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Articles

Explanatory notes

The following symbols are used in tables in the *Review*:

… Three dots indicate that data are not available or are not separately reported.

(–) A dash indicates that the amount is nil or negligible.

A blank space in a table means that the item in question is not applicable.

(-) A minus sign indicates a deficit or decrease, unless otherwise specified.

(.) A point is used to indicate decimals.

(/) A slash indicates a crop year or fiscal year; e.g., 2006/2007.

(-) Use of a hyphen between years (e.g., 2006-2007) indicates reference to the complete period considered, including the beginning and end years.

The word "tons" means metric tons and the word "dollars" means United States dollars, unless otherwise stated. References to annual rates of growth or variation signify compound annual rates. Individual figures and percentages in tables do not necessarily add up to the corresponding totals because of rounding.

Purchasing power parities for Latin America and the Caribbean, 2005-2013: methods and results

Hernán Epstein and Salvador Marconi

ABSTRACT

This work sets out some methodological aspects and gross domestic product (GDP) series for Latin America and the Caribbean for the period 2005-2013, expressed in purchasing power parities (PPP), and points out a number of limitations applying to this sort of exercise. Comparisons are made with series (at current and constant prices) denominated in dollars at market exchange rates, and also with the results of the 2005 round of the International Comparison Programme. A number of hypotheses are advanced to interpret the behaviour of the main economic variables calculated in the study.

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I

Introduction

Series of purchasing power parities (PPP) and of the components of gross domestic product (GDP) —or at more disaggregated levels— are extremely useful for analysing competitiveness, supporting negotiations on trade agreements and making economic policy decisions. They can also be used in international poverty measurements.

In a recent piece of work, entitled *Global absolute poverty fell by almost half on Tuesday*, Dykstra, Kenny and Sandefur (2014) show the substantial changes in many countries' poverty estimates based on the results of the 2005 round of the International Comparison Programme (ICP) and on extrapolations from the results of the 2011 round. This work shows the importance and the sensitivity of such calculations.

Accordingly, it is important to devote the necessary resources to obtain robust PPP figures through the ICP rounds, at least under a rolling benchmark scheme similar to that used by Eurostat and the Organization for Economic Cooperation and Development (OECD). Meanwhile, in the region we may use estimates which, notwithstanding the methodological limitations set forth in the following pages, are reported in this work.

The literature on the technical aspects of PPP is extremely broad. There is also a long list of publications on methods of calculation and the particular results obtained in ICP rounds, both from academia (such as the Penn World Tables) and from international agencies (World Bank, OECD, among others). By contrast, few works generate and analyse regional statistical series prepared on the basis of methodologies that complement those used to calculate PPP in the years of major statistical operations (rounds) when prices are surveyed and weights calculated.

The main objective of this work is to present some methodological aspects and GDP series for Latin America and the Caribbean for the period 2005-2013, expressed in PPP, as well as some of the limitations of this exercise. Comparisons are made with the results of the 2005 round of ICP and with dollar-denominated series (at current and constant prices) at market exchange rates. A number of hypotheses are advanced to interpret the behaviour of the

main economic variables calculated in the framework of the investigation.

Unlike an earlier work by the same authors, in which PPP series (2000-2011) were calculated on the basis of the 2005 round of ICP, the series presented in this study are based on the 2011 ICP results published by the ICP Global Office, as well as in more recent national accounts data published by the countries of Latin America and the Caribbean for the period 2005-2013 (Epstein and Marconi, 2014).

Simply put, PPP between two countries (A and B) is the ratio between the number of country A's monetary units required to buy —in country A— a product of equal quality and in equal quantity as could be bought by one of country B's monetary units in country B. Here, B is the reference country.

Using econometric calculations, these PPPs —initially calculated for staple products— can be calculated for groups of products (known as basic headings), and even at the level of GDP and its components.

On the basis of PPP, price differences can be analysed between countries and spatial comparisons made (geographical dimension), selecting a given country as a reference (usually the United States).

PPPs are used to measure not only the "real" size of a country's or a region's economy, but also to obtain more robust indicators of level of economic development (such as per capita GDP expressed in PPP), and of productivity and competitiveness, as well as better measurements of poverty.

Several Latin American countries (Ecuador, El Salvador and Panama) have adopted dollarization as an exchange-rate regime, which means forgoing some degrees of monetary policy freedom. Together with the calculation of real exchange rates, the updated PPP series afford these countries' economic authorities useful indicators of competitiveness.

Currently, PPPs are calculated in the framework of an exercise coordinated by the World Bank and implemented globally through the ICP. OECD and Eurostat run a regular programme to perform these calculations for their member countries.

Ideally, this programme should be carried out every year in every country in the world, which would provide annual PPP series. Unfortunately, owing to financial and logistical restrictions, PPPs are only available for the

years of the ICP rounds,[1] although they can be estimated for the years in which these great statistical sweeps are not conducted at the global level.

Academics from the University of Pennsylvania, led by Alan Heston, calculate series of PPP and of macroeconomic aggregates expressed in PPP for all the countries (Heston, several years). Starting in 1996, they use the results of previous ICP rounds as a benchmark to estimate long series, published under the name of Penn World Tables (PWT). Similarly to the work carried out here, PWT use the information from the ICP rounds as a reference to obtain PPP series.

However, in many cases, since these are efforts at the global level, the information put into the PWT (and into the World Bank database) is not the most up-to-date information for Latin America and the Caribbean. Moreover, the PPP extrapolations presented in the PWT use multiple reference years obtained from different ICP rounds, whereas this work focuses on the latest year available, on the premise that this provides the best quality of information and more advanced calculation methodologies than previous rounds.

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[1] The last two rounds of ICP take 2005 and 2011 as reference years.

In effect, the estimates presented in this study are conducted on the basis of the latest ICP information available, extrapolating (and retropolating) parities using the deflators derived from the national accounts of the Latin American and Caribbean countries and the United States, a method which has the advantage of being simple and inexpensive.

GDP series are presented at constant and current prices expressed in PPP for 2005-2013, a short period which, nevertheless, is statistically influenced by the crisis of 2008-2009, which could have repercussions on the results in both price and volume terms. Effectively, the financial crisis unleashed in those years, the end of the commodity price boom and the considerable fall in the investment rate over the latter years of the period analysed had a strong impact on relative prices of the goods and services that make up the output of the countries of Latin America and the Caribbean, on their PPP and, obviously, on the low rates of total and per capita GDP growth recorded in most of the countries of the region.

Following this introduction, this article is structured as follows: section II offers an overview of the methodology used in this work. Next, section III carried out comparisons of the results obtained in the study. Section IV offers final remarks. Lastly, a statistical annex is provided.

II

Brief methodological overview

The System of National Accounts (SNA, 2008, paragraphs 15.232 and 15.233) refers to the methods of updating PPPs:

> "The method commonly used to extrapolate PPPs from their benchmark year to another year is to use the ratio of the national accounts deflators from each country compared with a numeraire country [...] to move each country's PPPs forward from the benchmark.
>
> [...]
>
> Theoretically, the best means of extrapolating PPPs from a benchmark year would be to use time series of prices at the individual product level [...] In practice, it is not possible [...]. Therefore, an approach based on extrapolating at a macro level (for GDP or for a handful of components of GDP) is generally adopted" (EU/IMF/OECD/United Nations/World Bank, 2009).

SNA 2008 recommends using a benchmark year in which PPPs are robust (that is, a year in which an ICP round has been held), then to extrapolate (or retropolate, or both) using national accounts deflators.

However, a methodological problem arises in relation to the level of disaggregation. Extrapolating at the individual product level, as suggested in paragraph 15.233 of SNA 2008, would imply conducting a global comparison programme that would yield the required information (with the limitations typical of a project of this nature).

Obviously, if the information is available, ideally extrapolations should be performed at as detailed a level as possible, for example, for the major components of GDP spending or even at the level of certain basic headings. The choice of level at which to extrapolate depends chiefly on the quantity and quality of information available,

as regards both the national accounts and the prices of goods and services in a standard basket of products.[2]

As noted, the results of the 2011 round published by the World Bank were used to build series for 2005-2013, as well as the information in CEPALSTAT (available up to January 2015) to retropolate (2005-2010) and extrapolate (2012-2013) PPP values. The retro/extrapolation of PPPs for 2011 was performed according to the recommendations of SNA 2008, depending on the availability of implicit deflators and PPPs at the GDP level, using the following formula:

$$PPP_{t+k}^A = PPP_t^A \times \frac{ID_{t+k}^A}{ID_{t+k}^R} \qquad (1)$$

where PPP_t^A is the PPP for country A, in period t; ID_{t+k}^A is the implicit GDP deflator of country A in period $t+k$ (base = 100 for period t); and ID_{t+k}^R is the implicit GDP deflator of benchmark country R in period $t+k$ (base = 100 for period t). The main results are reported in the annex.

It should be noted, however, that the calculation of national accounts deflators use structures that vary over time in the denominators, which may obviously hinder comparison. Ideally, these deflators should be obtained on the basis of a fixed basket in the benchmark year.

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[2] A summarized presentation of the aggregation methods used in the framework of ICP is given in Epstein and Marconi (2014).

Box 1
THE ECONOMIC THEORY BEHIND PPP

The concept of purchasing power parity arose in the sixteenth century in the form of the law of one price, which established that the prices of two identical goods in two different countries should be equal over the long term, owing to international arbitrage. Thus, if the price of a good were to rise more in one country than in the other, the exchange rate between the two countries' currencies should vary proportionally to maintain international parity.

Expanding this notion to a group of goods, the PPP index for the whole economy should be equal to the long-term exchange rate.

However, there are reasons why the law of one price —and thus parity between PPPs and exchange rates— are not fulfilled, such as transport costs, taxes or trade tariffs, or the non-tradability of certain services between countries.

There is also another type of theory which can explain the differences in price levels between countries. The Balassa-Samuelson hypothesis establishes that countries with higher productivity (and therefore higher income) will have higher prices. A consequence of this hypothesis is the Penn effect, whereby countries with a higher GDP will have systematically higher price levels (calculated as the ratio between PPP and the exchange rate) and vice versa. This would also indicate that, as a country develops and its relative wealth increases, so will its relative prices.

Source: Prepared by the authors.

Once the PPP series had been calculated for the period, GDP series were obtained by dividing the values at current prices in national currency (NC) by the corresponding PPP estimated for each year between 2005 and 2013. This yielded the series expressed in PPP at current prices in United States dollars, for 30 Latin American and Caribbean countries.[3]

Meanwhile, the price level index (PLI) is defined as follows:

$$PLI_t^k = \frac{PPP_t^k}{XR_t^k} \qquad (2)$$

where PLI_t^k is the price level index for country k in year t; and XR_t^k is the market exchange rate of country k at time t with respect to the benchmark country, in this case the United States.

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[3] Argentina, Cuba and Guyana are not covered in this work. Cuba was not included in the study because the ICP Global Office included the following note in the results of the 2011 round of ICP: "The official GDP of Cuba for reference year 2011 is 68,990.15 million in national currency. However, this number and its breakdown into main aggregates are not shown in the tables because of methodological comparability issues. Therefore, Cuba's results are provided only for the PPP and price level index" (World Bank [online] http://icp.worldbank.org).

Argentina and Guyana were not included because they opted out of the 2011 round.

The price level index is a percentage that indicates the level of prices in country k with respect to the level of prices in the United States, taking the dollar as the benchmark currency. Thus, a PLI value equal to 0.8 (or 80%) means that in country k, 80 cents will buy the same as a dollar buys in the United States. Alternatively, it may be stated that price levels in country k are 20% lower than in the United States.

Lastly, the GDP series at constant prices expressed in PPP was calculated taking 2010 as the reference year. These series were obtained by taking 2010 GDP values at current prices and extra/retropolating for the period 2005-2013 using the corresponding growth rates of each country's GDP series, at constant prices.[4]

In this exercise, the series are expressed in 2010 prices (of the United States), which is also the base year of the regional series published by ECLAC.

Dalgaard and Sorensen (2002) warn that the aggregate method may bias the estimates if the structures of the countries' economies vary over time. The only way to mitigate this effect is to perform the extrapolation at the most disaggregated level possible.

In order to evaluate the results and compare the two methodological approaches (GDP at the highest level of aggregation compared with disaggregation), PPPs were calculated by components. The level of the components should match the PPPs published by ICP in the 2011 round: individual consumption expenditure

by government, collective consumption expenditure by government, consumption expenditure by households, gross capital formation, and exports and imports of goods and services. For each of these, the corresponding implicit GDP deflators were used to extra/retropolate PPPs for the reference year. On the basis of these series of PPPs by component, the EKS method was used to obtain the GDP-level PPPs for each of the years in the reference period.

The information was obtained from the ECLAC database (CEPALSTAT)[5] and, in the case of the benchmark country (United States), from the website of the Bureau of Economic Analysis (www.bea.gov).[6] For imports and exports of goods and services, the exchange rates of each year were used as PPPs, as recommended by ICP.

In order to eliminate the biases mentioned by Dalgaard and Sorensen (2002), it would be necessary to extrapolate at the product (not the component) level. The results obtained in this study therefore still include these biases, although to a lesser extent than the results of extrapolation at the aggregate GDP level.

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[4] This is equivalent to using the series in constant prices in national currency for the period 2005-2013 and dividing the values by the PPP of the reference year chosen.

[5] In the case of central government consumption expenditure, it is necessary to work with the breakdown into collective and individual consumption, and calculate the respective deflators separately, because this is the level of disaggregation published by ICP 2011. However, owing to the lack of information in this respect for most of the countries, it was decided to use the deflator for total general government consumption in the calculation of these two components.

[6] Data on general government consumption broken down into individual and collective components are not available for the United States, so estimates were obtained on the basis of the information published in the ICP rounds, as well as auxiliary data published by the countries.

III

Main results

A number of comparisons can be made with the results obtained in this study. Below are presented the main differences in ranking of the countries of the region when per capita GDP is expressed in market exchange rates and in PPP for the reference years (2005 and 2011). Series of total and per capita GDP expressed in PPP and at market exchange rates are also compared, at both current and constant prices, as well as price levels, thus showing which countries are more "expensive" and which "cheaper" in the region. We also report certain elements that arise from the comparison between the

results obtained using the components method and, lastly, we analyse a number of factors that should be taken into consideration when performing this sort of comparison.

1. Statics comparison: ranking of countries in 2005 and 2011

Figure 1 shows the differences in the ranking when market exchange rates (XR) and when PPP deflators are used for 2005 and 2011. The PPPs used in the calculation are those published in the ICP framework

for the corresponding rounds: for this reason, only the results for the ten countries participating in both rounds are included: Bolivarian Republic of Venezuela, Brazil, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru, Plurinational State of Bolivia, and Uruguay).

By exchange rate (XR), Mexico is the country with the highest per capita GDP in 2005, followed by Chile. This order is reversed if PPPs are used. This is because the price level is lower in Chile than in Mexico.

Similarly, there are significant differences in the ranking with respect to 2011: Brazil is the country showing the biggest relative difference, moving from third place (using XR) to fifth place using the PPP deflator. In 2011 the Brazilian currency, the real, underwent a sharp appreciation, reaching an average rate of 1.67

to the dollar, the lowest exchange rate in the period 2000-2013. This had a direct impact on Brazil's nominal per capita GDP in dollars that year, which is neutralized when PPPs are used as the deflator.

Four hypotheses could be put forward to interpret the differences in price level among the countries of the region, and each must be duly studied and verified. The first relates to differences in countries' degrees of trade and tariff openness; the second to levels of market concentration and differentiation of the products making up the "GDP basket." A third, not insignificant, element in price determination and evolution is the effect of monetary and fiscal policies, as well as the way in which economic agents form (anticipate) their expectations. Last but not least, productivity gaps, i.e. different dynamics

FIGURE 1

Per capita GDP in dollars at current prices, deflated with market exchange rates (XR) and PPPs, 2005 and 2011
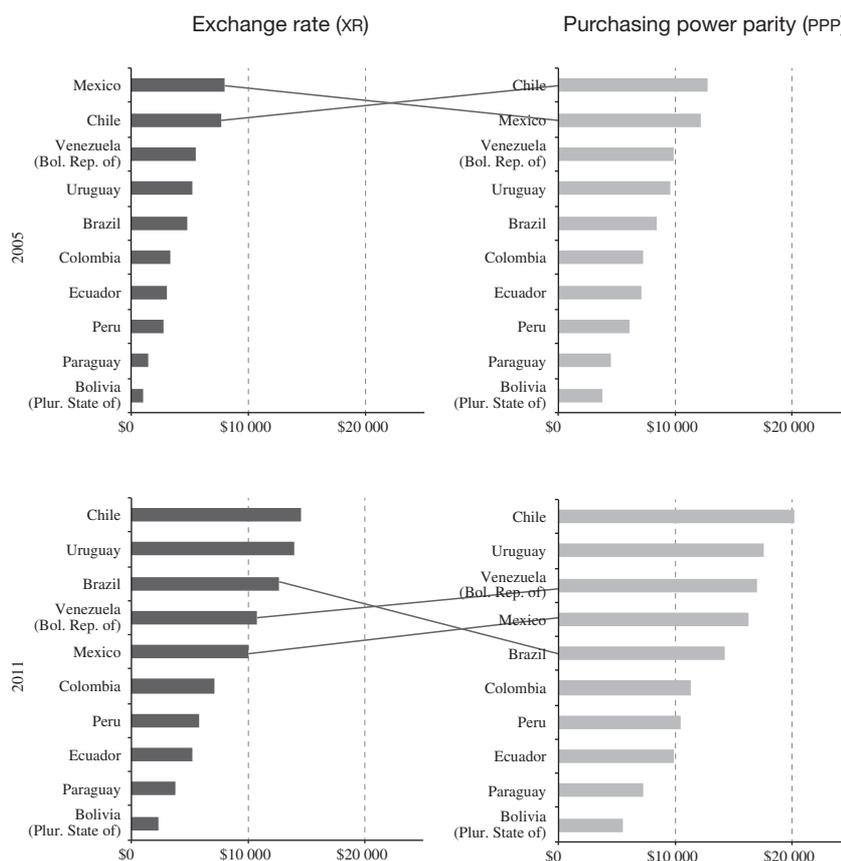
Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), Databases and Statistical Publications (CEPALSTAT) [online] http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp?idioma=i; and World Bank Data Base [online] http://data.worldbank.org/.

Note: GDP: Gross domestic product.

in processes of surplus generation and appropriation,[7] can significantly influence the configuration of absolute and relative prices and their intertemporal dynamics.

Notably, passing from 2005 to 2011 (i.e. reading the graph vertically), the ranking using PPP deflators is more stable than the ranking obtained using XR. This is evident, for example, in the changes in the rankings of Mexico and Brazil, the region's two largest countries. Using XR, Mexico moves from first to fifth places, while Brazil "jumps" from fifth to third place. These changes reflect the variation in relative prices (cf. supra). While Mexico moves from second (2005 round) to fourth place (2011 round) when using PPPs, Brazil remains in fifth place in both years.

2. Dynamic comparison: evolution of GDP expressed in PPP and in market exchange rates

One of the chief advantages of calculating GDP series in PPP is that it serves to assess the real contributions made by the countries to the overall regional economy, i.e. the relative size of the respective economies. Figure 2 shows these shares over the period studied for the region's two largest economies (Brazil and Mexico) in relation to total GDP for Latin America (expressed using the series in current prices).[8]

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[7] This last aspect is being studied by the authors in the framework of a research work based on the economic surplus method, applied to the Latin American countries.

[8] In the context of this work, the Latin American and Caribbean region includes only those countries for which the relevant calculations could be performed. Argentina and Cuba are therefore not included, for the reasons mentioned earlier.

FIGURE 2

Proportion of GDP of Brazil and Mexico with respect to regional GDP: PPP compared with XR, at current prices
(Percentages)
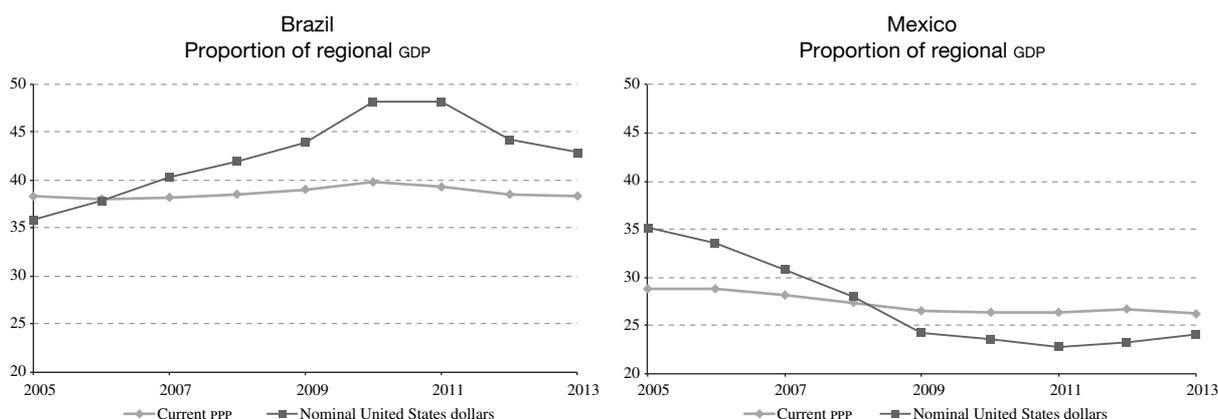
Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), Databases and Statistical Publications (CEPALSTAT) [online] http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp?idioma=i; and World Bank Data Base [online] http://data.worldbank.org/.

Note: XR: Market exchange rate; GDP: Gross domestic product; PPP: Purchasing power parities.

If the shares are calculated in terms of the nominal exchange rate in 2005, Mexico's and Brazil's economies are the same size (each representing 35% of the regional total), while in PPP terms, the results show that Brazil's economy is significantly larger than Mexico's (38% of total regional GDP compared with 29%).

As may be appreciated, Brazil's share in the regional economy grows in nominal terms, from 35%

in 2005 to 43% of total regional GDP in 2013, peaking at 48% in 2010 and 2011. However, when the price level is taken into account, the proportion remains between 38% and 40% throughout the reference period. This reflects both the rise in price levels in Brazil with respect to the rest of the region's countries, and the large exchange-rate variations registered during the period analysed.

Mexico's share in nominal terms is similar to Brazil's in 2005 (35%), then declines sharply, stabilizing at around 21% as of 2009. This is because, up to 2007, Mexico was one of the "most expensive" countries in the region; however, its price level did not rise as much as that of other large Latin American countries. Thus, among the region's five largest economies (in total GDP terms) covered by this study,[9] Mexico was the most expensive until 2007, but as of 2011 became the "cheapest." At the same time, the PPP series shows Mexico's share taking a slight negative trend, edging down from 29% in 2005 to 26% in 2013.

Notably, the shares expressed in PPP terms are more stable and less variable than those expressed in nominal terms. This holds not only for Mexico and Brazil, but for all the countries in the region.[10]

Figure 3 shows the evolution of per capita GDP for Latin America and the Caribbean, as well as the difference between the two subregions in the series expressed in PPP and in market exchange rates (XR).

The series in XR in current dollars show that in 2009 the two subregions began to move closer in terms of per

capita GDP, and maintained very similar values from 2011 on. In current values (XR), much of this change may be attributed to differences in relative prices.

Figure 4 shows the evolution of the GDP deflators for both subregions in the period. A clear difference in trend may be seen, especially as from 2009, when relative prices accelerate in Latin America compared to the Caribbean. This demonstrates the Balassa-Samuelson effect, because the acceleration occurs in the subregion least affected by the 2009 crisis and, thus, the subregion with larger relative GDP growth.

Comparing the price level index (PLI) with the relative income of each country (see figure 5) measuring on the basis of the per capita nominal GDP index with respect to the regional total, a certain correlation is evident between the two variables. Although the relationship is not very strong, it shows the Penn and the Balassa-Samuelson effects, because those countries with a higher income level generally show a higher price level. For this reason, measurement of GDP in PPP tends to show smaller per capita GDP gaps than comparisons done in nominal terms.

The series in constant prices allow a simultaneously intertemporal and interspatial study, unlike the series measured in current PPP in which the results have to be treated as a panel, allowing cross-sectional comparisons for each year available. However, it must be recalled that the methodology used has the disadvantage that both the

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[9] Bolivarian Republic of Venezuela, Brazil, Mexico, Colombia and Chile.

[10] The statistical annex presents the GDP series in PPP for the Latin American and Caribbean countries updated with information to January 2015, which can be used to conduct an analysis for each of the countries of the region.

FIGURE 3

Latin America and the Caribbean: per capita GDP in dollars at current prices, deflated by PPP and XR, 2005-2013
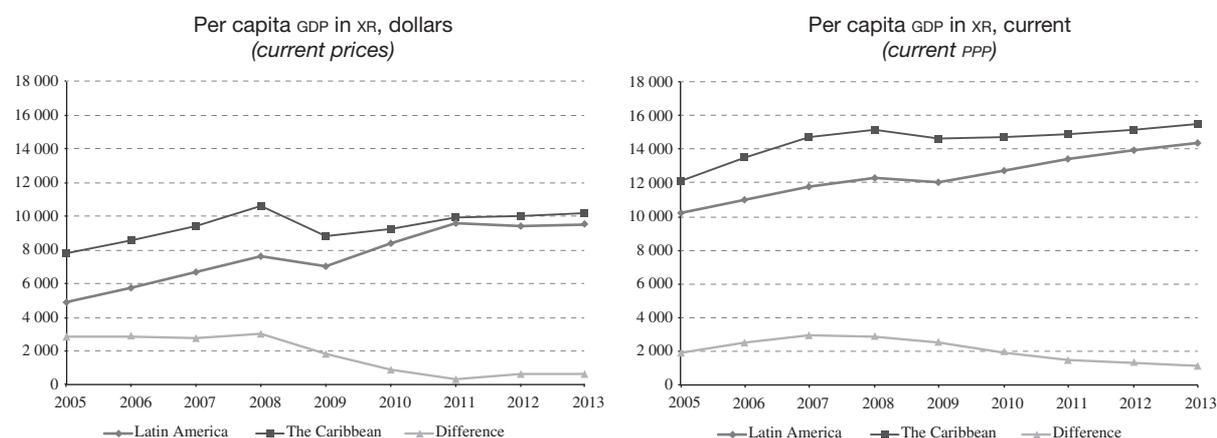
Per capita GDP in XR, dollars
(current prices)

Per capita GDP in XR, current
(current PPP)

Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), Databases and Statistical Publications (CEPALSTAT) [online] http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp?idioma=i; and World Bank Data Base [online] http://data.worldbank.org/.

