estimated																
2001	0.373	0.000	0.373	0.374	0.464	0.000	0.464	0.465	0.422	0.000	0.421	0.423	0.378	0.000	0.377	0.378
2010	0.332	0.000	0.331	0.333	0.384	0.000	0.384	0.385	0.403	0.000	0.402	0.403	0.362	0.000	0.362	0.362
Counterfactuals																
Education	0.325	0.001	0.323	0.326	0.362	0.001	0.361	0.363	0.403	0.001	0.402	0.403	0.356	0.001	0.355	0.357
Written contract	0.338	0.001	0.337	0.338	0.395	0.002	0.393	0.398	0.409	0.001	0.407	0.410	0.365	0.001	0.363	0.366
Health coverage	0.346	0.001	0.345	0.347	0.386	0.001	0.385	0.387	0.410	0.001	0.408	0.412	0.366	0.001	0.364	0.368

(1) Estimated refers to Gini calculated from the wage distributions obtained from the QR. Counterfactual refers Gini calculated from the wage distribution obtained from a counterfactual scenarios in which the distribution of each covariate was maintained as in the first year. Standard Errors obtained by performing 100 bootstrap replications

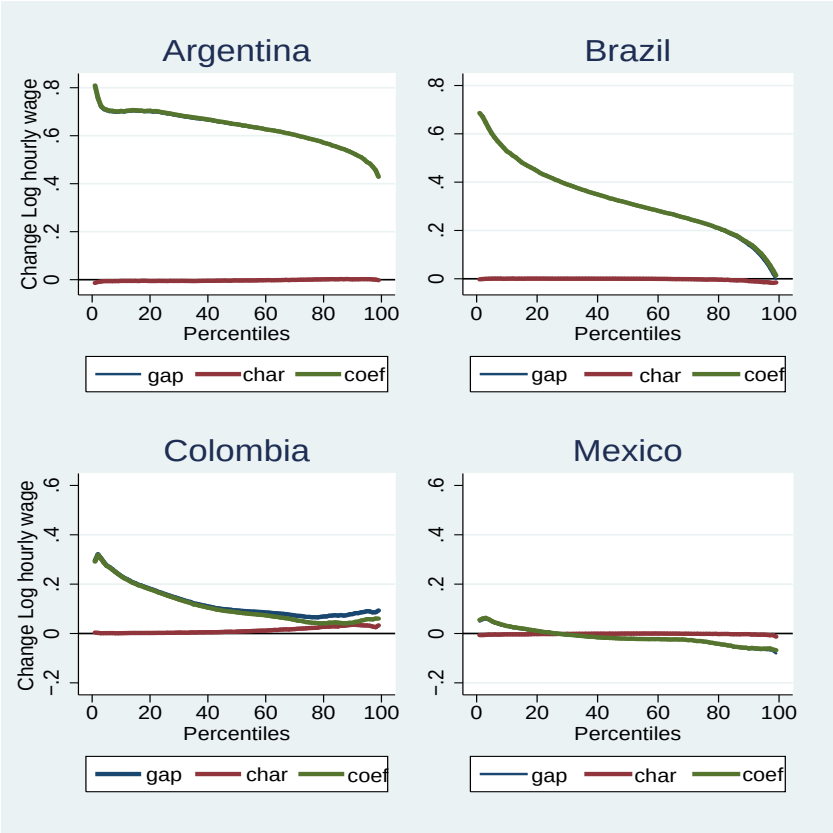

Figure 2. Decomposition of differences in wage distribution.
Note: Estimations based on Machado and Mata (2005)

Table 9. Decomposition of changes in inequality measures(1)

	Gini			90/10		
	Total	**Char.**	**Coeff.**	**Total**	**Char.**	**Coeff.**
	(1)	(2)	(3)	(4)	(5)	(6)
Argentina						
Education	-0.042	0.003	-0.045	-0.120	0.020	-0.140
Written contract	-0.042	-0.010	-0.032	-0.120	-0.065	-0.055
Health coverage	-0.042	-0.017	-0.025	-0.120	-0.097	-0.023
Brazil						
Education	-0.081	0.022	-0.103	-0.391	0.084	-0.475
Written contract	-0.081	-0.011	-0.070	-0.391	-0.067	-0.324
Health coverage	-0.081	-0.002	-0.079	-0.391	-0.006	-0.385
Colombia						
Education	-0.015	0.002	-0.017	-0.155	0.008	-0.163
Written contract	-0.015	-0.004	-0.011	-0.155	-0.024	-0.131
Health coverage	-0.015	-0.005	-0.010	-0.155	-0.017	-0.138
Mexico						
Education	-0.016	0.006	-0.022	-0.087	0.062	-0.149
Written contract	-0.016	-0.003	-0.013	-0.087	-0.001	-0.086
Health coverage	-0.016	-0.004	-0.012	-0.087	-0.030	-0.056

(1) Results based on Machado and Mata (2005) methodology. Total refers to the estimated total change in wage inequality; Comp refers to the part explained by changes in the distribution of covariates, and Coeff refers to the part explained by changes in coefficients or prices. By rows, we maintain the distribution of each covariate as in the first year and we assume that the rest were distributed as in 2010 and were all paid as in 2010.

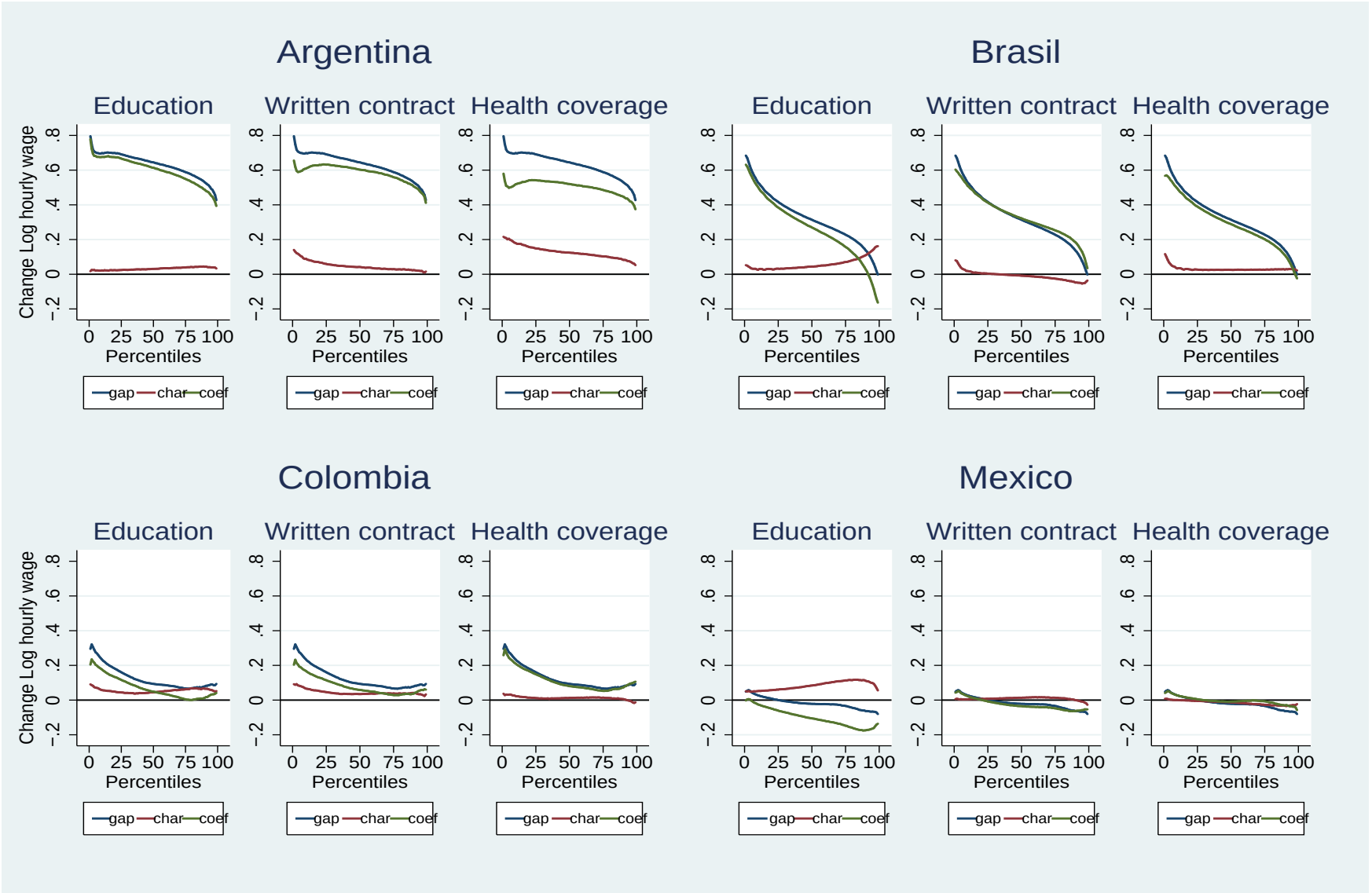

Figure 3. Decomposition of wage gap along distribution. Estimations based on Machado an Mata (2005) methodology.

