What changes the skill premium in South America?

¿Qué cambia la prima de calificación en América del Sur?

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Abstract

In this article, it is analyzed which variables limit the reduction of inequality in South America, as measured by the skill premium, in the period of economic stagnation 2016-2019. It considers the variables that explain the decline in inequality in the region in 2002-2015 and applies a generalized ordered Probit model to identify which variables would be limiting its reduction in 2016-2019. The results show that governance, human capital, and productivity are the dimensions that most affect the ability of countries in the region to reduce their skill premium.

Keywords: inequality, skill premium, governance, human capital, productivity.

JEL: D63, E24, J0, I3, O4.

Resumen

En este artículo, se analiza qué variables limitan la reducción de la desigualdad en Sudamérica, medida por la prima por habilidad, en el período de estancamiento económico de 2016-2019. Se consideran, para ello, las variables con las que se explica en la región su disminución en 2002-2015 y se aplica un modelo de Probit ordenado generalizado para identificar cuáles estarían limitando su reducción en 2016-2019. En los resultados, se muestra que la gobernanza, el capital humano y la productividad son las dimensiones que más inciden en la capacidad de los países de la región para reducir su prima por habilidad.

Palabras clave: desigualdad, prima por habilidad, gobernanza, capital humano, productividad.

JEL: D63, E24, J0, I3, O4.

1 Introduction

High rates of inequality are a structural and historical characteristic of South America (SA), the most unequal region of the world (Bárcena *et al.* 2016a, 2016b). In 2002-2015, and for the first time in its history, South American inequality decreased steadily, while in the world it increased. Despite in this period it reduced until 10 percentage points, it continuous being the most inequal region in the world. In 2016-2019, a period of economic stagnation, or even decline, inequality has been stable.

The income inequality per decile reduction in 2002-2015 is highly explained by the labor income inequality. In turn, it is directly related by the skill premium decreased. The skill premium is the ratio between the wages of skilled and unskilled workers. Unskilled workers have at most started secondary education, and skilled workers have at least completed secondary education.

In this research, it is examined the limits of the South American countries to decline their skill premium in 2016-2019. The countries considered are Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, and Peru. This work is focused in 2016-2019, because the development economics literature devoted to periods of stagnation is the scarcest, despite its conclusions should be fundamental to design public economic policies.

To identify the more important limits to reduce skill premium in 2016-2019 in SA, we attend to the determinants of the skill premium reduction in 2002-2015 identified in the related literature. They are included in eight dimensions that are education coverage, education results, digitalization and communication, trade, raw materials, productivity, labor market and governance. In each case we identified the most important variables and constructed each one of the dimensions.

After building the dimensions, we apply the jumping clusters methodology of Izquierdo *et al.* (2016). It is based on the generalized ordered Probit (GBP) model. We classify 57 countries[1] attending their skill premium in 2016-2019 in three clusters. Eight of these countries were from SA. The number of clusters, of three, is defined using the elbow method. The countries were classified by high, middle, and low-skill premium. Cluster 3 includes the countries with the lowest skilled premium, while cluster 1 represents the highest skill premium. In the low-skilled premium cluster (3) are Bolivia, Paraguay, and Ecuador; in the middle-skill premium cluster (2) are Argentina and Colombia and, in the high-skill premium group (1), are Brazil, Chile, and Peru. After this, we calculated the probability of the South American countries considered to move from one cluster to another.

1 The countries included in the sample are: Argentina, Australia, Austria, Belgium, Benin, Bolivia, Brazil, Bulgaria, Cambodia, Chile, Colombia, Costa Rica, Croatia, Czech Republic, Denmark, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, France, Germany, Ghana, Greece, Guatemala, Honduras, Hungary, India, Indonesia, Kazakhstan, Kenia, Latvia, Lithuania, Mexico, Mozambique, Netherlands, Nicaragua, Niger, Pakistan, Paraguay, Peru, Poland, Portugal, Russia, Rwanda, Senegal, Slovakia, South Africa, Spain, Sri Lanka, Tanzania, Togo, Turkey, Ukraine, United Kingdom, United States, and Vietnam.

The estimation shows that the dimensions that could help the SA countries in cluster 1 (high-skill premium) «to jump» to cluster 2 are education results, productivity and digitalization and communication. Low levels in these three dimensions would limit the possibility of reaching cluster 2 and being in the group with the lowest levels of skill premium. In contrast, the international trade conditions and the governance quality dimensions decrease the likelihood of promotion to the next cluster. For the SA countries in cluster 2 (medium-skill premium), education and productivity dimensions would help them «to jump» to the cluster 3. The governance quality is limiting their possibility to reduce its skill premium. Variables traditionally linked to the reduction of inequality in the region, such as the price of raw materials or the conditions of the labor market, are not relevant in this comparative analysis.

The rest of the document is structured as follows. In the second section, it is analyzed the theoretical and empirical literature that tries to explain why the skill premium declined in 2002-2015. In the third section, it is presented the statistical and econometric analysis implemented to identify, in a context of limited public budget, the dimensions on which the public sector should prioritize to reduce inequality. In the fourth section, it is described the results obtained. Finally, we present the conclusions.