Note: PPP: Purchasing power parities; GDP: Gross domestic product; XR: Market exchange rate.

FIGURE 4

GDP deflators for Latin America and the Caribbean, 2005-2013
(2005 = 100)
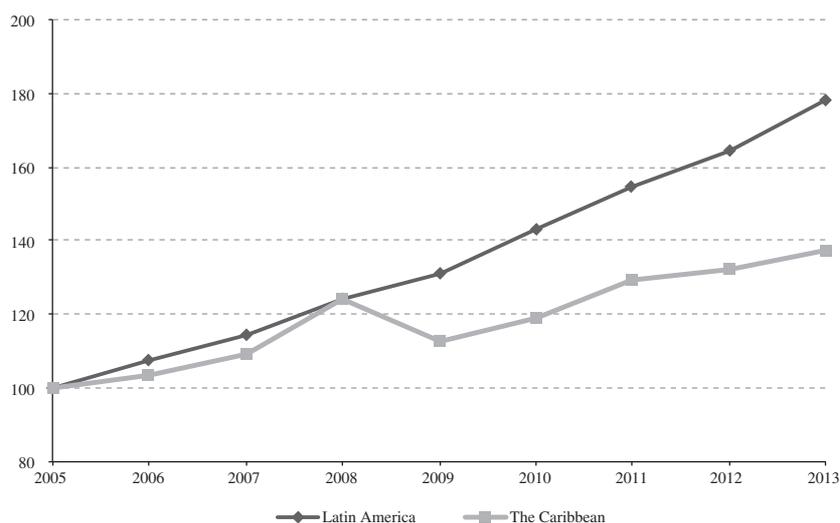
Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), Databases and Statistical Publications (CEPALSTAT) [online] http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp?idioma=i; and World Bank Data Base [online] http://data.worldbank.org/.

Note: GDP: Gross domestic product.

FIGURE 5

Latin America and the Caribbean: relation between level of per capita GDP and price level, 2011
(Horizontal axis, region = 100; vertical axis, United States =100)
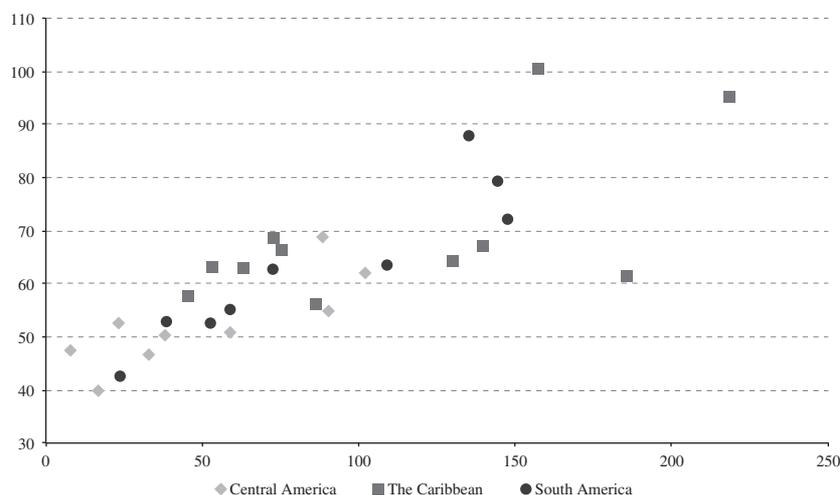
Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), Databases and Statistical Publications (CEPALSTAT) [online] http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp?idioma=i; and World Bank Data Base [online] http://data.worldbank.org/.

Note: GDP: Gross domestic product.

levels of series and the rates of regional or subregional growth can vary significantly depending on the base year chosen and the countries included in the analysis.[11]

The growth rates for the countries throughout the period are not analysed, because they are calculated on the basis of the constant price series published by the national institutions responsible for preparing the national accounts. Conversely, it is worth analysing the results at the regional and subregional levels. Figure 6 shows per capita GDP expressed in PPP at constant 2010 prices.

[11] The non-participation of a country as large as Argentina in the latest ICP round has obvious repercussions on the results of the study, in terms of both weighting and the level and evolution of regional PPPs. In this respect, Epstein and Marconi (2014) offer an analysis of the effect of incorporating Argentina into the calculations.

FIGURE 6

Latin America and the Caribbean: per capita GDP in dollars (PPP), at constant prices, 2005-2013
(Base year = 2010)
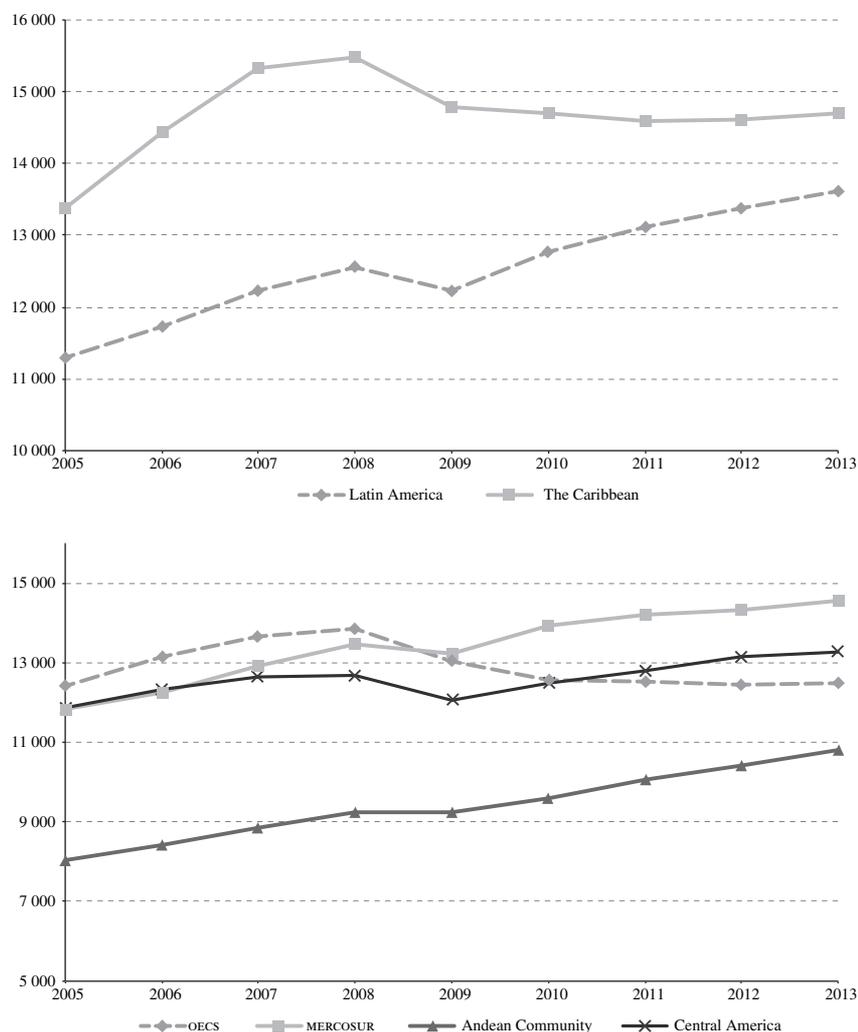
Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), Databases and Statistical Publications (CEPALSTAT) [online] http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp?idioma=i; and World Bank Data Base [online] http://data.worldbank.org/.

Note: OECS: Antigua and Barbuda, Dominica, Grenada, Saint Lucia, Saint Kitts and Nevis, and Saint Vincent and the Grenadines. MERCOSUR: Brazil, Paraguay, Uruguay and Venezuela (Bolivarian Republic of). Andean Community: Bolivia (Plurinational State of), Colombia, Ecuador and Peru. Central America: Costa Rica, Dominican Republic, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua and Panama. GDP: Gross domestic product.

The per capita GDP series in constant PPP for Latin America and the Caribbean are very similar to the series in current PPP (see figure 3). This is because, given the method of extrapolation of the PPPs used with implicit deflators, the current PPPs include the effect of relative prices vis-à-vis the United States.

Analysis of the GDP series in constant PPPs for the four subregions shows that the effect of the 2009 crisis was heavier for OECS (Antigua and Barbuda, Dominica, Grenada, Saint Lucia, Saint Kitts and Nevis, and Saint Vincent and the Grenadines) than the rest of the countries. In fact, the per capita value at the start of the period (2005) is similar to that of 2013 (US$ 12,413 and US$ 12,499, respectively). That subregion's GDP surpassed that of the other three subregions in 2005, but had moved down to third place in 2013, exceeding only that of the Andean Community. Conversely, the Southern Common Market (MERCOSUR) achieved significant growth during the period (a cumulative 23%), moving from US$ 11,835 in 2005 to US$ 14,539 in 2013, making it the subregion with the highest per capita GDP (in constant 2010 PPP).

Central America also felt the effects of the crisis. Its per capita GDP was US$ 11,868 in 2005, very similar to that of MERCOSUR, and registered cumulative growth of 11% between 2005 and 2013. Lastly, the Andean Community was the subregion with the lowest per capita GDP growth in constant PPP terms, despite showing the fastest growth, from US$ 8,040 in 2005 to US$ 10,814 in 2013 (a cumulative rise of 35%).

Finally, the differences between the series expressed in market exchange rates and those in PPP may be attributed to the evolution of the price level index per the International Comparison Programme (PLI). Table 1 shows PLI values with respect to total GDP for the countries of the region, expressed in relation to the price level of the United States.

Table 1 shows both the evolution of the PLI in relation to United States prices (the horizontal comparison in the table) and how the countries relate to each other in any given year (vertical comparison).

Analysing the evolution of the PLI, it may be seen that South America (cumulative 60%) is the subregion whose prices rose most with respect to United States prices, with PLI variations of between 37% and 90% over the period in cumulative terms. Uruguay's price level, for example, went from less than half of that of the United States in 2005 to over 80% in 2013. The analysis by GDP component suggests this is due to a strong increase in the government expenditure deflator (wage increase) in Uruguay, in comparison with other countries.

Central America (6%) showed a large increase, though not on the same scale as South America, with gains in price levels varying from 15% and 50% in cumulative terms over the period with respect to United States prices. Mexico, El Salvador and the Dominican Republic are exceptions, with variations of 4%, 8% and -2%, respectively.

Finally, the Caribbean (2%) shows small increases and even some decreases, with the exception of Suriname, whose price movements are more similar to those of South America.

With regard to the "vertical" comparison between countries, the Caribbean shows very similar price levels, with the exception of the Bahamas and Barbados, which are in fact more expensive than the United States in several years of the period analysed (PLI over 100). The Central America group also shows relatively similar levels, except for Costa Rica and Mexico, which are the most expensive countries of the subregion towards the end of the period 2005-2013. In this regard, Costa Rica is the country to have changed its PLI ranking most, from fourth place in 2005 to first place in 2013, easily passing Mexico (by over ten percentage points). As in the case of Uruguay, the explanation for this lies in policies adopted to increase public sector wages (see figure 7).

South America is the most uneven grouping in terms of relative prices. For example, Brazil, Colombia and Uruguay had similar price levels in 2005, but by the end of the period they were very different (with gaps of around 20 percentage points in 2013). Chile was the most expensive country in the subregion in 2005, surpassing the Bolivarian Republic of Venezuela by almost ten percentage points in this regard. But in 2013, price levels in Chile and the Bolivarian Republic of Venezuela were both around 70% of United States prices, and they were, respectively, the third and fourth most expensive countries in the subregion, after Uruguay and Brazil.

The differences between the various subregions are the consequence of two main factors: (i) prices in the Caribbean (and, to a lesser extent, in Central America) are more strongly tied than prices in South America to United States prices, and (ii) the exchange-rate effect, where exchange rates in the Caribbean are much more stable than those in Latin America, although there are a few exceptions, such as the cases of Jamaica and Suriname or the Latin American countries with dollarized economies (Ecuador, Panama and El Salvador). The first factor applies mainly to trend differences (the horizontal or temporal comparison), while the second partially explains both types of differences, trend and geographical (or vertical).

TABLE 1

Price level index, 2005-2013
(United States = 100)

Region or country	2005	2006	2007	2008	2009	2010	2011	2012	2013	Percentage variation 2005-2013
Central America										
Costa Rica	48.8	49.1	51.8	56.1	55.4	64.4	68.6	70.5	73.4	50
Dominican Republic	49.0	45.7	47.1	49.0	48.4	49.3	50.9	50.5	48.2	-2
El Salvador	45.8	46.4	47.2	48.7	48.1	48.6	50.3	49.9	49.3	8
Guatemala	37.2	38.1	39.4	42.9	40.8	43.0	46.6	47.0	47.7	28
Haiti	32.2	35.9	41.5	43.3	42.3	45.6	47.2	47.1	47.8	48
Honduras	40.2	40.9	42.5	44.9	48.0	49.7	52.5	51.7	49.6	23
Mexico	58.7	60.5	61.7	63.1	53.3	58.8	61.8	59.1	61.0	4
Nicaragua	34.2	34.2	34.7	37.7	38.0	38.7	39.8	40.0	39.9	17
Panama	49.4	48.9	49.1	51.9	51.7	53.6	54.7	55.6	56.8	15
	56.0	57.5	58.6	60.2	52.1	57.0	59.9	57.8	59.3	6
The Caribbean										
Antigua and Barbuda	63.4	61.7	62.3	63.9	64.5	64.6	64.1	64.6	63.5	0
Bahamas	103.5	101.2	101.5	101.0	99.2	97.6	94.9	95.6	95.9	-7
Barbados	105.3	107.2	107.4	105.7	110.6	105.2	100.8	95.6	96.5	-8
Belize	56.1	56.9	58.1	58.5	56.3	56.3	57.5	57.6	57.7	3
Dominica	67.3	66.9	66.2	66.1	70.6	68.2	68.9	69.5	69.4	3
Grenada	63.8	64.8	64.5	68.3	67.8	67.3	66.0	67.4	67.8	6
Jamaica	63.0	63.1	56.3	59.6	54.7	59.9	63.0	63.9	60.2	-4
Saint Kitts and Nevis	58.9	63.2	64.4	65.2	66.1	65.9	66.8	66.8	66.1	12
Saint Lucia	62.5	63.9	67.1	65.1	64.5	68.1	68.3	68.9	69.9	12
Saint Vincent and the Grenadines	61.0	60.9	64.3	63.1	62.1	64.1	62.6	62.3	61.8	1
Suriname	44.3	45.1	46.8	53.0	56.0	59.3	55.9	60.4	61.1	38
Trinidad and Tobago	54.0	52.7	57.9	70.7	50.5	53.4	61.4	58.8	60.0	11
	64.1	63.1	63.6	70.1	60.5	63.0	66.5	65.9	65.5	2
South America										
Bolivia (Plurinational State of)	25.0	27.8	29.7	34.8	34.8	37.4	42.5	44.8	46.8	87
Brazil	44.9	51.8	59.7	67.3	65.7	79.8	87.9	77.7	74.5	66
Chile	50.3	57.9	60.4	59.4	57.0	67.4	72.0	71.2	70.1	39
Colombia	41.1	41.4	48.1	53.6	50.0	58.5	62.9	65.5	63.0	54
Ecuador	39.4	41.3	42.9	47.9	47.9	50.8	52.6	54.3	55.1	40
Paraguay	27.7	31.2	37.4	46.2	41.1	45.2	53.1	51.8	52.5	90
Peru	40.9	43.1	44.5	47.2	46.3	51.5	55.2	57.7	55.9	37
Uruguay	46.2	48.6	53.1	63.1	61.3	71.4	79.1	79.4	83.4	80
Venezuela (Bolivarian Republic of)	40.8	45.4	51.1	65.2	69.8	50.9	63.3	70.9	69.7	71
	43.7	49.1	55.5	62.6	61.4	70.0	77.3	72.4	70.0	60
Latin America and the Caribbean	48.2	52.2	56.7	61.9	58.4	65.7	71.5	67.5	66.5	38

Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), Databases and Statistical Publications (CEPALSTAT) [online] http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp?idioma=i; and World Bank Data Base [online] http://data.worldbank.org/.

FIGURE 7

Price level index by subregion, 2005-2013
(United States = 100)

Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), Databases and Statistical Publications (CEPALSTAT) [online] http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp?idioma=i; and World Bank Data Base [online] http://data.worldbank.org/.
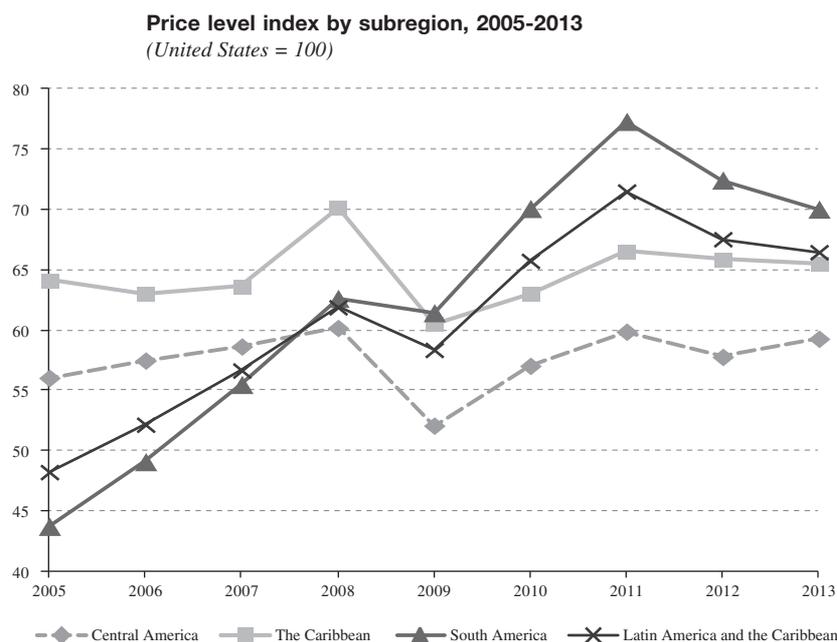
3. Comparison of the results at the aggregate level and by component (series at current prices)

As noted earlier, one of the objectives of the exercise was to compare the results obtained at the aggregate level of GDP and in the disaggregation by component. The exercise by component was carried out for the nine South American countries included in this study and Mexico, being the countries of the region that participated in the 2005 and 2011 rounds and, thus, offering a basis for comparison of the estimates with respect to the benchmark. Table 2 compares the results obtained from the two methods, i.e. comparing the calculations at the GDP level with those performed at the component level.

It should be noted that differences of more than 3% arise even for the base year 2011 (column shown in grey in table 2). *A priori*, these two PPPs could be expected to be the same; however, there are differences in the weightings of the components in the national accounts, both for the Latin American countries and for the benchmark country, with respect to those used in the ICP in 2011, which partly explains the disparities. Furthermore, the multilateral aggregation was applied

to the component estimates for only 11 of the countries involved (the ten Latin American countries plus the United States), while the ICP operation included the 16 Latin American countries participating in the Programme, except Chile and Mexico, which were included in the OECD "region".[12]

As is evident in table 2, there are significant differences which tend to grow broader at the tails of the series. This is the case of Brazil, Colombia, Ecuador, Peru and Uruguay, whose PPPs are similar in 2011, with the differences growing the further from that year the estimate is taken.

It should be noted that the PPPs estimated by components tend to show higher values than those estimated at the GDP level. The Bolivarian Republic of Venezuela and Chile show more irregular differences owing to changes in the prices of their main export commodities (oil and copper, respectively).[13] This

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[12] For further information on these methodologies, see World Bank (2013).

[13] In 2008 there was a sharp fall in the price of oil, which affected not only Venezuela, but also Ecuador (see figure 8). The copper price also saw significant falls in 2005 and in 2008-2009.

TABLE 2

Estimates of PPP at the GDP level and by component, in monetary units of each country per US$ 1, 2005-2013

Country	Estimate	2005	2006	2007	2008	2009	2010	2011	2012	2013
Bolivia (Plurinational State of)	GDP level	2.02	2.23	2.33	2.52	2.44	2.62	2.95	3.10	3.23
	Components	2.22	2.40	2.54	2.65	2.68	2.78	3.05	3.16	3.34
	Percentage difference	10	7.6	8.9	5.1	9.7	5.9	3.4	1.9	3.2
Brazil	GDP level	1.09	1.13	1.16	1.23	1.31	1.40	1.47	1.52	1.61
	Components	1.14	1.17	1.20	1.25	1.35	1.42	1.47	1.54	1.64
	Percentage difference	4.6	3.5	3.2	1.3	3.1	1.1	0.1	1.6	2.2
Chile	GDP level	281.66	307.21	315.56	310.23	319.72	343.75	348.02	346.33	347.14
	Components	305.38	304.00	310.57	331.14	339.08	343.77	349.92	355.75	362.25
	Percentage difference	8.4	-1.0	-1.6	6.7	6.1	0.0	0.5	2.7	4.4
Colombia	GDP level	952.72	977.70	1 000.36	1 055.24	1 082.98	1 111.17	1 161.91	1 177.60	1 177.98
	Components	1 016.56	1 038.43	1 056.63	1 085.38	1 139.19	1 148.59	1 176.76	1 192.26	1 203.58
	Percentage difference	6.7	6.2	5.6	2.9	5.2	3.4	1.3	1.2	2.2
Ecuador	GDP level	0.39	0.41	0.43	0.48	0.48	0.51	0.53	0.54	0.55
	Components	0.42	0.44	0.44	0.47	0.50	0.52	0.53	0.55	0.56
	Percentage difference	7.3	5.4	3.1	-0.9	4.5	2.6	1.7	2.1	2.1
Mexico	GDP level	6.40	6.60	6.75	7.02	7.20	7.43	7.67	7.78	7.79
	Components	6.59	6.69	6.88	7.14	7.52	7.75	7.91	8.11	8.20
	Percentage difference	3.0	1.4	1.9	1.7	4.4	4.2	3.0	4.2	5.3
Paraguay	GDP level	1 708.76	1 758.67	1 880.39	2 016.39	2 042.07	2 140.51	2 227.34	2 291.93	2 268.09
	Components	1 753.20	1 866.89	1 952.31	2 100.37	2 073.83	2 210.40	2 274.37	2 281.62	2 360.90
	Percentage difference	2.6	6.2	3.8	4.2	1.6	3.3	2.1	-0.4	4.1
Peru	GDP level	1.35	1.41	1.39	1.38	1.40	1.46	1.52	1.52	1.51
	Components	1.49	1.48	1.47	1.49	1.52	1.52	1.55	1.57	1.60
	Percentage difference	10.1	4.8	5.4	7.6	8.8	4.5	1.8	3.0	5.7
Uruguay	GDP level	11.32	11.70	12.47	13.21	13.84	14.31	15.28	16.12	17.09
	Components	11.81	12.30	13.08	13.55	14.42	14.66	15.33	16.19	17.11
	Percentage difference	4.3	5.1	4.9	2.5	4.1	2.4	0.3	0.4	0.1
Venezuela (Bolivarian Republic of)	GDP level	0.85	0.98	1.10	1.40	1.50	2.16	2.71	3.04	4.21
	Components	0.89	0.98	1.11	1.35	1.74	2.18	2.67	3.10	4.70
	Percentage difference	3.8	0.6	1.0	-3.6	16.1	0.9	-1.6	2.0	11.5

Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), Databases and Statistical Publications (CEPALSTAT) [online] http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp?idioma=i; and World Bank Data Base [online] http://data.worldbank.org/.

Note: PPP: Purchasing power parities; GDP: Gross domestic product.

is mainly because the component method uses the exchange rate for exports and imports as a benchmark PPP. The rationale for this practice is that commodity prices —in the absence of transport costs, insurance and taxes, among others— should be the same in dollars for all the countries, such that relative prices (and PPPs), should be given by the exchange rate.[14] Extrapolating

PPPs using the aggregate GDP deflator incorporates the effect of changes in the prices of the countries' export and import baskets (because they are involved in the calculation of the GDP deflator), which is not necessarily reflected in the exchange rates used in the estimation by component.

Figure 8 reports the per capita GDP series in current PPP, estimated at the aggregate level and by component.

In general, the values of per capita GDP in PPP estimated by component are smaller than those estimated at the aggregate level. These differences may be quite

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[14] The situation with services (tourism, for example) is different and much more complex; for the sake of simplicity the ICP uses PPP exchange rates as a benchmark.

large for some countries, as much as 10% of total per capita GDP for some years. This is the case of the Plurinational State of Bolivia.

For the reasons explained, the Bolivarian Republic of Venezuela and Chile, and to a lesser extent Ecuador, present some rather different traits, with per capita GDP differences that can change sign depending on the method used. For example, for the Bolivarian Republic

of Venezuela, the components methods yields a per capita GDP in PPP almost US$ 650 less in 2008, while in 2009 the aggregate method yields a value higher by almost US$ 2,300.

The components method also shows a stronger effect of the 2009 crisis on per capita GDP in PPP. This is apparent in figure 8 for all the countries analysed, with the exception of Paraguay.

