Exploring the Rise and Decline in the Latin American Skills Premium, 1992 to 2012

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Abstract

Most countries in Latin American have experienced a decline in income inequality since the year 2000 which has been explained as a result of the decline in the skills premium. In this paper we explore the patterns and determinants of the skills premium in Latin America over the period 1992 to 2012. We critically analyze whether the skills premium declined due to an increase in the supply of skilled labor, which is widely claimed in the literature as the outcome of improved education policies since the 1990s. Using a novel data set that provides comparable measures of the skills premium defined as private return to tertiary education, we estimate the determinants of the skill premium in Latin America using panel data analysis and three-stages least squares estimations. For the period after 2000, when both the skills premium and income inequality declined, we find limited evidence for excess supply of highly skilled labor. For the skills premium to still decline the relative productivity and wages of highly skilled labor must have equally declined due to more deep-seated structural changes. Using measures of technological innovation and structural changes we identify other possible explanations for the decline in the skill premium. We show that [...].

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1 Introduction

Since around the year 2000 most countries in Latin America have experienced a decline in income inequality. This stands in contrast to rising inequality in most OECD countries over the same period, as well as in contrast to rising income inequality in Asia, most notably China (see e.g. Atkinson et al., 2011; van Zanden et al., 2014). OECD economies, for instance, experienced a significant increase in income inequality over the past decade, with the Gini coefficient increasing from an average of 0.29 in the 1980s to 0.32 in 2010 (OECD, 2011). Over the same period the Gini coefficient declined from 0.54 to 0.48 in Latin America. While income inequality continues to persist on a high level in Latin America, it is not the highest in the world[1] and furthermore declining in contrast to other regions.

A growing literature has explored the determinants of income inequality in Latin America. The studies analyze how a continent that has been persistently unequal since the discovery by Columbus succeeded to change course. The Economist (2012) summarized the literature, outlining the two major reasons for the decline in income inequality as follows.

> First, the premium for high-skilled workers has been falling: a surge in secondary education has increased the supply of literate, reasonably well-schooled workers, and years of steady growth have raised relative demand for the less skilled in the formal workforce, whether as construction workers or cleaners. Second, governments around Latin America have reinforced the narrowing of wage gaps with social spending targeted at people with the lowest incomes. These include more generous pensions and conditional cash transfer schemes that offer payment to the poorest families in return for meeting specific conditions, such as making sure their children go to school.

This quotation claims that the skills premium declined as a result of successful expansion in the supply of higher skilled labor through good education polices, providing the major cause of the decline in income inequality (see Lopez-Calva and Lustig, 2010; Cruces et al., 2011; Vargas, 2012; Azevedo et al., 2013; Tsounta and Osueke, 2014). Evidence suggests that the skill premium has started to decline around the year 2000, after an expansion in schooling during the 1990s.

In table 1 we show recent estimates of the skills premium in Latin America (measured as the relative private return to tertiary education) that indicates a rise between 1992 and 2000 and a subsequent decline in most countries during the following decade.

It is argued, as the quotation states, that the decline in the skills premium has been the result of an expansion in education that raised the supply of higher skilled labor. As such Lopez-Calva and Lustig (2010, p.5) claim that 'in the race between skill-biased technical change and educational upgrading, in the past ten years the latter has taken the lead'.

[1] Income inequality in Sub-Saharan Africa and East Asia is higher.

Table 1: Percentage Changes in the Skills Premium

Country	1992 to 2000	2000 to 2012
Argentina	25.2	-25
Bolivia	32.4	-40
Brazil	8.5	-21
Chile	88.6	-11
Colombia		-19
Costa Rica	-2.2	12
Domican Republic		-15
Ecuador	9	-32
El Salvador		13
Guatamala		2
Honduras	-3.1	4
Mexico	15.6	-13
Nicaragua	15.2	-23
Panama		-20
Paraguay		-26
Peru		-11
Uruguay	11.4	-16
Venezuela		-8

Source: Authors' calculations based on data from Montenegro and Patrinos (2014).

The reference by Lopez-Calva and Lustig (2010) to skill-biased technological change (SBTC) refers to the broader literature on wage and income inequality wherein a major reason for the increase in the skills premium in many other countries has been explained by the effect of technological innovations since the early 1980s that raises the relative demand for skilled labor. What Lopez-Calva and Lustig (2010) thus claim is that the relative supply of higher skilled labor has exceeded the demand in Latin America over the past decade, causing a decline in the relative wages of higher skilled labor, i.e. the skills premium.

In this paper we take a critical look at this argument and ask why the skills premium has declined since 2000. We examine if the 'excessive' supply of the higher educated labor, or the changes in the demand for highly skilled labor, in the structure of Latin American economies and their integration in the global economy?

Our contribution lies not only in linking changes in the skills premium with patterns of industrialization and technological innovation, but in using novel data sets by Montenegro and Patrinos (2014) on comparable estimates of the skills premium (measured as relative returns to tertiary education) and by the ILO (2015) on demand for skills by level of education and cognitive task requirement of jobs, over the period 1992 to 2012.