2
Framework

In Figure 1, it is showed the evolution of the Gini Index in five medium and low-income regions in 2002-2019. It shows how SA

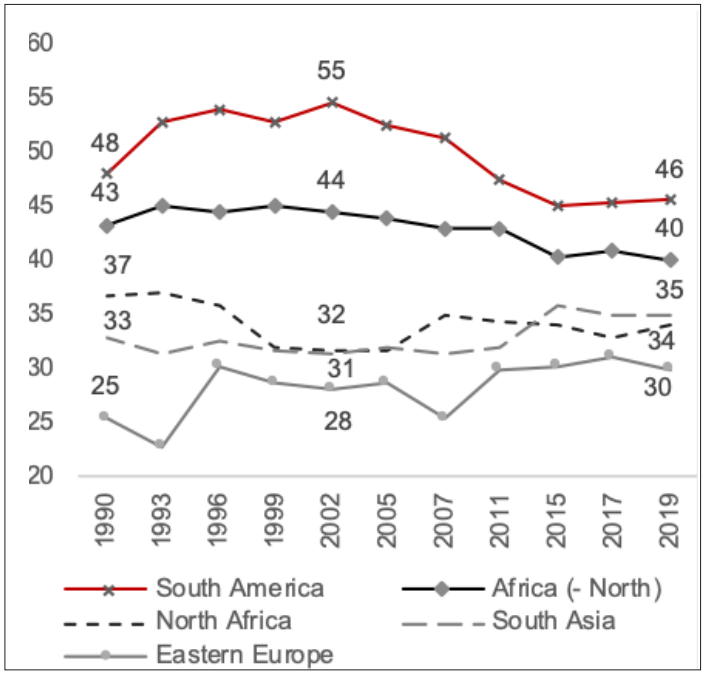


Figure 1
Gini Index by regions
Source: own elaboration, based on the World Bank (World Bank 2020).

has been experienced the most important decrease of the income inequality of the development regions in 2002-2015, after decades of increase. After that, it has remained stable until 2019.

Between the 50 and 70 % of the decrease in income inequality experienced in SA in 2002-2009 is due to a reduction of inequality of labor income (Alejo *et al.* 2014, Azevedo *et al.* 2013, Helfand *et al.* 2009). Labor income inequality had a direct relationship to the skill premium (Olarte *et al.* 2021). The skill premium is the ratio of the wages of skilled to unskilled workers. Unskilled workers have at most started secondary education, and skilled workers have at least completed secondary education.

Figure 2 shows the similar behavior of the Gini Index, the Labor Gini Index and the Skill Premium in 2002-2019 in SA. As the Gini Index, also the Labor Gini Index and the Skill Premium decreased in 2002-2015, having a similar behavior. In 2016-2019 the three index remain stables.

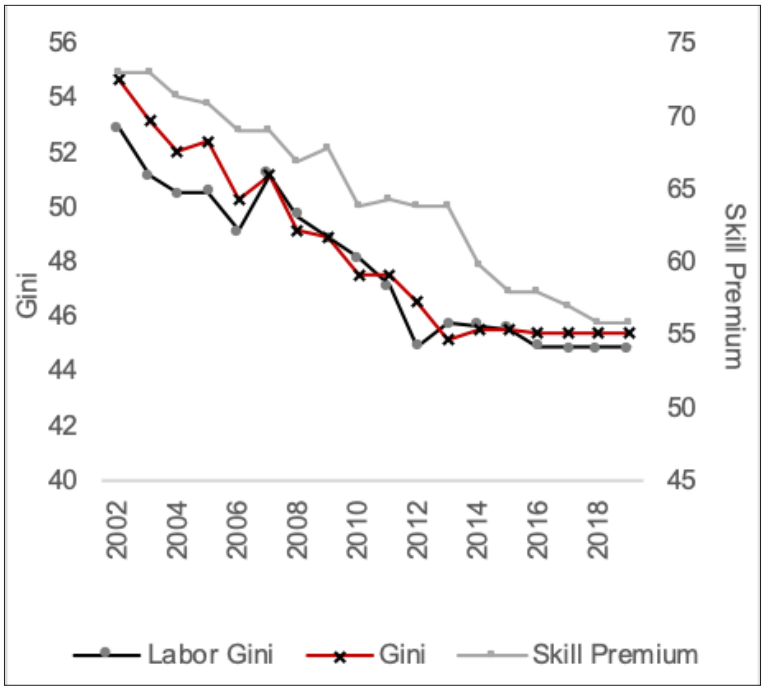


Figure 2
Gini index, Labor Gini Index and Skill Premium, South America
Source: own elaboration, based on the World Bank (2020).

Extensive literature has deep into the variables that influence the skill premium in 2002-2015. The study of the skill premium allows to better identify the variables related to the labor market that are impacting on inequality (Fernández & Messina 2018, Azevedo *et al.* 2013, Lustig *et al.* 2013, Gasparini & Lustig 2011).

From the supply side of the labor market, the most explored variables have been education coverage, education results and digitalization and communication. The contribution of these three dimensions to human capital in the lower deciles increases their productivity and consequently, their wages. Therefore, they were

having a negative relationship with the skill premium. The better the human capital, the lower the skill premium.

The increase of the number of skilled workers because of the growth of access to education in the eighties and nineties reduced the skill premium in the XXI century (Inchauste *et al.* 2014, Gasparini & Lustig 2011, Gasparini *et al.* 2011). It was due the promotion of the children's education in their early years and the support to the completion of primary and secondary improved the skills of the workers with the lowest capabilities (Busso *et al.* 2017). The impact of education on human capital also depends on its quality. Improving quality education in the lowest grades increases the possibilities to have better wages (Hanushek & Woessmann 2011, Beyer 2005) and, consequently, reduces the inequality gap (Manacorda *et al.* 2010, Zhang 2005).

Several papers find a positive association between the Information and Communication Technologies (ICTs) and human capital. The improvement of the use and access to computers shows a positive impact on the increase of low-skill workers capabilities and, in the case of students, in the results of their exams (Carrillo *et al.* 2011, Banerjee *et al.* 2007, Fairlie 2005, Turcotte & Rennison 2004). As a consequence, the access to ICT reduces the income gap between skilled and unskilled workers (Cowen 2014, Kharlamova *et al.* 2018).