FIGURE 8

Per capita GDP in PPP estimated by the aggregate and components methods, in dollars, 2005-2013
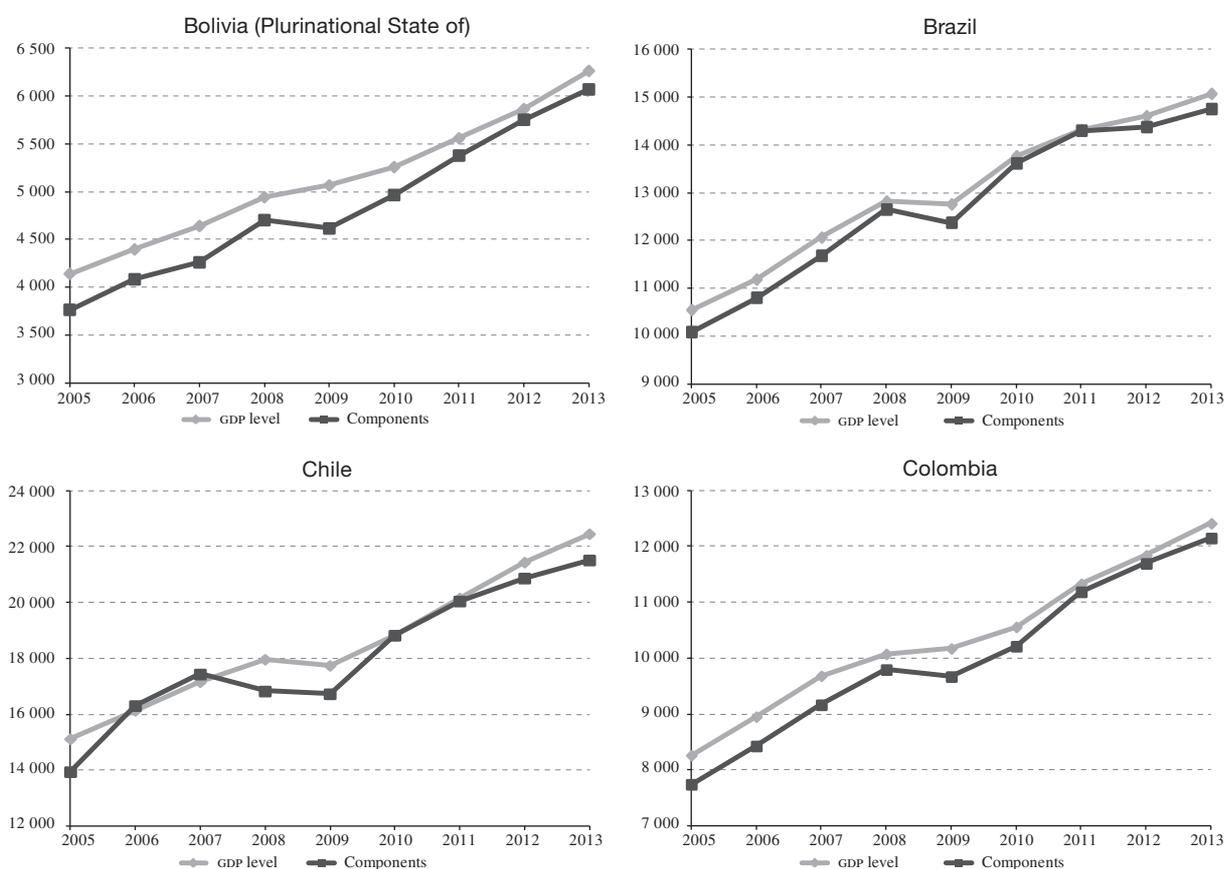
Figure 8 (concluded)
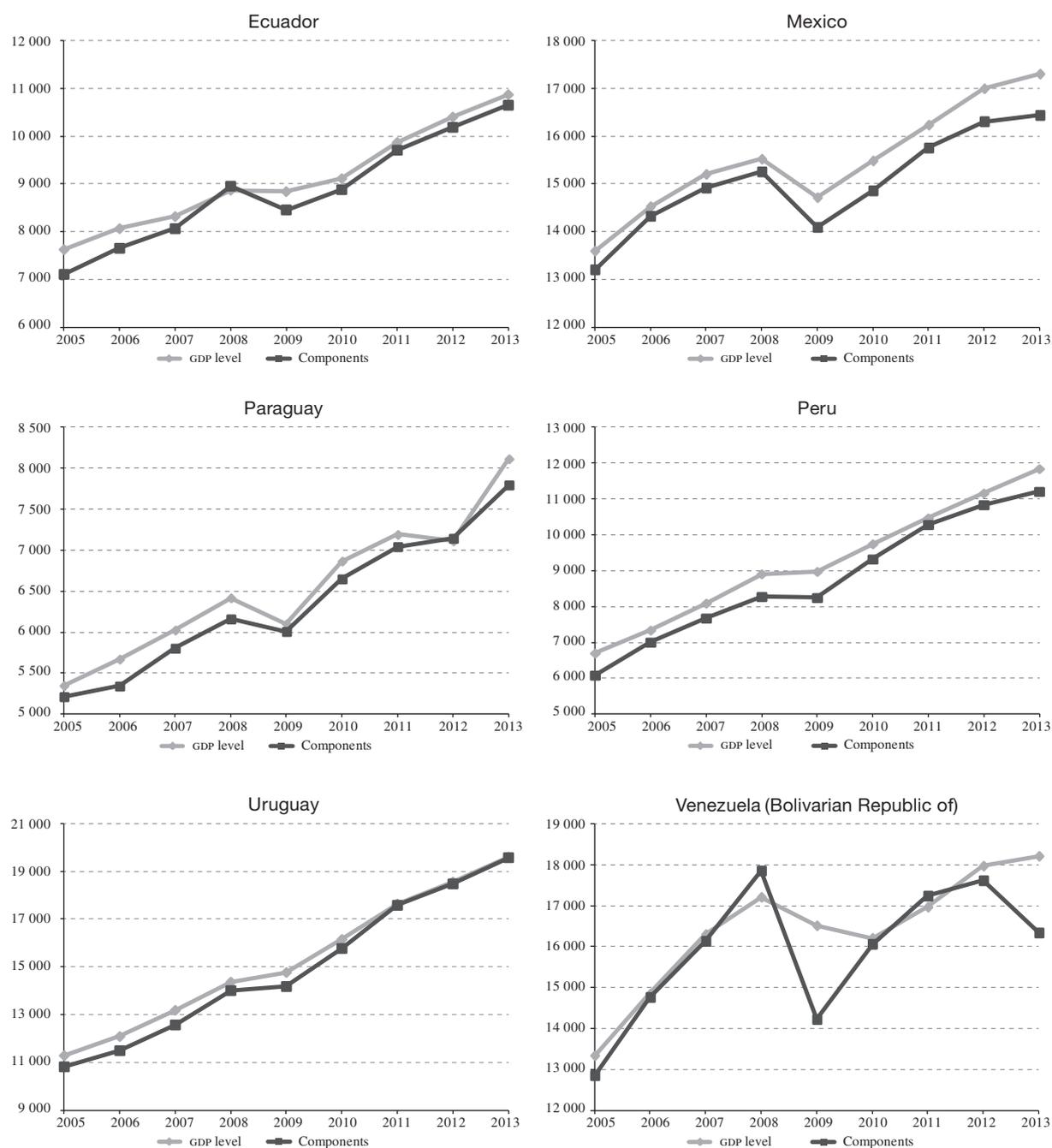
Ecuador

Mexico

Paraguay

Peru

Uruguay

Venezuela (Bolivarian Republic of)

Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), Databases and Statistical Publications (CEPALSTAT) [online] http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp?idioma=i; and World Bank Data Base [online] http://data.worldbank.org/.

Note: PPP: Purchasing power parities; GDP: Gross domestic product.

Finally, it is important to mention that, given the non-additive nature of the EKS method used by ICP and in this exercise, a statistical discrepancy arises between total real GDP in PPP and the sum of the components in PPP, which hinders the calculation of the real share of the components in GDP and the estimation of specific aggregates, such as domestic absorption. The size of this discrepancy varies markedly between the countries, with values of less than 1% for Colombia over the whole period and differences of almost 15% of total GDP in the Bolivarian Republic of Venezuela for 2005.

4. A crucial comparison: estimates versus benchmark

A comparison of the results obtained at the aggregate level and the figures calculated by component does not show which of the two is "closer to the truth," although from the theoretical point of view the components methods should be used, as recommended by SNA 2008.

A crucial comparison for verifying the goodness of fit of the estimation methods is to compare the results obtained with the estimates yielded in the framework of an ICP round (benchmark). Since the ICP calculation is based on comparison of prices surveyed at the individual product level, with abundant, detailed information, it may logically be assumed that these results are of better quality than any extrapolation performed using deflators. This section compares the results of the 2005 ICP round with the PPPs obtained by the two extrapolation methods for that year. The results are presented in table 3.

As may be appreciated, the PPPs obtained using the components method show closer values to the reference year 2005 for all the countries. For some countries, such as Ecuador, Peru and the Plurinational State of Bolivia, the PPPs by component show values very close to the reference period, with differences of less than 1%, while those estimated at the aggregate GDP level show larger differences of between 6% and 10%. In the case of the Bolivarian Republic of Venezuela, Brazil, Paraguay and Uruguay, the PPPs estimated differ notably from those obtained in the 2005 ICP round, which speaks to the weakness of extrapolation/retropolation methods.

It is also important to bear in mind that the results of the ICP for 2005 are also estimates and, as such, may have biases. In this regard, Deaton and Aten (2014) argue that PPPs calculated in the context of the 2005 round of ICP, especially those referring to household consumption, are overestimated owing mainly to the methodology used to link the different regions. These authors find that the overestimates are largest for the regions of Asia, Western Asia and Africa, although they also affect Latin America. In that case the "real" PPPs would be closer to the extrapolations performed in this study.

TABLE 3

Comparison of PPPs calculated in the 2005 round of ICP with the estimates obtained using extra/retropolation, 2005

Country	PPP ICP 2005	GDP level	Components	Difference by GDP level	Difference by Components
Bolivia (Plurinational State of)	2.23	2.02	2.22	-9.4%	-0.4%
Brazil	1.36	1.09	1.14	-19.6%	-15.9%
Chile	333.69	281.66	305.38	-15.6%	-8.5%
Colombia	1 081.95	952.72	1 016.56	-11.9%	-6.0%
Ecuador	0.42	0.39	0.42	-6.1%	0.7%
Mexico	7.13	6.40	6.59	-10.3%	-7.6%
Paraguay	2 006.83	1 708.76	1 753.20	-14.9%	-12.6%
Peru	1.49	1.35	1.49	-9.4%	-0.3%
Uruguay	13.28	11.32	11.81	-14.8%	-11.1%
Venezuela (Bolivarian Republic of)[a]	1.15	0.85	0.89	-26.0%	-23.2%

Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), Databases and Statistical Publications (CEPALSTAT) [online] http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp?idioma=i; and World Bank Data Base [online] http://data.worldbank.org/.

Note: PPP: Purchasing power parities; ICP: International Comparison Programme.
[a] The PPPs for the Bolivarian Republic of Venezuela for the 2005 ICP were divided by 1,000, owing to the exchange rate implemented in 2008, when the currency changed from the bolívar to the bolívar fuerte, at a rate of 1,000 to 1.

IV

Final remarks

This work examined different options for obtaining series of PPPs without incurring additional costs.

There are a number of limitations in relation to the availability of information, especially for those countries which did not participate directly in the 2005 or 2011 rounds of the International Comparison Programme (ICP). There are also methodological limitations, because despite having followed the recommendations of SNA 2008 to estimate the PPP series, the results may have significant biases arising from a "structure effect." These biases can be reduced by extrapolating at more disaggregated levels, as in the components method. However, it is not viable to use this method for the countries of the Caribbean, most of which do not compile GDP by type of expenditure at constant prices and, thus, do not have deflators by type of expenditure.

In order to improve the results and mitigate estimate biases, it is therefore necessary to perform the calculations by component, and even at a lower level in the case of household consumption, which merits a special analysis owing to its large share of GDP.

This article has pointed to other factors that may introduce discrepancies into the estimates and the benchmark values obtained for the reference years. A first difference lies in the fact that PPP rates are calculated on a multilateral basis, meaning that a change in the information of one of the countries involved affects the PPP estimates of all the countries. In this regard, if the group of countries participating in the calculation is not the same, this may have significant effects in the end results.

In the case of the components method, the results include only ten countries of Latin America and the United States as a benchmark, for reasons of comparability and availability of information for the 2005 and 2011 rounds of ICP.

The second difference occurs because of methodological differences implemented between the 2005 and 2011 rounds of ICP in the linking of the regional PPP calculations. The methodology used to link the regional results changed significantly between the two rounds: in 2005 a ring methodology was used, whereby only 18 countries participated in the global calculation in representation of all the participating regions. Conversely, the 2011 round adopted a common global basket using information from all the participating countries.

According to Deaton and Aten (2014), this methodological difference is responsible for much of the widespread overestimation of PPP for household consumption (and, thus, of GDP) in the 2005 round. These authors find that the overestimation is chiefly due to two factors: (i) the inclusion of products in the "ring basket" that were available only in developed countries and that were therefore expensive in poorer countries, and (ii) the use of average weightings in the ring methodology, which led to some products that were expensive but had little weight in a developing country's expenditure (such as air transport) weighing more in the ring calculation.

Despite the limitations mentioned, the series prepared for this work observe international standards and recommendations and may be used to conduct comparative studies between countries. From an analytical perspective, these results are an important input for proving the interpretative hypothesis on differences in the level and evolution of prices in the countries of the region, including gaps between them in trade and tariff openness and in productivity, and indeed, in the characteristics of their production matrixes and markets.

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ANNEX A1

TABLE A1.1

Latin America and the Caribbean: purchasing power parities (PPP),[a] 2005-2013
(National currency units per dollar)

Country	2005	2006	2007	2008	2009	2010	2011	2012	2013
Antigua and Barbuda	1.71	1.67	1.68	1.72	1.74	1.74	1.73	1.74	1.71
Bahamas	1.03	1.01	1.01	1.01	0.99	0.98	0.95	0.96	0.96
Barbados	2.11	2.14	2.15	2.11	2.21	2.10	2.02	1.91	1.93
Belize	1.12	1.14	1.16	1.17	1.13	1.13	1.15	1.15	1.15
Bolivia (Plurinational State of)	2.02	2.23	2.33	2.52	2.44	2.62	2.95	3.10	3.23
Brazil	1.09	1.13	1.16	1.23	1.31	1.40	1.47	1.52	1.61
Chile	281.66	307.21	315.56	310.23	319.72	343.75	348.02	346.33	347.14
Colombia	952.72	977.70	1 000.36	1 055.24	1 082.98	1 111.17	1 161.91	1 177.60	1 177.98
Costa Rica	233.30	251.24	267.69	295.09	317.41	338.54	346.74	354.55	366.83
Dominica	1.82	1.81	1.79	1.79	1.91	1.84	1.86	1.88	1.87
Dominican Republic	14.90	15.23	15.68	16.98	17.43	18.19	19.45	19.86	20.17
Ecuador	0.39	0.41	0.43	0.48	0.48	0.51	0.53	0.54	0.55
El Salvador	0.46	0.46	0.47	0.49	0.48	0.49	0.50	0.50	0.49
Grenada	1.72	1.75	1.74	1.84	1.83	1.82	1.78	1.82	1.83
Guatemala	2.84	2.89	3.02	3.24	3.33	3.46	3.63	3.68	3.75
Guyana	83.85	85.93	94.34	100.87	102.24	107.78	114.43	118.87	117.33
Haiti	13.04	14.52	15.28	16.92	17.41	18.14	19.11	19.76	20.76
Honduras	7.57	7.74	8.04	8.50	9.08	9.39	9.91	10.09	10.09
Jamaica	39.26	41.48	38.96	43.35	48.10	52.24	54.12	56.69	60.38
Mexico	6.40	6.60	6.75	7.02	7.20	7.43	7.67	7.78	7.79
Nicaragua	5.72	6.00	6.41	7.30	7.73	8.27	8.92	9.43	9.86
Panama	0.49	0.49	0.49	0.52	0.52	0.54	0.55	0.56	0.57
Paraguay	1 708.76	1 758.67	1 880.39	2 016.39	2 042.07	2 140.51	2 227.34	2 291.93	2 268.09
Peru	1.35	1.41	1.39	1.38	1.40	1.46	1.52	1.52	1.51
Saint Kitts and Nevis	1.59	1.71	1.74	1.76	1.78	1.78	1.80	1.80	1.78
Saint Lucia	1.69	1.73	1.81	1.76	1.74	1.84	1.84	1.86	1.89
Saint Vincent and the Grenadines	1.65	1.65	1.74	1.70	1.68	1.73	1.69	1.68	1.67
Suriname	1.21	1.24	1.28	1.45	1.54	1.63	1.83	1.99	2.02
Trinidad and Tobago	3.40	3.32	3.66	4.44	3.19	3.40	3.94	3.78	3.86
Uruguay	11.32	11.70	12.47	13.21	13.84	14.31	15.28	16.12	17.09
Venezuela (Bolivarian Republic of)	0.85	0.98	1.10	1.40	1.50	2.16	2.71	3.04	4.21

Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), Databases and Statistical Publications (CEPALSTAT) [online] http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp?idioma=i; and World Bank Data Base [online] http://data.worldbank.org/.

[a] Extrapolated at the aggregate level.

TABLE A1.2

Latin America and the Caribbean: total GDP in PPP, at current prices,[a] 2005-2013
(Millions of dollars)

Country	2005	2006	2007	2008	2009	2010	2011	2012	2013
Antigua and Barbuda	1 574	1 840	2 068	2 110	1 870	1 758	1 762	1 866	1 892
Bahamas	7 448	7 870	8 196	8 163	7 881	8 100	8 356	8 593	8 780
Barbados	3 694	4 025	4 201	4 298	4 152	4 213	4 333	4 421	4 500
Belize	1 986	2 141	2 222	2 339	2 373	2 482	2 587	2 734	2 817
Bolivia (Plurinational State of)	38 135	41 192	44 219	47 858	49 840	52 531	56 390	60 373	65 424
Brazil	1 963 425	2 103 824	2 291 370	2 457 133	2 467 637	2 685 941	2 816 317	2 896 444	3 012 883
Chile	247 238	266 530	286 210	302 511	301 650	322 929	348 842	374 216	395 268
Colombia	357 038	392 654	430 919	454 954	465 981	490 405	533 513	565 082	600 331
Costa Rica	40 888	45 844	50 799	53 210	53 069	56 379	60 138	64 361	67 604
Dominica	550	595	648	710	707	723	738	740	745
Dominican Republic	73 048	83 327	92 794	97 588	99 250	108 802	114 299	119 445	126 782
Ecuador	105 272	113 284	118 845	128 879	130 594	136 849	150 664	161 376	171 382
El Salvador	37 343	39 996	42 637	44 028	42 972	44 090	45 998	47 705	49 227
Grenada	1 090	1 079	1 175	1 210	1 138	1 146	1 179	1 186	1 233
Guatemala	73 103	79 402	86 654	91 252	92 429	96 242	102 318	107 248	112 852
Haiti	12 883	13 578	14 405	14 812	15 384	14 716	15 849	16 599	17 571
Honduras	24 273	26 662	29 065	30 889	30 367	31 885	33 791	35 818	37 307
Jamaica	17 831	18 907	22 727	23 007	22 153	22 092	22 931	23 211	23 689
Mexico	1 473 580	1 594 433	1 689 647	1 746 559	1 676 347	1 785 035	1 893 303	2 004 931	2 064 130
Nicaragua	18 506	19 867	21 474	22 520	22 065	23 072	24 888	26 590	28 229
Panama	33 434	37 400	43 046	47 904	50 187	53 772	60 793	68 226	75 026
Paraguay	31 580	34 115	36 921	40 039	38 744	44 351	47 233	47 485	55 048
Peru	185 811	205 939	229 428	255 316	259 955	285 366	310 051	334 398	358 920
Saint Kitts and Nevis	922	1 006	1 062	1 127	1 072	1 050	1 090	1 096	1 159
Saint Lucia	1 496	1 669	1 705	1 799	1 825	1 828	1 889	1 892	1 912
Saint Vincent and the Grenadines	903	1 002	1 063	1 102	1 087	1 063	1 080	1 112	1 147
Suriname	5 071	5 820	6 280	6 669	6 922	7 368	7 916	8 300	8 667
Trinidad and Tobago	29 579	34 881	37 410	39 437	37 992	38 537	38 317	39 491	40 737
Uruguay	37 549	40 289	44 067	48 156	49 662	54 493	59 702	63 008	66 758
Venezuela (Bolivarian Republic of)	356 492	403 718	450 741	483 837	471 902	470 552	500 326	537 963	553 312
Latin America and the Caribbean	5 181 742	5 622 887	6 091 999	6 459 414	6 407 207	6 847 769	7 266 591	7 625 912	7 955 333
Latin America	5 109 598	5 542 054	6 003 241	6 367 444	6 318 035	6 757 409	7 174 415	7 531 270	7 858 056
The Caribbean	72 144	80 833	88 758	91 970	89 172	90 360	92 176	94 642	97 277

Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), Databases and Statistical Publications (CEPALSTAT) [online] http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp?idioma=i; and World Bank Data Base [online] http://data.worldbank.org/.

Note: GDP: Gross domestic product; PPP: Purchasing power parities.
[a] Extrapolated at the aggregate level.

TABLE A1.3

Latin America and the Caribbean: total GDP in PPP, at constant prices,[a] 2005-2013
(Millions of dollars at constant 2010 prices)

Country	2005	2006	2007	2008	2009	2010	2011	2012	2013
Antigua and Barbuda	1 732	1 964	2 151	2 152	1 893	1 758	1 726	1 796	1 794
Bahamas	8 195	8 402	8 523	8 325	7 978	8 100	8 187	8 271	8 326
Barbados	4 065	4 297	4 369	4 384	4 202	4 213	4 245	4 255	4 268
Belize	2 185	2 285	2 311	2 385	2 402	2 482	2 534	2 631	2 671
Bolivia (Plurinational State of)	41 963	43 976	45 983	48 810	50 449	52 531	55 249	58 109	62 046
Brazil	2 160 497	2 245 989	2 382 801	2 506 030	2 497 767	2 685 941	2 759 343	2 787 792	2 857 289
Chile	272 054	284 541	297 630	308 531	305 333	322 929	341 785	360 179	374 855
Colombia	392 874	419 187	448 114	464 008	471 671	490 405	522 720	543 885	569 328
Costa Rica	44 992	48 942	52 826	54 269	53 717	56 379	58 922	61 947	64 113
Dominica	605	635	674	724	716	723	723	713	706
Dominican Republic	80 380	88 958	96 497	99 530	100 462	108 802	111 987	114 964	120 235
Ecuador	115 838	120 939	123 587	131 444	132 189	136 849	147 616	155 322	162 532
El Salvador	41 092	42 699	44 339	44 904	43 497	44 090	45 068	45 916	46 685
Grenada	1 200	1 152	1 222	1 234	1 152	1 146	1 155	1 142	1 169
Guatemala	80 440	84 768	90 111	93 068	93 558	96 242	100 248	103 225	107 024
Haiti	14 176	14 495	14 980	15 106	15 572	14 716	15 529	15 977	16 663
Honduras	26 709	28 463	30 225	31 504	30 738	31 885	33 108	34 475	35 381
Jamaica	19 621	20 184	23 634	23 465	22 424	22 092	22 467	22 340	22 465
Mexico	1 621 486	1 702 176	1 757 069	1 781 315	1 696 815	1 785 035	1 855 001	1 929 722	1 957 533
Nicaragua	20 364	21 209	22 331	22 968	22 334	23 072	24 385	25 593	26 771
Panama	36 790	39 927	44 763	48 858	50 799	53 772	59 564	65 667	71 152
Paraguay	34 749	36 420	38 394	40 836	39 217	44 351	46 277	45 704	52 205
Peru	204 461	219 855	238 583	260 397	263 129	285 366	303 778	321 854	340 384
Saint Kitts and Nevis	1 014	1 074	1 104	1 150	1 085	1 050	1 068	1 055	1 100
Saint Lucia	1 646	1 781	1 773	1 835	1 847	1 828	1 850	1 821	1 813
Saint Vincent and the Grenadines	994	1 070	1 106	1 124	1 100	1 063	1 058	1 070	1 088
Suriname	5 580	6 213	6 531	6 801	7 006	7 368	7 756	7 989	8 219
Trinidad and Tobago	32 548	37 238	38 903	40 222	38 456	38 537	37 542	38 009	38 633
Uruguay	41 318	43 012	45 825	49 114	50 269	54 493	58 494	60 644	63 310
Venezuela (Bolivarian Republic of)	392 273	430 999	468 727	493 466	477 663	470 552	490 204	517 783	524 737
Latin America and the Caribbean	5 701 842	6 002 851	6 335 085	6 587 958	6 485 440	6 847 769	7 119 586	7 339 848	7 544 497
Latin America	5 622 457	5 916 555	6 242 786	6 494 157	6 395 179	6 757 409	7 029 275	7 248 756	7 452 243
The Caribbean	79 385	86 296	92 299	93 801	90 261	90 360	90 311	91 092	92 254

Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), Databases and Statistical Publications (CEPALSTAT) [online] http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp?idioma=i; and World Bank Data Base [online] http://data.worldbank.org/.

Note: GDP: Gross domestic product; PPP: Purchasing power parities.
[a] Extrapolated at the aggregate level.

Official development assistance, social capital and growth in Latin America

Isabel Neira, Maricruz Lacalle–Calderón and Marta Portela

ABSTRACT

This study focuses on the relationship among official development assistance (ODA), social capital and economic growth in Latin American countries, attempting to determine whether the impact of such assistance on growth is conditional on the receiving country's stock of social capital. To this end, we use "trust" to measure social capital in an unbalanced panel of 18 Latin American countries over the period 2001-2010. After accounting for country and time effects in a dynamic panel data model, our results show that the impact of ODA on growth is indeed conditional on the level of trust that exists. This suggests that this assistance will be more effective when used in a trust-rich environment.

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I

Introduction

The effectiveness of official development assistance (ODA) has been the subject of numerous empirical studies. However, the impact it is expected to have on growth in receiving countries continues to be an object of debate (Easterly, 2008; Gibson and others, 2009).

Several of these studies have also looked at other factors, such as institutions or social relationships, that may have an impact on the effectiveness of ODA and hence could indirectly promote or hinder the growth process. For example, Burnside and Dollar (2000) find that the potential for ODA to have a positive impact on growth depends on the presence of sound fiscal, monetary and trade policies. Kaufmann, Kraay and Zoido-Lobatón (1999) propose six indicators of governance that they believe can function as important ODA selection criteria. Rivera-Batiz (2002) notes that governance-improving democracy increases growth by reducing corruption. Choritz (2002), Simon and McGillivray (2003) and Knack (2001) find that a better understanding of the region's existing social capital and other drivers of growth needs to be achieved prior to the implementation of development policies and projects. Baliamoune-Lutz and Mavrotas (2009) study whether social capital and institutions enhance the effectiveness of ODA. Apart from this last paper, which suffers from some limitations, the literature does not provide any other empirical evidence regarding the macroeconomic effect of social capital on the effectiveness of ODA.[1]

An application of the basic two-gap model (Chenery and Strout, 1966) indicates that ODA is required in order to close the savings-investment gap in poor countries. Therefore, when aid is used to finance productive investment, it can be expected to have a positive impact on growth. However, the decision to use ODA for productive investment, along with its subsequent effect on growth, may be influenced by the levels or quality of a given country's social capital.