Appendix B. Decomposing changes in wage distributions. Machado and Mata methodology (2005)

The Machado and Mata (2005) methodology states the follow:

Let $w(t)$, $X(t), t = 2001, 2010$ denote wages and covariates at time t.
Let $g(X, t)$ the joint density of the covariates at time t.
Let $z(t)$ one particular covariate of interest at time t.
Let $f(w(t))$ an estimator of the marginal density of wages at t of the observed sample
Let $f^*(w(t))$ an estimator of the marginal density of wages at t of the generated sample
Let $f^{**}(w(2010); X(2001))$ the counterfactual densities that would result in t=2010 if all covariates had their distributions in 2001.
Let $f^{**}(w(2010); z(2001))$ the counterfactual densities that would result in t=2010 if only one covariate were distributed as 2001.

A. The algorithm proposed to the marginal densities implied by the conditional model f(w$^*(t)), is$:

1. For data set at time t, estimate by quantile regression $\hat{\beta}_t(\theta)$ for a grid of values $\theta = 0,01, 0,99$
2. Generate a random sample $X^*(t)$of size m with replacement from the rows of $X(t)$.
3. Multiply each $\hat{\beta}_t(\theta)$ by each $X^*(t)$ in year t generating N*m fitted values of $\hat{w}^*(\hat{\beta}_t, X_t^*)$. The empirical conditional distribution function of these values is the desired distribution.

B. To estimate $f^{**}(w(2010); X(2001))$, the methodology proposes:

1. Follow the previous algorithm but in the second step drawing the bootstrap sample from the rows of $X(t = 2001)$

C. To estimate $f^{**}(w(2010); z(2001))$, the methodology states:

1. Take a covariate of interest (z) and divide its space into j classes.
2. Select the subset of the random sample for $j = 1$ from the 2010 estimated marginal density.
3. Generate a random sample equal to the number of observations for $j = 1$ in 2001 from the subsample for $j = 1$ in 2010.
4. Repeat step 3 for $j = 2...J$.

D. To decompose the changes in the distribution of wages $f(w(2010)) - f(w(2001))$, the methodology compares:

The contribution due to changes in the coefficients $f^*(w(2010); X(2001)) with f^*(w(2001))$ with the contribution due to changes in the distribution of the covariates $f^*(w(2010))$ with $f^*(w(2010); X(2001))$. For an individual covariate, the contribution is $f^*(w(2010)) - f^*(w(2010); z(2001))$.

If we let $\alpha(.)$ be an inequality measure, by estimating $\alpha f(w(2010)) - \alpha f(w(2001))$ we can decompose its changes.

Chapter III

Skills, jobs and earnings in Latin America: A task-based approach[24]

Abstract

In this paper, we study the employment patterns in high-skilled and low-skilled jobs in urban labour markets in Brazil, Mexico, and Colombia. By considering a task-based approach, we analyse where, in the distribution of skills and for what type of occupations, employment has grown in the last decade. We also test whether the employment patterns can be explained by the routinization hypothesis. Our results suggest that employment fell strongly for some middle-skilled occupations such as secretaries, machinery operators, and handicrafts, and increased mildly for both low-skilled and high-skilled occupations. According to the decomposition results, changes in the share of employment for routine cognitive occupations such as secretaries and stenographers are fully explained by changes within industries, as the routinization hypothesis has stated. However, employment changes in routine manual jobs such as machinery operators and handicrafts are less related to the routinization hypothesis.

Key words: Job polarization, Technical change, Wage inequality
Journal of Economic Literature Classification: E24, J24, J31

1. Introduction

Recent theoretical developments have proposed models where the rapid adoption of computer technologies has changed the tasks performed by workers at their jobs.[25] The task-based approach presented by Autor, Leavy, and Murnane (ALM) in 2003 argues that technological changes have resulted in the substitution of routine tasks by computers and other machines (routinization hypothesis). According to this framework, as the price of computer capital falls, the demand for workers who perform routine activities decreases, and the demand for workers who perform non-routine activities climbs. The authors assumed that routine tasks can be substituted by technology, and non-routine cognitive tasks are complementary, while non-routine manual tasks are not directly affected by technical changes. The main implication of this model is that, as a result of technological advances, employment and wages can grow in different areas of the distribution of skills and not only in the upper part, as the Skill-Biased Technological Change (SBTC) predicts.

[24]This paper was accepted to the III International Tasks Conference: Changing Tasks−Consequences for Inequality.

[25]The idea for these kinds of models is straightforward. Workers are endowed with various skills that they use to perform tasks in order to obtain output. A range of tasks can be codified to be executed by computers or other machines. This particular set of tasks is called "routine". Record-keeping, calculations, and repetitive assembly tasks are some examples. By contrast, forming and testing hypotheses, managing personnel and driving trucks are defined as "non-routine" tasks. The literature also distinguishes between cognitive and manual tasks within routine and non-routine classifications.

The employment pattern where relative employment grows in both well-paid skilled jobs and low-paid skilled jobs, but decreases for jobs requiring a medium level of skills is called job polarization (Goos and Manning, 2007). Besides the routinization hypothesis for job polarization, there are two additional explanations for job polarization. One deals with the impact of globalization (off-shoring), while the other relates to the increasing demand for services in advanced economies (Goos et al., 2009). In the first case, job polarization can also be explained by trade patterns and changes in the structure of international production. In the second case, it is linked to changes in the sectorial composition of demand along the economic development process.

Empirical evidence of the polarization of employment in the US is provided by Autor et al. (2003, 2006, 2009), and Acemoglu and Autor (2011). In the case of the UK and Germany, evidence is provided by Goos and Manning (2007), Spitz-Oener (2006), and Dustmann et al., (2009), while for 14 European OECD countries, it is documented by Goos et al. (2009). These studies analyse changes in the demand for skills not only among occupations but also within them. Thus, they study changes in skill requirements in the extensive and in the intensive margins. Job polarization has important distributive effects on wages, since both employment and wages grow in the upper and lower part of the skills distribution relative to the middle part, leading to an increase in wage dispersion. Evidence for developed countries suggests a strong relationship between employment polarization and increasing wage inequality during the 1980s and the 1990s.

In Latin America, evidence of job polarization is scarce. In particular, the role of the demand for skills in labour markets in the region has always been concentrated on the analysis of the wage gap between two (or three) groups of skilled and unskilled workers. In particular, models such as the one proposed by Katz and Murphy (1992) have been widely used to test the role of supply and demand factors for different countries by different periods. Empirical evidence of the role of the demand for skills under this framework can be found for Mexico in Montes-Rojas (2006), for Colombia in Santamaria (2004), and for the region in Gasparini et al. (2011). Beyond a recent fall in the returns of tertiary education for several countries in Latin America, we do not know anything more about the demand for skills in the region.

The main contribution of this paper is to provide empirical evidence concerning the role of the demand for skills under a task-based framework in urban labour markets in Brazil, Colombia, and Mexico. We analyse where, in the distribution of skills and for what types of jobs, employment has grown in the last decade. Have labour opportunities polarised in Latin America? To what extent can employment changes be explained by the routinization hypothesis? In particular, are employment patterns in routine manual jobs explained mainly by technological changes or by changes among industries as a result, for example, of patterns in international trade? We address these questions by studying employment changes in the extensive margin, using for the first time detailed data on occupations from household surveys.

Our empirical strategy relies on two steps. First, we group occupations into six broad categories of routine and non-routine jobs, according to the framework of Acemoglu and Autor (2011); that is, non-routine analytic, non-routine interactive, routine manual, and non-routine manual. In addition, we divide routine cognitive jobs into two categories. Then we study the changes in employment sharing and wages. Second, we perform a decomposition exercise with the changes in employment at each routine and non-routine occupation between and within industries. This is highly relevant because changes in employment could be more a result of changes in industry in favour of sectors that use more abstract and manual occupations than a result of technical

changes that affect all industries. Thus, using the within-industry component allows us to test the routinization hypothesis directly. We run a regression test to examine how changes in the within-industry component account for changes in employment share by routine occupations across industries.

The paper is structured as follows. In section 2, we present a literature review of theoretical models based on the analysis of tasks. In section 3, we describe the empirical strategy and comment on the main issues in the measurement of the skill content of jobs and the decomposition technique. The data is explained in section 4. In section 5, we present the empirical results. Finally, we provide several concluding remarks in section 6.

2. Literature review

In this section, we describe the two main theoretical contributions recently proposed to account for changes in the demand for skills and their empirical evidence. On the one hand, ALM (2003) proposed a theoretical framework where the rapid adoption of computer technologies changes the tasks performed by workers at their jobs. In the model, computer capital replaces workers performing cognitive and manual tasks (that can be accomplished by following explicit rules), and complements workers in performing non-routine, problem-solving, and complex communication tasks. Empirically, they expect that industries and occupations that were initially intensive in labour input of routine tasks would exhibit relatively larger investments in computer capital as its costs declines. They find for the US that within industries, occupations, and educational groups, computerization is associated with reduced labour input of routine manual and routine cognitive tasks and with increased labour input of non-routine cognitive tasks.