The rest of the paper is structured as follows. In section 2 we present a conceptual framework, based on theory and a survey of the relevant literature for identifying the determinants of the skill premium. This framework allows us to derive an estimating

equation with which we can test some hypotheses as to why the skills premium declined in Latin America since the year 2000. In section 3 we outline the database and provide descriptive statistics to examine the relationship between the skills premiums, changes in the demand and supply for highly skilled labor, and the nature of structural changes in Latin America. In section 4 we present and discuss the results, identifying the determinants of returns to education in our sample of countries. The final section concludes with a summary and policy recommendations.

2 Conceptual Model

Our basic conceptual model that we use to explain changes in the skills premium in Latin America is based on the standard approach to explain wage or skills premia, outlined and explained for instance in Acemoglu (2003), Caselli and Coleman (2006) and Gerosa (2007).

We start by denoting GDP in our closed economy by Y, which is produced using total labor supply (L), total capital stock (K) and technology (A). We make a distinction between skilled (L_s) and unskilled labor (L_u) following the notation in Gerosa (2007), so that $L = L_s + L_u$. Writing output per worker as $y = \frac{Y}{L}$ we assume first a Cobb-Douglas production function specification between capital and labor (i.e. the elasticity of substitution σ between K and $L = 1$.

$$y = F(k, L_u, L + s) = k^{\alpha}[(A_u l_u)^{\sigma} + (A_s l_s)^{\sigma}]^{\frac{1-\alpha}{\sigma}} \tag{1}$$

With $0 < \sigma < 1$ and $l_u = \frac{L_u}{L}$ and $l_s = \frac{L_s}{L}$ and $k = \frac{K}{L}$.

Equation (1) $\frac{1}{1-\sigma}$ denotes the elasticity between skilled and unskilled labor. In a competitive equilibrium where wages (w) equal marginal productivity, we can calculate the skills premium as,

$$\frac{w_s}{w_u} = \frac{\partial F/\partial L_s}{\partial F/\partial L_u} = (\frac{A_s}{A_u})^{\sigma}(\frac{L_s}{L_u})^{\sigma-1} \tag{2}$$

Equation (2) shows that the skills or wage premium depends on the extent to which technology is skill-biased ($\frac{A_s}{A_u}$), as well as on the relative supply of skilled labor ($\frac{L_s}{L_u}$).

In particular, an increase in technology per worker will raise the productivity of high-skilled labor (and hence their wages) if $\sigma > 0$, and an increase in the relative supply skilled labor will reduce the skills premium as it leads to a substitution of skilled with unskilled labor.

Based on the assumption of a Cobb-Douglas production function between K and L, capital per labor does not enter into equation (2), since it presents an unrealistic assumption if the CSC indeed exists. As in Gerosa (2007) and Duffy et al. (2004) we can modify the Cobb-Douglas assumption to the more general Constant Elasticity of

Substitution (CES) production relationship that allows us to modify equation (2) to include capital per worker, as well as to include different elasticities of substitution between capital and skilled, and capital and unskilled workers. We can also model the complementarity between K and L assuming a CES aggregated (composite) production factor X as,

$$X = [bK^{\theta} + (1-b)L_s^{\theta}]^{\frac{1}{\theta}} \tag{3}$$

Where θ is the elasticity of substitution between capital and skilled labor and b the constant share parameter.

This allows us to re-write equation (2) as follows,

$$\frac{w_s}{w_u} = \frac{\partial F/\partial L_s}{\partial F/\partial L_u} = (1-b)(\frac{A_x}{A_u})^{\sigma}(\frac{L_s}{L_u})^{\sigma-1}(\frac{X}{L_s})^{\sigma-\theta} \tag{4}$$

Where σ is now the elasticity of substitution between capital and unskilled labor and A_x reflects the technological skill bias of the capital-skilled labor composite factor. Equation (4) indicates that an increase in capital per worker will increase the skills premium if $\sigma > \theta$, in other words if capital replaces with more facility unskilled compared to skilled labor.

So far our conceptual framework is outlined for a closed economy without trade. Given the discussion on the main suspects in driving inequality and the wage premium, it is important to allow for an open economy. Greater trade openness that defines the increasing globalization of the world economy has been identified as a potentially important driver of the skills premium, also in Latin American countries (see e.g. **??**). For instance, in the standard Heckscher-Ohlin (H-O) model of international trade liberalization trade is expected to increase the demand for a country's relatively more abundant factor, hence the H-O expectation is that trade liberalization will increase the demand for skilled labor in advanced economies where it is relatively more abundant, and increase the demand for unskilled labor in developing countries, where this is the relatively more abundant factor. Hence, trade drives the demand and wages for different types of labor and can be expected to reduce the skills premium in developing countries.