Following Burnside and Dollar (2000) and Baliamoune-Lutz and Mavrotas (2009), this study looks at whether the impact of ODA on growth is conditional on the receiving country's institutional and social environment, which can be —and has been— measured on the basis of such variables as good governance, democracy or social capital. An effort is made to test the hypothesis that the impact of ODA on growth in Latin America is conditional on the existing stock of social capital, with "trust"[2] being used as the most accurate proxy for this variable. An estimation procedure that is superior to ordinary least square (OLS) is employed for this purpose. The present study thus contributes to the literature by exploring the interaction between ODA and social capital (measured by trust) as a determinant of GDP growth.

Using a modified neoclassical growth model, we empirically study the effectiveness of ODA in the presence of trust based on an analysis of an unbalanced panel of 18 Latin American countries[3] during the period 2001-2010. The results show that ODA has a positive and statistically significant effect on growth in a trust-rich environment, but has no effect in its absence.

The rest of this paper is organized as follows. Section II summarizes the most important literature on the effectiveness of ODA in driving growth. In section III, trust is analysed as a form of social capital, and an effort is made to determine how it may condition the effectiveness of ODA. Section IV presents the data and the panel data model used to explore the dynamics of ODA, trust and the impact of their interaction on economic growth. Section V presents a discussion of the results of the comparison of the effectiveness of ODA in the presence and absence of trust. Section VI concludes.

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[1] Other authors, such as Knowles (2007), have studied the effect of social capital on the allocation of aid; this area of inquiry is beyond the scope of this paper, however.

[2] Following the recent literature, trust is probably the most accurate proxy for measuring social capital (Knack and Keefer ,1997; Whiteley, 2000; Beugelsdijk and Van Schaik, 2005; Helliwell and Putnam, 2000; Temple, 2001; Dollar and Kraay, 2002; Neira, Vázquez and Portela, 2009).

[3] Specifically: Argentina, the Bolivarian Republic of Venezuela, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, the Plurinational State of Bolivia, and Uruguay.

II

Official development assistance and economic growth

Several recent empirical studies have sought to determine whether or not ODA has a macroeconomic impact on growth. Two main but opposing positions on the effectiveness of aid can be defined, although the evidence is still ambiguous and the debate continues (Easterly, 2008; Sachs, 2011).

In the aftermath of the Second World War, ODA emerged as an imperative, since external financial flows were necessary in order to reduce the internal and external gaps existing in the economies of poor countries (Chenery and Strout, 1966). In the decades that followed, a determined research effort was made to demonstrate the effectiveness of ODA in driving growth. Some studies obtained positive results (Levy, 1988), but in others the results were clearly negative (Mosley, Hudson and Horrel, 1987; Mosley, 1980; Boone, 1996). Many of these studies did not treat the endogeneity of ODA, which may account for their contradictory results (Arndt, Jones and Tarp, 2010). Then, in a study conducted in 2000, Burnside and Dollar (2000) found that ODA "works" in "good policy environments." The belief that ODA boosts economic growth, reduces poverty and improves social indicators within good policy environments led the World Bank to increase its ODA budgets worldwide (Easterly, 2003).

Since the appearance of Burnside's and Dollar's paper (2000), several studies have produced contrasting results. Hansen and Tarp (2000 and 2001), Dalgaard and Hansen (2001), Lensink and White (2001) and Clemens and others (2012) find a positive causal relationship between aid and economic growth that is not conditional on a good policy environment or high-quality institutions, as their results indicate that ODA spurs growth even in countries hampered by an unfavourable policy environment. In contrast, several other studies have found that ODA has no effect on growth, whether or not there is a sound policy environment (Easterly, 2003; Easterly, Levine and Roodman, 2004; Rajan and Subramanian, 2008). These authors contend that neither short-impact aid nor any other type of assistance has positive effects on growth. Moreover, they also find no difference between the growth impact of bilateral and multilateral aid. Djankov, Montalvo and Reynal-Querol (2006 and 2008) find that ODA has a negative impact on democracy and economic growth in developing countries. The main problems faced by these authors when attempting to gauge the impact of ODA on growth have been the erratic nature of such assistance, poor data quality, the low ratio of ODA to GDP in most recipient countries, endogeneity problems and the use of weak instruments (Tarp, 2006).

Two recent meta-analyses provide contrasting results. Doucouliagos and Paldam (2011) find that ODA is ineffective in promoting growth, while Mekasha and Tarp (2013) find that its effect on growth is positive and statistically significant. An extensive review of the literature demonstrates that the debate continues.

III

Social capital, official development assistance and economic growth

Social capital is not homogenous; its nature and the forms it takes change over time depending on the type of balance that exists between public and private organizations and on the situation in the particular country concerned. There are many different definitions of social capital, since the concept is relevant to numerous disciplines, including sociology, political science, economics and many others. Most of these definitions use terms such as "networks," "trust" and "rules" or "norms." One of the aphorisms frequently used to describe social capital is "It's not what you know, it's who you know." According to Coleman (1988 and 2000), social capital is anything

that facilitates individual or collective action and is generated by networks of relationships, reciprocity, trust and social norms. This definition of social capital is close to Bourdieu's (1986) and Loury's (1977). For Coleman (1988), social capital can be described as a neutral resource derived from the social structure that facilitates certain actions on the part of individuals or corporate actors, thereby allowing the achievement of certain ends which, in the absence of social capital, would not be attainable.

From a political viewpoint, Putnam (1995) describes social capital as "features of social organization, such as networks, norms and trust, which facilitate coordination and cooperation for mutual benefit." The definitions proposed by the Organization for Economic Cooperation and Development (OECD) and the World Bank are

similar. The former states that social capital includes the "networks, norms, values and understandings that facilitate cooperation within or among groups" (OECD, 2001). In turn, the World Bank defines social capital as the institutions, relationships and norms that shape the quality and quantity of a society's social interactions (World Bank, 1985). Therefore, the expression of a relationship, a link between trust or confidence and civic cooperation, is inherent in the idea of social capital. Social capital is the result of a process of dynamic interaction. It must be created. It can be increased or destroyed, either deliberately or not, and requires ongoing investment. Hence, for all these reasons, social capital should be considered just that: a form of capital. The most important contributions to this body of thought are summarized in table 1.

TABLE 1

Definitions of social capital

Author	Generating elements	Consequences
Bourdieu (1985)	Permanent networks and membership in a group	Assuring members of a set of current or potential resources
Coleman (1988)	Aspects of social structure	Facilitating certain common actions on the part of agents within the structure
Putnam, Leonardi and Nanetti (1993)	Aspects of social organizations such as networks, norms and confidence	Facilitating action and cooperation for mutual benefit
World Bank (1998)	Institutions, relationships and norms	Shaping the quality and quantity of a society's social interactions
OECD (2001)	Networks together with norms, values and shared opinions	Facilitating cooperation within and among groups
ECLAC (2002)	Social capital is a society's set of norms, institutions and organizations	Promoting confidence and cooperation among people, communities and society as a whole
Social Capital Interest Group (SCIG) (1999)	The potential benefits, advantages and preferential treatment that arise as the result of compassion and the sense of obligation that a person feels towards a group or the group feels towards another person	Including the potential benefits, advantages and preferential treatment that originate from one person's sympathy and sense of obligation towards his or her idealized self

Source: I. Neira, E. Vázquez and M. Portela, "An empirical analysis of social capital and economic growth in Europe (1980-2000)", *Social Indicators Research*, vol. 92, No. 1, Springer, 2009.

Note: SCIG is affiliated with the University of Michigan.

In an effort to measure social capital, empirical studies have used a range of different variables to attempt to capture this elusive concept and its multiple dimensions (Durlauf, 2002; Bjørnskov, 2006). However, Oorschot and Arts (2005) note that there is a growing consensus that the empirical indicators of social capital can be grouped into three broad dimensions based on the above definitions. The first is *social trust*, which is the most frequently used variable in the empirical literature on social capital (Knack and Keefer, 1997; Whiteley, 2000; Beugelsdijk, De Groot and Van Schaik,

2004; Helliwell and Putnam, 2000; Temple, 2001; Dollar and Kraay, 2002). Social trust usually involves different types of trust or confidence, ranging from confidence in family members, neighbours, the country's population and so forth. This first dimension is the variable that we have chosen to measure social capital in this paper. The second variable is *social networks*, which is often used to measure participation in various associations in an attempt to assess the social integration of the members of the community being analysed (Helliwell, 1996; Knack and Keefer, 1997; Beugelsdijk and Van Schaik,

2005; Hall, 1999). The third dimension, *social norms*, is employed to analyse shared norms and civic values as reflected in such variables as the level of corruption, the degree of democracy, crime rates, divorce, levels of unemployment and so forth (Putnam, 2000; Bartolini and Bonatti, 2008).

There are several studies that have sought to determine whether a greater degree of social capital is always positively related to economic development and whether the different stages of development require different mixes of social capital. It is also possible that, at certain times or in particular societies, there may be particular forms of antagonistic social capital. Some authors advance the idea that social capital has a negative effect on society. The excessive religious fervour with which certain countries run their societies can result in wars or the onset of other kinds of conflicts, and membership in zealous groups of that type may have negative effects. Fukuyama (1999) states that: "Both the Ku Klux Klan and the Mafia achieve cooperative ends on the basis of shared norms, and therefore have social capital, but they also produce abundant negative externalities for the larger society in which they are embedded." However, although some networks may have a negative impact if they focus on themselves to the detriment of society at large, trust relationships are generally assumed to be positive factors in terms of social cohesion and economic success (Beugelsdijk, De Groot and Van Schaik, 2004; Beugelsdijk and Van Schaik, 2005; Helliwell and Putnam, 2000; Neira, Vázquez and Portela, 2009). The presence of social capital (measured by trust) within social structures can enhance many activities and make them less costly, thereby furthering the development process. Such activities include collective decision-making, the coordination of different actions, the spread of innovation and so forth. In the presence of social capital, these activities are conducted more efficiently because, in a context marked by trust and the pursuit of common goals, people are more willing to cooperate with one another (Knack and Keefer, 1997; Fukuyama, 2001; Adler and Kwon, 2002).

The literature does not, however, offer any empirical studies dealing with the question of how trust, as a form of social capital, may enhance the effectiveness of ODA in driving growth.[4] From the perspective of the countries receiving ODA, we can posit three basic ways in which trust may alter the effectiveness of ODA and therefore influence these countries' economic growth paths.

First of all, trust reduces transaction costs and facilitates the flow of information. Since the foreign aid system is extremely fragmented (Easterly, 2008), a trust-rich environment in the recipient country will engender coordination within the system, collaboration among agents, consensus on specific and global objectives and communication, all of which will help to ensure that scarce resources are employed where they are most needed. A transparent bureaucracy and the existence of mechanisms for promoting dialogue and resolving conflicts are necessary conditions for the successful use of ODA. By contrast, in the absence of trust, agents will probably work towards contradictory goals or will duplicate objectives and tasks.

Second, trust reduces opportunistic behaviour. In contexts marked by low levels of trust, there is a risk that cooperation will be of a sort that will benefit the wealthiest members of the recipient societies or the most selfish ones who have no regard for their compatriots. A trust-rich environment is crucial in order for ODA to be channeled into productive investments benefiting the most vulnerable populations. Trust between donor and recipient countries and between recipient governments and civil society is of pivotal importance because a proper use of ODA requires the combination of different forms of knowledge that are embedded in all the various types of social agents.

Third, trust paves the way for a sense of ownership on the part of recipients, and without that kind of ownership, recipient countries will not make the commitments needed to ensure the optimal progress of development projects (Gibson and others, 2009). Such projects should be coupled with local ownership of the corresponding funds. Knack (2001) and Dollar and Pritchett (1998) point to the need to emphasize the role of citizens' participation and social capital in recipient countries in ensuring that the foreign aid system will be effective. For all these reasons, it can be assumed that trust has a positive effect on the effectiveness of ODA in driving growth.

The literature on the effectiveness of ODA in promoting growth includes several studies dealing with factors other than social capital that relate to the quality of the receiving country's institutional structure. These factors include good governance, good policies and a democratic environment. Dollar and Pritchett (1998) note that development assistance bolsters economic growth and helps to reduce poverty if local governments are good managers of their social, political and economic

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[4] To the best of our knowledge, only Baliamoune-Lutz and Mavrotas (2009) have undertaken a study of this type, but they did not use trust as a proxy for social capital. Instead, they used ethno-linguistic fractionalization as a proxy for social cohesion and social cohesion as a major indicator of social capital.

institutions. Burnside and Dollar (2000) find that, in order for ODA to be effective, better fiscal, monetary and trade policymaking practices in recipient countries are needed. Kaufmann, Kraay and Zoido-Lobatón (1999) propose six indicators of good governance that they believe can function as important development assistance selection criteria. In addition, Rivera-Batiz (2002) notes that governance-improving democracy boosts growth by reducing corruption.

The "good policies" premise has shaped the ODA policies developed over the last decade; however, some authors, such as Baliamoune-Lutz and Mavrotas (2009),

contend that they are not a key determinant and that factors such as social capital are more important in determining whether ODA is used successfully or not. Along these lines, Choritz (2002), Simon and McGillivray (2003), Knack (2001) and Baliamoune-Lutz and Mavrotas (2009) highlight the need for a better understanding of the social capital existing in a recipient region before the authorities begin to formulate policies or design development projects. In other words, the existing stock of social capital in a region has to be identified in advance because it may leverage or hinder the effectiveness of ODA in furthering the growth process.

IV

Empirical analysis

Studies of the effect of ODA on growth are generally based on a sample of countries around the world and use specific dummies for different continents. Our sample of 18 Latin American countries is used to study the role of trust in determining the effectiveness of ODA in this geographical area. Accurate data on the influence exerted by social capital on ODA recipient countries are generally quite limited; however, in the case of Latin America, which is a major ODA recipient, the Latinobarómetro database provides very good data on trust, which is the proxy used for social capital in this study.

1.   Data

The dataset used to analyse the impact of trust on ODA effectiveness was obtained by combining several sources (see annex table A.1). The variable records were matched by country and year. After excluding some records that could not be matched, we obtained a final dataset composed of an unbalanced panel of 18 countries over the period 2001-2010.

The dependent variable is economic growth[5] as measured by the log of real GDP purchasing power parity (PPP) (Log_GDP_{it}) derived from the World Development Indicators (World Bank, 2014). The main explanatory variables are ODA (Log_ODA), measured as the log of total net ODA (OECD, 2013), and TRUST (*trust*), measured

as the percentage of people who answered that "You can trust most people" in response to the question "Generally speaking, would you say that you can trust most people, or that you can never be too careful when dealing with others?"(Latinobarómetro, 2010). Other variables that are used in the literature as explanatory variables for growth and that are included in our model are: population (Log_popu), measured by the log of the total number of people in the country; employment (*employment*), measured by the proportion of a country's total population (aged 15 years and older) that is employed; and investment (Log_gcf), which is measured by the log of gross capital formation. The figures for all three of these variables are drawn from the World Development Indicators database (World Bank, 2014). The education (*edu*) variable, measured by total years of schooling, is derived from Barro and Lee (2012). Following Acemoglu and others (2008) and Burnside and Dollar (2000), we also introduce the country's level of democracy (*democ*) as a control variable (taken from Polity IV, 2013), since we consider democracy to be a separate variable that is independent of social capital.

Map 1 and figure 1 illustrate the levels of net ODA received by each country during the period under study. Maps 2 and 3 show the average levels of trust and democracy in each country for the selected years. Since the net amount of ODA received by each country changes significantly from year to year within our study period, we have depicted these data in map 1 and figure 1. In the case of trust and democracy, since these data are very stable between and within countries, we have simply mapped the average values for the period 2001-2010.

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[5] Since we are using the generalized method of moments (GMM), the estimated dependent variable is economic growth. GMM uses variables in differences (see equation (2)) but, given that the variables are in logarithmic form, their differences become rates of growth for the original variables in levels (Acemoglu and others, 2008).

MAP 1

Latin America: net official development assistance (ODA) received by each country, 2001-2010

(Billions of dollars)
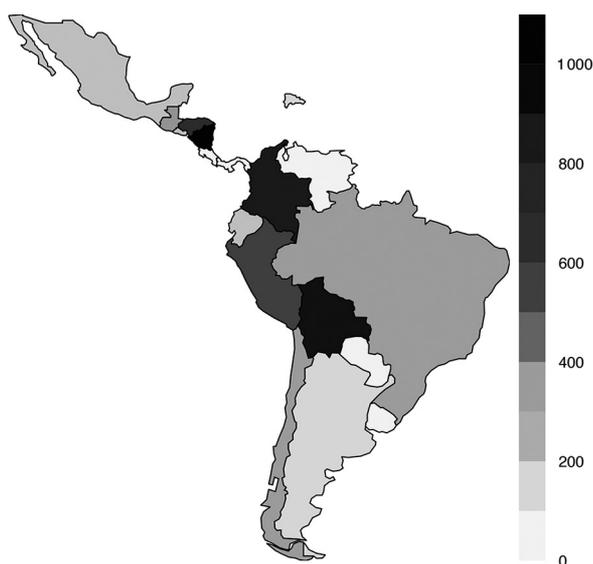
Source: Prepared by the authors, on the basis of the Organization for Economic Cooperation and Development (OECD) database (average for selected years).

Note: The boundaries shown on this map do not imply official endorsement or acceptance by the United Nations.

MAP 2

Latin America: trust levels in each country,[a] average for selected years between 2001 and 2010

(Percentages)
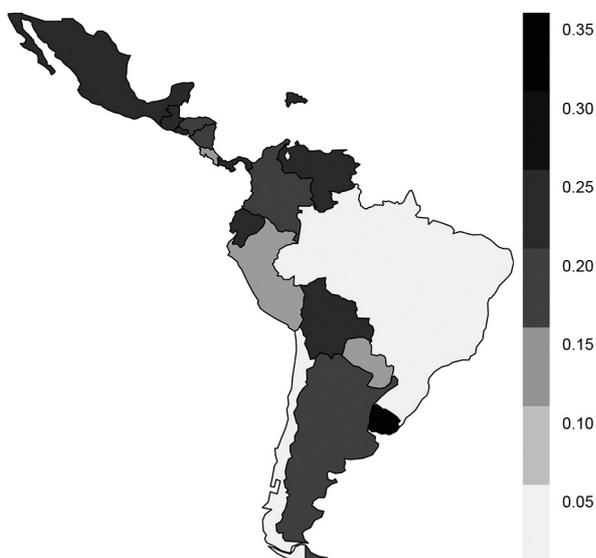
Source: Prepared by the authors, on the basis of Latinobarómetro (2010) database.

Note: The boundaries shown on this map do not imply official endorsement or acceptance by the United Nations.

[a] Percentage of persons replying "You can trust most people" to the question "Generally speaking, would you say that you can trust most people, or that you can never be too careful when dealing with others?"

All the countries in our sample are ODA recipients and, as can be seen in map 1 and figure 1, Haiti and Nicaragua are the main recipients that experienced major changes in the volumes of ODA received from year to year. Other countries receiving large amounts of ODA include the Plurinational State of Bolivia, Honduras and Colombia. On the other hand, the Bolivarian Republic of Venezuela, Uruguay, Costa Rica and Paraguay received the smallest net ODA volumes.

MAP 3

Latin America: democracy levels in each country, average for selected years between 2001 and 2010
(Index)
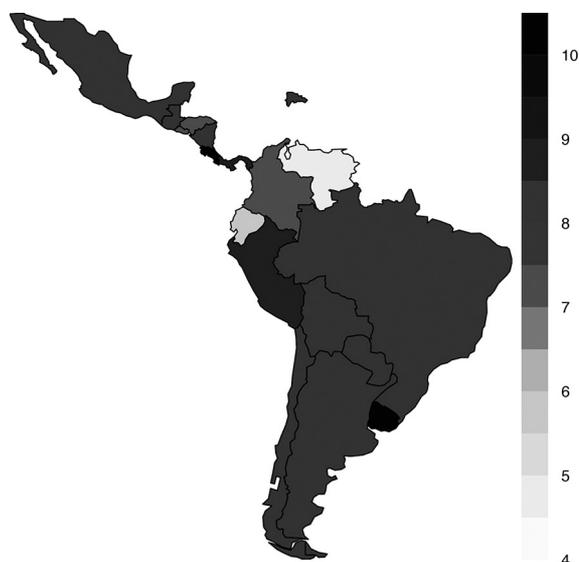
Source: Prepared by the authors, on the basis of Polity IV (2013) project database.

Note: The boundaries shown on this map do not imply official endorsement or acceptance by the United Nations.

Trust levels in all the countries in our sample are low. Only 18% to 32% of the population in these countries responded that "You can trust most people" when they were asked "Generally speaking, would you say that you can trust most people, or that you can never be too careful when dealing with others?" The countries with the highest values are the Dominican Republic, Uruguay, Mexico and Guatemala. The countries with the lowest values are the Bolivarian Republic of Venezuela, Argentina, Honduras and the Plurinational State of Bolivia.

The democracy data take integer values ranging from 1 (absolute lack of democracy) to 10 (the highest level of democracy). In this case, Ecuador, the Bolivarian Republic of Venezuela, Haiti and Honduras are the countries with the highest coefficients, while Argentina, Guatemala, Brazil and the Dominican Republic have the lowest. Therefore, the correlation of the data on trust and democracy is low. In countries where trust levels

are high, the level of democracy may be low, medium or high.

Annex table A.2 provides descriptive statistics for all the variables in the regressions. In each case, we report means and standard deviations, along with the total number of countries for which we have data and the total number of observations. Annex table A.3 presents the correlations among the different variables.

2. Estimation procedure

The following analytical model, which is a modified neoclassical model, has been the basis for our work:

$$y_{it} = \alpha + \lambda y_{it-1} + \beta_i x'_{it} + \delta_i + \omega_t + \varepsilon_{it} \qquad (1)$$

where the lagged value of log GDP ($Log\_GDP_{i,t-1}$) is used to control for persistence of economic growth over time,

FIGURE 1

Latin America: net official development assistance (ODA) received by each country, 1996-2001

(Billions of dollars)
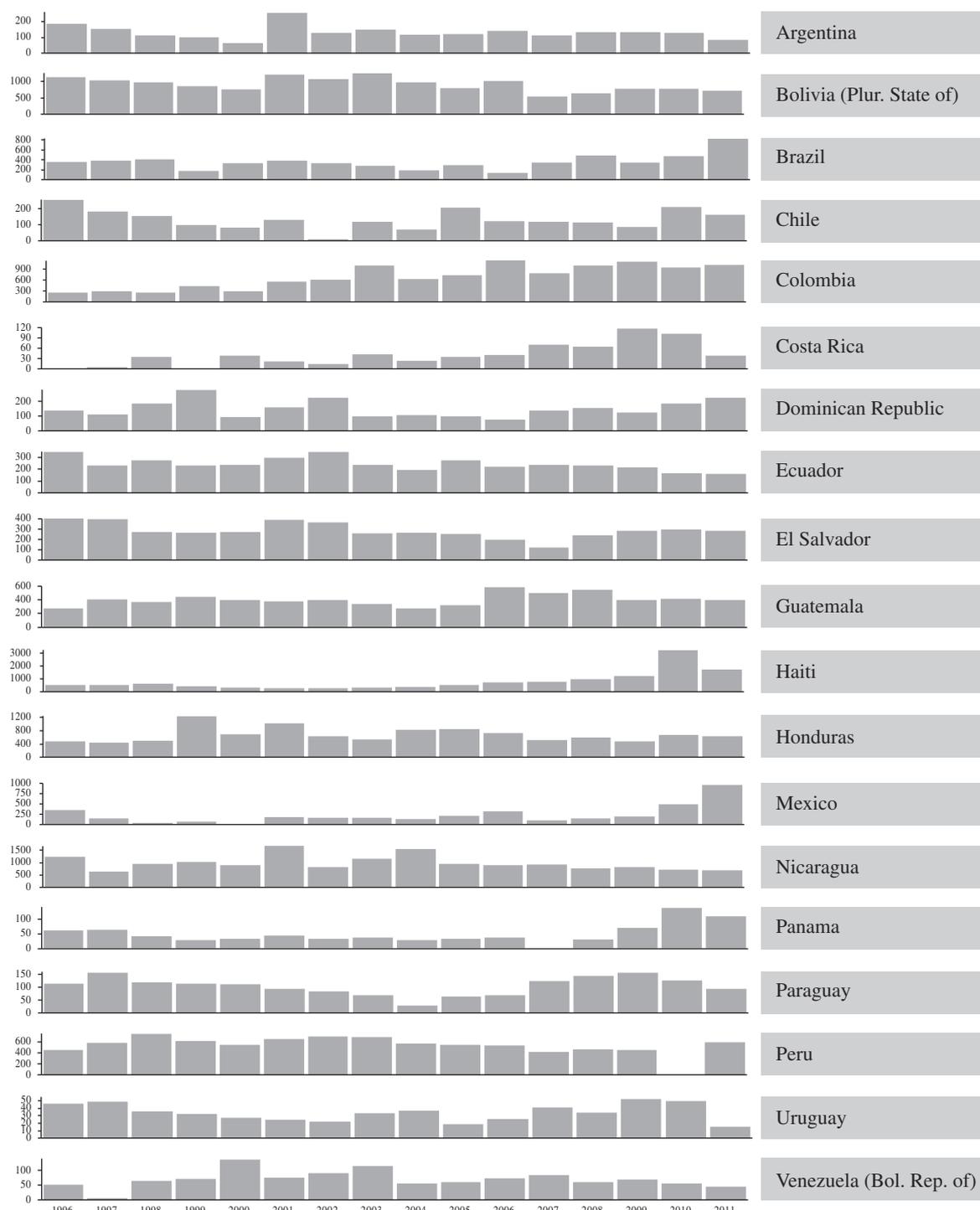
while X'_{it} includes ODA and trust, our main independent variables; a group of control variables is also included in the main growth models (education, population, employment, investment and democracy). In addition, X'_{it} contains the interaction term "*Log_ODA*trust*" to contrast our hypothesis that ODA effectiveness is conditional on the level of social capital in the country; it also includes the interaction term "*Log_ODA*democ*" in order to compare the different social and institutional measures. The terms δ_i and ω_t capture unobservable time and country heterogeneity, since we allow for the presence of country effects; α and β are the parameters to be estimated; and ε_{it} is the error term, capturing all other omitted factors, and $E[\varepsilon_{it}]=0$ for all i and t.