A more-recent theoretical framework is provided by Acemolgu and Autor (2011). They propose a general, task-based model that explains central empirical facts observed in the US in the last two decades for which the "canonical" model could not account.[26] Empirical evidence of the SBTC in the canonical model can be found in Katz and Murphy (1992). In the new approach, the assignment of skill level to tasks is endogenous, and technical change involves the substitution of machines for certain tasks previously performed by labour. The model treats skills (embodied in labour), technologies (embodied in capital), and trade or offshoring as offering competing inputs for accomplishing various tasks. Thus, which input (labour, capital, or foreign supply via trade) is applied in equilibrium to accomplish which tasks depends on cost and comparative advantage (Acemoglu and Autor, 2011).[27]

According to Acemoglu and Autor (2011), the canonical model is a special case of this more general task-based model, implying that the model generates similar responses to changes in relative supplies and factors augmenting technical changes. In their empirical application, they test whether wages for workers with comparative advantages in either abstract or manual/service tasks in the US have increased over time in regard to wages for workers with comparative ad-

[26] That is, the significant decline in real wages of low-skill workers, the non-monotone changes in wages at different parts of the earnings distribution during different decades, the broad-based increases in employment in high-skill and low-skill occupations relative to middle-skill occupations, the rapid diffusion of new technologies that directly substitute capital for labour in tasks previously performed by moderately skilled workers, and the expanding offshoring of opportunities, enabled by technology.

[27] The equilibrium allocation of skill to tasks is determined in a continuum of tasks by two thresholds, IL and IH, such that all tasks below the lower threshold, IL, are performed by low-skill workers, all tasks above the higher threshold, IH, are performed by high-skill workers, and all intermediate tasks are performed by medium-skill workers.

vantages in routine tasks. According to their results, there was a rise in relative wages from the 1980s forward in male demographic subgroups that had initial specialization in both abstract tasks and manual/service tasks.

A large body of empirical literature documents the job polarization patterns and their relationship to technological changes in advanced economies.[28] The term job polarization was first introduced by Goos and Manning (2007) in the analysis of employment patterns in the UK from 1975 to 1999. The term refers that due to the impact of technology, relative demand increases for both well-paid skilled jobs and low-paid least-skilled jobs, and decreases for middle-skilled jobs. In their study, they found that job polarization explains one-third of the rise in the wage differential at the bottom of the distribution and one-half of the rise in the wage differential at the top. Additional evidence for the routinization hypothesis for the US is also presented in Autor et al., (2003, 2006, 2008). They show that employment and wage growth by skill percentile were positively correlated during the 1980s and 1990s. Firpo et al. (2011) also suggest a relevant role not only of technological changes and the de-unionization of the 1980s and 1990s, but also a relevant role of offshorability from the 1990s.

Concerning Germany, Spitz-Oener (2006) states that during the 1980s and the 1990s, shifts in occupations from cognitive and routine manual tasks toward analytical and interactive work were observed within occupation-education groups and within age groups. According to her results, the diffusion of computer technologies intensified such employment changes. Likewise, Dustmann et al. (2009) assert that occupations in the top of the 1980 wage distribution experienced the largest growth rates, while occupations in the middle part decreased relative to occupations at the bottom. In regard to changes in the lower part, they highlight as relevant factors episodic events such as supply shocks and changes in labour market institutions. For the most-recent period, Antonczyk et al. (2009) suggest, however, that the task-based approach cannot explain the increase in wage inequality during the period from 1999 to 2006.

Goos et al. (2009) report the polarization of labour markets for 14 OECD countries from 1993 to 2006. They found a disproportionate increase in high-paid and low-paid employment. By testing other sources of polarization, they concluded that evidence for the role of offshoring and inequality is much weaker. Additional evidence for the US, Japan, and nine European countries from 1980 to 2004 is provided by Michaels et al. (2014). According to the ALM framework, they report that industries with faster growth of ICT had greater increases in relative demand for highly educated workers and bigger falls in relative demand for workers with mid-level educations. Adermon and Gustavsson (2011) consider the case of Sweden from 1975 too 2005. They found that the routinization hypothesis is an important explanation for the job polarization observed during the 1990s and 2000s but not during the 1970s and 1980s.

Regarding Latin America, a task-based approach to study changes in wage inequality has not yet been considered. Most of the literature related to the role of the demand for skills is based on the analysis of skilled premia under the canonical framework. Studies of the roles of technological change and globalization (trade reforms and foreign direct investment) relating to specific countries during the 1990s can be found in Harrison and Hanson (1999), Feenstra and Hanson (1997), Montes-Rojas (2006), Acosta and Montes-Rojas (2006), and Santamaria (2004). Campos-Vasquezs work (2013) is the only study that suggests some job polarization for Mexico from 1996 to 2006. Thus, the main contribution of this paper involves an analysis

[28] These studies consider changes in the demand for skills in the extensive margin (between jobs) and also in the intensive margin (within jobs).

of employment and inequality changes during the 2000s using a theoretical model based on tasks.

3. Empirical strategy

3.1 Job complexity

The measure of job complexity is one of the key issues in the empirical work under the task-based framework. Such a measure allows us to construct the distribution of skills from a classification of occupations in the household surveys. Here we comment on two of the main strategies used in literature. In the seminal paper, ALM (2003) used the Dictionary of Occupational Titles (DOT) to measure the skill content of occupations. They reduced DOT variables to a subset using textual definitions of DOT as well as means of DOT evaluations from the Handbook for Analyzing Jobs. Then they translated the DOT measures into percentile values corresponding to their rank in the 1960 distribution of tasks input and studied their trends.

The DOT measures have, however, several drawbacks. In particular, as Acemoglu and Autor (2011) highlight, the DOT and its successor, the Occupational Information Network (O*NET), contain numerous potential tasks scales that made the construction of routine and routine tasks measures very difficult. Since we do not have measures of skills content for jobs in the case of US and Germany, in this paper we follow Goos et al., (2009) and we use wages by occupation as a proxy for the skill content of a job. We use the occupational data from household surveys to study changes in employment. First, we plot changes in employment share for all countries ranked by the median wage in 2002. We retain occupations that are only observed during that period. We consider 448 occupations for Brazil, 370 for Mexico, and 75 for Colombia. We also estimate a smoothed function of employment changes, as is common in literature. After that, we classify occupations into 26 broad categories comparable across countries. This is an easier way to document changes in employment structure given the differences in the national classifications.

We also estimate the regression suggested by Goos and Manning (2007) of a quadratic relationship between change in the log of employment in job j, ΔE_j, and the log initial median job in 2002, w_{j0} as follows:

$$\Delta E_j = \beta_0 + \beta_1 w_{j0} + \beta_2 w_{j}^2 0 \tag{1}$$

If changes in employment by skill percentile follow a u pattern, we should observe a negative linear term and a positive quadratic term in the estimation of equation (1). In order to link job polarization and wage inequality, we study the relationship between changes in employment and changes in wages following the approach of Autor, Katz, and Kearney (2008). We estimate equation by OLS for the next regression:

$$\Delta E_{\rho t} = \alpha_t + \beta_t \Delta w_{\rho t} + \epsilon_{\rho t} \tag{2}$$

where $\Delta E_{\rho t}$ is the variation in employment share at ρ percentile over time, and $\Delta w_{\rho t}$ is the variation in median wage at ρ percentile by occupation.

3.2 Routine and Nonroutine jobs

The classification of jobs as routine and non-routine occupations is based on Acemoglu and

Autor's (2011) proposal. The only difference is that we divide routine cognitive jobs into two categories, since there are jobs more likely to be replaced by technological advances. In particular, we expect a bigger impact of technology on occupations such as secretaries and cashiers than on jobs like street salesperson. In Table 1, we report the categories considered. According to the table, non-routine analytical occupations are dominated by professionals and technicians; non-routine interactive occupations are related to managers; routine cognitive 1 relates to secretaries, stenographers, cashiers, telephone switchboard operators; routine cognitive 2 refers to other clerks and sales; routine manual jobs are production craft, repair, and operators; and finally non-routine manual occupations are protective services, food preparation, cleaning services, and personal care.