The positive effect of human capital on the reduction of skill premium and, therefore, the income inequality is due to its positive influence on labor productivity (Schultz 1961). As the wage is a payment for the aggregate value that a worker could add, the higher is this value, the better is the wage. As a consequence, workers should be categorized and remunerated according to their productivity (Doeringer & Piore 1985). These arguments have been reflected in several theoretical models to assess the relationship between human capital and inequality, where an inverse relationship is found because the technological-knowledge bias towards high-skilled human capital (Afonso & Gil 2013, Benabou 1994). Related empiric literature confirms the positive impact on labor productivity of the improvement on education (Banco de Desarrollo de América Latina 2016, De la Fuente 2011), as well as digitalization and communication (Najarzadeh *et al.* 2014, Bresnahan *et al.* 2002, OECD 2004, Brynjolfsson & Hitt 2000).

From the demand side, the more explored dimensions in the economic literature that tries to explain the skill premium reduction in 2002-2015 are trade rules and the raw materials prices.

Attending to the decrease of the barriers to trade, its impact on the skill premium is linked to contextual factors such as the structure of the economy of the partner countries, or the national economic policy of the moment (Esquivel & Rodríguez-López 2003, Ferreira *et al.* 2007). In general terms, the trade openness can reduce skill premium if the Heckscher-Ohlin theorem is verified. The

trade increase would suppose a rise of the demand of goods and services with little added value, the most important exports, but a decline in the demand of national goods and services with high added value. As a consequence, the skill premium would decrease (Robertson 2004, Gonzaga *et al.* 2002). In addition, skilled wages could also decrease if the commercial opening reduces the price of capital goods, complementary to skilled labor (Cañonero & Werner 2002). Gasparini *et al.* (2011) and Galiani *et al.* (2010) found a negative relationship between the terms of «trade» and the «skill premium». Their findings suggest that positive terms of «trade» favoring the non-tradable at the expense of the tradable sectors leads to a decrease in the skill premium in the case where the non-tradable sectors are significantly more intensive in low-skilled labor.

The rise into the income of the lowest deciles in SA is also explained by the increase in commodity prices, specially the crude oil (Alvaredo & Gasparini 2015, Guerra-Salas 2018). The growth of the terms of «trade» increases specially the demand of non-tradable goods and services, both private and public, and intense in unskilled labor. In addition, if the terms of «trade» increases, the political and social context tends to be more favorable to accept reforms to improve the institutionally to reduce wage inequality in the labor market through better and reinforced rules (Gasparini & Lustig 2012).

Both the commercial opening and the price of raw materials are directly related to the amount of income to acquiring more and better capital. Capital productivity is negatively related to premium skill. As in the case of labor productivity, the higher the productivity of capital, the lower the skill premium.

Although both the supply and demand side factors have been treated as a fundamental input of productivity, it includes other variables that merit consideration as a fundamental dimension for understanding changes in skill premium. The work of Olarte and Sosa (2020) explains how unskilled wages a stronger relationship with productivity than skilled wages, which allow them to confirm that the increases of productivity are more explained by the improvements of the unskilled workers capabilities, by supply or demand reasons, which would explain why they improve their payment and reduce the skill premium.

In addition to the labor market supply and demand variables related to productivity, there are two dimensions that have been widely addressed in the literature that have tried to explain the reduction in inequality in the period 2002-2015. They are those related to the dimensions of labor market form and the governance quality.

Attending to the structure of the labor, the economic sectors with high capital accumulation have the largest wage gaps because they need more skilled labor (Acosta & Gasparini 2007, Pavcnik 2003). In this sense, increasing the non-tradable economic sectors such as construction, transportation and storage, promoted the de-

cline in skill premium in several South American countries during the 2000s, in contrast to the effect of the delay of tradable sectors such as manufacturing and agriculture (Guerra-Salas 2018). An evaluation carried out for Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela suggests that the skill premium reached its peak during the decade of 20's, coinciding with the increase in the participation of the industry, and establishing a relationship between these two variables (Astorga 2017). In the same direction, De la Torre *et al.* (2012) suggest that the relocation of the workforce from manufacturing and agriculture to services implied a reduction of the skill premium within the region.

Attending to the minimum wage (MW) increases, while the World Bank (1995, p. 75) argues that «[…] MWs may help protect the poorest workers in industrialized countries, but clearly do not do so in developing countries», for the International Labour Organization (ILO), «MWs are a labour market policy instrument with an important potential to reduce poverty» (Van der Hoeven & Rodgers, 1995).

The divergence between the two proposals stems from the uncertainty about who would benefit from an increase in the MW in the region. To reach the lowest deciles, it is necessary that the MW increase does not harm the employment of the most disadvantaged groups, and that its effect reaches families with the lowest incomes, even considering the levels of self-employment and informality (International Monetary Fund 2019). The first constraint for this to happen is the potential increase in unemployment, a risk that would affect all countries. The second is that the increase in the MW will not reach groups living in poverty, due to the levels of self-employment and informality, which are typical of developing countries.

Regarding the possible impact on employment, economic theory oscillated between the extremes, and finally reached a consensus on the idea, albeit from different paradigms, that the result on employment will depend on the context (Herr 2009).

Neumark *et al.* (2006) conducted several regressions by deciles in Brazil for the period 1996-2001 and observed that, as the decile decreases, the impact of MW reduces until it disappears in the lowest deciles. Saget (2001) also applied regressions in Latin American countries to confirm that, as the decile decreased, the effect of the MW on income minimized to almost zero. Arango & Pachón (2004), in Colombia, apply a panel model to conclude that the MW affected the intermediate deciles, which might be in poverty, but as the decile went down the impact was reduced, until it was also eliminated.

In terms of possible causes, related analyses show that the increase in the MW would be destroying employment, although in contexts of growth or stagnation, the effect could be smaller. Likewise, for Grau & Landerretche (2011) in Chile and Alves *et al.* (2012) in Uruguay, when the MW increase occurred in a period of growth, it generated a marginal increase in unemployment, but, when it occurred

in periods of stagnation and even decline, it could significantly reduce employment. Messina and Silva (2018) in Paraguay, Ferreira *et al.* (2017) in Brazil and Arango and Pachón (2004) in Colombia found that the MW increased unemployment among the lowest deciles.