In line with the procedure used in Asiedu and Nandwa (2007), we estimate the equation based on the work of Hansen and Tarp (2001), who analysed several ODA regressions to highlight the fact that ODA variables cannot be exogenous to growth regressions. This implies that alternatives to OLS estimates are required. Equation (2) is the specification of a dynamic panel data model of the logarithm of real GDP (Log_GDP_{it}),

$$\Delta y_{it} = \alpha + \lambda \Delta y_{it-1} + \beta_i \Delta x'_{it} + \Delta \varepsilon_{it} \qquad (2)$$

We estimate equation (2), a dynamic panel data model, using the consistent GMM proposed by Arellano and Bond (1991). This method allows for unobserved country-specific effects, measurement errors and endogeneity problems, not only in the case of the lagged dependent variable but also of any other regressor (Arndt, Jones and Tarp, 2010). The main theoretical reason for using the dynamic panel is that it is modelling a partial adjustment-based approach. If we are dealing with a partial adjustment process, then the coefficient on the lagged dependent variable measures the speed of adjustment. In addition, the lagged dependent variable can remove any autocorrelation.

In order to treat endogeneity, Arellano's and Bond's (1991) "difference GMM" estimator uses the lagged levels of first difference of the variables as instruments for both the lagged dependent variable and the other explanatory variables. This method identifies the number of lags of the dependent variable, the predetermined variables and the endogenous variables as valid instruments and shows how to combine these lagged levels with the first differences of the strictly exogenous variables into a potentially large instrument matrix. We employ the so-called "two-step" difference GMM estimator, which allows for heteroskedasticity in the error terms. Arellano's and Bond's model assumes that when x_{it} and ε_{it} are not serially correlated, this hypothesis can be contrasted using the m2 statistic tests to analyse the second-order serial correlation in the first-difference residuals. Specification tests are applicable in this context. One such test is the Sargan test for over-identifying restrictions (Sargan, 1958). The results of this test indicate that it is not necessary to consider other instruments.

V

Results

The estimation results of the models in equations (1) and (2) are presented in table 2. The reader will recall that our aim is to determine whether the effectiveness of ODA in promoting growth is conditioned by the level of trust existing in the country concerned.

The Arellano-Bond (1991) serial autocorrelation tests have the expected outcomes in all cases except for model 1, which was included in order to test the robustness of the results. These test results are always significant for a first-order autocorrelation (t–1), but not significant for the second-order autocorrelation. The Sargan specification test always accepts the null hypothesis of validity of the over-identifying restrictions, indicating that the specification of both the model and instruments is good.

The results displayed in table 2 show coefficient estimates with the expected signs. The results are always statistically significant.

The results reported in table 2 reflect four main findings. First of all, there is a negative and significant relationship between ODA and economic growth, and this result is consistent in all our specifications. Even when controlling for trust (model 1) or for the interaction term "*Log_ODA*trust*" (model 2) or for democracy (model 4) or for the interaction term "*Log_ODA*democ*" (model 5), the effect of ODA on growth remains negative. These

results are similar to those obtained by Boone (1996), Easterly (2003), Rajan and Subramanian (2008) and Djankov, Montalvo and Reynal-Querol (2006 and 2008), who find that ODA has a negative impact on economic growth in developing countries.

Second, trust, as a form of social capital, is positive for the effectiveness of ODA in driving growth. Model (1) in table 2 indicates that trust, on its own, is an important explanatory factor for growth. The results in columns 2 and 3 are interesting. ODA has a positive and statistically significant effect on growth in trust-rich environments; however, if the interaction between aid and trust is omitted, ODA no longer has a

positive effect on growth. It is also interesting that the estimated coefficient for the interaction of trust and ODA remains positive even when ODA is excluded from the regressions. All this means that the impact of ODA on growth is consistently greater in a trust-rich environment than in a trust-poor one. These results are consistent with those of Burnside and Dollar (2000) in showing that the effectiveness of ODA is conditional upon other variables (fiscal, monetary and trade policies) and, in our study, also on social capital. They are also consistent with Baliamoune-Lutz and Mavrotas (2009), who find that, when ODA is interacted with social cohesion, the result is a significantly positive coefficient.

TABLE 2

Estimation results for an 18-country sample, 2001-2010

Dependent variable:		*Log GDP*					
Independent variables:		(1)	(2)	(3)	(4)	(5)	(6)
Log ODA		-0.0064***	-0.0074***		-0.0094***	-0.0095***	
Trust		0.0788***		-	-		
Lagged dependent variable		0.5409***	0.5109***	0.5263 ***	0.6539***	0.6572***	0.6691***
Log gcf		0.1551***	0.1519 ***	0.1551***	0.1373***	0.1396***	0.1343****
Employment		0.0043 ***	0.0055 ***	0.0044***	0.0047***	0.0044***	0.0052***
Edu		0.0104 ***	0.0082***	0.0109 ***	0.0062***	0.0061***	0.0051 ***
Log popu		0.9224 ***	0.9458 ***	0.9190 ***	0.6623***	0.6828***	0.6212 ***
*Log ODA*trust*			0.0141***	0.0089***			
Democ					0.0002***		
*Log ODA*democ*						0.00003***	0.00003***
Arellano-Bond	1st order	-2.2478*	-2.1647*	-2.9171	-2.4269*	-2.3995*	-0.0179***
Autocor. test	2nd order	-1.8521**	-1.7874**	-1.1069 ****	-1.5201***	-1.5387***	-0.0234***
Sargan specification test		0.9	0.9	0.9	0.9	0.9	0.9
Total observations		218	218	218	256	256	256

Source: Prepared by the authors.

Note: All variables except the inflation and interest rate variables are expressed in log form. *** Significant at p-value<0.01; ** significant at p<0.5; * significant at p<0.1. Arellano-Bond t-statistic means $\rho=0$.
ODA: Official development assistance.

Third, in line with previous results, models 4 to 6 show that ODA has a significant negative effect on growth, but this result turns positive and significant in countries with high levels of democracy. Specifically, these three models show that democracy on its own and the interaction term "*Log_ODA*democ*" have positive estimated coefficients. These findings are consistent with those of Burnside and Dollar (2000) and Collier and Dollar (2002), as the effect of ODA is positive in "good policy environments."

Fourth, and of no less importance than the previous results, when comparing columns 2 and 3 with columns 5 and 6, we realize that the estimated coefficient for the interaction of trust and ODA is higher than the estimated coefficient for the interaction of democracy and ODA. This means that a trust-rich environment has a greater impact on the effectiveness of ODA in promoting growth than an environment with high levels of democracy. Therefore, donor agencies need to direct their efforts towards enhancing the capabilities of a larger proportion of the

population rather than simply trying to replace primitive infrastructures with modern, technically sophisticated investments (Ostrom, 2000). If the local community is involved, the chances that ODA will be effective are greater. It is important for donors to gain a fuller understanding of the country's existing stock of social capital prior to developing policies or designing projects. Assessments of social capital could be combined with assessments of poverty and social policies and should be aimed at identifying institutions, social relationships and networks that contribute to or impede growth and poverty alleviation (Grootaert, 1998).

Finally, a robustness analysis has been done in order to determine if the above results have been driven by just a few countries. The results were similar to those shown in table 2.[6]

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[6] Robustness results are available upon request.

VI

Conclusions

In this study, we have analysed the interaction among ODA, social capital and economic growth in order to investigate whether the effectiveness of development assistance in driving growth is conditional on the level of trust (a form of social capital) that exists in a recipient country. In line with similar findings presented in the literature, we have determined that the level of trust conditions the effectiveness of ODA in promoting growth: development assistance has a positive impact on growth in those countries where there is a significant level of trust and has a negative effect where trust is not present. Moreover, we have found that trust is a more important factor than democracy in heightening the effectiveness of ODA. In other words, a trust-rich environment has more of an impact on the effectiveness of ODA in leveraging growth than an environment with high levels of democracy has. Therefore, it is important for ODA investments to be directed towards those sectors that will further the development of social capital as a means of escaping poverty. It is also necessary to involve local communities more directly in order to attain the levels of trust required to make ODA more effective.

The presence of social capital, measured by trust, is important for growth and, when combined with ODA, can enhance its effectiveness. This is probably because trust facilitates cooperation among individuals by reducing transaction costs. However, an in-depth investigation of this aspect is beyond the scope of this study and would require an examination of the transmission mechanisms involved in the interaction between the existence of trust and growth based on ODA.

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ANNEX A1

TABLE A1.1

Latin America (189 countries): variable list specification, 2001-2010

Variable	Description	Units	Source
Dependent variable:			
Log GDP	Log of real GDP, PPP (constant 2005)	International dollars	World Development Indicators
Explanatory variables:			
(a) Persistence in economic growth over time			
Log GDP$_{i,t-1}$	Log of real GDP, PPP in the preceding year (constant 2005)	International dollars	World Development Indicators
(b) Main variables			
Log ODA	Log of total net ODA	International dollars	OECD (DAC database)
Trust	Trust	Percentage of persons	Latinbarómetro
(c) Control variables			
Edu	Total years of schooling	Years	Barro and Lee database
Employment	Employment to population ratio (ages 15 +)	Percentage of persons	World Development Indicators
Log gcf	Log of gross capital formation	International dollars	World Development Indicators
Log popu	Log of total population	Number of persons	World Development Indicators
Democ	Democracy index	0-10	Polity IV[a]

Source: Prepared by the authors.

Note: ODA: Official development assistance.

[a] Polity IV is a research project on global freedoms, but it is also one of the largest databases capturing the evolution of freedoms worldwide.

TABLE A1.2

Descriptive statistics

	Log GDP	Log ODA	Trust	Edu	Employment	Log gcf	Log popu	Democ
Mean	24.93	363.84	0.19	6.91	58.88	3.04	16.27	7.48
Median	24.54	236.89	0.19	7.18	58.30	3.05	16.07	8.00
Maximum	28.34	3231.14	0.44	9.74	73.10	3.73	19.11	10.00
Minimum	21.27	1.28	0.02	3.27	43.20	2.40	13.50	-88.00
Standard deviation	1.61	376.97	0.08	1.59	58.88	3.04	1.25	6.23
Observations	332.00	300.00	260.00	340.00	340.00	340.00	340.00	252.00

Source: Prepared by the authors.

TABLE A1.3

Correlation matrix

	Log GDP	Log gcf	Employment	Log ODA	Log popu	Edu	Democ	Trust
Log GDP	1.00	-0.08	-0.11	-0.00	0.95	0.17	-0.07	-0.18
Log gcf	-0.08	1.00	-0.08	0.12	-0.07	-0.09	-0.04	-0.04
Employment	-0.11	-0.08	1.00	0.35	0.03	-0.15	-0.12	-0.14
Log ODA	-0.00	0.12	0.35	1.00	0.24	-0.38	-0.12	-0.17
Log popu	0.95	-0.07	0.03	0.24	1.00	-0.03	-0.11	-0.25
Edu	0.17	-0.09	-0.15	-0.38	-0.03	1.00	0.05	0.04
Democ	-0.07	-0.04	-0.12	-0.12	-0.11	0.05	1.00	0.07
Trust	-0.18	-0.04	-0.14	-0.17	-0.25	0.04	0.07	1.00

Source: Prepared by the authors.

Peru, 2002-2012: growth, structural change and formalization

Juan Chacaltana

ABSTRACT

In a dramatic change of trend, labour formalization took place in Peru in the period covered by this study. The context was one of economic growth accompanied by a labour market reform that created a special regime for micro and small enterprises, thereby reducing employment costs, and introduced improvements in workplace inspections. A panel of subnational regions is used to analyse the role played by these factors in the formalization process. In the first place, this study confirms that the composition of growth matters to formalization. A combined analysis of economic factors (growth and sectoral growth) and recent institutional changes shows that the former accounted for the bulk of formalization in the period analysed and that growth in labour-intensive sectors adds explanatory power, while the institutional changes, far-reaching though they were, did not have a significant effect.

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I

Introduction

The early years of the twenty-first century were exceptional ones for the Peruvian economy: gross domestic product (GDP) grew at an annual rate of over 6% for more than a decade (except in the crisis period of 2008-2009), which is practically unprecedented for the country. From 2002 to 2013, in fact, Peru ranked second for growth in Latin America.

Certain social and economic indicators were dynamized during this period. For example, poverty fell by more than half between 2002 and 2013, from 54% to 24%, declining even in rural areas. Some labour market indicators also moved positively. In 2013, open unemployment fell to less than 4% nationally, the lowest value recorded in Peruvian statistics for some decades. Between 2002 and 2013, total employment rose by 2.4% a year, outstripping the growth in the working-age population (1.8% a year). Urban real wages rose at a rate of 3.6% a year and social security health-care coverage climbed from 30% to 59%.[1]

Probably the most significant change was that the proportion of workers in formal employment rose from 20.1% in 2007 to 26.3% in 2013, according to official data from the National Institute of Statistics and Informatics (INEI, 2014). While the rate is still quite low, this six percentage point increase is striking, as it means that formal employment grew by far more than overall employment in the period. Another indicator of formalization is registered employment nationwide, calculated by the Ministry of Labour and Employment Promotion (MTPE).[2] This also grew continuously from 2002, following a period of relative stagnation in the late 1990s. This represents a change of trend from earlier decades, when informality usually increased regardless of economic circumstances.

Very little has been written about formalization in developing countries with high levels of informality like Peru. The academic literature and discussion have concentrated primarily on analysing informality. Furthermore, almost everything that is known about formalization in Peru is based on theories or studies preceding specific interventions, and little on evaluations of these. The present article offers an *ex post* analysis of two major institutional changes: the creation of the special employment regime for micro and small enterprises, and the improvements to the workplace inspection system. In other words, it analyses formalization in a specific period to identify explanatory elements and draw lessons, and asks a number of questions. What caused formalization to change trend and rise in Peru? Was it the result of high growth rates or of the labour market reform, which created a special employment regime for micro and small enterprises, substantially reducing labour costs in most of the wage employment market? In particular, what role was played by the sectoral composition of growth and by the major institutional changes that occurred in the same period? This study analyses all these factors jointly, seeking to identify the relative contribution of each to the formalization seen in the different regions. This process is recent in Peru, and it offers a unique opportunity to apply a comparative analysis to opposing theories about formalization. This analysis will provide a basis for consolidating and enhancing formalization policies or strategies as part of an integrated or multidimensional approach.[3]

The article is organized as follows. The second section reviews the existing literature on the causes of informality and its different determinants. The third section analyses recent economic and institutional changes in Peru that may have contributed to formalization, using subnational regions as units of analysis during 2002-2012. The fourth section carries out an econometric estimate to quantify the determinants of the formalization process. Lastly, the fifth section presents the conclusions of the study.

[1] ILO (2014). Includes non-contributory and semi-contributory regimes.

[2] The registered employment index shows the behaviour of wage employment in firms with 10 or more workers. It is calculated on the basis of the National Monthly Survey on Employment Variation (ENVME).

[3] Other reforms may have contributed to formalization in Peru, particularly policies to promote micro, small and medium-sized enterprises and reforms to simplify bureaucratic procedures. Evaluating such policies is beyond the scope of this article, however.

II

Literature review

For more than four decades since the concept of informality was first proposed in the early 1970s (Hart, 1972), there has been a great deal of discussion of its causes around the world but no consensus when it comes to defining or even measuring it.[4] This lack of conceptual consensus undoubtedly explains the disparate emphases of the various policy recommendations.

An array of theoretical approaches or frameworks have been developed and put forward to account for informality.[5] In a first group of studies, it is connected to economic factors, especially the lack of production development, the characteristics of this, or both. Thus, a position is taken whereby the only thing that matters for economic development is the level of growth, with particular emphasis on physical capital accumulation.[6] The best-known implication of these models is that there should eventually be convergence between countries, although the empirical literature has not borne out this prediction. Another approach maintains that the composition of growth is also important, since it can be uneven across sectors, mainly because of the composition of demand (Ray, 2010).

One prominent variant of this second position is the dualistic approach, whereby economic change is determined not only by the level of growth, but also by the transfer of productive resources from a subsistence sector to a capitalist sector (Lewis, 1954). Doeringer and Piore (1971) argue that there is a sector of "good" jobs and one of "bad" jobs. Acemoglu (2001) additionally proposes a job-seeking model in which there are good and bad jobs.

Another variant is the changing production patterns or structural change approach, whereby technical progress is not introduced evenly across all sectors and branches of activity, tending rather to be concentrated in certain production sectors and strata, especially exporting ones, with large sectors of the economy being left out of this

modernization process. This state of affairs is known as "structural heterogeneity," and it encompasses productivity differences between sectors, their contribution to GDP and the volume of employment they generate. Heterogeneity exists between but also within sectors, between production strata and, most especially, between firms of different sizes. The continuing employment of a large section of the workforce in low-productivity sectors or strata is a considerable source of inequity in income distribution among those in work, and also explains informality in employment (Infante and Sunkel, 2012). These authors also stress that production heterogeneity by business stratum (firm size) is the core from which inequality spreads through society.

Some authors emphasize the role of agriculture in promoting structural change (De Janvry and Sadoulet, 2010). Others stress the role of manufacturing growth as an engine of employment and productivity (Kaldor, 1961; Chang, 2007). There are also authors who assert that a dynamic services sector can mean more inclusive growth because it is labour-intensive, especially when seconded by policies to boost education and employment. Bhagwati and Panagriva (2013) add that modern services can be technologically progressive to a high degree, with the retail, financial and telecommunications sectors, for example, working with modern technologies. There is also a large literature exploring the effects of natural resource-based growth. McMillan and Rodrik (2011) argue that heavy dependence on natural resources for exports makes the repercussions of structural change on labour productivity very much smaller. Conversely, growth in more labour-intensive sectors and in manufacturing will generate more employment in middle-income countries.

There is also the possibility that there may be interrelationships between the formal sector and the formal sector. Tokman (1978) explores the nature of these interrelationships and finds that the informal sector and the modern sector are not watertight compartments, but that there are very active communicating vessels in both the product and labour markets. In the case of Peru, León and Cermeño (1990) review the main propositions advanced regarding the interrelationships between the formal and informal sectors in that country and Latin America generally. Analysing the case of manufacturing

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[4] Kanbur (2009) says that the literature on the subject is in a mess, there is a "conceptual incoherence" to it and everyone uses a different definition.

[5] Numerous studies have tried to classify the different approaches. See, for example, WIEGO (2012).

[6] Solimano (1996) associates this way of thinking first and foremost with the neoclassical school.

microenterprises in Lima, these authors find that all microenterprises, but particularly manufacturing ones, are highly interrelated with the rest of the economy, and especially with the modern production sector (through procurement of inputs) and with final consumers (who are their main customers, especially those in low-income strata). Portes, Castells and Benton (1989) offer a picture in which informal sectors are integrated with modern ones via the decentralization of production, in particular local and international subcontracting, with subcontractors employing workers who are not covered by employment legislation with a view to holding down costs and thus being able to sell cheaply.

A second group of explanations deal with institutional factors. Foremost among them is the well-known legality-based approach of De Soto and others (1986), originally developed in consideration of the situation in Peru. This approach points out that informal workers are forced by lack of capital and by inadequate demand for formal labour and the high costs in money and time of the long and cumbersome procedures involved in setting up a formal enterprise to operate with very limited resources and at very low levels of productivity and income. Furthermore, these workers usually do not hold title to their land, properties and productive assets, so that they have no access to the financial system. On this view, informal workers represent development potential, and the deregulation of bureaucratic procedures and obstacles is essential for this to be released.

A variant of this approach is one that treats informality as resulting from a voluntary decision by the worker or business owner, who decides to operate outside of the legal rules following a comparative analysis of the benefits and costs of formality in respect of registration, taxation, wages and social security, among other things (Fields, 1990; Perry and others, 2007; Maloney, 1999). In the case of Peru, Yamada (1996) finds evidence of voluntary choice among the informal self-employed. Similarly, Levy (2008) adds that the existence of social protection programmes, especially non-contributory ones, could create incentives to opt for informality.

Another approach, also centred on institutions, focuses on the weakness of public administration, with particular reference to inspection and oversight systems and corruption. Kanbur (2009) emphasizes the need for a theory of law enforcement, a subject of great importance in Latin America, where laws are often passed but not enforced. Loayza (2013) lists the following as determinants of informality: the government's ability to enforce rules (law and order index), an index of economic freedom as a proxy for restrictions imposed by the legal

and regulatory framework, average years of schooling as a proxy for the development of education, workforce skills, an index of sociodemographic variables and the agricultural share of GDP.

Naturally, each line of thought leads to different and even opposing policy conclusions and recommendations. Fortunately, recent decades have seen progress in this discussion that has brought a degree of consensus. In 1993, the fifteenth International Conference of Labour Statisticians (ICLS) defined the scope of the concept of the "informal sector" and associated it with the characteristics of the economic unit.[7] Subsequently, in 2003, the seventeenth ICLS supplemented this definition and introduced the concept of "informal employment," based on job characteristics.[8] Combining the two concepts yields the so-called "informal economy" (ILO, 2002). This means, however, that informal employment exists not just in the informal sector but also outside it, although the relative weight of each of these components differs from country to country. Furthermore, it is clear that the policies applicable to informal employment in the informal sector are different from those for informal employment outside it.

This, along with overwhelming international evidence that informality is highly heterogeneous, has opened up the possibility of approaching formalization policies in a broader way. In its 2014 and 2015 discussions, the International Labour Conference (ILC) proposed an integrated approach to facilitate the transition from informality to formality. These discussions led to the adoption of the Recommendation concerning the transition from the informal to the formal economy (ILO, 2015), marking the start of a global consensus on policy recommendations. This entails a recognition that informality is so heterogeneous that all the factors which might be thought to cause it must play some kind of role, that not all informal workers are in this situation for the same reason, and that the causes of informality are many and operate in multiple dimensions. For this reason, any formalization policies devised need to take a multidimensional approach that involves numerous actors operating in coordination. Looking at the matter in this way shows how limiting it is to think that any single or isolated measure can foster formalization in

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[7] This concept differs from that of the "informal sector," much used in Latin America by the Regional Employment Programme for Latin America and the Caribbean (PREALC) and referring to low-productivity forms of production, including smaller firms, unskilled own-account workers and domestic work.

[8] See ILO (2013) for a fuller discussion.

all countries and circumstances. Another implication is that the different factors leading to formality differ between countries, territories and sectors. In other words, the ultimate determinants of informality (or formality) in a specific country have to be established empirically

and not theoretically, according to the circumstances of each case. In particular, there is a need to establish empirically and case by case which of the factors associated with formality (or informality) have greater influence than others.

III

Stylized facts, the Peruvian case

Peru has always been regarded as a country with a high level of informality. According to official data from the National Institute of Statistics and Informatics (INEI, 2014), which prepares an informal economy satellite account for Peru,[9] the informal sector, measured by the characteristics of economic units, accounted for 19% of GDP and 61% of total employment in 2007.[10] Informal employment, which includes such employment in the informal sector but also in the formal sector and the household sector, was 73.7% nationally in 2013. The information on informal employment in Peru is obtained from the National Household Survey (ENAHO), which shows that about two in every three workers in informal employment work in economic units in the informal sector.

1. Formalization in Peru?

Almost all academic studies on this subject in Peru have sought to explain the phenomenon of informality, and in particular its unremitting rise.[11] They could hardly do otherwise. In past decades, the rule has been for informality to increase in the Peruvian labour market.[12] Thus, the start of a movement towards formalization

has probably been the most striking development in that labour market in recent years, marking a shift in a long-term trend that is worth analysing.

Different indicators confirm this change in trend (see figure 1). First, as noted, official INEI data for urban and rural workers in all economic sectors nationally show the proportion in formal employment rising from 20% in 2007 to 26% in 2013 (left axis of figure 1). Likewise, the index of registered employment calculated by MTPE since 1997 shows such employment growing constantly from 2002 (right axis of figure 1) after holding fairly steady in the late 1990s and early 2000s.[13] Other data from administrative records are even more encouraging. Social security records show that the number of dues-paying members of the social health insurance programme (EsSalud) rose from 1.6 million in 2002 to 4.3 million in the last quarter of 2013, while the number paying into some pension scheme rose from 1.5 million in 2002 to 4.0 million in 2013. Again, the number of registered payroll workers rose from less than a million in 2000 to 3.1 million in 2013.

Estimates prepared by the author using a methodology similar to that of INEI but for a longer period (2002-2012)[14] show that the increase in the formal employment rate occurred primarily among wage workers, for whom it rose from 41% to 50% between those years (see table 1). This trend is very important, as the proportion of wage workers in the employment total also rose in the period,

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[9] See INEI (2014). This informal economy satellite account is consistent with the country's System of National Accounts. Informal employment is estimated in equivalent working days to ensure compatibility with the national accounts (period from 2007 to 2013).

[10] There are other estimates of the informal sector contribution to GDP, but they use indirect methods. The INEI approach is direct. If these figures are right, the formal sector is eight times as productive as the informal sector.

[11] Chong, Galdo and Saavedra (2007) record a persistent increase in informality in 1986-2001, using different definitions of informality.

[12] Unlike the analysis of informality, the study of formalization processes has only recently become a subject of academic interest internationally. See Berg (2010) on Brazil, and Bertranou, and Casanova (2014) on Argentina.

[13] The index of registered employment shows the behaviour of wage employment in firms with 10 or more workers. It is calculated from the National Monthly Survey on Employment Variation (ENVME).