In order to test whether the changes in total employment of non-routine and routine occupations are due to the effect of technical changes (and are not the result of changes in the composition of industry toward sectors that use more abstract or manual occupations), we decompose these changes by each type of occupation between and within industries. We follow Acemoglu and Autor (2011), and we perform a standard shift-share decomposition of the change in the overall share of employment in occupation j over time interval as follows:

$$\Delta E_{jt} = \sum_k \Delta E_{kt}\lambda_{jk} + \sum_j \Delta\lambda_{jkt}E_k \tag{3}$$

$$\equiv \Delta E_t^B + \Delta E_t^W \tag{4}$$

where the change in the overall share of employment ΔE_{jt} can be decomposed in equation (4) into the part attributable to changes in industry composition ΔE_t^B, and the part attributable to within-industry shifts ΔE_t^W. The change in industry $k's$ employment share during time interval t is given by $\Delta E_{kt} = E_{kt1} - E_{kt0}$. average employment share of industry k over the sample interval is given by $E_k = (\Delta E_{kt1} + E_{kt0})/2$. The change in occupation $j's$ share of industry k employment during time interval t is given by $\Delta\lambda_{jkt} = \lambda_{jkt1} - \lambda_{jkt0}$. The occupation js average share of industry k employment during that time is $\lambda_{jk} = (\lambda_{jkt1} + \lambda_{jkt0})/2$. We use the changes in employment share by routine and non-routine occupations and the results of their within-decomposition component for each industry, year, and country to construct a panel and test the correlation in both components.[29]

4. Data

The empirical analysis is based on employment and wage data from household surveys. See the data appendix for details. The information on economic activities is classified according to the International Standard Industrial Classification ISIC (Rev. 3 to two digits). We consider only urban wage-earner workers who are between 18 and 65 years old. We keep urban areas that can be observed throughout the period. We rule out workers who do not report earnings as well as those who work in the agriculture and mining sectors. The data comes from the second quarter of each year. From 2002 to 2012, no changes in the national classification of occupations were made. From the third quarter of 2012 on, Mexico implemented a new structure classification for occupations.

5. Empirical Results

[29]This is very important to demonstrate that general conclusions remain true in shorter periods within the decade.

5.1 Job Polarization

In Figure 1, we present the changes in the employment share by skill percentile. At the top panel on the graph, we plot absolute changes in employment weighted by their share in 2002. At the bottom part, we graph the smoothed changes estimated by locally weighted regression with bandwidth of 0.5. According to the top panel, larger employment changes took place in the lower and middle part of the skill distribution. However, at first glance, it is difficult to identify any clear pattern of employment changes. Therefore, we plot smoothed variations in the lower panel. Results suggest that the polarization of job opportunities at such a level of disaggregation is very weak for all countries. There are some drops in employment in the middle of the distribution, but the u shape documented in advanced economies is not observed.[30]

In Table 2, we present the results from the correlation between changes in employment and the initial log median wage in the job as in equation (1). Results from this quadratic form confirm the results commented on previously. Coefficients do not have the expected signs and are not statistically significant. To study comparable occupations across countries, we built a classification of 26 broad jobs, keeping the most-relevant occupations in terms of employment share. We rank these new jobs according to their median wages in 2002. Results are presented in Table 3. Occupations are reported from the highest paid to the lowest paid. As we can see, there is not a perfect correlation in the ranking of occupations across countries. However, some consistency of jobs among high-skilled, middle-skilled, and low-skilled occupations is observed. At the top of the distribution, we find, for example, physicists, mathematicians, life science professionals, health professionals, and executive managers. In the middle-skill occupations, we find clerks in general, machine operators, and precision and handicraft jobs. Service jobs in general and street salesperson are jobs at the bottom of the skill distribution.

In Table 3, we also present changes in employment during the period and employment shares by 2002. Except for executive managers, important employment growth for physicists, mathematicians, and life science professionals are reported. Significant negative changes for secretaries, stenographers, typists, machinery operators, and precision handicrafts are observed in the middle of the skill distribution. Changes in the lower part are more heterogeneous, with increasing shares for cooks and bartenders, and building workers. But what about changes in wages? Are changes in median wages at this level of aggregation related to the changes in employment?

We plot in Figure 2 the smoothed changes in employment and wages by the 26 jobs. The results suggest that employment and wages could be correlated positively only among low-skilled jobs. However, the relationship is very weak, and the main conclusion would be that changes in employment and wages do not correspond to polarization patterns. In Table 4, we also present the results of equation (2). Evidence suggests no relationship between changes in wages and changes in employment considering the most disaggregated classifications in Brazil and Colombia. In Mexico, the coefficient is positive and statistically significant, meaning that both employment and changes grow in the lower part and fall in the upper part of the skill distribution. Coming back to Figure 2, the lower panel shows that the growth of wages decreases as we move to well-paid jobs. In fact, in Mexico wages for high-skilled workers were lower compared with those in 2002. The results of wages are consistent with the decline in labour income inequality in Latin America.

[30]However, we document later that in aggregate terms, employment growth for professionals and low-paid service jobs was at very low rates.

5.2 Explaining employment patterns

In Table 5, we present employment shares by industry and by routine and non-routine occupations. The first column for each country presents the average employment by industry. The other columns relate the distribution of routine and non-routine occupations within each industry. According to the results, retail trade, repair of personal goods, education, and public administration are industries with the highest weight in total employment in all countries. Industries such as construction, transport, storage, and communications also generate important levels of employment. By looking at the distribution of jobs by skill level, we find that services are intensive in non-routine analytic jobs while the manufacturing industry is intensive in routine manual occupations.

In Table 6, we present the changes in employment sharing by routine and non-routine occupations during the period. The most important result for our purpose is the fall in sharing of routine cognitive 1 and routine manual jobs, and thus, we are interested in knowing where such changes come from. The decrease in routine jobs could be explained either by the routinization hypothesis or by changes in industry composition as a result, for example, of international trade. To test the hypothesis, we decompose changes in employment using equation (3). If the technical change is the main factor in explaining changes in the middle-skilled occupations, the within-industry component should be negative and greater than the between-industry component.

The results from the decomposition are presented in Table 7. The changes in routine cognitive 1 occupations within industries are negative and explain comprehensively the decreasing employment share for all countries. This result is in line with the routinization hypothesis. For Brazil and Colombia the changes in routine manual occupations within industries are negative and also greater than the between component. Mexico is the only country with a positive within component and the country where the between component mainly explains the drop in employment share. We need to check the robustness of the results by considering shorter periods of time.

In Table 8, we present estimations from a panel data of 26 industries from 2002 to 2012 of the relationship between the within component of the decomposition and changes in total employment by routine and non-routine jobs. Considering the routine cognitive 1 category, we found that the within component is statistically significant for all countries. It explains more than 80% of the fall in employment in this category. For routine manual jobs such as machinery operators and handicrafts, we found that the within component explains more than 40% of the total variation in employment. In general, these results support the idea that the effect of technological change on labour demand is not homogeneous even within routine ocupations.

6. Conclusion

In this paper, we examined the employment changes along skill distribution in the urban labour markets of Brazil, Mexico, and Colombia. We used, for the first time, detailed data on occupations in order to analyse changes in employment structure by skill distribution and also among occupations classified as routine, non-routine, cognitive, and manual jobs. According to the results, employment fell strongly for some middle-skilled occupations (secretaries, machinery operators, and handicrafts) and increased mildly for both low-skilled and high-skilled occupations (non-routine analytic jobs). This is consistent with the decreasing wage inequality

reported in the last decade.

Results from the decomposition of the routine-non-routine employment shifts suggest that the fall in the share of routine cognitive 1 (secretaries, stenographers, cashiers) is fully explained by the routinization hypothesis. Changes in the within component explain more than 80% of the fall in this group. The effect of technical change on routine manual jobs was however weaker. The within component explains in this case no more than 43% of the changes in employment share. More research is necessary in order to demonstrate to what extent the changes in industry composition are due, for example, to international trade.

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Table 1. Classification of occupations

Occupation		**Acemoglu and Autor (2011)**
Physics, mathematicians, engineering profess.	Nonroutine analytic	Nonroutine cognitive
Physics, mathematicians, engin. associate profes.		
Life science and health professionals		
Life science and health associate professionals		
Economist, accountants		
Lawyers		
Writers, artists and sportsmen		
Education workers		
Other professionals		
Other associate professionals		
Executive managers	Nonroutine interactive	
Other managers		
Secretaries, stenographers, typists	Routine cognitive 1	Routine cognitive
Cashiers, tellers and the similar		
Telephone switchboard operators		
Other clerks	Routine cognitive 2	
Sales		
Street salesperson		
Machinery operators	Routine manual	Routine manual
Precision, handicraft, and related workers		
Drivers	Nonroutine manual	Nonroutine manual
Building workers		
Cooks, bartenders, porters		
Protective services workers		
Other services		
Other		