In practice, however, it was observed that trade liberalization actually increased the demand for skilled labor in both advanced and developing countries (see e.g. **?**). To explain this apparently counter-intuitive finding, Acemoglu (2003) proposed an open economy model of endogenous technological change. An important result from Acemoglu's (2003) model is that with technology endogeneity any increase in the proportion of skilled labor creates incentives for technological innovation (R&D) that in turn will raise the demand for skilled labor. This may mitigate or even reverse the decrease in the skills premium that is predicted from equation (4), hence even a positive relationship between the supply of skilled labor and the skills premium is possible, described as the outcome of a 'race between technology and education'. Trade liberalization can magnify this effect in this model and export SBTC from advanced economies to developing countries, as shown by Acemoglu (2003).

To include considerations of an open economy, we assume, following Acemoglu (2003), that $j+1$ countries exit (j developing countries and the United States, the world's technological leader). In each country there is, as before, skilled and unskilled labor, with relatively more skilled labor in the United States than in any of the developing country, i.e.

$$\frac{L_s^{USA}}{L_u^{USA}} > \frac{L_s^j}{L_u^j} for j = 1 \dots J \tag{5}$$

Skilled and unskilled labor is used to produce final consumer goods that are either skill- or labor-intensive, and that can be traded. Consumers obtain utility from consuming both types of goods, and assuming that consumption demand follows a CES aggregation, then the relative price of the skill-intensive good in country j can be written as,

$$\frac{p_s^j}{p_u^j} = \frac{1-\gamma}{\gamma}\left(\frac{C_s^j}{C_u^j}\right)^{\frac{-1}{\varepsilon}} \tag{6}$$

Where ε is the elasticity of substitution between skills-intensive and labor-intensive final goods (C_s and C_u). We assume that $C_s + C_u = Y$. This allows us to re-write equation (1) for the production of respectively skills and labor intensive goods. In an open economy, these goods can be internationally traded and developing countries can use technology adopted from the USA in the local production of skill-intensive goods. Pre-trade it should be recalled that equation (4) implies that the skills premium may be less in developing countries than in the United States. In the latter technology will be more skill-biased (as there are more skilled labor) and more capital per worker will be employed. With trade the relative price of skill-intensive goods depicted in equation (6) will increase as Cs increase globally. This will provide incentives for technological innovation that is further biased towards skilled labor. In an open economy, as opposed to a closed economy where the price of skill-intensive goods will differ across countries, prices of skill-intensive goods will equalize[2] - this will then also raise the demand for and supply of skilled labor, and use of skill-biased technologies in some developing countries. This is particularly the case if they are closer to the world (United States) technological frontier and have relatively more supplies of skilled workers compared to the rest of the world (Acemoglu, 2003, p.217).

Based on these considerations and the literature review we can now propose the following cross-country steady-state linear approximation to equation (4) (see Gerosa, 2007, p.9) with the potential effects of trade openness included,

$$ln\left(\frac{w_s}{w_u}\right)_{it} \approx C_{0t} + \beta_1 ln(L_s/L_u) + \beta_2 ln(S)_i t + \beta_3 ln(I)_{it} + \beta_4 ln(R)_i t + \beta_5 ln(T)_i t + \nu_{it} \tag{7}$$

Where S = measures of savings rate (real investment) to measure capital accumulation per worker (CSC); I = measures of the institutional environment that may capture

[2] Although the prices of skill-intensive goods will equalize, the wages may not, because advanced technologies may be used less productively in developing countries due to possibilities of being 'inappropriate' Acemoglu (2003, p.207)

barriers to capital accumulation; R = technological sophistication of the economy reflecting skill-biasedness of technological change; and T = measures of trade openness. Thus we see that the relative supply of skilled labor, capital, technology and trade will determine the skill premium and eventually income inequality. We expect $\beta_1 < 0$ and $\beta_2, \beta_4, \beta_5 > 0$.

The estimation of equation (7) still implies that technological innovation is exogenous. As per the discussion and the arguments set out in Acemoglu (2003) technological innovation depends also on the skills premium. To capture this interdependency it is appropriate to implement a 3SLS estimation of equation (7).

For the empirical analysis we use a three-stage least squares estimation (3SLS) for systems of simultaneous equations, that are typically used to estimate demand-and-supply models. In such models, some equations contain endogenous variables among the explanatory variables, for example 'price' that determines simultaneously the equilibrium quantity of supply and demand, the dependent variables of the two equations. It was first introduced by Zellner and Theil (1962), combining two-stage least squares (2SLS) with seemingly unrelated regressions (SUR). The equilibrium condition states that supply equals demand.

$$\text{Equilibrium condition} : \text{Quantity} = \text{Demand} = \text{Supply}$$

The estimation then occurs in a three step approach:

Step 1. Development of instrumented values for all endogenous variables in the equations. These instrumented values can simply be considered as the predicted values resulting from a regression of each endogenous variable on all exogenous variables in the system. This stage is identical to the first step in 2SLS and is critical for the consistency of the parameter estimates.

Step 2. Receipt of consistent estimates for the covariance matrix of the equation disturbances. These estimates are based on the residuals from a 2SLS estimation of each structural equation.