Regarding the effect of MW increases on the lowest deciles, Gindling and Terrell (2010), using a Probit for 2001-2004, found a positive relationship between MW increases and reductions in poverty and extreme poverty in Honduras, in the case of formal wage earners. In Nicaragua, Alaniz *et al.* (2019) showed that an increase in MW affected only the incomes of near-income earners. And, while Maurizio (2014) found evidence for Argentina, for Corseuil *et al.* (2015), the effect in Brazil was not only on the lowest wage deciles, but also on the following economic groups (Ferreira *et al.* 2017).

Empirical evidence focusing on other Latin American countries shows that the impact of the MW on labor income decreased as the decile fell (Neumark *et al.* 2006, Arango & Pachón 2004, Saget 2001). This could be due to a reduction in employment; however, the literature shows evidence in favor (Messina & Silva 2018, Ferreira *et al.* 2017, Arango & Pachón 2004) or it is inconclusive (Alves *et al.* 2012, Grau & Landerretche 2011).

The main reason for the lack of impact of the increase in the MW on the incomes of the lowest deciles is informality, as reported by Alejo and Parada (2017) in Brazil, Gindling and Terrell (2010) in Honduras and, in Nicaragua, Alaniz *et al.* (2011). Informality refers to workers who carry out economic activities that are not registered, recognized, or protected by law or public authorities. The concept includes workers without a contract, self-employed workers who do not register their activities, or people who work in family businesses without regularization (International Labour Organization 1972).

The SM would not be affecting the lowest deciles because it is not a compulsory practice in the region. In Latin America, 40 % of the population earns below the legal MW. While in Uruguay the SM is just above the second decile, in Ecuador and Peru it is around the fifth decile (Olarte & Sosa 2020). Consequently, their variations do not affect workers who are earning less than the SM. Indeed, in Argentina, Bolivia and Colombia, Alaniz *et al.* (2011), Nogales *et al.* (2019) and Maloney and Nunez (2000) found that MW increases had a positive effect only on the earnings of workers whose wages hovered around the MW, but not for those earning less, regardless of the decile in which they were located.

Informality also influences directly the premium skill (Katovich & Maia 2018). The fact that the space for informality can be created, and is generally accepted, opens the possibility that wages can be kept below labor productivity, which limits the reduction of premium skill. High levels of informality, in addition, are negatively related to investment in human capital, which reduces capacity so that the premium skill can be decreased via productivity improvement (Berniell 2020).

In terms of governance variables, the quality of institutions is directly related to the outcome in terms of inequality. Better levels of government effectiveness and political stability are related to better low-skilled wages, because they are able not only to manage resources better, but also to fulfil their true social role and guarantee the exercise of individual freedoms. In this context, weak levels of unionization are related to the inability to exercise the universal right of association and organization. Good levels of governance should be able to guarantee this right (Olarte *et al.* 2021).

3 Methodology

The jumping clusters methodology of Izquierdo *et al.* (2016), a variation of a generalized ordered Probit model, is applied in this research. It identifies what areas can increase the probability of a country with high wage gaps between skilled and unskilled workers can jump to a cluster with a low wage gap, considering that the impact of each dimension is conditioned to the levels reached by a country in the other ones.

At first, 69 countries were included in the sample to estimate; however, as the data collection advanced, a strongly balanced panel was obtained with 57 countries.[2] After that, we categorize the countries in clusters according to our dependent variable; in this case, the skill premium. The elbow method is used as an instrument to determine the optimal number of clusters.

The elbow method comprehends an analysis of the variance of the errors in function of the number of clusters for a given variable. Algebraically it is expressed through the residual sum of squares (Makles 2012, Forests 2018), as shown in equation (1):

$$W(C_k) = \sum_{x_j \in C_k} (x_i - \mu_k)^2 \qquad (1)$$

Where x_i is the observation which belongs to the group C_k; also, μ_k represents the middle value of assigned points to the group C_k. Each observation (x_i) is assigned to a group; thereby, the sum of the squares of the distance of the observation compared to the assigned centers μ_k is minimized.

The total within-cluster variation is defined as shown below:

$$\sum_{k=1}^{k} W(C_k) = \sum_{k=1}^{k} \sum_{x_j \in C_k} (x_i - \mu_k)^2 \qquad (2)$$

Where C_k is the k^{th} cluster and $W(C_k)$ is the within-cluster variation.

2 The countries included in the sample are: Argentina, Australia, Austria, Belgium, Benin, Bolivia, Brazil, Bulgaria, Cambodia, Chile, Colombia, Costa Rica, Croatia, Czech Republic, Denmark, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, France, Germany, Ghana, Greece, Guatemala, Honduras, Hungary, India, Indonesia, Kazakhstan, Kenia, Latvia, Lithuania, Mexico, Mozambique, Netherlands, Nicaragua, Niger, Pakistan, Paraguay, Peru, Poland, Portugal, Russia, Rwanda, Senegal, Slovakia, South Africa, Spain, Sri Lanka, Tanzania, Togo, Turkey, Ukraine, United Kingdom, United States, and Vietnam.

In a general form, the results are presented by a graphic of dispersion between the number of clusters and within sum squares. The inflection point is observed. The first cluster will contribute with valuable information; however, at some point a marginal gain can be obtained, so it can be observed graphically how the angle tends to stabilize as the number of clusters increases, hence its name elbow method. Thus, the inflection point allows choosing the optimum «k» or the number of clusters in which the countries should be classified (Syakur *et al.* 2018). In Figure 3, it is reflected the result of the method. The optimal number of clusters to use in our investigation was three, according to the stabilization of the residual sum of squares.