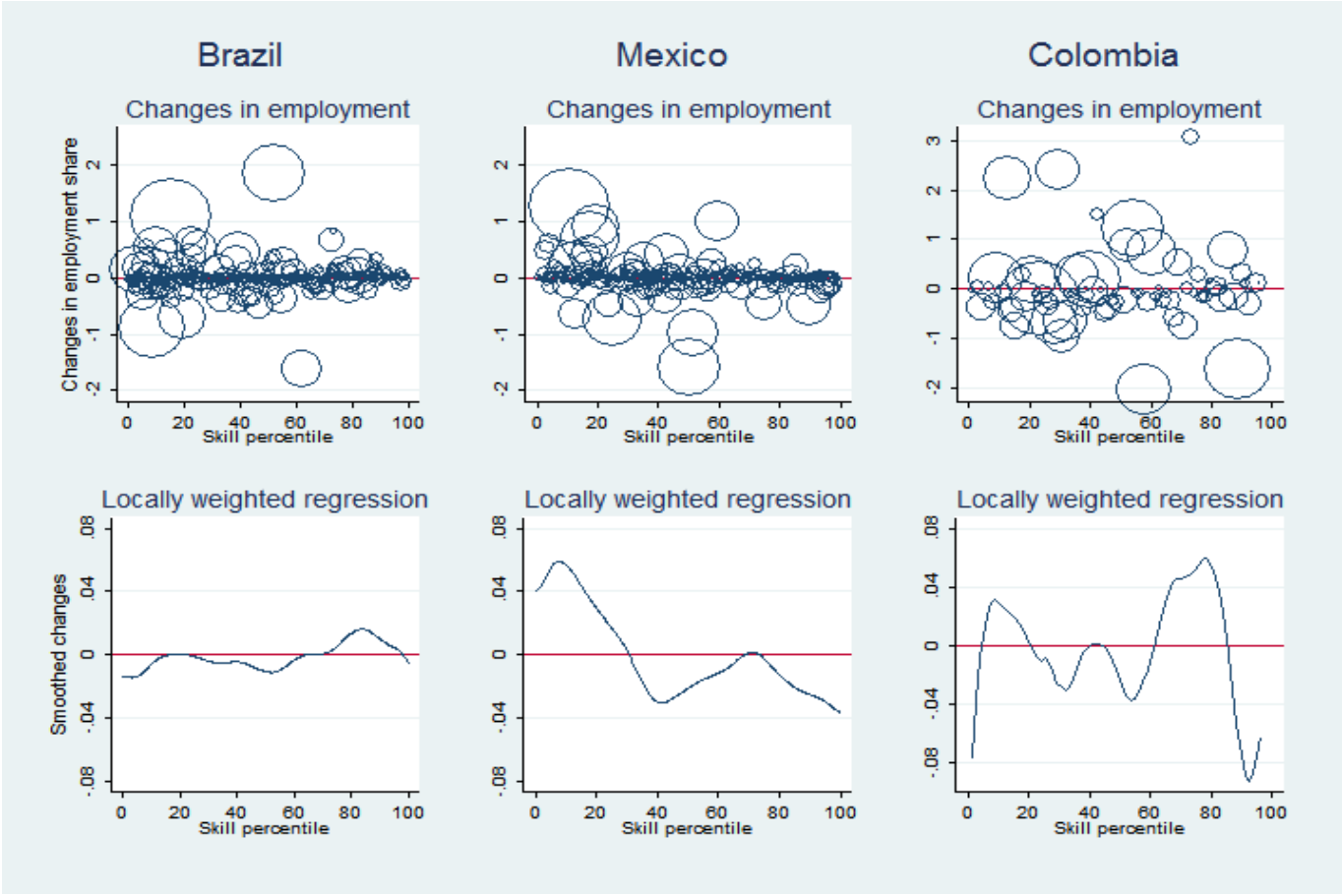

Figure 1. Changes in employment share by skill percentile 2002-2012.

Note: The first panel shows absolute changes in employment share with the size of circle representing the weight of each job in total employment in 2002. The second panel plots smoothed changes in employment share estimated by a locally weighted regression with bandwidth of 0.5. Skill percentile is proxy the median wage in 2002.

Table 2. Employment changes and initial median wage

	β_1	β_1
Brazil	0.274	0.079
	0.274	0.091
	1.00	0.87
Mexico	-1.395	0.175
	1.069	0.149
	-1.30	1.17
Colombia	-1.678	0.099
	4.142	0.246
	-0.41	0.40

Note: Dependent variable is the log of changes in employment. Standard errors in the second row. t-statistic in the third row. The sample is 448 for Brazil, 370 for Mexico, and 75 for Colombia.

Table 4. Employment and wage changes

	β_1
Brazil	-0.326
	0.248
	-1.31
Mexico	0.410***
	0.244
	1.68
Colombia	-0.535
	0.456
	-1.17

Note: *** p <0.05; ** p < 0.10. Standard errors in the second row. t-statistic in the third row. The sample is 448 for Brazil, 370 for Mexico, and 75 for Colombia

Table 3. Employment share during period

Brazil	e_2002	Δ_e	**Mexico**	e_2002	Δ_e	**Colombia**	e_2002	Δ_e
05.Life science and health p	1.1	0.48	01.Executive managers	2.6	-0.62	08.Lawyers	0.7	0.11
03.Physics, mathematicians, p	1.2	0.18	03.Physics, mathematicians, p	1.3	0.11	01.Executive managers	0.0	0.09
07.Economist, accountants	0.5	0.18	05.Life science and health p	1.3	0.10	03.Physics, mathematicians, p	1.6	0.58
08.Lawyers	0.3	0.20	10.Education workers	5.8	-0.73	05.Life science and health p	1.5	-0.09
01.Executive managers	4.6	-0.29	08.Lawyers	0.6	-0.07	07.Economist, accountants	1.5	-0.10
24.Protective services	0.4	0.08	11.Other professionals	0.5	0.17	10.Education workers	6.4	-1.64
10.Education workers	7.6	-0.37	09.Writers, artists and sportsmen	0.8	0.31	11.Other professionals	0.7	-0.21
11.Other professionals	1.8	0.36	07.Economist, accountants	1.2	-0.15	06.Life science and health a	0.3	-0.10
09.Writers, artists and sp	1.0	-0.21	02.Other managers	7.8	-1.54	09.Writers, artists and sport	1.5	-0.50
12.Other associate prof	2.9	-0.61	06.Life science and health as	1.5	-0.14	02.Other managers	8.1	-1.24
04.Physics, mathematicians,	2.2	0.03	12.Other associate professionals	2.2	0.01	04.Physics, mathematicians,	0.8	3.00
06.Life science and health a	1.6	0.19	04.Physics, mathematicians,	1.8	0.54	12.Other associate prof	0.1	0.11
02.Other managers	3.2	-0.99	13.Secretaries, stenographers	5.2	-1.85	14.Cashiers, tellers and	4.9	0.46
15.Telephone switchboard o	0.7	0.20	16.Other clerks	6.2	1.27	13.Secretaries, stenographers	4.7	-2.06
19.Drivers	5.2	0.01	15.Telephone switchboard o	0.2	0.02	15.Telephone switchboard op	0.3	1.50
16.Other clerks	8.5	2.47	19.Drivers	6.9	-0.22	16.Other clerks	8.5	0.57
13.Secretaries, stenograph.	2.7	-1.06	14.Cashiers, tellers and	1.9	0.11	17.Machinery operators	3.1	-1.52
14.Cashiers, tellers	2.9	-0.10	17.Machinery operators	8.3	-1.37	24.Protective services workers	6.2	0.18
18.Precision, handicraft	9.8	-1.18	20.Building workers	5.0	1.27	26.Other services	2.7	0.64
17.Machinery operators	5.3	-0.81	24.Protective services workers	3.7	-0.17	21.Sales	11.8	-0.09
21.Sales	9.4	0.83	18.Precision, handicraft	12.1	0.62	18.Precision, handicraft	13.8	-4.29
23.Cooks, bartenders	7.8	0.38	27.Other	1.1	0.21	23.Cooks, bartenders	8.3	0.33
26.Other services	10.9	-0.81	21.Sales	12.1	0.16	27.Other	1.6	-0.65
27.Other	2.7	-0.48	26.Other services	3.3	0.03	19.Drivers	6.7	2.57
20.Building workers	5.4	1.58	23.Cooks, bartenders	6.2	1.88	20.Building workers	4.0	2.49
22.Street salesperson	0.5	-0.26	22.Street salesperson	0.6	0.04	22.Street salesperson	0.3	-0.14

Note: e_2002 is the percentage sharing in total employment; Δ_e refers to variation in employment sharing from 2002-2012