Step 3. Performance of a GLS-type estimation using the covariance matrix estimated in the second stage and with the instrumented values in place of the right-hand-side endogenous variables.

In our analysis the quantity is defined by the share of the labor force with tertiary education, and by government expenditure in tertiary education. The price is represented by the returns to tertiary education (RTE), and presents the equilibrium condition between supply and demand of highly skilled labor (HSL).

The two separate equations can be defined as,

$$\text{Demand of HSL} = \beta_0 + \beta_1 \text{RTE} + \beta_{2\ldots n} X_{2\ldots n} + \epsilon \tag{8}$$

$$\text{Supply of HSL} = \beta_0 + \beta_1 \text{RTE} + \beta_{2\ldots n} Z_{2\ldots n} + \epsilon \tag{9}$$

The important statistical implication is that "returns to tertiary education" is not a predetermined variable and that it is correlated with the error term of both equations. Demand for higher education is determined by the price of highly skilled labor, but supply is equally determined by expected returns to tertiary education.

1) wage = f(tech, structural change)
2) tech = f(wage, structural change)
3) struc = f(wage, techn)

3 Data and Descriptive Statistics

3.1 Data

Analyses of the role of the skills premium on income inequality have tended to rely on Mincerian estimates of returns and survey data on Gini-coefficients using data that suffers from potential lack of comparability. In this paper we use a new internationally comparable dataset on returns to education provided by Montenegro and Patrinos (2014) and Milanovic (2014) 'all the Gini's dataset' that provides a set of coefficients better comparable across countries and over time.

Table 2: Data Sources and Variables

Data Source	**Measure**
World Development Indicators	Income Level Classification, GDP Per Capita, Unemployment Rate, Oil Rents, Start-Up Cost, Trade Share, Top and Low 10 Percent Income Share, Expenditure in R&D, Number of Researchers and Technicians, Manufacturing Exports, High-Technology Exports, Tax Revenues, Value-Added in Manufacturing
Montenegro and Patrinos (2014)	Returns to Education, Returns to Tertiary Education
All the Gini's (Milanovic, 2014)	Gini Coefficient
WIPO	Number of patents

Based on the data availability by Montenegro and Patrinos (2014), we selected 20 countries in Latin America for the analysis, providing a representative picture of the region.

While the data information on the returns on education is the most comparable and complete that so far exists, it still has a number of limitation. Due to the availability of labor survey information the variable only takes the wages of formal employees into account. The variable is therefore not representative of the complete labor force, especially in developing countries, where a large share works in the informal sector. Furthermore self-employed workers, unpaid family members and similar, more vulnerable jobs are not included in the variable.

3.2 Descriptive Statistics

We use the data set to summarize a number of key patterns and trends relating to the skills premium, and educational attainment in Latin America over the period 1992 to 2012. Our interest is ultimately in determining patterns of changes in the skills premium in Latin American countries and the determinants of the post-2000 decline therein.

In section 2 we have noted that the relative supply of skilled labor is one important determinant of the skills premium. Many scholars consider improvements in educational attainment in Latin America since the 1990s as being primarily responsible for the decline in the skills premium. Hence we note in this section the extent of these improvements. We also summarize other key determinants of skills premium as contained in equation (7).

3.2.1 Supply of and Demand for Skilled Labor

For nineteen Latin American countries for which data is available, we calculated the changes in the supply and demand for skilled labor over the period 2000 to 2010, when the skills premium declined in most countries. We expect a priori that, if the hypothesis of 'good educational policies' are correct, that we would see at least that increases in the supply of skilled labor outstrip increases in the demand for skilled labor.

We define 'highly skilled labor' as labor that has completed at least tertiary education. We then calculate changes in the supply of skilled labor as changes in the ratio of the proportion of the population older than 15 years of age with a completed tertiary education to the proportion of the population with only a secondary education. This gives an indication of the relative size of the change in highly-skilled labor supply and is directly comparable to our measure of the skills premium, which is the rates of return to tertiary education relative to secondary education. It is also more comparable to measures of the wage premium used for instance in the USA, based on rates of return to college education to secondary school education. Data on these proportions of the population are obtained from Barro and Lee (2010) and is available in 5-years intervals from 1950 to 2010.

From these we find that for Latin America as a simple population unweighted averages the supply of labor by different level of education (primary, secondary and tertiary) completed over the period 1950 to 2010 reflects the following.

First, between 1950 and 2010 the most significant increase in educational attainment share has been on secondary level where the percentage of the population that completed a secondary education increased from 2.6 percent in 1950 to 26 percent in 2010. Tertiary education also expanded, with the share of the supply of labor that completed such level of education increasing from 0.7 per cent in 1950 to 6.4 percent by 2010.