[14] Methodology based on the measuring guidelines of the seventeenth International Conference of Labour Statisticians (ILO, 2013). The difference from the INEI (2014) estimate stems from the latter being based on the equivalent number of jobs (calculated from the length of working days) to ensure compatibility with the System of National Accounts.

from 39% to 45%. Among such workers, the largest increase in the formal employment rate was for those in firms with more than 10 employees, where it rose from 61% to 71%, with this group's share of total employment additionally moving up from 23% to 29%. In the case of smaller firms, the increase in the formal employment rate was from 13% to 15%, while their share of total employment rose from 16% to 17%.

FIGURE 1
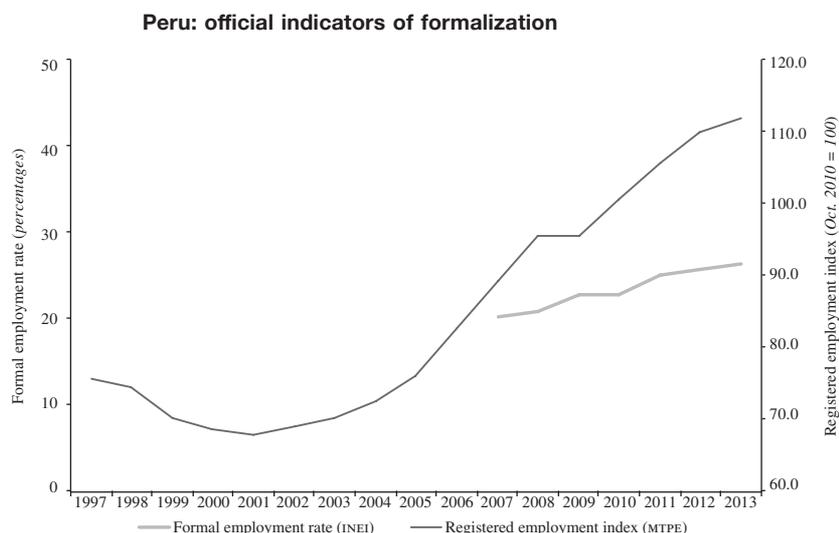
Peru: official indicators of formalization

Source: Prepared by the author, on the basis of National Institute of Statistics and Informatics (INEI), *Producción y empleo informal en el Perú. Cuenta satélite de la economía informal 2007-2012*, Lima, 2014, and statistics from the Ministry of Labour and Employment Promotion (MTPE).

TABLE 1

Peru: formal employment rates, 2002 and 2012
(Percentages)

	2002		2012	
	Formal employment rate	Share of total employment	Formal employment rate	Share of total employment
Total				
Employer	34.1	5.1	39.9	5.4
Wage employee in firm	40.7	39.1	50.1	45.4
1 to 10	12.7	16.3	15.2	16.7
Over 10	60.9	22.7	70.5	28.7
Wage employee in household	10.0	3.5	19.3	2.6
Own account	4.3	35.4	4.6	34.8
Auxiliary family worker	0.0	16.7	0.0	11.6
Other	21.3	0.2	16.3	0.3
Total	19.6	100.0	27.1	100.0

Source: Prepared by the author, on the basis of National Institute of Statistics and Informatics (INEI), National Household Survey (ENAHO), various years.

Informal employment among wage employees carrying out domestic work in households also evolved significantly, with their formal employment rate rising from 10% to 19%, even as their share of total employment dropped from 4% to 3%. In the case of own-account workers, the formal employment rate rose from 4.3% to 4.6% while their share of total employment remained unchanged at 35%. These changes still left own-account

workers, workers in firms with up to 10 employees and domestic workers accounting for over two thirds of total informal employment.

The fact that the rise in formal employment has involved mainly wage employees rather than own-account workers highlights the differences between the causes of informality and the policy responses required in the two cases. It also suggests that the situation of each group needs to be analysed separately.

2. Recent economic and institutional changes

Some economic and institutional changes may be connected to this shift in the formalization trend.

The first thing that stands out is the strong economic growth attained by the Peruvian economy, precisely since 2002. One of the main debates in the literature on informality concerns its procyclical or countercyclical character. If it were countercyclical, there would be reason to think it was a kind of adjustment "cushion" against a lack of opportunities in the formal sector. If there were procyclical elements, voluntary choice might be involved. In the recent Peruvian situation, economic growth has been high and sustained, averaging 6.1% between 2002 and 2013. This stands in contrast to earlier decades, as the Peruvian economy grew by about 3% a year in the 1990s and hardly at all in the 1980s. Recent Peruvian growth has been associated mainly with a highly favourable international context, owing partly to high export commodity prices and improved terms of

trade, partly to the availability of external financing and foreign direct investment (FDI). It has also been related to macroeconomic policies, such as inflation targeting in monetary policy, the build-up of international reserves, exchange-rate flexibility and countercyclical fiscal policies (MEF, 2011). Productivity, one of the variables most emphasized in discussions of formalization, grew by 3.3% a year in 2000-2011 (Infante, Chacaltana and Higa, 2014). Although not as high as the rate in some Asian countries over the period, this was among the highest in Latin America and the Caribbean.[15]

In the second place, a connection is often made between the sectoral composition of growth and informality, and thence formalization. This is due to the existence of a high degree of productive heterogeneity in the Peruvian economy, manifested both between and within sectors. Indeed, elevated heterogeneity and productivity dispersion may be the most salient structural characteristic of the Peruvian economy, combined with manifest delinkage between the most and least productive sectors. This can clearly be seen in table 2, which shows that in 2007 the sector with the highest productivity (mining) was 50 times as productive as the one with the lowest (farming and fishing).

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[15] Greater uncertainty in the international context is expected over the coming years, and the effects this change could have on the country's growth rates are currently being discussed. There is some consensus, for example, that the prices of commodities relevant to Peru (particularly copper) will not rise in the same way or to the levels seen in the last decade.

TABLE 2

Peru: structure of production and employment in the informal and formal sectors, 2007

	GDP share of the informal sector (%)	Employment share of the informal sector (%)	Labour productivity (2007 nuevos soles)		
			Total	Formal	Informal
Total	19	61	19 125	39 722	5 957
Other services (inc. government)	6	13	27 714	29 944	12 791
Manufacturing	13	39	30 141	42 988	10 047
Mining	2	30	224 961	314 945	14 997
Commerce	32	65	11 910	23 139	5 863
Transport	37	73	23 807	55 549	12 066
Farming and fishing	89	98	4 620	25 411	4 196
Construction	25	54	23 820	38 838	11 028
Restaurants and hotels	47	67	8 955	14 382	6 282

Source: Prepared by the author, on the basis of National Institute of Statistics and Informatics (INEI), *Producción y empleo informal en el Perú. Cuenta satélite de la economía informal 2007-2012*, Lima, 2014.

Note: GDP: Gross domestic product; Inc. government: Includes government-provided services.

Differences within sectors are also striking: productivity is 15 times as great in formal mining as in informal mining. Figure 2 also shows that, mining aside, the most productive part of the informal sector (Other services) is less productive than the least productive part of the formal sector (Restaurants and hotels). This is indicative of a divided country and an uninclusive production structure with the potential to generate informality.[16]

Where trends are concerned, the official production data reveal changes in the composition of growth (see table 3). In the period prior to 2002, growth rates were very high in sectors such as mining, even in the period of international crisis that began in 1998. This composition began to change in 2003, with stronger growth in sectors such as manufacturing and construction.

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[16] Távara, González de Olarte and Del Pozo (2014) analyse the heterogeneity of the Peruvian economy over the long term and find

that this has increased in both growth and crisis periods. They also find that most services (financial and non-financial) are produced and consumed by the large enterprise sector. The same is true of energy.

FIGURE 2

Peru: productive heterogeneity in the formal and informal sectors, 2007
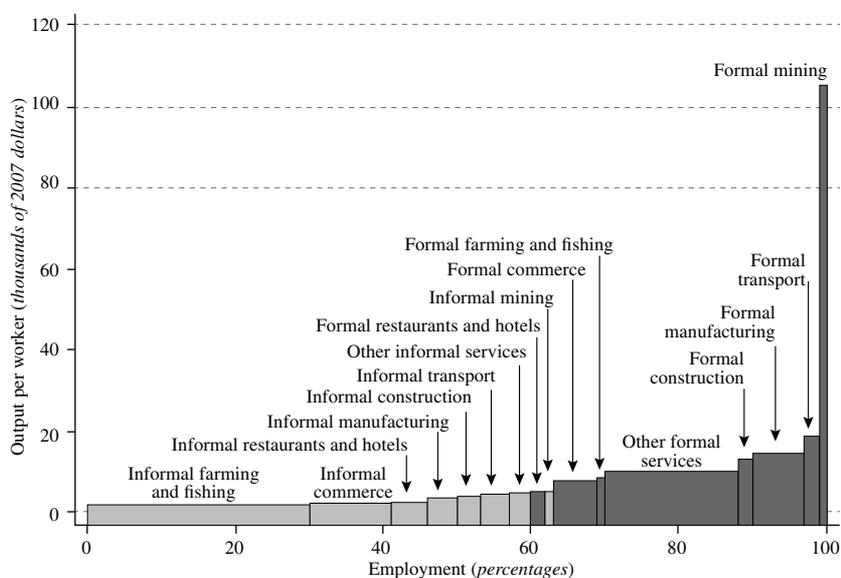
Source: Prepared by the author, on the basis of National Institute of Statistics and Informatics (INEI), *Producción y empleo informal en el Perú. Cuenta satélite de la economía informal 2007-2012*, Lima, 2014.

TABLE 3

Peru: average annual GDP growth by economic sector, four periods between 1993 and 2012

(Percentages)

	1993-1997	1998-2002	2003-2007	2008-2012
Farming, hunting and forestry	8.4	4.7	3.7	4.9
Fisheries	0.2	3.0	5.8	0.5
Mining	8.1	8.1	4.6	2.2
Manufacturing	6.3	1.5	7.4	4.4
Electricity and water	8.7	3.9	5.8	5.9
Construction	16.2	-3.3	9.7	11.4
Commerce	7.6	0.8	7.2	7.5
Transport and communications	6.8	1.4	9.5	7.2
Restaurants and hotels	6.4	0.9	5.7	8.0
Other services	4.9	1.5	5.5	6.7
Total	6.9	1.8	6.5	6.4

Source: Prepared by the author, on the basis of national accounts from the National Institute of Statistics and Informatics (INEI).

Note: GDP: Gross domestic product.

Fewer data are available on changes in composition within sectors. Even so, some studies have provided evidence of their scale. Infante, Chacaltana and Higa (2014) estimate that of the 3.3% annual productivity growth in the 2000-2011 period, 2.8% was due to large enterprises (with over 200 workers) and the remaining 0.5% to micro, small and medium-sized enterprises. Tello (2012) analyses the behaviour of productivity in 2002-2007 and finds that it is the reallocation of employment between sectors rather than productivity changes within them that best explains shifts in Peruvian productivity.

Major institutional changes also took place in the last decade. The most important of these was probably the reform that created special employment regimes, i.e., specific regulations for certain groups of workers. By far the most salient development here was the creation of the special employment regime for micro and small enterprises under the Promotion and Formalization of Micro and Small Enterprises Act.[17] There had already been reforms in the 1990s to the rules on hiring and dismissal in the general employment regime.[18] The creation of special regimes is a new regulatory trend beginning essentially after the turn of the century. For workers in microenterprises (up to 10 workers), the Act, passed in 2003, drastically cut non-wage costs to less than a quarter, and dismissal costs to a third, of the amounts stipulated in the general regime.[19] In 2008, the special regime of the Act was extended and an intermediary regime was set up for firms with up to 100 workers, cutting employment costs to about half what they were under the general regime.[20] This new dispensation came into effect in early 2009.

Given that microenterprises account for over 70% of wage employment in Peru, these reforms meant a very large shift in average employment costs (see figure 3). In weighted terms, so-called non-wage labour costs fell from 54% of wages to 17% in 2003.[21] Despite their

reach, these regimes have been little studied. Chacaltana (2008) analyses the first four years of the microenterprise regime and finds coverage to be minimal. Jaramillo (2013) reaches similar conclusions, while Díaz (2014) adds that the formalization of recent years took place to a greater extent in the large enterprise sector than among small and medium-sized enterprises.

Lastly, another factor in formalization is the ability of the State to enforce its own rules.[22] Peru's inspection capability has always been considered, and has in fact been, weak. Nonetheless, there were major changes in the last decade. The strength of the State to enforce its rules is shown by the likelihood of breaches of employment regulations being detected. This depends on the number of inspectors, on the technology used to carry out inspections, and on the way these are organized. There have been improvements in all these areas. The number of inspectors has increased, but most importantly there have been changes in inspection technology. In 2006, an agreement was signed between the Ministry of Labour and Employment Promotion and the Office of the National Superintendent of Tax Administration (SUNAT), setting up an electronic payroll system. In Peru, firms are required to send in their payrolls to the State, including information on workers, wages, contract type and other benefits. Prior to the agreement, firms had to physically submit print-outs of their payrolls once a year to the MTPE. With the electronic payroll system, these have to be submitted to SUNAT monthly along with the firm's tax return. Since SUNAT has demonstrated a stronger inspection capability than MTPE, this ought to have meant an increase in the likelihood of infractions being detected, at least as far as the SUNAT remit runs.[23]

There may possibly be other factors at work, but these are the ones most mentioned or emphasized in the academic and political discussion in Peru. Just a few studies have carried out combined analysis of multiple factors relating to formality (or informality),[24] as most have concentrated on just one. Indeed, it is possible that each taken separately may present some degree of correlation and significance. The challenge is to see if these still persist in a comparative analysis, controlling for other possible explanations.

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[17] The Agriculture Promotion Regime, which likewise includes the special employment and tax regimes, applying these to agricultural enterprises of any size, was created in 2000. See Chacaltana (2007) for further information.

[18] Chacaltana (2001) finds that the labour market reforms of the 1990s, which deregulated hiring and dismissal, were not accompanied by improvements in formalization.

[19] There is a debate about the concept of "non-wage costs," with some considering holiday pay, for example, to be part of wages.

[20] Calculated from Law No. 30288, published in the official journal *El Peruano* (16 December 2014).

[21] This regime was extended yet further in 2013 and the legal ceiling on the number of workers abolished. The calculations were carried out using data from Law No. 30288, published in the official journal *El Peruano* (16 December 2014).

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[22] Kanbur (2009) mentions that the issue of enforcement has been neglected in the economic literature and a theory about it is needed.

[23] The electronic payroll information is available to the inspectorate.

[24] See, for example, Machado (2012), Loayza (2013) and Verdera (2014).

FIGURE 3

Peru: index of labour costs by regime and weighted average, 2000-2013
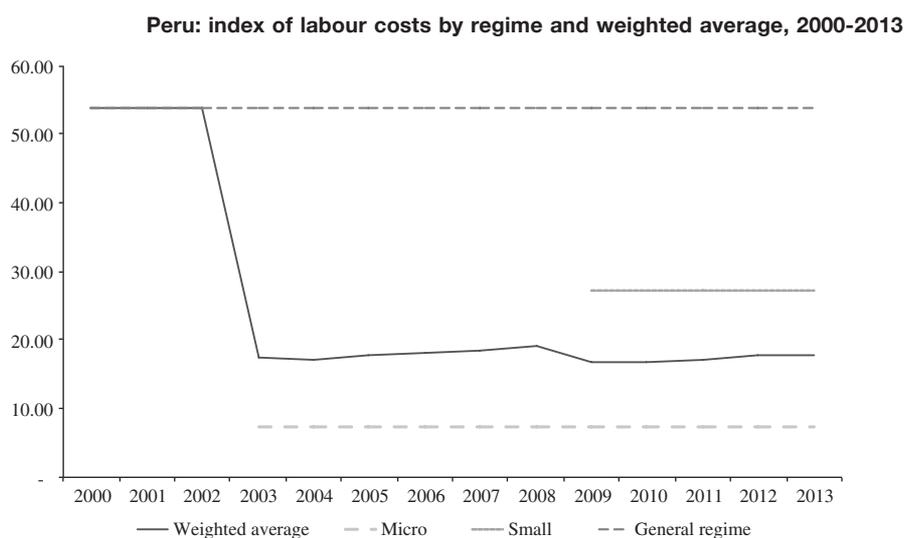
Source: Prepared by the author, on the basis of the official journal *El Peruano*, "Ley N° 30288", 16 December 2014, and of National Institute of Statistics and Informatics (INEI), National Household Survey (ENAHO), various years.

Note: The weighted average was calculated by taking the proportions of workers by firm size and non-wage costs likewise by firm size.

IV

Empirical analysis[25]

This section seeks to explain the increase in formalization in Peru between 2002 and 2012 at the region level. In a first stage, the relationship between formalization and economic growth is analysed, with a particular focus on the role of its composition, i.e., the growth of each economic sector in each region. In a second stage, besides economic growth and sectoral growth, a proxy for institutional reforms is included with a view to establishing their relative contribution.

Panel-type information for the country's 24 regions and the 11-year time period covered is available for this purpose. With a view to analysing the role played by the composition of economic growth by sector, the panel also includes information on value added per worker for eight economic sectors in each region (Farming and fishing, Mining, Manufacturing, Construction, Commerce, Transport and communications, Restaurants and hotels, and Other services, which encompass government administration and social services).[26]

Different indicators can be employed to measure formality. Unless otherwise stated, the registered employment rate for each region is used, this being defined as the percentage of the region's total workforce that workers reported by firms represent.[27] Information is available for 15 regions in 2002-2007 and for all regions from 2008 to 2012. This is therefore an unbalanced panel.

The information on production and its sectoral composition was obtained from the *Compendio estadístico del Perú* (INEI, 2013), which yields a total of 264 observations for each sectoral observation of production data.

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[25] Unless otherwise indicated, the fourth section uses information on the registered employment rate from the MTPE National Monthly Survey on Employment Variation (2002-2012) for the econometric exercise.

[26] Regional value added is regional GDP minus taxes and import duties,

measured at constant 1994 prices. It is divided between the total number of workers in the region to calculate value added per worker. At the time of publication, information disaggregated by sector and region was only available up to 2012.

[27] The Ministry of Labour and Employment Promotion (MTPE) kindly provided access to the absolute values of this indicator from the National Monthly Survey on Employment Variation (ENVME), allowing the registered employment rate (wage employment in firms with 10 or more workers) to be constructed as a proportion of total employment in each region.

1. Growth and formalization: the composition of growth does matter

The first finding is that there is indeed a direct relationship between formalization and output growth. This can be seen in figure 4, where the registered employment rate of each region is correlated with regional value added per worker. It can also be seen that this positive relationship has a high degree of variance, especially at higher levels of regional value added per worker (panel A of figure 4). It may also be noted that this relationship changes in the higher bands when the analysis excludes Moquegua (panel B of figure 4), a region where value added per worker is high because of the presence of copper mining, but at the same time informal employment is widespread because the bulk of its workforce is agricultural. This observation is important because it raises the possibility that there may be regional fixed effects that need controlling for.

FIGURE 4

Peru: relationship between the registered employment rate and value added per worker, by region, 2012
(Percentages)
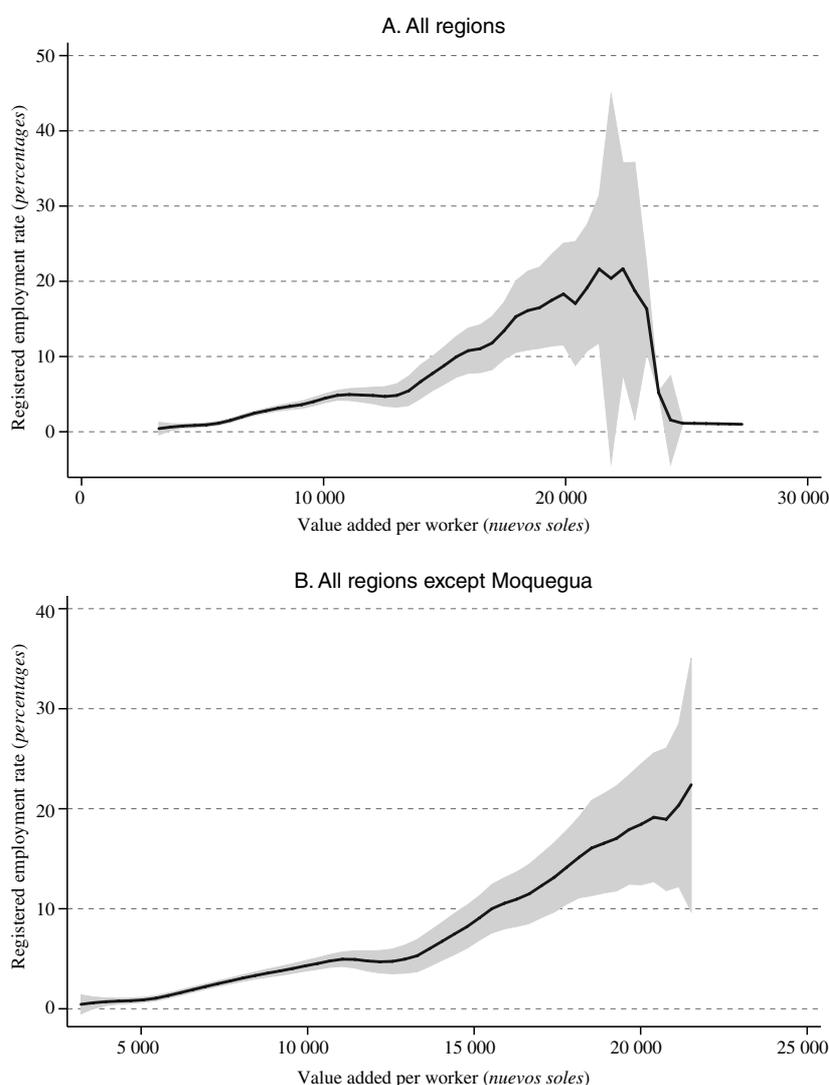
A. All regions

B. All regions except Moquegua

Source: Prepared by the author, on the basis of information from the National Institute of Statistics and Informatics (INEI) and the Ministry of Labour and Employment Promotion (MTPE).

In any event, the simple correlation between the registered employment rate and value added per worker has a high degree of variance. Consequently, there must be other factors explaining formalization levels and growth in this indicator. One possibility is that not just economic growth in itself but also its composition is important for formalization. The hypothesis here would be that the type of economic growth, and particularly its sectoral composition, will affect formalization outcomes. In other words, the sectoral composition of growth is not neutral when it comes to formal job creation. Changing production patterns would help to shape and extend formal employment.

One way to approach this analysis is to break down the change in formality rates by identifying the contribution of sectoral change.[28] First, the formal employment rate is defined as a weighted sum of sectoral rates:

$$\tau_t = \sum \tau_{it} . \theta_{it}.$$

Here, τ is the formal employment rate and is expressed as a weighted average of the formal employment rates in sectors τ_i and the share of sector i in total employment, i.e., the sectoral structure of employment θ_i in each period. The difference in the formal employment rate in period t and period k can be written as follows:

$$\Delta\tau_i = \sum \theta_{i,t-k}\Delta\tau_{it} + \sum \tau_{it}\Delta\theta_{i,t}$$

In other words, the change in the formal employment rate can be expressed as the sum of two components. The first component (the rate effect) is meant to measure the contribution of changes in rates within each sector, keeping the employment structure unchanged. The second component (the composition effect) is meant to measure the change in the sectoral structure of employment, keeping the formal employment rate unchanged. The results of this exercise are shown in table 4, which uses the definition of the formal employment rate for 2002-2012.[29]

[28] This methodology is based on McMillan and Rodrik (2011). It has been used to analyse formalization by Bertranou and Casanova (2014) for Argentina and by Díaz (2014) for Peru.

[29] In this exercise, use was made of the formal employment rate furnished by household surveys instead of the registered employment rate, as these provided sectorally disaggregated employment information.

TABLE 4

Peru: decomposition of changes in the formal employment rate, 2002-2012
(Percentages)

	Formal employment rate		Share of total employment		Decomposition		
	2002	2012	2002	2012	Rate effect	Structure effect	Sum
Sector of activity							
Farming and fishing	5.4	7.4	33.3	24.6	0.5	-0.5	0.0
Mining	60.4	60.1	0.7	1.3	-0.0	0.4	0.4
Manufacturing	22.6	32.4	10.1	10.8	1.1	0.2	1.2
Construction	12.8	23.9	3.7	5.9	0.7	0.3	0.9
Commerce	13.1	18.8	17.4	17.9	1.0	0.1	1.1
Transport and communications	13.1	17.5	5.8	7.3	0.3	0.2	0.5
Restaurants and hotels	10.4	14.3	5.3	6.5	0.3	0.1	0.4
Other services	46.5	54.5	23.7	25.7	2.0	0.9	3.0
Total	19.6	27.1	100.0	100.0	5.8	1.7	7.5

Source: Prepared by the author, on the basis of National Institute of Statistics and Informatics (INEI), National Household Survey (ENAHO), various years.

Note: Sectors as classified by the International Standard Industrial Classification of All Economic Activities (ISIC).

It can be seen that the 6.5 percentage point increase in formal employment that occurred in Peru between 2002 and 2012 breaks down into almost 6 percentage points deriving from the changes in rates within sectors and a further 1.7 percentage points deriving from the shift in the sectoral structure of employment. In other words, this shift accounts for over 20% of the increase in formal employment. The only sector to show no change in the composition effect is Farming and fishing, as it is the only one whose share of total employment fell. The Other services sector (which includes government) displays the largest rate and composition effects.

Meanwhile, employment may have undergone (and did undergo, according to a number of recent studies) major recomposition within sectors. Using data for 2002-2011, Díaz (2014) carries out a similar decomposition and finds that over 40% of the drop in informality is connected to the change in the structure of employment by firm size. Infante and Chacaltana (2014) add that this is because large and medium-sized enterprises displayed the greatest dynamism in respect of output, employment and productivity over the period.