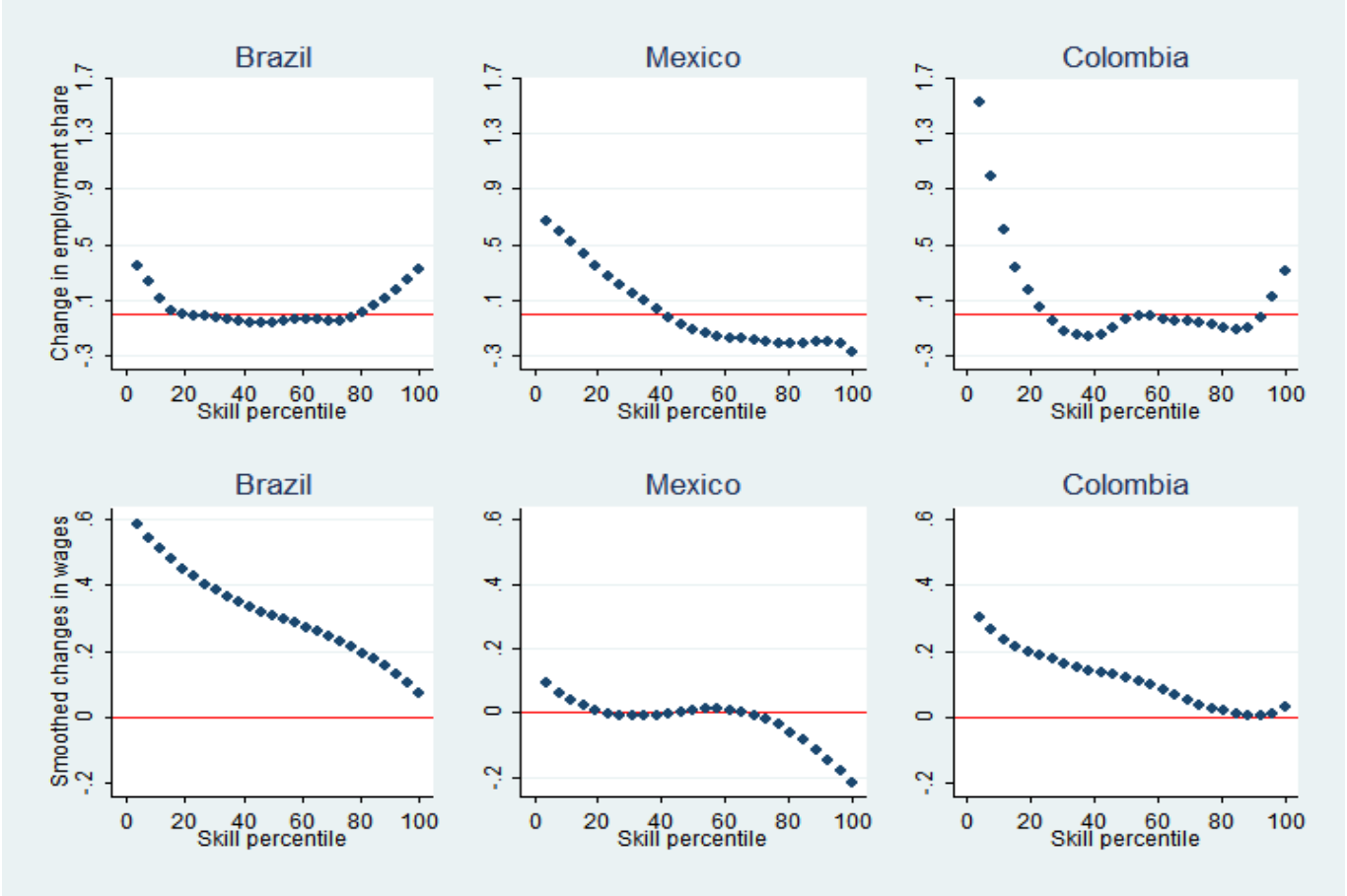

Figure 2. Changes in employment and wages by skill percentile 2002-2012.

Note: The first panel shows smoothed changes in employment share estimated by a locally weighted regression with bandwidth of 0.5. The second panel plots smoothed changes in median wages obtained in the same way. Skill percentile is proxy the median wage in 2002.

Table 5. Employment share by industry and routine-nonroutine occupation

	Brazil							Mexico						
Industry	**%**	**NRA**	**NRI**	**RC1**	**RC2**	**RM**	**NRM**	**%**	**NRA**	**NRI**	**RC1**	**RC2**	**RM**	**NRM**
01. Manuf. of food and tobacco	3.4	8.2	8.1	1.1	18.5	36.4	27.7	4.2	4.5	9.4	2.7	32.0	39.7	11.8
02. Manuf. of textiles	1.0	8.4	10.9	1.5	9.0	60.7	9.5	1.0	3.3	12.1	1.4	7.3	70.4	5.6
03. Manuf. of wearing apparel, lea	3.2	5.2	6.3	0.6	6.6	75.2	6.1	3.3	3.9	6.4	1.4	4.8	80.4	3.1
04. Manuf. of wood, publishing	1.8	13.2	8.4	2.7	11.5	46.9	17.2	2.3	8.1	9.9	4.0	12.8	58.6	6.6
05. Manuf. of refined petroleum	1.4	21.5	12.0	1.5	19.6	22.2	23.2	1.5	13.8	14.4	3.1	24.1	22.3	22.3
06. Manuf. of rubber, plastics and	1.9	7.4	7.2	1.5	10.1	36.7	37.0	2.5	5.2	12.7	1.8	8.3	49.6	22.3
07. Manuf. of basic metals	0.7	14.0	10.4	1.0	9.6	51.9	13.1	0.5	8.9	16.1	3.5	7.8	50.1	13.7
08. Manuf. of fabricated metal	1.2	8.6	9.6	1.1	9.5	63.2	8.1	1.9	3.4	6.1	2.9	5.1	75.3	7.2
09. Manuf. of machinery and equip.	1.7	18.6	9.4	2.2	12.8	47.2	9.9	0.5	8.4	13.7	4.1	7.6	60.1	6.1
10. Manuf. of electrical machinery	0.4	32.1	9.4	2.6	16.2	31.7	8.0	1.8	10.3	18.5	2.6	6.2	56.2	6.2
11. Manuf. of motor vehicles	2.8	10.5	8.4	1.2	10.2	59.7	10.0	2.5	7.5	16.6	1.1	5.4	62.2	7.2
12. Other manufacture industries	0.1	6.0	3.3	0.8	17.8	31.8	40.4	1.5	6.3	10.1	2.2	8.7	57.9	14.7
13. Electricity, gas and water	0.7	29.5	8.1	4.2	14.9	23.9	19.4	0.6	16.8	20.6	10.4	15.6	18.1	18.4
14. Construction	7.7	5.5	8.9	0.6	2.9	8.6	73.5	7.2	6.3	5.8	1.9	3.0	10.6	72.4
15. Wholesale trade	3.9	1.9	6.2	3.4	34.6	43.3	10.7	4.4	6.9	11.4	6.4	53.2	3.7	18.4
16. Retail trade and repair	15.0	3.6	7.7	10.2	56.6	5.8	16.1	12.4	4.2	6.8	9.8	63.0	6.4	9.8
17. Hotels and restaurants	4.4	1.1	7.4	3.7	10.5	3.3	74.0	6.3	2.3	7.7	4.9	10.5	26.9	47.8
18. Transport, storage and commun.	6.7	8.8	4.9	14.0	11.0	3.9	57.4	7.5	7.2	6.0	5.6	13.0	4.0	64.1
19. Financial intermediation	2.2	18.9	24.9	23.7	27.8	0.3	4.3	1.8	30.3	17.0	20.2	29.0	0.4	3.2
20. Real estate and renting act.	1.6	12.2	6.1	4.2	14.5	1.6	61.4	0.8	9.5	9.3	8.8	24.9	4.2	43.2
21. Public administration and defens.	10.1	25.0	9.2	4.4	15.0	2.2	44.2	8.8	18.5	18.8	15.5	14.8	1.7	30.7
22. Specialized technicians and prof.	7.7	22.7	5.4	9.9	19.8	2.1	40.2	6.6	29.6	8.7	8.9	16.7	1.4	34.6
23. Education	10.3	72.3	3.1	3.1	5.4	0.2	16.0	7.9	68.4	6.8	5.7	3.9	1.2	13.9
24. Health and social work	6.2	49.2	2.7	3.1	20.4	0.5	24.1	4.9	58.0	5.0	5.8	12.4	2.8	16.1
25. Recreational, cultural and sport.	1.5	43.9	6.9	15.0	11.7	2.7	19.8	1.5	38.7	7.7	5.2	11.8	4.9	31.7
26. Other community, social and serv.	2.3	13.6	5.5	4.5	12.1	0.8	63.5	5.6	9.6	4.7	3.2	5.3	38.6	38.5

Note: Employment share is given by percentage points. % is the average employment share during 2002-2012. NRA is the average employment of nonruotine occupations on industry j.

Table 5. (Cont.) Employment share by industry and routine-nonroutine occupation

		Colombia					
Industry	**%**	**NRA**	**NRI**	**RC1**	**RC2**	**RM**	**NRM**
01. Manuf. of food and tobacco	4.5	5.4	7.7	5.2	25.6	27.5	28.6
02. Manuf. of textiles	1.4	3.2	10.5	4.2	10.0	57.6	14.5
03. Manuf. of wearing apparel, lea	5.7	3.4	6.3	3.1	12.9	65.6	8.7
04. Manuf. of wood, publishing	2.0	11.8	5.6	7.0	16.4	36.7	22.6
05. Manuf. of refined petroleum	2.0	12.7	14.0	6.1	24.7	10.1	32.5
06. Manuf. of rubber, plastics and	2.2	8.7	10.6	3.8	10.5	45.2	21.2
07. Manuf. of basic metals	0.2	4.4	8.5	4.2	1.8	46.4	34.7
08. Manuf. of fabricated metal	1.3	4.9	4.2	3.8	8.3	68.8	9.9
09. Manuf. of machinery and equip.	0.7	9.8	5.9	5.2	18.5	48.8	11.8
10. Manuf. of electrical machinery	0.4	13.6	8.9	14.5	17.2	34.8	11.1
11. Manuf. of motor vehicles	0.9	6.2	11.8	5.8	12.0	43.8	20.4
12. Other manufacture industries	2.1	3.0	5.6	4.4	11.1	42.4	33.6
13. Electricity, gas and water	0.9	31.1	11.1	14.7	13.2	15.6	14.3
14. Construction	6.3	6.9	2.6	2.9	4.9	8.4	74.2
15. Wholesale trade	3.7	7.2	9.7	15.8	39.3	6.5	21.6
16. Retail trade and repair	15.2	2.7	7.9	11.2	51.7	10.9	15.8
17. Hotels and restaurants	6.7	1.4	8.3	5.3	11.2	2.6	71.1
18. Transport, storage and communi.	7.4	6.7	12.3	12.8	19.8	3.1	45.3
19. Financial intermediation	3.5	16.8	12.6	28.5	32.2	0.1	9.8
20. Real estate and renting act.	3.3	3.3	4.9	4.7	10.0	2.0	75.1
21. Public administration and def.	5.5	24.1	8.5	10.3	12.9	1.9	42.3
22. Specialized technicians and prof.	5.8	27.2	7.3	24.1	20.2	2.1	19.1
23. Education	8.3	71.8	2.8	7.0	4.1	0.5	13.8
24. Health and social work	5.9	29.6	4.9	10.9	14.5	1.0	39.2
25. Recreational, cultural and sporting	2.0	30.9	10.1	10.9	13.8	5.0	29.5
26. Other community, social serv.	2.2	16.5	8.3	10.8	12.3	0.8	51.3

Note: Employment share is given by percentage points. % is the average employment share during 2002-2012. NRA is the average employment of nonruotine occupations on industry j.