Second, most of the increase in the labor supply with a tertiary education occurred between 1990 and 2000 (and not 2000 and 2010 when the skills premium declined) when

tertiary education completion rates grew by 32 per cent over the period; in contrast the growth rates in the proportion of the labor supply with tertiary education completed was only 13 percent between 2000 and 2010 (three times slower than the preceding period). Also, the ratio of the supply of labor with a tertiary education to the supply of labor with a secondary education actually declined between 2000 and 2010 from 0.29 to 0.25 a relative decline of around 16 percent. Hence we can conclude that the most rapid expansion in tertiary education occurred in the decade before the decline in the skill premium but that the skill premium declined at the same time that the relative supply of labor with tertiary education to secondary education declined most, between 2000 and 2010.

We measure the demand for skilled labor as the shares of the labor force in actual employment per skill categories. The ILO (2015) published internationally comparable estimates of the employment per low, medium and high skills as well as employment per routine and non-routine cognitive and non-routine manual type of jobs from 1991 to 2012. We calculate changes in the demand for skilled labor as the percentage change in the ratio of the proportion of the labor force with high-skills to medium-skills and also as changes in the ratio of the proportion of the labor force in cognitive non-routine jobs to routine jobs.

From these we find for Latin America on average that in 1991 65.4 percent of the demand for labor was for medium-skilled labor, 19.1 percent for low-skilled labor and 15.4 percent for high-skilled labor. By 2000 this had changed to respectively 62.8 percent, 19.8 percent and 17.6 percent. This indicates that during the 1990s the demand for high skilled labor grew by 19 percent, that the demand for low-skilled labor grew very slightly, but that the demand for medium-skilled labor contracted (by 4 percent). Between 1991 and 2000 the demand for jobs with routine tasks declined by 1 percent and the demand for jobs requiring cognitive, non-routine skills increased by 13 percent. This is evidence of mild labor market polarization in Latin America, a potential cause of wage and income inequality.

In contrast to the period 1991 to 2000 when the demand for high-skilled labor grew fast, the demand growth slowed down during the 2000s. Between 2000 and 2010 the demand for high-skilled labor grew by only 6 per cent, but the demand for jobs with cognitive, non-routine tasks by 13 percent. However the demand for medium-skilled labor was basically constant (grew by only 1 percent) while the demand for low-skilled labor contracted by 8 percent. Hence the period that saw overall declines in the skill premium were a period of faster growth in the relative demand for high-skilled labor and for jobs with non-routine, cognitive requirements. Taken together with the finding reported in the previous paragraph that the relative supply of high-skilled labor declined during this period, it is puzzling that the skills premium declined over this period. There is little evidence based on these findings, of an excess supply of high-skilled labor in Latin America.

We summarize our findings on the demand and supply of high-skill labor in Latin America per country in table 3. This table summarizes the salient features since 2000, the period when income inequality started to decline most significantly.

The table shows that the relative supply of skilled labor declined in almost all countries

Table 3: Changes in the Supply of and Demand for Skilled Labor and of the Skills Premium

Country	**Demand for High-Skilled Labor (% change) (1)**	**Demand for High-Skilled Labor (% change) (2)**	**Supply of High-Skilled Labor (% change)**	**Skills Premium (% change)**
Argentina	-21	-14	-27	-12
Brazil	16	40	-4	-17
Bolivia	59	52	184	
Chile	25	36	-47	-11
Colombia	20	16	74	-16
Costa Rica	20	20	-1	12
Dominican Republic	24	17	-69	-6
Ecuador	21	23	-52	-21
El Salvador	-3	-3	-69	13
Guatemala	25	21	-100	-23
Honduras	12	17	-39	5
Jamaica	30	38	-2	
Mexico	-25	-17	23	-13
Nicaragua	31	45	-23	-23
Panama	0	2	-9	-21
Paraguay	10	10	-24	-27
Peru	28	21	-60	-8
Uruguay	5	7	-36	2
Venezuela	19	9	-55	-8

Source: Authors' compilation based on the Barro and Lee (2010), ILO (2015) and Montenegro and Patrinos (2014)
(1) Estimates based on the ILO's employment per skill level.
(2) Estimates based on the ILO's employment per job requirement of cognitive vs non-cognitive skills.

in Latin America between 2000 and 2010, with the exceptions of Bolivia, Colombia and Mexico. The largest declines can be found in Guatemala, the Dominican Republic, El Salvador and Venezuela. In contrast, the relative demand for skilled labor increased in almost all countries with the exceptions of Argentina, Mexico and El Salvador.

Considering the patterns of demand and supply of skilled labor, we can concluded that the hypothesis that the increase in the supply of skilled labor (as a result of good education policies) during 2000 and 2010 lead to a decrease in the skills premium over the same period may only be valid in the cases of Colombia, Costa Rica, El Salvador, Honduras, Mexico and Uruguay. Only here do we see movements in demand and supply that is consistent with a decline in the skills premium. In the majority of countries the skills premium declined despite declining supply and increasing demand for skilled labor.

3.2.2 Technological Innovation, Capital Deepening and Structural Transformation

3.2.3 Trade Openness and Quality of the Institutional Environment

The elite extraction of the 'surplus' in Latin America was done more ruthlessly and efficiently by the new colonial elites (Williamson, 2009). This involved also unequal ownership of land, with globalization rapidly increasing the returns of land in Latin America after 1870 (Morley, 2001). Lack of access to educational opportunities and high wages for skilled workers have also been noted and is consistent with an elite-dominated society wherein inherited circumstances would limited the opportunities for the majority of the population to improve their incomes and wealth (Lopez-Calva and Lustig, 2010; Ferreira and Gignoux, 2011).