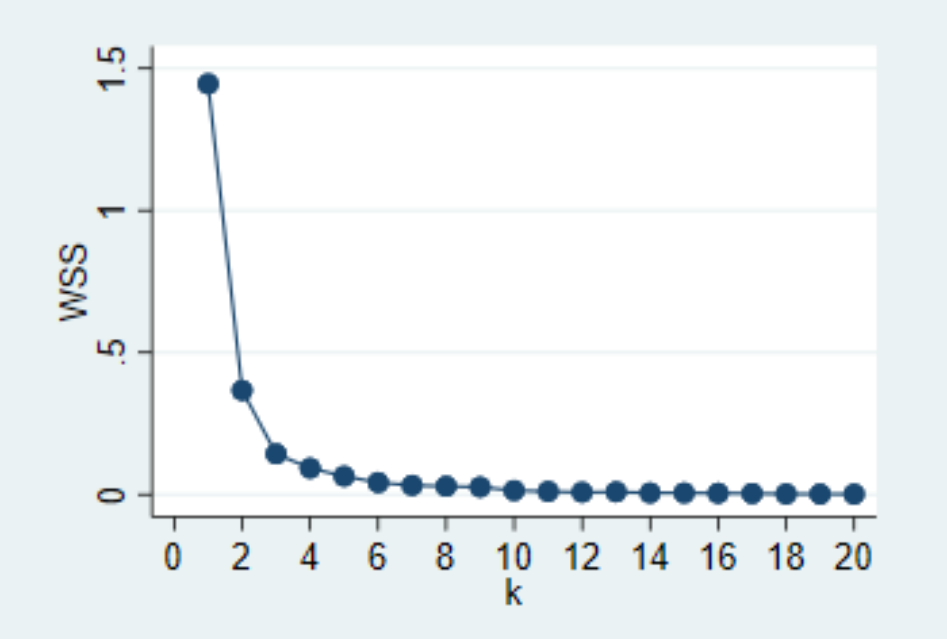
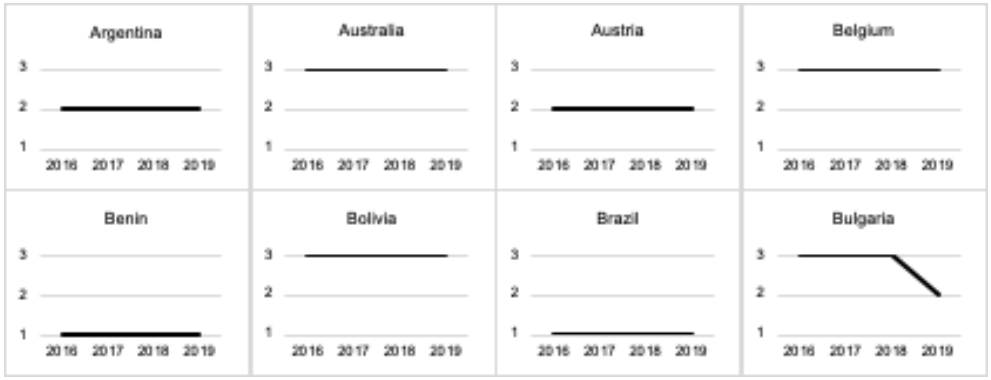


Figure 3
Criteria for the selection of the optimal number of clusters
Source: own elaboration.