Table 6. Employment share by routine and nonroutine occupations

	Brazil			Mexico			Colombia		
Occupation	**2002**	**2012**	**Δ**	**2002**	**2012**	**Δ**	**2002**	**2012**	**Δ**
Nonroutine analytic	20.13	20.57	0.44	16.94	17.09	0.15	15.10	16.28	1.18
Nonroutine interactive	7.81	6.52	-1.29	10.34	8.18	-2.16	8.11	6.96	-1.15
Routine cognitive 1	6.27	5.31	-0.96	7.24	5.52	-1.72	9.85	9.75	-0.10
Routine cognitive 2	18.40	21.44	3.04	18.85	20.32	1.47	20.58	20.91	0.33
Routine manual	15.10	13.12	-1.98	20.46	19.71	-0.75	16.96	11.14	-5.82
Nonroutine manual	32.29	33.05	0.76	26.17	29.18	3.01	29.39	34.96	5.57

Table 7. Decomposition of the changes in employment 2002-2012

	Brazil			Mexico			Colombia		
Occupation	**B**	**W**	**T**	**B**	**W**	**T**	**B**	**W**	**T**
Nonroutine analytic	-1.16	1.62	0.46	-0.96	1.10	0.14	-0.95	2.14	1.19
Nonroutine interactive	-0.08	-1.21	-1.29	-0.28	-1.87	-2.15	0.06	-1.20	-1.14
Routine cognitive 1	0.16	-1.12	-0.95	0.05	-1.76	-1.72	0.49	-0.60	-0.12
Routine cognitive 2	0.48	2.55	3.04	0.37	1.10	1.47	-0.35	0.70	0.35
Routine manual	-0.90	-1.09	-2.00	-1.50	0.75	-0.75	-1.98	-3.86	-5.84
Nonroutine manual	1.50	-0.76	0.75	2.33	0.67	3.00	2.74	2.82	5.56

Table 8. Changes in employment within industries

	NRA	NRI	RC1	RC2	RM	NRM
Brazil						
Within component	0.67***	0.97***	0.98***	1.01***	0.94***	1.27***
Std. Err.	0.05	0.02	0.01	0.02	0.08	0.08
t	13.8	46.7	77.1	48.0	11.42	16.38
R-sq	0.44	0.91	0.96	0.92	0.39	0.56
Number of obs.	234	234	234	234	234	234
Mexico						
Within component	0.93***	0.92***	0.95***	1.18***	0.89***	1.41***
Std. Err.	0.08	0.03	0.03	0.06	0.09	0.06
t	11.4	31.1	37.0	20.0	10.2	22.9
R-sq	0.35	0.79	0.84	0.60	0.30	0.69
Number of obs.	260	260	260	260	260	260
Colombia						
Within component	1.15***	1.04***	0.83***	1.09***	0.82***	0.96***
Std. Err.	0.07	0.03	0.03	0.06	0.06	0.06
t	16.59	40.09	31.12	18.45	13.18	15.52
R-sq	0.54	0.87	0.80	0.58	0.43	0.49
Number of obs.	260	260	260	260	260	260

Note: Fixed-effects (within) regression. *** $p < 0.05$; ** $p < 0.10$. The dependent variable is the employment change by routine and nonroutine occupations. Columns represent separate regressions. Panel data for 26 industries from 2002-2012. Observations are weighted by the average employment share during period.

Data Appendix

1. Household surveys

The main results throughout the chapters are based on micro data of household surveys from Argentina, Brazil, Colombia, and Mexico. The surveys are carried out by the official institutes of statistics in each country, and are the main source to build labour market indicators. They collect information about composition of households, physical characteristics of the dwelling, demographic characteristics of individuals such us gender, age, and socio-economic information as level of education, employment status, job characteristics, labour incomes, and no labour incomes. These surveys are available online from 2000 and have been used in empirical work both at country and at regional level.

In order to construct our database, we take the raw data for each country and we process the information by quarter according to the procedures established by the respective statistical office. Given the representativeness in terms of GDP and population of our country sample, our final database constitutes an important source of information for the study of labour markets dynamics in the region. There are few efforts in Latin America to harmonise information from microdata of household surveys. Undoubtedly, the most important is the Socio-Economic Database for Latin America and the Caribbean (SEDLAC) which covers 24 countries.

Our sample covers a period that goes from 2001 to 2012 for all countries except Argentina where the new survey was implemented in 2003. Additionally, since some municipalities enter and leave the sample, we only consider the municipalities observed consistently during this period. In Table 1 we present the final sample by year and country. Next, we present the main features of each household survey and the definition of the main variables used in all chapters.

1.1 Argentina: Encuesta Permanente de Hogares (EPH)

The EPH is a household survey implemented from 2003 by the Instituto Nacional de Estadistica y Censos (INDEC). It is a survey with only urban coverage. It was applied firstly in Buenos Aires in 1974 and it was extended to urban areas with more than 100,000 inhabitants later. The survey is structured into sections of socio-demographic and socioeconomic characteristics. It collects information about employment status, labour characteristics, and incomes. In particular, it asks for incomes from all jobs, incomes from renting, pensions, profits, interests, and transfers. One important feature of this survey is that in the socioeconomic characteristics section it imputes incomes from non-responses. It has a section that explains how the incomes were imputed and how to recognize them in the data.

Regarding our variables of interest, the survey reports the level of education that we use to obtain the years of schooling. For employees, the survey also give the type of firm (private or public), the number of employees in the firm, the type of contract, and the coverage of the health protection. The economic activities are classified according to the Classification of Economic Activities for Socio-Demographic Surveys of Mercosur (CAES-MERCOSUR) which is based on

the International Standard Industrial Classification (ISIC). Occupations are classified according to the National Classification of Occupations (CNO) which has not comparable international classification.

1.2 Brazil: Pesquisa Nacional por Amostra de Domiclios (PNAD)

The PNAD is a national annual household survey implemented in the month of September by the Instituto Brasileiro de Geografia e Estadística (IBGE). The survey was not implemented during census years (2000 and 2010) and sometimes includes specific modules of relevant issues. It is also structured into household section and individual section. The survey gives the number of years of schooling, and the same labour market variables mentioned for the case of Argentina. The economic activities are classified according to the National Classification of Economic Activities (CNAE-Domiciliar) based on the ISIC. Occupations are classified according to the Brazilian Classification of Occupations (CBO-Domiciliar) which has as reference the International Standard Classification of Occupations ISCO-88.

1.3 Colombia: Encuesta Continua de Hogares (ECH) and Gran Encuesta Integrada de Hogares (GEIH)

The ECH was a household survey implemented from 2000 to second quarter of 2006 by the Departamento Adiministrativo Nacional de Estadistica (DANE). It was replaced by the GEIH. The main change between two surveys was the entering of more municipalities in the sample. By 2001, the ECH covered 30.000 housing in the 13 metropolitan areas and 7.500 housing in small cities and rural areas. By 2010 the GEIH covered 240.000 housing in all country. For consistency, we consider only the 13 metropolitan areas during period. In terms of income, since the GEIH has more questions about other labour incomes, we just consider incomes in both surveys.

Like Argentina, we do not have years of schooling. Instead we have levels of education. So we construct the years of schooling from the information reported in the education section. We also have variables related to industry, firm and workers characteristics. The economic activities are classified according to the International Standard Industrial Classification ISIC. Occupations are classified according to the National Classification of Occupations (CNO) which has as reference the ISCO-88.

1.4 Mexico: Encuesta Nacional de Empleo Urbano (ENEU) and Encuesta Nacional de Ocupación y Empleo (ENOE)

The official institute of statistics in Mexico (Instituto Nacional de Geografía y Estadística, INEGI) has implemented two surveys since 1987 to collect information about labour market indicators. The first one was the ENEU applied to urban areas until 2004 with coverage of 133.000 housing per quarter in 2002. The second one is the ENOE from 2005 which includes rural areas with coverage of 497.040 housing per quarter in 2010. For our purpose, we keep only those municipalities that we observe consistently during period. The surveys are also structure into socio-demographic and socioeconomic modules but in the last module they do not report incomes more than labour income from the main job.