Recent estimates from Latin America indeed suggests that inequality of opportunity still remains important: Ferreira and Gignoux (2011) calculates measures of inequality of opportunity for Brazil, Colombia, Ecuador, Guatemala, Panama and Peru and determines that between 25 and 50 percent of consumption inequality is due to inequality of opportunity as reflected in inherited life circumstances.[3]

Many scholars have presented arguments those substantial increases in social spending (e.g. large-scale conditional cash transfer schemes) and labor market reform (Lopez-Calva and Lustig, 2010; Cornia, 2012) has been responsible for the decline in inequality. On the latter policies and also on the role of changes in terms of trade and FDI there is however no strong agreement (see Vargas, 2012; Tsounta and Osueke, 2014) and the impacts are also quite different across countries.

Finally, a better institutional and policy environment has facilitated more robust growth, benefitting proportionately more the poorer households. For instance, the average growth rate in income or consumption of the poorest 40 percent of the population was approximately 5 percent, which was significantly higher that the growth rate in incomes or consumption of the total population of approximately 3 percent.

4 Results

Analyses of the role of returns to education on income inequality have so far relied on Mincerian estimates of returns and survey data on Gini-coefficients using data that suffers from potential lack of comparability. In this paper we use a new internationally comparable data set on returns to education provided by Montenegro and Patrinos (2014) and Milanovic's (2014) "all the Gini's dataset" that provides a set of coefficients better comparable across countries and over time.

[3] Their index of equality of opportunity is constructed on the basis of circumstances over which an individual has little control such as gender, ethnicity, father and mother's education and occupation and region of birth (Ferreira and Gignoux, 2011).

4.1 Estimators

4.2 Descriptive Statistics

5 Concluding Remarks

This paper analyzed the relationship between inequality, structural change and the returns to education, to answer the question if [...]. Based on our results, we conclude that [...]. In the remaining section we first summarize the findings, before discussing policy implications in the second part.

The decline in income inequality in much of Latin America since around 2000 has been explained as a result of the decline in the skills premium across countries over the same period. In this paper we explored the patterns and determinants of the skills premium in Latin America over the period 1992 to 2012. In particular we critically analyzed whether the skills premium declined because of an increase in the supply of skilled labor, widely claimed in the literature as the outcome of improved education policies in the continent since the 1990s.

Using a novel data set that provides comparable measures of the skills premium in the form of private rates of return to tertiary education, we estimated the determinants of the skill premium in Latin America using panel data and three stages least squares methods. We found that for the period after 2000 when the skills premium and income inequality declined there is little evidence of excess supply for skilled labor, the exceptions being Colombia, Costa Rica, El Salvador, Honduras, Mexico and Uruguay.

These findings imply that for the skills premium to have fallen as it did, that the relative productivity and wages of skilled labor must have declined due to more deep-seated structural reasons. This conclusion is strengthened by the fact that what has been notable about the decline in the skills premium (and income inequality) in Latin America since 2000 is that it have been across most countries with few exceptions. This has posed an interesting puzzle, because, these declines were in in 'fast-growing countries [...] and slow-growing countries [...] macro-economically stable countries [...]. and countries recovering from crisis; in countries with large indigenous groups and countries with a low share; in countries governed by leftist regimes [...] and in countries with a historically exclusionary state' (Lopez-Calva and Lustig, 2010, p.1,2).

The observation that the the skills premium and inequality declined simultaneously in countries with such differing sets of policies, institutions and histories suggest that the reasons for the decline could lie in more deep-seated structural and demographic changes that affected labor markets, and wages (a major determinant of incomes) across most countries of the region irrespective of their institutional environments. This is not however to deny that policies and institutions did not play any role in reducing (or increasing in some cases) the skills premium and income inequality, such as social policies, minimum wages and policies that promoted inclusive growth. We offered two possible

and interrelated explanations for the further decline in the skills premium.

First, Latin America has experienced patterns of structural change (including de-industrialization) that has reduced poverty and unemployment but increased vulnerable employment in sectors that are not dynamic. The region is a textbook case of de-industrialization, which largely took place during the 1970s to 1990s, when as a result first of an oil boom and then a debt crisis, followed by fiscal retrenchment and the 'lost decade' of the 1980s, resulted in a contraction in the share of industry in employment in value added. Since the early 1990s however, the share of industry has remained fairly constant, with the share of agriculture declining and the share of services increasing. The latter however, although offering more productive employment that agriculture, does not offer many opportunities for further productivity growth, and indeed many employment opportunities in services are in low-productive, vulnerable types of occupations. As a result, while poverty has been reduced and low-skilled wages improved (also as a result of better minimum wages and other labor protection measures) the patterns of structural change has resulted in a relative decline in the demand for highly skilled labor. As a result, the rate of return to tertiary education has declined in most countries.