The countries were classified by high, middle, and low skill premium. In cluster one, there are the lower skill premium countries, while cluster three includes the higher skill premium. For illustration purposes, the categorization by group of countries is presented in Figure 4. In 2019, from the 57 countries of the sample, 14 of them belonged to the cluster of high skill premium, which include Brazil, Chile, and Peru; meanwhile, most of the countries were in the middle-skill premium cluster (23 countries) being placed Argentina and Colombia in this cluster. Cluster 3, *i.e.,* those with low skill premium, were constituted by 21 countries, where Bolivia, Paraguay and Ecuador were part.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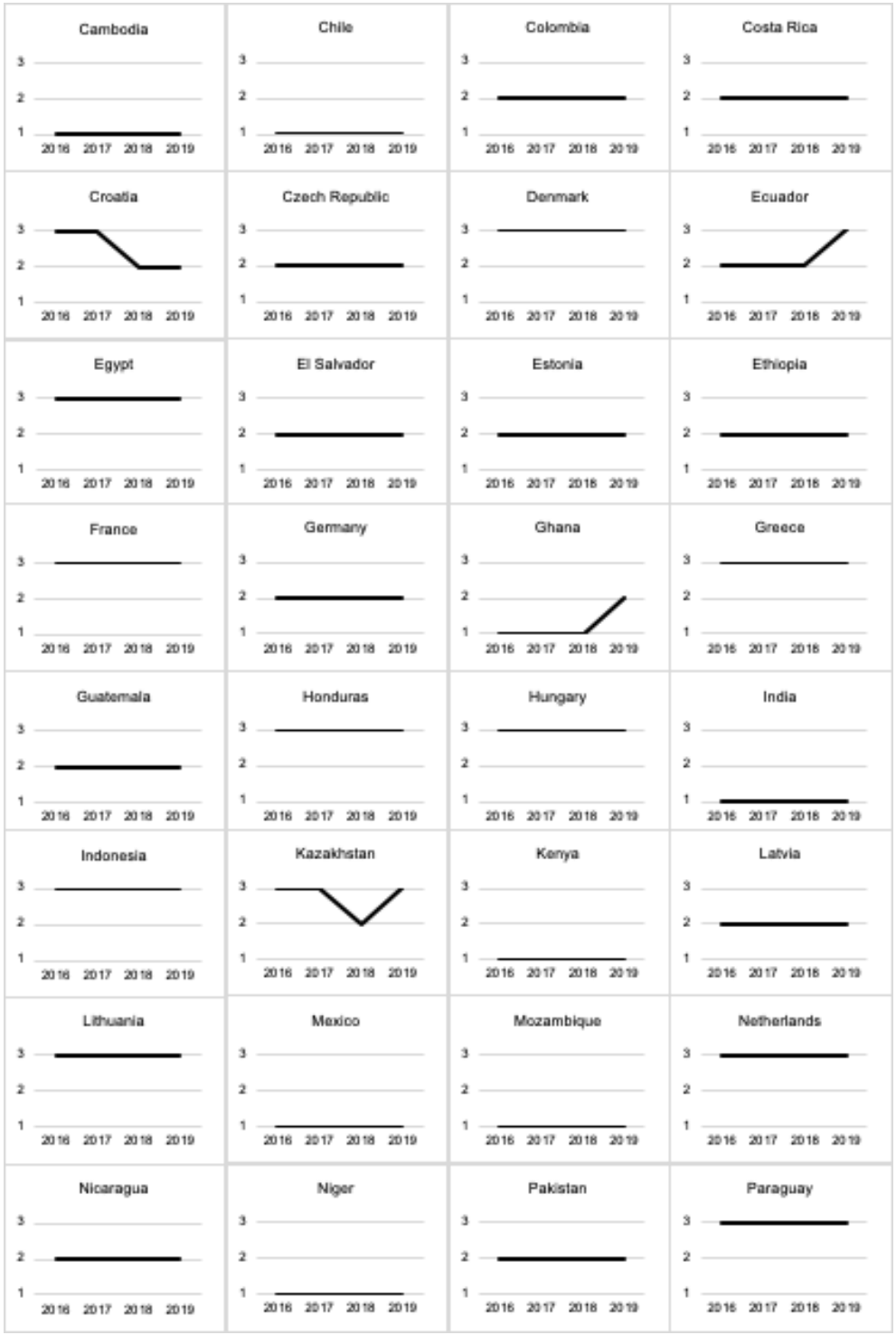
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Guatemala
Honduras
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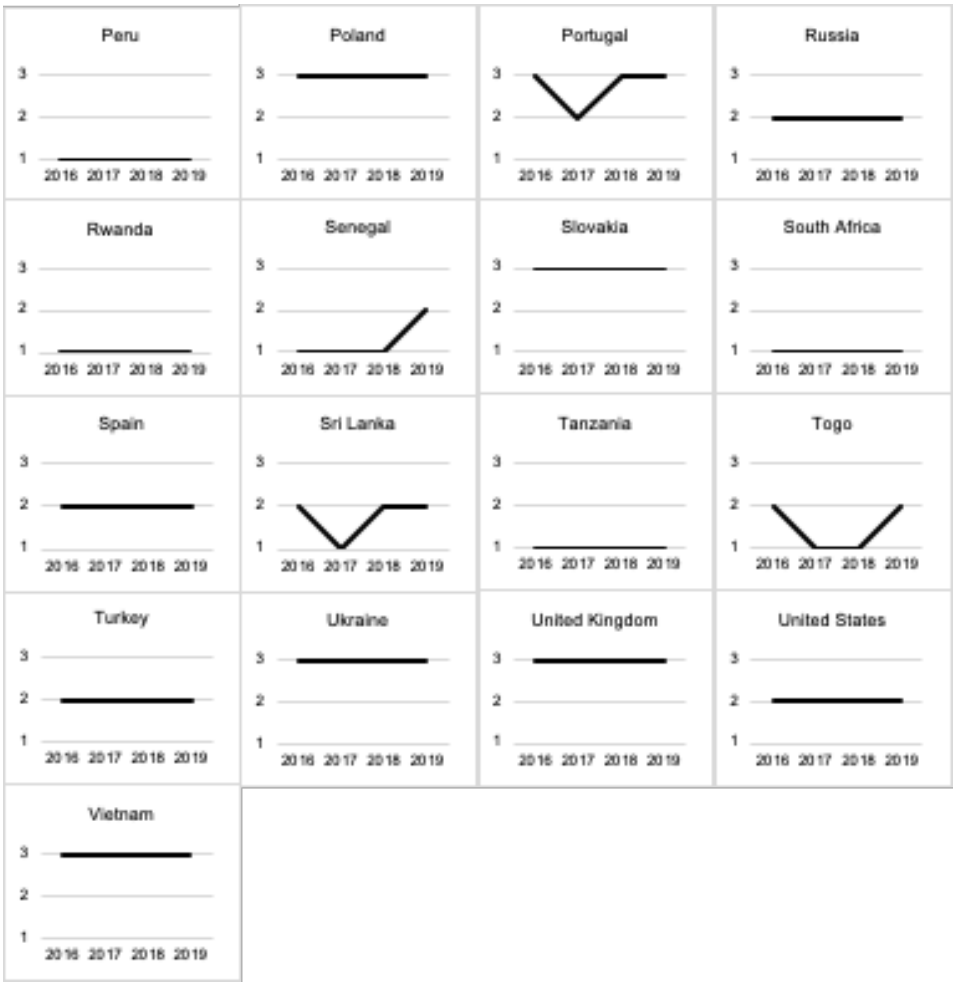

Figure 4
Distribution of country-year skill premium observations by cluster
Source: own elaboration.

Once categorized the dependent variable, a data panel is constructed with the variables that have major incidence over the skill premium based on the analysis realized in the framework section. Based on the above considerations, eight dimensions were constructed, considering 29 indicators. The distribution of the indicators in each dimension is detailed in Table 1. The dimensions are «education coverage», «education results», «digitalization and communication», «trade», «raw materials», «productivity», «labor market» and «governance».