This exercise only considers changes in the sectoral composition of employment, which means that a specific relationship still needs to be found between formalization and sectoral growth. To do this, the present study follows the methodological strategy used by Ravallion and Chen (2006) and Loayza and Raddatz (2006), who linked the composition of growth to the evolution of poverty.[30] Essentially, what is offered here is an equation linking formalization to the sectoral composition of growth. Operationally, this means estimating an equation that relates changes in the registered employment rate at the region level with changes in sectoral output at that level. Given the earlier observation about Moquegua, the relationship is assumed to have regional fixed effects, and thus to take the following form:

$$\Delta \tau_{jt} = \delta_j + \sum \delta_i . s_{ijt} . \Delta y_{ijt} + \varepsilon_{jt}$$

Here, $\Delta \tau_{jt}$ is the change in the registered employment rate in region j, Δy_{ijt} is the change in value added per worker in sector i in region j, and S_{ijt} is the share contributed by sector i to the regional value added of

region j. The δ_j coefficients are regional fixed effects. As indicated in the studies cited, the advantage of this specification is that if all the δ_i coefficients are equal, it is possible to add together changes in sectoral value added weighted by its share of regional value added. In this case, the equation becomes a simple regression between the change in the registered employment rate $\Delta \tau_{jt}$ and the change in regional value added Δy_{jt}. Thus, if the null hypothesis that the coefficients are equal cannot be rejected, then all that matters is the level of output and not its composition. Conversely, if the null hypothesis is rejected, the composition of growth is important. The focus in this article is on $\Delta \tau_{jt}$, since the aim is precisely to estimate the effects of the sectoral composition of growth on a territorially aggregated variable.

Table 5 presents two estimates. The first, shown in the first column of the table, is arrived at using the panel sample with the maximum likelihood (ML) method. The second column of the table contains the same estimation arrived at using pooled data with the ordinary least squares (OLS) method, which helps to verify whether the unbalanced panel affects the results, these being practically the same.

The coefficients that are significant and positive, with a 99% confidence level, are those for Farming and fishing, Commerce and Other services. The Restaurants and hotels coefficient is significant at 90%. In all the other cases, the coefficients are not significant. In the case of Farming and fishing, the coefficient above 1 means that a proportional change of 1 percentage point in value added per worker in this sector implies growth of more than 1 percentage point in the registered employment rate at the region level. The same applies in the case of the Restaurants and hotels sector, while in the Commerce sector the coefficient is approximately equal to 1.

In the case of the Other services sector (which includes government), the change is less than proportional. The test for equality of all coefficients indicates that the null hypothesis of all coefficients being equal is rejected with a 99% confidence level. The hypothesis of all the coefficients equalling zero is likewise rejected. This confirms the hypothesis that growth has a greater effect in increasing the registered employment rate in some sectors than in others, and thus that the composition of growth matters. Following an additional test for the equality of coefficients by subgroups, the hypothesis that the coefficients for sectors with a significant coefficient are equal to one another cannot be rejected. The result is similar when sectors with a non-significant coefficient are grouped.

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[30] Ravallion and Chen (2006) use data from China to analyse the relationship between growth composition and poverty. Loayza and Raddatz (2006) use international country data and likewise relate poverty and the composition of growth. Arias-Vásquez, Lee and Newhouse (2012) extend this type of analysis to employment variables, although they do not analyse formality.

Why do some sectors have a greater impact on formality than others?[31] Panel A of figure 5 shows that the sectors obtaining significant coefficients (Farming and fishing, Commerce, Restaurants and hotels and Other services) are generally highly employment-intensive, i.e., the number of workers in them as a share of the regional employment total is high. The regional employment share of Farming and fishing ranges from 5% to 80%, depending on the region. At the same time, these sectors evince lower levels of value added per worker, this being less than 20,000 nuevos soles a year

in every region (panel B of figure 5). Furthermore, there is a low level of formality in these sectors. Accordingly, similar production changes probably entail larger changes in both formal employment rates and numbers of formalized workers when the registered employment rate is low at the outset.[32]

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[31] Information on output by firm size is not available at the region level.

[32] In addition, there is evidence that agricultural growth has been concentrated in certain regions of the country where there has been a recomposition of employment away from low-productivity sectors towards more productive ones. Some have associated these changes with the Agricultural Sector Promotion Act (Law No. 27360 of 2001), analysis of which is beyond the scope of this article. See Infante and Chacaltana (2014).

TABLE 5

Peru: results of the regression between changes in the registered employment rate and sectoral growth

	Data panel (ML)	Pooled data (OLS)
Change in the rate of output per worker in the sector weighted by share of regional value added		
Farming and fishing	1.349***	1.414***
	(0.244)	(0.252)
Mining	-0.015	-0.020
	(0.017)	(0.018)
Manufacturing	0.068	0.113
	(0.153)	(0.167)
Construction	-0.011	-0.008
	(0.152)	(0.164)
Commerce	1.038***	0.990**
	(0.295)	(0.313)
Transport and communications	0.541	0.557
	(0.298)	(0.327)
Restaurants and hotels	1.410*	1.406*
	(0.552)	(0.611)
Other services	0.681***	0.640**
	(0.197)	(0.210)
Test 1: equality of coefficients	0.00	0.00
Test 2: coefficients equal to 0	0.00	0.00
Test 3: equality of coefficients in employment-intensive sectors	0.14	0.11
Test 4: equality of coefficients in non-employment-intensive sectors	0.25	0.24
Adjusted R^2		0.28
Rho	0.17	
Number of observations	175	175

Source: Prepared by the author.

Note: (*) = significant at 10%, (**) = significant at 5% and (***) = significant at 1%.
Standard deviation in parentheses.
Employment-intensive sectors: Farming and fishing, Commerce, Restaurants and hotels and Other services.
ML: Maximum likelihood; OLS: Ordinary least squares.

FIGURE 5

Peru: regional distribution of employment intensity and value added per worker, by sector, 2002-2012

A. Employment intensity, 2002-2012

Mining
Restaurants
Manufacturing
Other services
Construction
Transport
Commerce
Farming and fishing
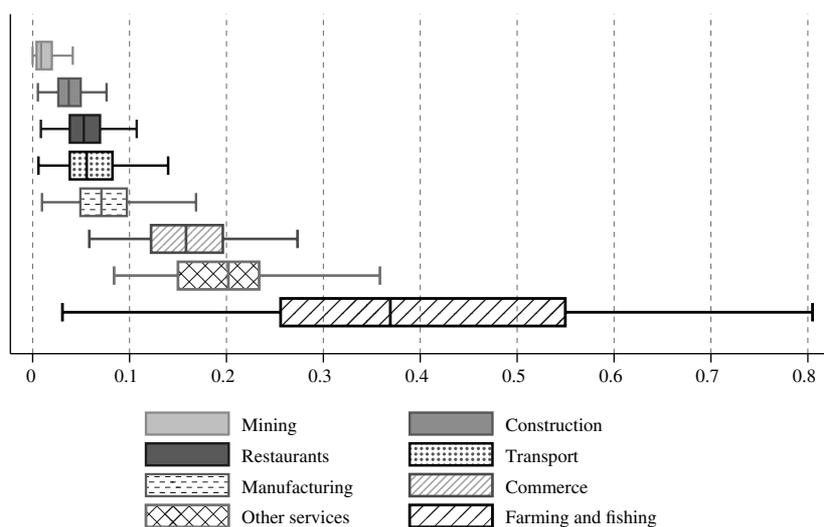
B. Value added per worker, 2002-2012
(*nuevos soles*)
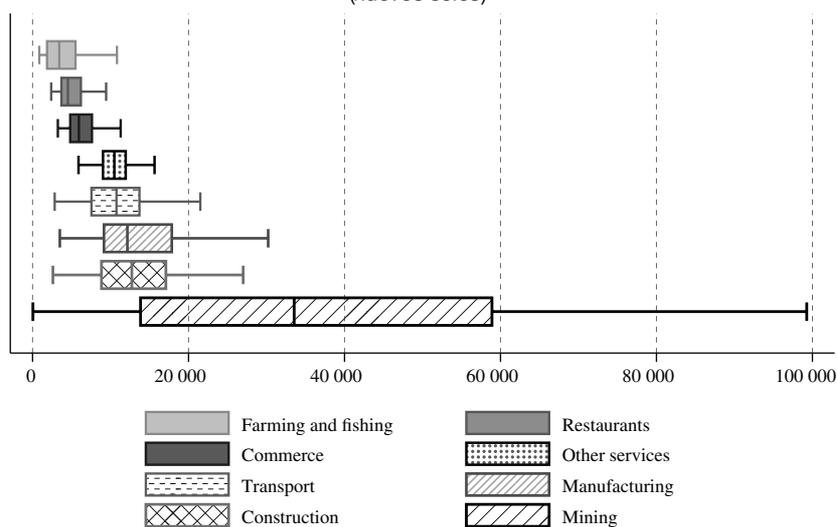
Farming and fishing
Commerce
Transport
Construction
Restaurants
Other services
Manufacturing
Mining

Source: Prepared by the author, on the basis of National Institute of Statistics and Informatics (INEI), National Household Survey (ENAHO), various years.

Note: Employment in sector *i* in region *j* as a share of total employment in region *j*. Output per worker in each region is measured in 1994 nuevos soles.

2. Formalization in 2002-2012: explanatory factors

This subsection conducts a combined analysis of a number of factors that may have influenced the formalization process in Peru, as observed between 2002 and 2012. Each factor could have a significant individual relationship with formality, but it is important to check whether this significance is maintained when competing variables or hypotheses are controlled for. Accordingly, it is important to carry out a combined analysis of economic factors (size and composition) and of variables associated with legal or institutional changes that came about in the period.

In accordance with the analysis of the previous sections, four possible factors highlighted by the literature and by recent academic and political debate are evaluated:

(i) Economic growth. In the period of analysis, GDP grew by 6% a year, meaning that the economy expanded by 70% in real terms. Regional value added per worker also rose in this period.

(ii) The change in the production structure, given the finding that the sectoral composition of growth matters. In particular, it is worth carrying out a comparative evaluation of the role that may have been played by the rising output share of the most employment-intensive sectors (Farming and fishing, Commerce, Restaurants and hotels and Other services), identified earlier as making a significant contribution.

(iii) Regulatory changes. There was a major labour market reform whose specific goal, according to its authors, was to reduce labour costs by creating a special regime for smes. The reform took place in 2003 and was extended in 2008 (coming into effect in 2009). To gauge the effect of these regulatory

changes on formalization, in the context of the database used here, weighted average labour costs were calculated for each region. The structure of employment by firm size was used for this so that the relevant labour costs could be weighted (see figure 3).

(iv) Changes in the ability of the State to enforce its rules. As mentioned, there were major changes in this respect too, making it hard to obtain statistics that are comparable over time. Accordingly, the number of inspection orders completed by mtpe per 1,000 workers was used as a proxy for the likelihood of detection.[33] The coverage of inspections is fairly low in Peru and is largely confined to formal firms and wage workers. The expectation is that an increase in the likelihood of detection would improve the registered employment rate.

Figure 6 shows simple partial correlations for these variables in variations. A greater correlation is observed between formalization and economic variables than between formalization and reform variables (change in average regional labour costs) or inspection variables (change in inspection orders per 1,000 workers). In particular, the correlation between formalization and regional growth (change in regional value added per worker) is high, showing that the quantum of growth is very important. The correlation between formalization and changes in the share of employment-intensive sectors is also positive, which is consistent with the previous finding that sectoral growth is important.

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[33] Inspection data were obtained from the statistical yearbooks of the Ministry of Labour and Employment Promotion (mtpe).

Simple formalization correlations
(Changes in the registered employment rate)
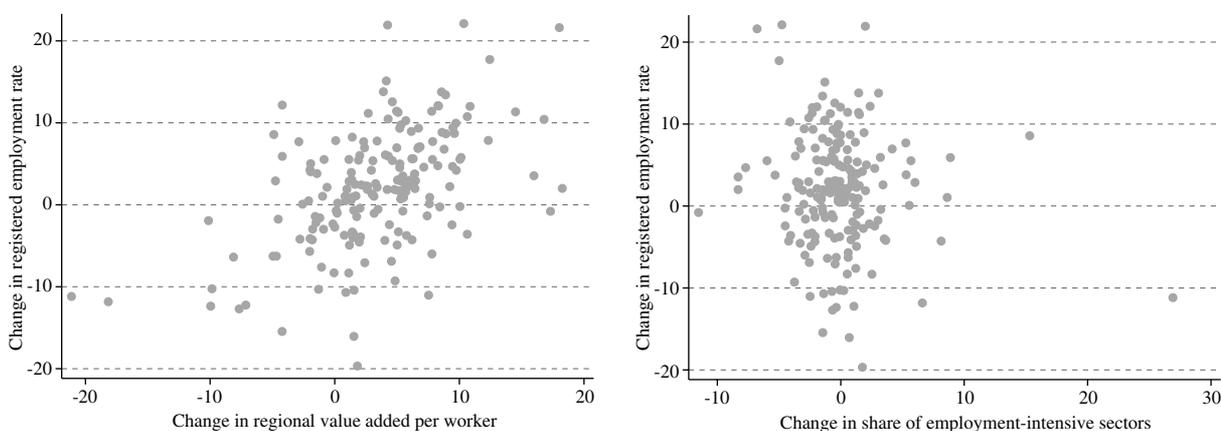
Figure 6 (concluded)
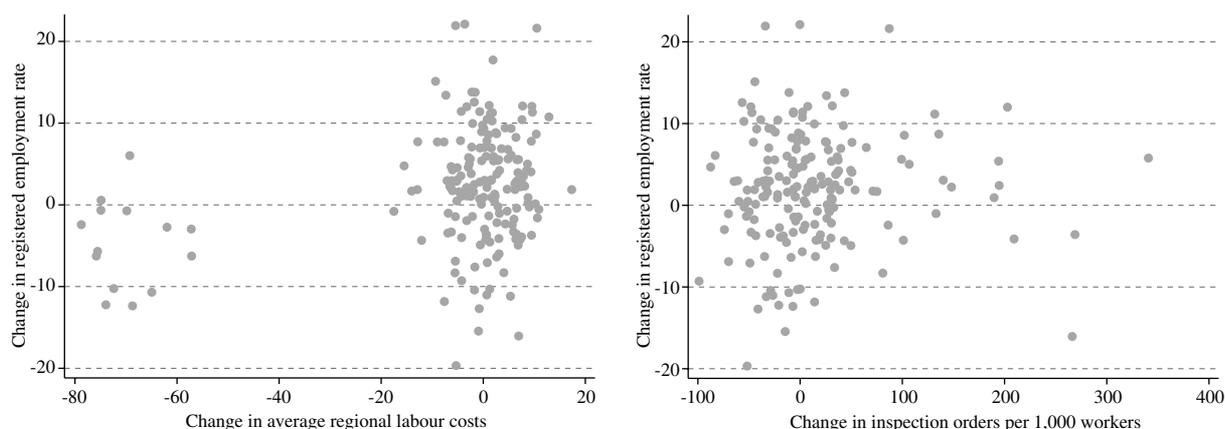
Source: Prepared by the author, on the basis of information from the National Institute of Statistics and Informatics (INEI), the Ministry of Labour and Employment Promotion (MTPE), the National Household Survey (ENAHO) and Law No. 30288.

Note: Employment-intensive sectors: Farming and fishing, Commerce, Restaurants and hotels and Other services.

All these factors were then analysed in combination using a multiple regression analysis.[34]

$$\Delta\tau_{jt} = \beta_j + \beta_1\Delta y_{jt} + \beta_2\Delta s_{jt}^{high} + \beta_3\Delta r_{jt} + \beta_4\Delta f_{jt} + \xi_{jt}$$

In this case, β_j are the regional fixed effects, Δy_{jt} is the growth of regional value added per worker, s_{jt}^{high} is the change in labour-intensive sectors' share of regional value added, Δr_{jt} is the proxy for the introduction of the Promotion and Formalization of Micro and Small Enterprises Act and Δf_{jt} is the change in the rate of inspection orders per 1,000 workers. The results of this exercise are shown in table 6, which presents various estimates that progressively incorporate the different variables.

Panel (a) of table 6 uses a regression in variations. First, it relates the change in the registered employment rate with the growth of regional value added per worker. The coefficient is significant at 1% (model 1 of table 6). To this regression is then added a variable representing growth in employment-intensive sectors' share of regional value added. Its coefficient is also significant at 5%, and the significance of regional value added per

worker is maintained (model 2). The third step is to add in the proxy for the introduction of the Promotion and Formalization of Micro and Small Enterprises Act (the change in regionally weighted average labour costs); its effect is found to be non-significant, even when the significance of the previous variables is maintained (model 3). Lastly, the variable for inspection changes is added; with the previous results unaltered, its introduction proves non-significant (model 4). Interestingly, the adjusted R^2 adjustment coefficient is 0.31 when regional value added per worker alone is considered (model 1), rising to 0.35 when the change in the composition of growth is added (model 2).

As an alternative, panel (b) of table 6 uses dummy variables as proxies for the institutional variables. In this case, one dummy is used for the year 2003, when the employment regime for microenterprises was set up (model 3), and another one for 2009, when the extension of this law to firms with up to 100 workers came into effect (model 4). As a proxy for the effect of the "electronic payroll" system,[35] a dummy was also created for 2008,

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[34] The multiple regression analysis is presented here solely for the purpose of carrying out a controlled analysis of the effects of different variables on registered employment, and is not meant to evaluate their individual impact. There are studies that have set out to evaluate some of these factors separately. Evaluating all these factors in combination would require a multiple treatment analysis, which is beyond the scope of this article.

[35] The electronic payroll system is an electronic procedure whereby employers with three or more workers have to submit monthly reports to the Office of the National Superintendent of Tax Administration (SUNAT) with information on their workers, pensioners, service providers, trainees, outside staff and dependants. The report used to be made directly to the Ministry of Labour. This administrative change has increased the ability of the Ministry to supervise and verify compliance with employment obligations, as it can use the installed capacity and detection capabilities of SUNAT (ILO, 2014b).

the year its use became compulsory (model 5).[36] The analysis of these variables, controlling for the growth of regional value added per worker and sectoral growth, yielded non-significant coefficients for them.

These findings imply that the increase in value added per worker in the regions proved a decisive factor in the rise of the registered employment rate in Peru. The growth

of certain sectors, such as the more employment-intensive ones, also adds explanatory power to this process. The variables associated with labour market reform do not prove significant, in contrast to the scale of the changes this entailed. Much the same can be said of the measures to strengthen inspections, which remain weak despite the changes made.[37]

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[36] Because the changes are permanent, dummies with a value of 1 were used for the year concerned and following years. The dummies are nationwide because the regime does not vary by subnational region.

[37] The National Labour Inspection Authority (SUNAFIL) was set up in 2013 to strengthen the inspection service.

TABLE 6

Multiple regression results, 2002-2012

a. Variables for economic growth and institutional changes (in variations)

Dependent: variation in the registered employment rate	Model 1	Model 2	Model 3	Model 4
Variation in regional value added per worker	0.633***	0.781***	0.759***	0.747***
	(0.068)	(0.079)	(0.079)	(0.080)
Variation in the regional output share of labour-intensive sectors		0.493***	0.464**	0.464**
		(0.141)	(0.141)	(0.141)
Variation in regional labour costs			0.038	0.038
			(0.022)	(0.022)
Variation in the rate of inspection orders completed per 1 000 employees, by region				0.001
				(0.001)
F test	86.3	51.9	36.0	27.3
Prob > F (*p*-value)	0.00	0.00	0.00	0.00
Adjusted R^2	0.314	0.354	0.361	0.361
No. of observations	186	186	186	186

b. Variables for economic growth and institutional changes (dummies)

| Dependent: variation in the registered employment rate	Model 1	Model 2	Model 3	Model 4	Model 5
Variation in regional value added per worker	0.633***	0.781***	0.886***	0.918***	0.924***
	(0.068)	(0.079)	(0.098)	(0.098)	(0.101)
Variation in the regional value added share of labour-intensive sectors		0.493***	0.588***	0.661***	0.667***
		(0.141)	(0.150)	(0.153)	(0.155)
Dummy variables associated with small and medium-sized enterprise employment regimes					
Year 2003 (microenterprise regime)			-0.949	-0.133	-0.068
			(0.538)	(0.668)	(0.706)
Year 2009 (small enterprise regime)				-1.778	-1.377
				(0.874)	(1.629)
Dummy variables associated with stronger inspections					
Year 2008 (electronic payroll)					-0.49
					(1.68)
F test	86.3	51.9	36.0	28.5	22.7
Prob > F (*p*-value)	0.00	0.00	0.00	0.00	0.00
Adjusted R^2	0.314	0.354	0.361	0.372	0.369
No. of observations	186	186	186	186	186

Source: Prepared by the author, on the basis of information from the National Institute of Statistics and Informatics (INEI), the Ministry of Labour and Employment Promotion (MTPE), the National Household Survey (ENAHO) and Law No. 30288.

Note: * significant at 10%, ** significant at 5% and *** significant at 1%.
Standard deviation in parentheses. Employment-intensive sectors: Farming and fishing, Commerce, Restaurants and hotels and Other services.

V

Conclusions

Peru recorded high growth rates in the 2000s and early 2010s. This period of economic growth brought down unemployment, which reached a historic low of less than 4% nationally in 2013. There was also a significant reduction in the poverty rate, which more than halved from its level of the early 2000s, something that certainly indicates an improvement in incomes, although it also brings into relief the role of redistributive social policy and its connection to the greater availability of fiscal resources. In turn, the percentage of formal employment rose from 20.1% to 26.3% between 2007 and 2012. This is remarkable progress, even though the rate of informal employment is still very high.

The present article has analysed this formalization process and sought to identify the factors that could explain it. Much of the foregoing discussion has concentrated on certain specific relationships, particularly the one between informality and labour market reform. The goal here was to identify the contribution of each element as part of an integrated approach in which it was assumed that different policies may have some explanatory power. The Peruvian case is an interesting one for this purpose, since different factors that could in theory explain the process came together in the period of analysis, examples being economic growth, labour market reform (with the creation of a special regime that reduced employment costs for most of the labour market) and improvements in the inspection system. All these elements have been flagged up by different theories as factors explaining informality, and thence formality.

The analysis was carried out in two stages. First, the effects of sectoral growth on formalization were estimated on the basis of a model originally developed to measure the effects of sectoral growth on poverty. The findings show that the sectoral effects are differentiated,

which bears out the hypothesis that the composition of growth matters for formalization. In particular, economic growth in the most employment-intensive sectors (Farming, Commerce, Other services and, to an extent, Restaurants and hotels) accounts for the formalization seen. Then, considering that formalization is a process with multiple causes, a comparative analysis of the factors that might have been behind the growth in the registered employment rate between 2002 and 2012 were analysed. The results indicate that a key element was the growth in regional value added per worker. Also significant was the growth in the share of value added per worker accounted for by the most employment-intensive and at the same time least productive sectors, as this indicates that their value added per worker grew more quickly than regional value added per worker. The variables associated with labour market reform and inspection changes did not have significant effects.

These findings are consistent with the fact that at least two of every three workers with an informal job in Peru are employed in informal economic units which are not registered as businesses or for tax purposes, and that economic units in the informal sector have productivity levels an eighth those of the formal sector. In these circumstances, it is understandable that only variables associated with growth, and particularly growth in lower-productivity sectors, should have significant coefficients. This implies that the formalization of employment presupposes formalization of the economic units where informal jobs are generated. Consequently, the emphasis on reducing employment costs for smes probably needs to be replaced with a greater stress on enhancing the benefits of formality, such as access to larger markets, financing, business development services and security, among others.

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Fiscal decentralization and economic growth in Colombia: evidence from regional-level panel data

Ignacio Lozano and Juan Manuel Julio

ABSTRACT

This paper provides evidence for the positive effects of fiscal decentralization on regional economic growth in Colombia since the enactment of the Political Constitution of 1991. The empirical strategy involved choosing a suitable estimator for the panel data approach, the augmented mean group (AMG) estimator, that enabled unobserved determinants suggested by the literature to be added to traditional long-term explanatory factors. The strategy was supplemented with exercises that provided support for the results from (i) cross-sectional models for different periods and various control variables; (ii) a test of the hypothesis of complementarity between public goods provided by different jurisdictions (spillover effects), and (iii) an assessment of unconditional convergence in regional income differences.

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I

Introduction

The decentralized provision of public goods has usually been seen as an important channel for encouraging regional economic development. The canonical theoretical assumption is that local governments are more efficient at allocating public resources, since they have better information and stronger incentives to get things right than the central government. Firstly, local authorities will eventually supply the goods that people prefer, as they are closer to the population (Oates, 1999). Secondly, subnational governments that provide basic services are under the scrutiny of their constituents and so have incentives to execute public policies in accordance with the interests of the community (Tiebout, 1956). Decentralization might also be beneficial for governance and market mechanisms, favouring private activities (Tulchin and Selee, 2004; Weingast, 1995). In practice, the combination of these factors may be conducive to learning, experimentation and competition in the provision of collective consumption goods, thus fostering long-term economic growth.

Nevertheless, the welfare gains from decentralized fiscal arrangements have been called into question by other branches of the literature. Scale economies, for instance, might mean that central governments are more efficient than local ones at producing public goods optimally, thanks to advantages in the organization and use of technologies (Stein, 1998). In addition, local governments could be less well able to plan and implement projects, mainly because their human resources are likely to be less educated or experienced (Iimi, 2005). From the perspective of political science, decentralized systems are likely to be more exposed to the risks of corruption and rent-seeking, with negative effects on economic activities (Rodden and Rose-Ackerman, 1997; Brueckner, 2001; Fisman and Gatti, 2002; Bardhan and Mookherjee, 2005).

Empirically, there are numerous studies analysing the effects of fiscal decentralization on economic growth,

both across countries and in single cases. The results are manifold and point in all sorts of directions. Surprisingly, early papers from the 1990s yielded little in the way of consensus about the benefits of fiscal decentralization for economic activity, but the findings have been changing recently (Blöchliger, 2013; Kim, 2013; Asatryan, 2010; Baskaran, Feld and Schnellenbach, 2009).

Fiscal decentralization was implemented in Colombia in the early 1990s, after 30 years of trying. By that time, most Latin American countries were strengthening the role of regional governments in economic development. Indeed, this type of reform was taking place worldwide. According to several studies, 63 of the 75 countries with a population over 5 million have undergone major decentralization since 1980 (Lee and Roy, 1999; Manor, 1999; Oxhorn, Tulchin and Selee, 2004). Thus, broadly speaking, decentralization became the core of institutional reforms during the late twentieth century, especially in developing countries.