Second, Latin America seems not to have experienced the same degree of labor market polarization as took place in high-income OECD countries. In the latter countries, labor market polarization has been a major explanation for rising income inequality. In essence it is argued, technological advanced particularly in industry has made automation of routine-tasks much easier and cheaper, and hence there has been a hollowing-out of the skills composition of the labor force, which could mean that even if returns to tertiary education (high-skills) decline, if the middle skills demand is eroded, and the wages of low-skilled workers decline (as a result of having to compete with medium skilled workers than have climbed down the occupational ladder) then income inequality would still rise. This seems however not to have taken place in Latin America.

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A Data Manipulation

Data on returns to education were extracted from Montenegro and Patrinos (2014), and in the cases where information for a single year was reported more than once (due to different survey sources), the average value was calculated and imputed.

Furthermore all variables were interpolated, using the STATA command "ipolate", where the missing value is replace by a linear interpolation of the yvar on xvar for missing values of the yvar. The missing values were not extrapolated beyond the data range.

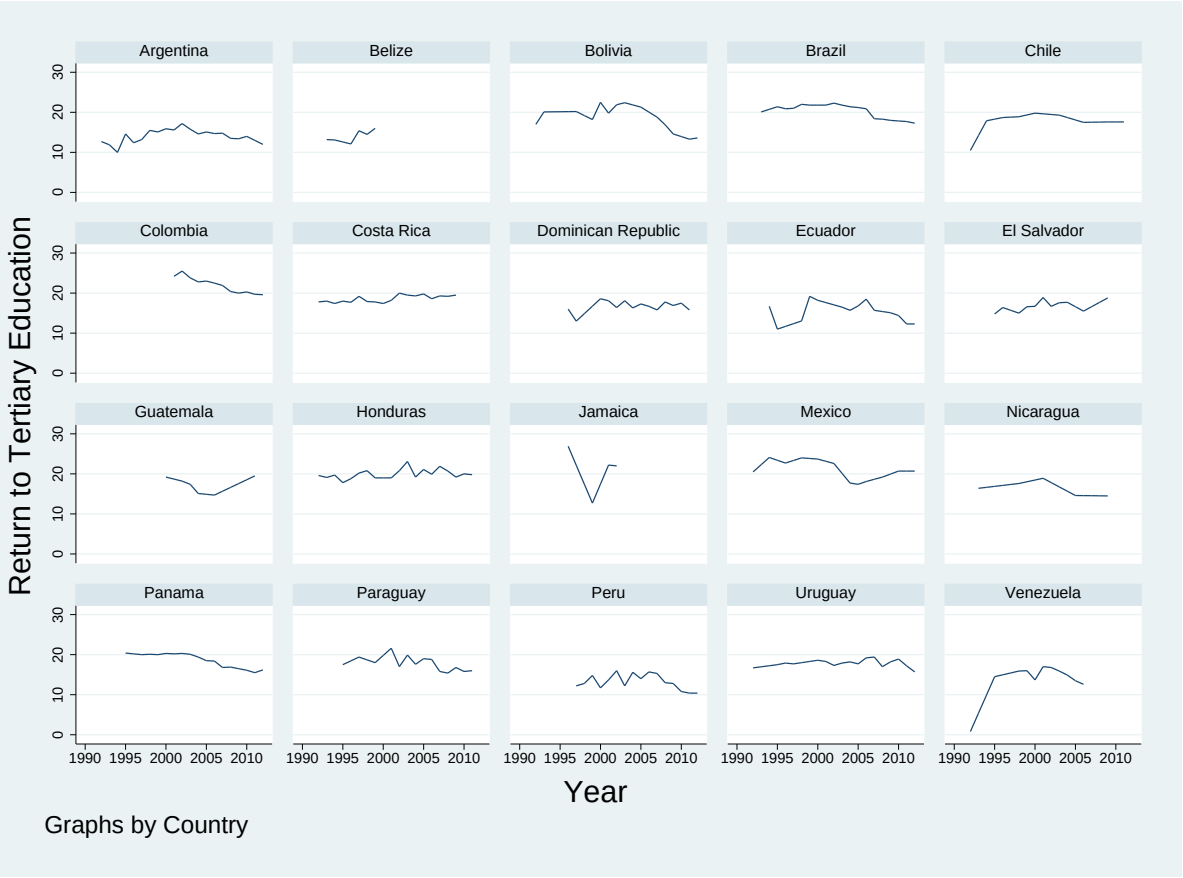
B Variable Information

Definition of Variables

Country	Country name
Employment in Manufacturing	Percent of total employment in manufacturing
Trade Share	Trade share (in percent of GDP)
Gini	Gini coefficient (from 0 to 100)
GDP per Capita	GDP per capita (in 2005 constant USD)
High-tech Exports	High technology exports (in percent of manufactured exports)