The surveys also provide the years of schooling and the levels of education. Moreover, they have information on the type of firm (private or public), the number of employees in the firm, the type of contract, and the coverage of the health protection. The economic activities are classi-

fied according to the North American Industry Classification System (NAICS), a classification that is compatible with the ISIC. Occupations are classified according to the Mexican Classification of Occupations (CMO) which has as reference the International Standard Classification of Occupations ISCO-88.

We use these household surveys to construct our main variables in the analysis of the changes in inequality. In chapter 1 we consider all kind of incomes coming from different sources at individual and at household level. The employment status and schooling variables are also taken into account. In chapter 2 we focus on wages as well as on the labour market changes in terms of characteristics of workers, characteristics of firms, and characteristics of industries. Finally in chapter 3 we analyse the structure of occupations. We built a harmonized classification of 83 occupations for Brazil and Mexico. We also present a unified classification for the three countries composed by 26 occupations.

2. Definitions of variables

2.1 Incomes

The surveys ask for incomes obtained in the labour activity of the reference week. Usually the information of income is reported monthly before taxes. In cases where the incomes correspond to different periods of time, we convert them into monthly. It is typically the case of non-labour incomes. In the case of labour incomes, we define the hourly wage as the reported wage obtained in the last month divided by the number of hours worked. All incomes are deflated by the price index in each country. In the estimations, we discard observations of individuals whose information of key variables are reported as missing or outside the coding provided by the INDEC, IBGE, DANE, and INEGI.

3. Other sources of data

Throughout chapters, sometimes we use data from different sources either to support the empirical facts or to control for relevant factors in the econometric estimations. For the study of changes in income inequality, we use in the first chapter the database developed by the World Institute for Development Economics Research (WIDER), the Socio-Economic Database for Latin America and the Caribbean (SEDLAC), and the database of Income Distribution in Latin America (IDLA). In the econometric estimation, we also consider aggregate variables from the World Bank Indicators, from the International Monetary Fund database, and also from the database of the Economic Commission for Latin America and the Caribbean (CEPALSTAT).

Depending on the purpose, we use either Consumer Price Index (CPI) of each country or the Purchase Parity Power (PPP) to convert nominal values into real values or national currency values in dollars. Regarding to the CPI in Argentina we work with the index provided by the INDEC although we are aware of the change in methodology in 2008. In the case of minimum wages and depending of the country, we consider the information reported by the central bank, by the minimum wage commission, or by the department of labour. In Table 2 we relate the minimum wages by the four countries from 2001 to 2013 with the details about the source. In the case of Mexico, we convert the diary minimum wage into monthly real value for the econometric estimation. In the part of robustness checks we use the minimum wage index published by CEPALSTAT for the enlarge sample.

Table 1. Total sample in household surveys

Year	Brazil	Mexico	Colombia	Argentina
2001	378,836	344,899	111,826	
2002	385,431	335,397	111,575	
2003	384,834	317,118	111,082	46,397
2004	399,354	265,639	108,476	20,238
2005	408,148	267,043	108,212	19,960
2006	410,241	265,111	100,000	20,782
2007	399,964	263,600	99,185	27,037
2008	391,868	258,445	100,693	26,403
2009	399,387	250,260	92,755	25,551
2010	Census	249,862	94,046	59,499
2011	358,959	245,194	95,380	58.726
2012	362,451	244,200	96,584	56.842

Source: Household surveys. Coverage: Brazil (national); Mexico and Argentina (urban), Colombia (13 metropolitan areas).

Table 2. Minimum wages in Latin America

Year	Brazil Monthly Brazilian reals	Mexico Diary Mexican pesos	Colombia Monthly Colombian pesos	Argentina Monthly Argentine pesos
2001	180.0	37.57	286,000	200
2002	200.0	39.74	309,000	200
2003	240.0	41.53	332,000	300a
2004	260.0	43.297	358,000	350b
2005	300.0	45.24	381,500	570c
2006	350.0	47.05	408,000	780d
2007	380.0	48.88	433,700	960e
2008	415.0	50.84	461,500	1200f
2009	465.0	53.19	496,900	1440g
2010	510.0	55.77	515,000	1740h
2011	540.0	58.06	535,600	1840i
2012	622.0	60.5	566,700	2300j
2013	678.0	63.12	589,500	3300k

Source: Brazil: Central Bank. Mexico: National Commission for Minimum wages. Colombia: Central Bank. Argentina: Department of Labor a. Dec/2003, b. Jan-Aug/2004, c. Jun/2005, d. Sep-Oct/2006, e. Oct-Nov/2007, f. Aug-Nov/2008, g. Oct-Dec/2009, h. Aug-Dec/2010, i. Jan-Aug/2011, j. Sep/2011-Aug/2012, k. Aug-Dec/2013

Conclusions

This compilation of essays considers some of the most relevant factors in accounting for the recent changes in income inequality in Latin America. We document the recent evolution of income inequality and discuss channels through macroeconomic conditions, and particular labour market changes that affect the distribution of earnings and wages for a representative sample of countries in terms of population and GDP. Our contributions deal not only with general issues in the income inequality literature such as the redistributive effects of the business cycle, the educational upgrading, or the impact of technological change on inequality, but also with more specific features related to the size of the informal sector in these economies. Given the relevance of these topics in the current discussion of public policy in the region, we expect that our results will contribute to the debate in an important way.

In the first chapter, we found that the decrease of income inequality from 2001 to 2012 is robust to the inequality measure and population subgroup considered. Labour income for households and wages for individuals remains as the most relevant sources of income inequality in the region. Pensions lose weight in household budgets for all countries. Given the better macroeconomic conditions, we explore the role played by the business cycle into inequality changes. We found that the unemployment rate has a positive and statistically significant effect on labour income inequality accounting for about 30% of changes in the Gini coefficient during the period studied for countries like Argentina, Brazil, and Colombia. The distribution of education was found to also be important, explaining more than a half of the variation in inequality for Brazil and Mexico and in a lesser degree for Argentina and Colombia. Minimum wages appear as a relevant factor for these last two economies.

In the second chapter, we found that schooling has a positive effect within group wage inequality. We also document the decline in the returns to education during the period, not only on average but also at median and at first decile and at ninth decile. According to the decomposition results, the fall in inequality is explained mainly by the changes in the distribution of prices or returns to characteristics of the workforce. We also found that the more equal distribution of education had an un-equalizing (quantity) effect on wage inequality for all countries while the higher proportion of workers with written contracts or with health coverage had an equalizing impact among wage earners in Argentina, Brazil, and Colombia. This latter result is novel in the literature despite the highest levels of job informality in these economies. This therefore provides evidence of how improvements in labour conditions have positive effects on reducing inequality.

In the third chapter, we use a task-based theoretical model to analyse patterns in the demand for skills. We found little evidence of a strong job polarization pattern as reported in the US or Europe. In fact we found that employment fell widely for some middle-skilled occupations such as secretaries, machinery operators, and handicraft workers, and increased mildly for high-skilled occupations like professionals and also for low-skilled jobs. However, the pattern of wages was completely different. Wages increased more for the low-skilled occupations than for the other jobs. According to the decomposition results, the decreasing share of employment for secretaries and related jobs was explained mainly by the within industry effect. This is evidence

for routinization hypothesis in the extensive margin. For machinery operators and handicraft workers, their decreasing employment share was explained more for a between industry effect that suggest a minor role of technological change. All in all, more research on this issue is required.

Our results have some drawbacks. We only analysed one dimension of inequality; that is, the part related to income. We do not consider inequality in consumption as much as the other researchers suggest. Consequently, we are aware about the differences between inequality measures obtained by income and by consumption data. Unfortunately until now, we did not have this kind of data readily available. Likewise, we know that inside household surveys, the variable income is always problematic. People do not report information or sometimes the information reported is biased. Here we do not apply any technique to input incomes by ourselves. We merely kept the complete information as many researchers do. A final problem is related to the gross and net incomes. In some surveys it is not possible to identify the net income, so we work with gross income for all countries. Therefore, we are not considering the redistributive effects of tax policy. Despite these considerations we are confident about the relevance of our results.

For future research we would like to mention mainly two lines. First, we present some evidence of the effect of minimum wages on inequality in the first chapter and discuss the role of changes in the informal sector in the second. Despite the fact that we present general results, we think that given the country heterogeneity in institutional frameworks, it will be worth it to go directly to the analysis in a country-to-country case. For example, in Colombia there has recently been a program created to formalize workers. This case will be interesting since this country also has high levels of job informality and inequality. Second, we do not consider the spatial dimension of inequality. The trends in inequality differ not only across countries but also across regions inside countries. For example, the dynamics of big cities that influence returns to skills is relevant in explaining the pattern in the skill wage gap. An analysis of spatial differences will definitely improve our understanding of the sources of changes in income inequality in the region.