Dimension	Variable	Source
Skill premium	Ratio between wage high and low skilled	Wage Indicator Foundation (ILO)
Education coverage	School enrollment, primary (% gross)	UNESCO
	School enrollment, secondary (% gross)	UNESCO
	School enrollment, tertiary (% gross)	UNESCO

Dimension	Variable	Source
Education results	Mean years of schooling (ISCED 1 or higher) of the population age 25+	UNESCO
	Literacy rate, adult total (% of people ages 15 and above)	UNESCO
	Pisa results	OECD
Digitalization and communication	GCI 4.0: Digital skills among population	World Bank
	Mobile-cellular telephone subscriptions per 100 inhabitants	International Telecommunication Union (ITU)
	Fixed-telephone subscriptions per 100 inhabitants	ITU
	ICT goods exports (% of total goods exports)	ITU
	Individuals using the internet (% of population)	ITU
Trade openness	External balance on goods and services (% of GDP)	World Bank
	Exports of goods and services (% of GDP)	World Bank
	Terms of trade adjustment (constant LCU)	World Bank
Raw materials	Raw materials price	World Bank
Productivity	Labor productivity (GDP constant 2011 international $ in PPP)	ILO
	Capital productivity (%)	OECD
	Total factor productivity (level at current PPPs, USA = 1)	Penn World Table
Labor market	Employment in agriculture (% of total employment)	ILO
	Employment in industry (% of total employment)	ILO
	Employment in services (% of total employment)	ILO
	Unemployment, total (% of total labor force)	ILO
	MW	ILO
	Informality	ILO
Governance	Government effectiveness	World Bank
	Regulatory quality	World Bank
	Rule of law	World Bank
	Control of corruption	World Bank
	Trade union density	ILO, OECD

Table 1
Dimensions and variables considered in the model
Source: own elaboration.

Before calculating the variables, linear interpolation was realized in those variables that did not have complete information in the analysis period to count with a strongly balanced panel with complete information. The interpolating function given two points (X_k, Y_k) (X_{k+1}, Y_{k+1}) pretends to find the value of *Y* for an *X* given in an interval, and it expresses through the following lineal equation (Martínez 2006):

$$Y = Y_k + \frac{Y_{k+1} - Y_k}{X_{k+1} - X_k}(X - X_k) \tag{3}$$

With the balanced panel, the data were normalized to obtain homogenization in their distributions, *i.e.,* an equivalent zero-mean and a standard deviation of one. Equation (4) summarizes this process:

$$z^* = \frac{(x - m)}{sd} \tag{4}$$

Where *x* represents the observation, *m* is the mean of *x* and *sd* represents the standard deviation of *x*.

Once the normalization of individual indicators was calculated, it proceeded to multiply by -1 those variables that have a negative impact. Later, the dimensions were constructed as averages of the individual indicators and then were normalized again to solve potential correlation problems. In the dimensions we have not weighted the different variables, because the literature varies in terms of the impact that each variable could potentially have in its corresponding area.

To the previous ideas, a generalized ordered Probit model was applied as a part of the econometric analysis of this paper. According to Williams (2006), the model can be explained as the following mathematical expression:

$$P(Y_i > j) = \mathrm{g}(X\beta_j) = \frac{\exp(\alpha_j + X_i\beta_j)}{1 + [\exp(\alpha_j + X_i\beta_j)]}, j = 1, 2, \ldots, M - 1 \tag{5}$$

Where *M* represents the number of classes that belong to the ordinal dependent variable, α_j denotes the cut points within generalized model, x_i is the vector of independent variables, and β are the coefficients of the estimation.

From the equation (5), it can be determinate the probabilities that Y will take for each value from 1, …, *M* which is equal to:

$$P(Y_i = 1) = 1 - g(X_i\beta_1) \tag{6}$$

$$P(Y_i = j) = g(X_i\beta_{j-1}) - g(X_i\beta_j)\ j = 2, \ldots, M - 1 \tag{7}$$

$$P(Y_i = M) = g(X_i\beta_{M-1}) \tag{8}$$

When the model has more than two categories ($M > 2$), the estimation is equivalent to a series of binary regressions, where the categories of the dependent variable interacted. Particularly, for the model of this research where $M = 3$, for $J = 1$, category 1 is contrasted with the categories 2 and 3; for $J = 2$, the contrast is produced between categories 1 and 2 versus category 3.

The main difference between generalized model and ordered binary model is that the generalized estimation uses a set of parameters β_j for each result category; in contrast, binary models use the same coefficients for all categories (Greene & Hensher 2010, Soon 2010).

The estimation considers as explained variable the wage gap between the skilled and unskilled workers, which conceptually is known with the name of «skill premium». The dimensions constitute the group of explanatory variables. A possible issue for the estimation is the endogeneity, thus lagged variables were used in the estimation to reduce it.

Once the estimation was calculated, we test the robustness of the model through a post estimation exercise denominated «bootstrapping». This technique consists in a resample process to value the approximate true distribution of the parameters within the population. In this sense, the estimation was evaluated with 5,000 repetitions. In Table 2, it is reflected the coefficients for the estimation by bootstrapping. In this case, all the parameters are significant and similar for the second cluster, except the productivity dimension compared with the original estimation. However, for the first cluster, the model loses significance for productivity, and education, as well as digitalization and communication variables.

	Cluster 1	**Cluster 2**
Productivity	0.289	0.289
	–0.192	–0.192
Trade	–0.267	–0.194
	–0.165	–0.193
Labor market	0.121	0.121
	–0.136	–0.136
Education coverage	–0.077	0.086
	–0.217	–0.235
Education results	0.524	1.047***
	–0.324	–0.346
Governance	–0.406**	–0.406**
	–0.206	–0.206
Raw materials	0.131	–0.045
	–0.229	–0.206
Digitization	0.536	–0.312
	–0.344	–0.341
_cons	0.942***	–0.544***
	–0.191	–0.17

	Cluster 1	Cluster 2
R2	20.9	
Countries	57	
Observations	171	

* p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses.