Income	World Bank classification of income level In Latin America countries are classified as either lower middle, upper middle or high
Low 10 Share	Income share of low 10 percent
Manufacturing Exports	Manufacturing exports (in percent of merchandise exports)
Oil Rents	Oil rent (in percent of GDP)
Patents	Number of patents (per million people)
Population	Total population of the country in a specific year
R&D	Investment in R&D (in percent of GDP)
Researcher	Number of researchers (per million people)
Returns to Education	The returns to education were calculated using OLS The dependent variable is the log of net wages, the main independent variable the returns to education, and covariates experience and experiences squared This calculation was also used for the other variables on the returns to degrees
Returns to Primary Education	Returns to primary education as compared to someone without
Returns to Secondary Education	Returns to secondary education as compared to someone with primary education
Returns to Tertiary Education	Returns to tertiary education as compared to someone with secondary education
Share Tertiary	Labor force with tertiary education (in percent of total labor force)
Start-Up Cost	Cost of starting a new enterprise (in percent of average income)
Tax Revenue	Tax revenue (in percent of GDP)
Technician	Number of technicians per million people
Top 10 Share	Income share of top 10 percent
Unemployment Rate	National unemployment rate (in percent)
Value-Added in Manufacturing	Value-added in manufacturing (in percent of GDP)
Year	Year of data information (from 1992 to 2012)

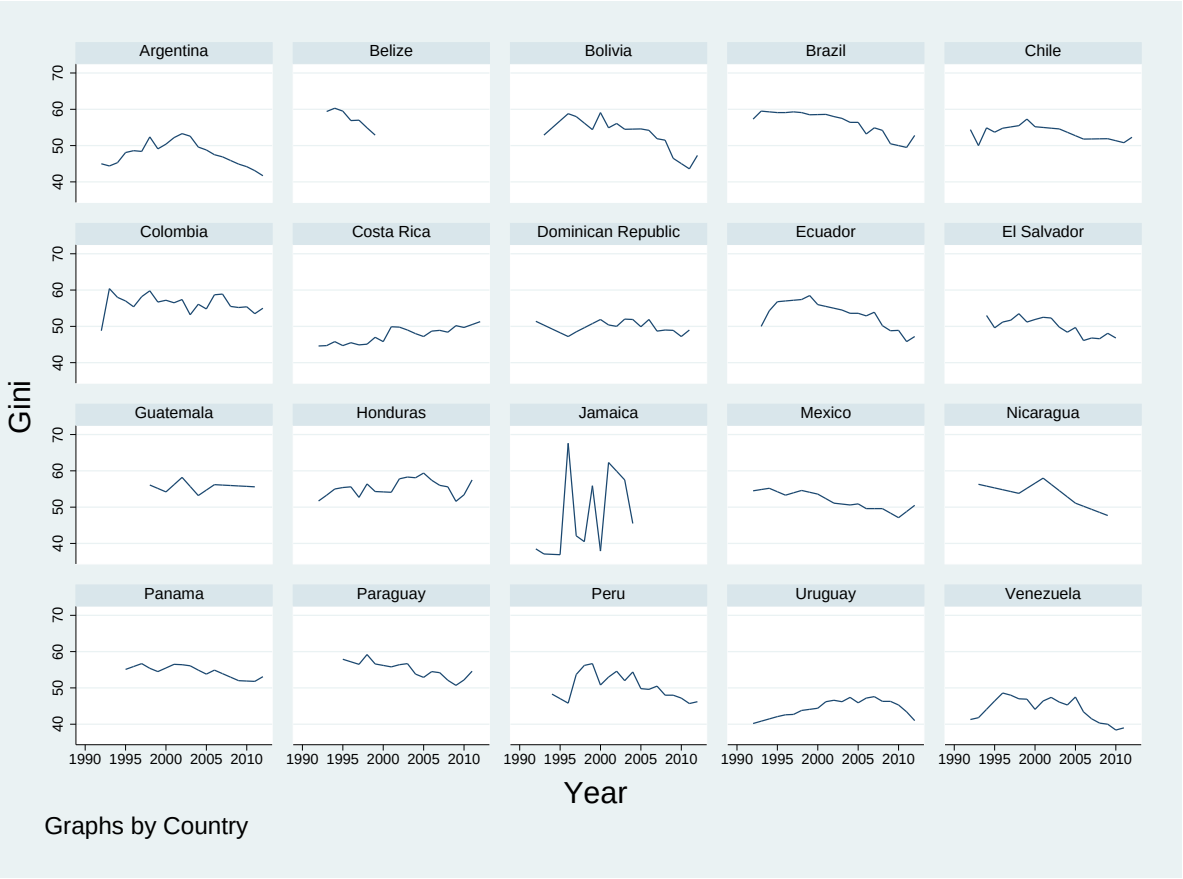
C Additional Graphs

Figure 1: Returns to Tertiary Education in Latin America, 1992 to 2012



Source: Authors' calculations based on Montenegro and Patrinos (2014).

Figure 2: Gini Coefficient in Latin America, 1992 to 2012



Source: Authors' calculations based on Milanovic (2014).