Note: among the most important variables, there are those linked to «labor supply» and «demand», having behind the idea of their contribution to productivity; and structural variables, which are labor market and governance conditions.

Table 2

Estimated coefficients applying bootstrapping (5,000 repetitions)

4 Results

The main findings from the model applied are presented in Table 3. The first column shows the probabilities for the countries located in cluster 2 to jump to cluster 1, considering the eight dimensions identified. The second column indicates the probabilities for the countries located in cluster 3 to jump to cluster 2. The results for the countries situated in cluster 2 (middle-skill premium) particularly reflect the probability for the countries of jumping to the cluster with the lowest skill premium.

In Table 3, it is showed that the estimation presents an overall adjustment of 20.9 %. Moreover, to arrive to cluster 2 from the cluster 1, digitalization, productivity, results in education, trade and governance are significant. The dimensions of «productivity», «trade», «education results» and «digitalization» are statistically significant at 10 % of the confidence level, while governance is at 1 % level. On the other hand, in cluster 2, results in «education» dimension continue to be significant, but it is at 1 % of the confidence level. Furthermore, governance and productivity are maintained constant with their significance level.

	Cluster 1 to cluster 2	Cluster 2 to cluster 3
Education coverage	–0.077	0.086
	(0.183)	(0.197)
Education results	0.524*	1.047***
	(0.268)	(0.302)
Digitization and communication	0.536*	–0.312
	(0.289)	(0.299)
Trade	–0.267*	–0.194
	(0.137)	(0.151)
Raw materials	0.131	–0.045
	(0.203)	(0.185)
Productivity	0.289*	0.221*
	(0.158)	(0.452)

	Cluster 1 to cluster 2	Cluster 2 to cluster 3
Labor market	0.121	0.471
	(0.122)	(0.120)
Governance	−0.406**	−0.422**
	(0.179)	(0.109)
_cons	0.942***	−0.544***
	(0.162)	(0.144)
R2	20.9	
Countries	57	
Observations	171 (57 countries × 3 years)	

Note: * p < 0.10, ** p < 0.05, *** p < 0.01, robust standard errors in parenthesis.

Table 3
Results of generalized ordered Probit model

According to Williams (2006), the positive coefficients of the significant dimensions indicate that these dimensions are contributing to be in next cluster, while the negative coefficients indicate that they are increasing the probability of being in the current or lower cluster.

Here we find that the coefficients are in the expected direction. Productivity, education results, digitalization and communication affect in a positive way the probability of the countries in cluster 1 to be in cluster 2. Meanwhile, the dimensions as «governance» and «trade» impact negatively.

The results of the model must be interpreted considering the normalization of the data. Therefore, probabilities must read in standard deviations terms. Consequently, an increase of 1 standard deviation in the factor of digitalization for the countries belonging to cluster 1 increases the probability in 0.54 standard deviations of jumping to cluster 2, *i.e.,* to a greater measure than which would be an increase of 1 standard deviation for dimension such as the education results (0.52 standard deviations) and productivity (0.29 standard deviations). Contrary, having a negative coefficient such as the case of «governance» and «trade» dimension implies that an increase in the probability of these dimensions for the countries located in cluster 1 causes to remain them in the current group by 0.41 and 0.27 standard deviations.

Regarding the coefficients in the second column, the key dimension to promote the countries' jump to the highest cluster are the «education results» and «productivity». An increase in 1 standard deviation in «education results» stimulates the mobilization of countries from cluster 2 to cluster 3 by 1.04 standard deviations. In the same way, an increase of 1 standard deviation in productivity implies an increase in the probability of ascending to the next cluster by 0.28 standard deviations. The «governance» dimension keeps with the negative sign. It has increases in 0.41 standard deviations to maintain in cluster 2.

5
Conclusions

The extraordinary reduction in inequality in SA in 2002-2015 has generated a huge volume of literature trying to explain the reasons for it. Not only was the size of the reduction surprising, but the fact that it occurred for the first time and continuously over time in all countries of the region, while in the rest of the world it increased. The literature on the period of inequality stagnation, in 2016-2019, is smaller, because this phenomenon is more recent in time, which allows fewer authors to be interested, and because periods of stagnation or decline generate less interest.

This work connects the two periods. It uses all the effort made to explain the reduction in inequality in 2002-2015 to try to understand why it stagnates in 2016-2019. The analysis is carried out on the change in the skill premium because it is a phenomenon naturally linked to inequality and allows us to focus the analysis on factors linked directly and indirectly to the labor market, thus being able to narrow down the analysis.

The multi-causal phenomenon of inequality reduction in 2002-2015 is used to identify the fundamental variables that must be addressed by public policy to reduce the skill premium, insofar as public budgets in the region are particularly limited. Beyond the particularly deep ideological currents that define national economic policy, based on a theory defined elsewhere, an attempt is made to identify the dimensions that should be addressed, regardless of personal beliefs.

Countries with the highest levels of skill premium, *i.e.,* with the largest gap between the wages of skilled and unskilled workers, should prioritize strategies to improve governance, quality of education, productivity, access to digitalization and communication, and to monitor trade-related variables. Countries with an intermediate skill premium should prioritize the quality of education, improving governance and productivity.

The results confirm the importance of improved governance and investment in human capital to enhance productivity and promote long-term prosperity. Joint support to the dimensions that proved significant is vital; the overall jump probability effect could be more remarkable given the interactions between them.

Issues that have so far been the focus of public debate, such as commodity prices or labor market conditions, and especially minimum wage variations, traditionally linked to ideology in the realm of regional economic policy, have been irrelevant in this comparative analysis.

In the following analyses, if we have the data to do so, it would be worthwhile to analyze the result by country or group of countries, and to study the variables that within each dimension would have the greatest impact.

6
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7
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