The advance of decentralization in Colombia has touched many aspects of government. Where resourcing is concerned, the process has been based on a gradual increase of financial transfers from central to regional governments. However, progress in devolving powers and responsibilities has been less clear. On the political side, popular election of mayors started in 1988 and that of departmental governors in 1992. The free choice of regional governors and mayors became a key strategy of democratic reformers, who wanted to ensure that decentralization would make the State more accessible to citizens as well as counterbalance the abuse of power by national leaders. Finally, central government fund transfers were supplemented from 2000 by other measures, such as those designed to prevent financial disequilibria in regional entities while strengthening physical investment.

The Colombian literature includes papers analysing the effects of fiscal decentralization on the coverage of education and health services (Melo, 2005; Faguet and Sánchez, 2008 and 2009) and other public utilities (Sánchez, 2006). Non-linearity between decentralization and education coverage and its impact on quality have also been investigated (Lozano and Martínez, 2013). Other papers have addressed related issues such as:

(i) the response by different municipalities to the system of intergovernmental transfers (Loboguerrero, 2008); (ii) the fairness of the transfer system (Bonet, 2006); (iii) the relationship between decentralization and armed conflict (Sánchez and Chacón, 2005; Villa, Restrepo and Moscoso, 2014), and (iv) the effect of decentralization on poverty at the municipal level (Ramírez, Díaz and Bedoya, 2014).

Two decades after the 1991 adoption of the Constitution, which paved the way for fiscal decentralization in Colombia, there is still no evidence to show whether it has strengthened regional economic growth or not. As described above, the most relevant empirical studies have focused on assessing its impact on certain production

factors, but not directly on output. This is the gap we try to fill in this paper, which also provides evidence on the spillover effects of public goods provision by different jurisdictions and on regional growth convergence.

Following this Introduction, the paper is organized as follows. Section II provides an overview of some institutional aspects and major indicators of fiscal decentralization in Colombia. Section III briefly describes the economic model adopted to evaluate the subject. Section IV discusses the links between economic theory and the statistical model to be estimated, highlighting the main empirical issues. The results are presented and discussed in section V, and the paper concludes in section VI with some final remarks.

II

An overview of fiscal decentralization in Colombia

Although the Political Constitution of 1991 propelled Colombia's decentralization process, important measures had actually begun three decades earlier, when the central government began transferring a significant percentage of its tax revenues to the regions (Act 33 of 1968 and Act 46 of 1971). During the 1980s, the replacement of the sales tax by value added tax (VAT) under Act 14 of 1983 introduced new changes into the system of transfers to municipalities. The main one was the gradual increase in VAT transfers to 50%, a level that was to be reached in 1992 (Act 12 of 1986). The Constitution of 1991 introduced new criteria for setting the size of transfers to the subnational departments (the so-called *situado fiscal*) and the amount and purpose of transfers to municipalities. The constitutional mandates were regulated by Act 60 of 1993. However, central government budget constraints made it unfeasible to increase transfers to the regions after the early 2000s. Consequently, two additional reforms to the transfer system were implemented at the turn of the century.

The first one combined the two existing transfer systems, the *situado fiscal* and the *participación municipal* into a single basket called the General Participation System (SGP) (Legislative Act 1 and Act 715 of 2001). The radical change it introduced was to

separate the size of transfers from the current revenues of the central government by setting real growth rates. The SGP assigned new weights to the three major funding destinations: basic education (58.5%), health (24.5%) and a general-purpose destination (17.0%) that included basic sanitation programmes (drinking water, sewage and refuse collection). As for the geographical distribution criteria, there were no substantial changes from the previous regime, with population size continuing to be the main variable for resource allocation (i.e. population served and to be served by education and health services, urban or rural location, conditions of extreme poverty, etc.). The second reform took place in 2007 and was basically aimed at rectifying the temporary system for calculating transfer amounts set up in 2001. This reform introduced higher real growth rates for the SGP until 2016, and added new resources for the education sector.

In the transition towards decentralization, financial transfers became the main source of revenue for many regional governments, both municipal and departmental. Such transfers have been particularly salient in regional government funding in Colombia, coming to represent nearly 50% of the total by the end of the 1990s. Of course, the extent to which dependence on them has increased varies from one municipality to another. The largest

municipalities (those in the special and first categories, defined as having over 500,001 inhabitants and between 100,001 and 500,000 inhabitants, respectively, together with an income criterion) are far better able to finance their spending from locally raised taxes. By contrast, municipalities of the sixth category (the smallest) were only financing 13% of their spending from self-generated taxes in the late 1990s (Lozano and Martínez, 2013).

From an overall tax collection perspective, subnational governments in Colombia currently collect only a little less than 14% of tax revenues, while their share of total public expenditure is close to 44%. Calculated by the most widely used indices, spending has clearly decentralized more quickly than revenue-raising, as shown by figure 1 for the region level.[1] The degree of decentralization varies widely between regions, with

Bogota, Antioquia, Valle and Cundinamarca leading on both the expenditure and revenue indexes.

Figure 2 displays the sources of regional tax revenues and the distribution of spending on leading programmes financed out of both self-generated revenues and central government transfers. Locally raised tax revenues have increased from about 2% to 2.8% of gross domestic product (GDP) over the last 20 years, led by taxes on economic activity (those levied on commercial and industrial activities and consumption taxes on alcohol and cigarettes) and real estate. Overall spending increased by almost 5 percentage points of GDP (from 4.8% to 9.4%), with the most significant rises being in the areas of education and health care (human capital) and infrastructure (physical capital). However, most of this growth took place over the course of the 1990s, probably as a result of the ambitious social commitments of the 1991 Constitution. Indeed, transfers from central government to the regions increased from about 2% to 4.6% of GDP between 1990 and 2003, stabilizing at around 4% thereafter.

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[1] The indices are defined as subnational governments' share of general government expenditures and revenues (Blöchliger, 2013). More detail on these indicators is provided in section V.

FIGURE 1

Fiscal decentralization, 1990-2012

(Revenue versus expenditure, index averages)
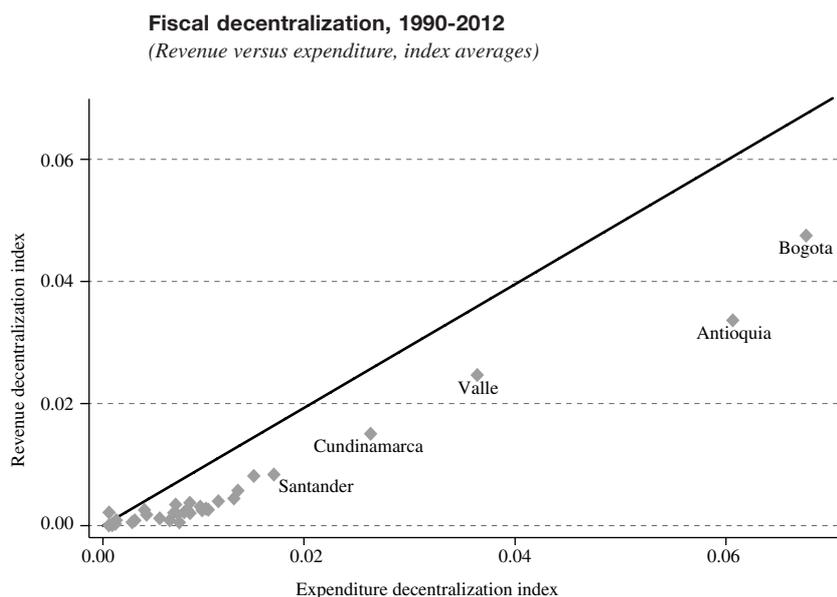
Source: Prepared by the authors.

FIGURE 2

Subnational government tax revenue and expenditure
(Percentages of GDP)

Tax revenue

Expenditure[a]

Tax revenue legend: Economic activity, Vehicles, Housing, Other

Expenditure legend: Education, Infraestructure[b], Health, Other
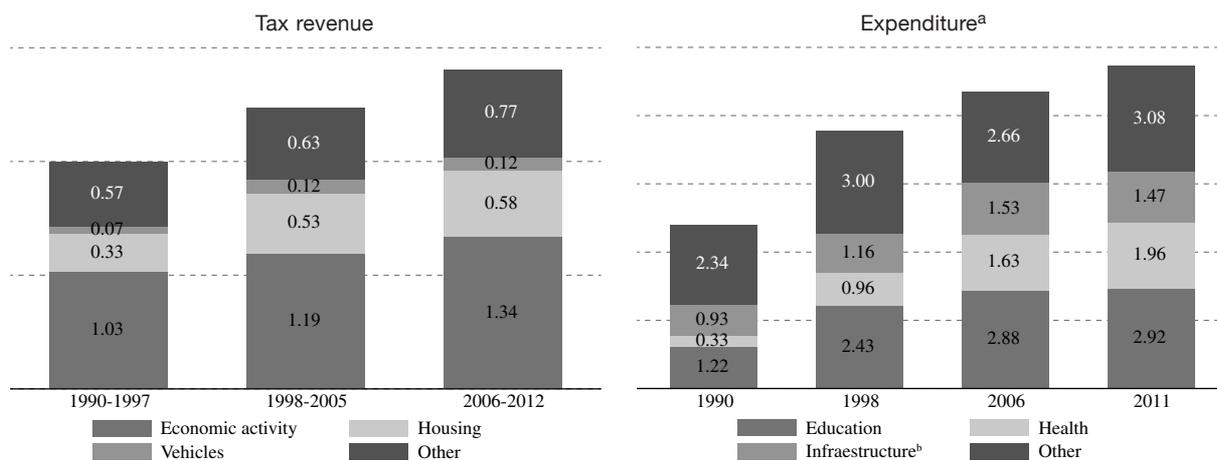
Source: Prepared by the authors.

Note: GDP: Gross domestic product.

[a] Expenditure financed from both local revenues and central government transfers.

[b] Owing to data limitations, the ratio of infrastructure spending to GDP for 2011-2012 was estimated by the authors.

Increasing subnational expenditure on infrastructure, human capital and other public services could have positive effects on regional economic growth, as may be inferred from figure 3. In the short term, higher spending could stimulate aggregate demand and hence economic activity, while over a longer time horizon it could positively affect factor accumulation and productivity. The correlation coefficient between the expenditure decentralization index and per capita GDP is positive across all regions, and while not particularly high (0.186) is statistically significant at a 99% confidence level. Once again, Bogota, Antioquia and Valle have the highest decentralization levels, while Arauca and Casanare, the oil-producing regions, have the highest levels of per capita GDP.

FIGURE 3

Simple correlation between decentralization and regional GDP, 1990-2012
(Index averages and millions of pesos)
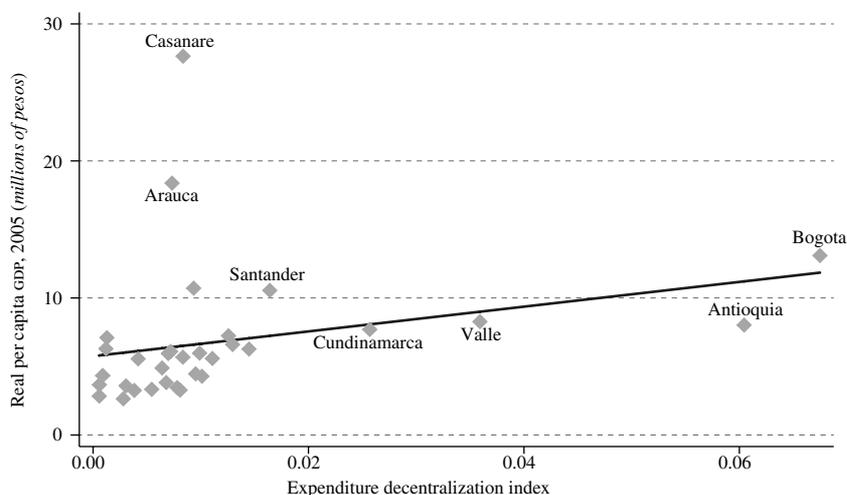
Source: Prepared by the authors.

Note: GDP: Gross domestic product.

III

The analytical framework

1. The basic configuration

We start from a simple version of Barro's (1990) endogenous growth model, which assumes that the government purchases a portion of private-sector output to provide free public services to private producers (infrastructure services, property rights, etc.). Let y be the output, k the private capital and g the government purchases, with all variables defined in per capita terms. Under constant returns to scale, the aggregate production function could be written as: $y = Ak^\alpha g^\varphi$, where $0 < \alpha < 1$, $0 < \varphi < 1$, $\alpha + \varphi = 1$ and $A > 0$ denotes the technology parameter. We omit the time subscripts for simplicity.

In order to introduce the fiscal decentralization discussion, government purchases are disaggregated into the shares financed by central, state and local authorities (Davoodi and Zou, 1998). Without loss of generality, we consider only two levels, namely central and local governments (Kim, 2013; Iimi, 2005), causing the production function to be written as follows:

$$y = Ak^\alpha f^\beta l^\gamma \qquad (1)$$

where f denotes per capita central government purchases and l those made by local government, $0 < \beta < 1$, $0 < \gamma < 1$ and $\beta + \gamma = \varphi$. Therefore, the degree of fiscal decentralization can be defined as local government spending relative to total public spending. As a result, the degree of fiscal decentralization increases if local government spending rises relative to that of central government, and vice versa. Accordingly, the allocation of total government spending (g) between the different levels of government takes the following form:

$$f = \theta_f g; \ l = \theta_l g; \ \theta_f + \theta_l = 1 \qquad (2)$$

where $0 < \theta_i < 1$ for $i = f, l$, with θ_f and θ_l being the shares of central and local government spending, respectively. On the revenue side, governments set a flat income tax rate (τ), keeping to the balanced budget constraint ($g = \tau y$). The model is closed with standard preferences for a Ramsey-Cass-Koopmans (see Ramsey, 1928; Cass, 1965 and Koopmans, 1965) representative household, where c is per capita private consumption and $\rho > 0$ is the time discount rate. As usual, the dynamic budget

constraint of the representative agent is given by $\frac{dk}{dt} = \dot{k} = (1-\tau)y - c = (1-\tau)k^\alpha f^\beta l^\gamma - c$. For a given level of g and θ_l, the steady-state solution for per capita output growth is given by:

$$\frac{dy/dt}{y} = \frac{\dot{y}}{y} = \frac{1}{\sigma}\left[(1-\tau)\tau^{\frac{1-\alpha}{\alpha}}A\alpha(1-\theta_l)^{\frac{\beta}{\alpha}}\theta_l^{\frac{\gamma}{\alpha}} - \rho\right] \quad (3)$$

The empirical long-term relationship between fiscal decentralization and economic growth may be assessed from the previous equation. In point of fact, increasing decentralization has a positive effect on growth as long as the productivity of local government spending is greater than that of the central government's, i.e. $\frac{dy/dy}{d\theta_l} > 0$ for $\theta_l < \frac{\gamma}{\beta + \gamma}$. Additionally, for a given level of total government spending (as a share of GDP), a reallocation of public spending between different levels of government can lead to higher economic growth if the current allocation differs from the one resulting from a growth-maximizing expenditure problem, given by $\theta_f^* = \frac{\beta}{\beta + \gamma}$ and $\theta_l^* = \frac{\gamma}{\beta + \gamma}$.

2. Complementarity between public goods and unobservable determinants of growth

Barro's growth model was extended by Nishimura (2006) and Akai, Nishimura and Sakata (2007) to capture complementarity between public goods provided by the regions within a country. Programmes implemented in each jurisdiction could have a spillover effect on others, and thence on the national economy. Thus, the discussion about the role of government in growth is not only about the benefits of a centralized versus a decentralized fiscal regime, but also about the spillover impacts of public goods financed across regions.

The complementarity hypothesis is incorporated through an aggregate production function for public goods, which depends partially on a large set of public inputs financed by subnational governments (education and health programmes, infrastructure, libraries, parks, property rights, social services, etc.). In practice, it

implies letting $g = \sum_{i=1}^{I} l_i + f$ in Barro's model, where $i = 1,\ldots, I$ is the number of regional units.

The extended framework, called the human fallibility model of government, assumes that there are J identical jurisdictions in each region i, each of them with the same number of firms and households. Some public programmes might generate positive spillover effects on growth (externalities) at both the interregional and intraregional levels while others do not. If $p(j)$ denotes the public programmes financed by jurisdiction j, then the aggregate public good in a region i (l_i) is a function of the public services provided by J.

$$l_i = \left(\sum_{j=1}^{J} \frac{1}{J} p(j)^{\rho} \right)^{\frac{1}{\rho}}, \quad \rho \geq 0 \qquad (4)$$

Equation (4) represents the public goods production function for region i, which depends on inputs (programmes) provided by the jurisdictions J (municipalities). Furthermore, ρ captures the degree of global (inter-)complementarity between public services, to use the terminology of Bénabou (1996). A higher value of ρ means lower complementarity and vice versa. Empirically, it is usual to treat expenditure on the public programmes financed by jurisdiction j as a proxy for their effectiveness. Section IV will add other technical details of the method used to estimate ρ.

Aside from the usual factors determining long-term economic growth and the role of regional governments, an important branch of the literature has focused on models in which spatial considerations are crucial (Breinlich, Ottaviano and Temple, 2013). This approach points out that economic activities tend to gravitate mainly towards areas that have relatively good transport links and are close to large markets. Therefore, regional growth performance could be connected with geographical features in addition to other unobservable determinants (culture, the quality of institutions, etc.). If outcomes in one region are closely linked to the outcomes and characteristics of other regions (i.e. there is spatial interdependence), the econometric strategy has to reflect this. Our empirical exercises also pay particular attention to these issues. The technical details will be discussed further in the next section.

IV

Linking the economic theory to a statistical model

We begin by using the equation:

$$y_{it} = \beta_i' x_{it} + u_{it} \qquad (5)$$

where $x_{it} = \begin{bmatrix} d_{it} & k_{it} \end{bmatrix}^T$, d_{it} is a fiscal decentralization indicator for region $i=1,2, \ldots, N$ and period $t=1,2, \ldots, N$, β_i is a vector of region-specific slopes (technology) and u_{it} is closely related to (unobservable) total factor productivity (TFP) growth, ΔTFP, for regions and periods.

The following assumptions in equations (6) to (8) yield a (possibly non-stationary) dynamic factor system representation of the observable and unobservable variables in N correlated regions:

$$u_{it} = \alpha_i + \lambda_i' f_t + \varepsilon_{it} \qquad (6)$$

$$x_{mit} = \pi_{mi} + \delta_{mi}' g_{mt} + \rho_{1mi} f_{1mt} + \cdots + \rho_{nmi} f_{nmt} + \upsilon_{mit} \qquad (7)$$

$$f_{mt} \subset f_t; \; f_t = \eth' f_{t-1} + \epsilon_{1t}; \; g_t = \varkappa' g_{t-1} + \epsilon_{2t}; \; \epsilon_t = \begin{bmatrix} \epsilon_{1t}' & \epsilon_{2t}' \end{bmatrix}' \qquad (8)$$

Under assumption (6), the unobserved ΔTFP splits into a common (cross-regional) unobserved time-varying total factor productivity component (f_t), a fixed regional factor productivity effect (α_i) and a time- and sector-varying TFP innovation (ε_{it}). Assumption (7) implies, in turn, that each observable factor of x_{it}, $x_{mit} \subset x_{it}$, for $m = 1,2$ (i.e. $x_{1it} = d_{it}$ and $x_{2it} = k_{it}$), depends on: (i) a set of unobserved time-varying but variable-specific factors that are common across regions, g_{mt}; (ii) a subset of the factors $f_{nmt} \subset f_t$ driving TFP; (iii) a set of effects that are variable-dependent but fixed across regions (π_{mi}), and (iv) an innovation υ_{mit} that changes with the time, the region and the variable explained in (7). Finally, with equation (8), the common factors driving TFP, fiscal decentralization and private capital growth, follow VAR(1) dynamics.

According to Banerjee, Eberhardt and Reade (2010), the statistical model in equations (5) to (8) represents a production-related function with (i) observed

heterogeneous technology across regions; (ii) possibly integrated observable and unobservable variables; (iii) spillovers and spatial cross-correlations between the observable and unobservable variables across regions; (iv) observed and unobserved heterogeneity among variables; (v) endogenous factors of production, and (vi) observable as well as unobservable dynamics. On this last, see Bond and Eberhardt (2013), Baltagi, Bresson and Pirotte (2008) and Hsiao and Pesaran (2008).

The last two equations bring out three broad sources of variation in fiscal decentralization. The first source are time-varying shocks that affect fiscal decentralization equally across regions (g_{1t}), such as central government transfer policies. This source is, therefore, the first element of ε_{2t}. The second source are region-specific time-varying shocks (υ_{1it}), which may arise, for example, from idiosyncratic tax or spending policies. The third source are factor productivity shocks common to all regions (f_{n1t}), such as countrywide policies on tax-raising or spending, that can induce correlations between regional output growth and fiscal decentralization through spillovers between regions. This third source of shocks is one element of ε_{1t}.

As a result, a one-time innovation in fiscal decentralization has a transitory effect on output growth and a permanent effect on per capita output. Indeed, all else being equal, a one-time positive shock to the first element of ε_{2t}, i.e. a fiscal decentralization innovation, or one element of ε_{1t}, i.e. a common TFP innovation affecting fiscal decentralization, transmits through an AR(1) process to g_t or f_t, respectively, and thence, through the same AR(1) process, to regional per capita output growth. When this response is integrated, therefore, a permanent shift in regional per capita output arises. Furthermore, a one-time positive time-varying region-idiosyncratic fiscal decentralization shock υ_{1it} translates, other things being equal, into one-time regional per capita output growth of size β_1, which after integration becomes a permanent shift in the output level of the same size. Therefore, regardless of whether fiscal decentralization shocks are common or idiosyncratic in origin, per capita output shifts permanently upward in the long term.

Estimation is carried out using the augmented mean group (AMG) technique proposed by Eberhardt and Teal (2010) and Bond and Eberhardt (2013). Just like the earlier choice of statistical model, this choice was dictated by the very moderate size of the dataset available. Under these circumstances, several of the parameters that are not of interest are treated as a nuisance. In fact, under the assumption that regional technology vectors β_i are random with mean $\overline{\beta}$, only the latter is identified and can consistently be estimated. See Coakley, Fuertes and Smith (2006).

V

Results

1. The dataset

Our dataset contains yearly records of the variables described in annex I for 24 Colombian regions spanning the 1990-2012 period. Unfortunately, complete information is not available for all 32 regions in the country, but the 24 regions in our sample account for an average of 97.7% of national GDP. The variables employed in the panel data regressions are described in annex A1, as are other variables used in the cross-sectional exercises and those required to assess the complementarity effect among public goods.

Two particular remarks must be made about the dataset. The first concerns the fiscal decentralization indicators based on expenditure and revenues (d_{it}). Autonomous expenditure and taxes were taken as the most relevant measures in our framework. Autonomous expenditure is spending by the government of region i excluding transfers from the central government (i.e. expenditure financed out of the region's own resources). Autonomous taxes are those over which subnational governments have some degree of legal autonomy delegated by central government. These measures were supplemented by a measure of subnational government expenditure as a share of total general government expenditure, this ratio being one of the most commonly employed indicators for studies at panel data level across countries (Blöchliger, 2013). The higher the ratio, the greater the

level of decentralization in that region.[2] Autonomous revenue as a share of the total was likewise included.

The second remark concerns estimation of the stock of private capital at regional level (k_{it}), as this information is unfortunately unavailable in Colombia. Use was originally made of the initial value of the aggregate capital stock as calculated by the National Planning Department (DNP) with the permanent inventories methodology. This value was updated using net investment as reported in the national accounts and a standard yearly depreciation rate of 4.92%. The next step was to identify the public component of capital over the time period (and thence the private component), the weight used being infrastructure spending (a proxy for public investment) as a percentage of total investment, again as reported in the national accounts. In the final step, two complementary tools were used to proxy the regional distribution of private capital. First, the figures were weighted by the distribution of output between regions, on the standard assumption that capital and output grow at equal rates in the steady state. Second, the regional distribution of manufacturing firms' capital, identified from the Annual Manufacturing Survey, was factored into the calculations.

2. Growth regression models

Prior to the findings being presented, some statistical properties of the variables involved in the panel data models were examined (unit root, stationarity and cross-sectional dependence). Annex A2 shows the results. First, the standard unit root tests reject the presence of unit roots in the variables included in equation (5) (for different versions), which means that these versions of the equation are stationary panels. Second, Pesaran's (2004) cross-sectional dependence (CD) test strongly suggests the existence of variable-wise cross-sectional dependence among the 24 regions in Colombia considered. Third, principal components analysis suggests that unobservable dynamic factors might have to be brought in to explain the total variation of regional economic growth in Colombia, something that is in fact done by the AMG estimator used in this paper.

Table 1 shows the results of the model described by equations (5) to (8), based on the AMG estimator, which was designed for moderate panel size and was used in the presence of heterogeneous slope coefficients across regions and possible correlation across the panel members. The signs of the parameters are as theoretically expected, and the model seems to explain growth mechanisms aptly. The key coefficients of fiscal decentralization are positive and statistically significant, implying that the transfer of fiscal functions to subnational governments may have strengthened economic growth. Expenditure autonomy indicators, for instance (model 1), indicate that a 10% increase in spending autonomy in a representative region i could lead in the long term to an increase of 2.4% in economic growth.

The higher coefficient of the tax autonomy indicator (model 2) is surprising because there is currently limited scope for subnational governments to manage their own taxes. This may be a potential source of growth to be examined, as it is reasonable to argue that fiscal spending decentralization has also been associated with a strengthening of regional income bases. Finally, fiscal decentralization as measured by spending and revenue shares has been positive and statistically significant, although with semi-elasticity greater than 1.

The positive effect of fiscal decentralization on regional economic growth is explained by channels associated with demand as well as supply. Taking the indicator of fiscal decentralization based on expenditure (model 3), for instance, the relative growth of subnational expenditure on infrastructure, human capital and other public services could have positive effects on regional economic growth both in the short term, through the stimulus to aggregate demand (contemporary effect), and on a longer time horizon, owing to the positive effects on factor accumulation and productivity (TFP). It should be recalled that this parameter measures the average effect across both agents and time.

The positive links found between fiscal decentralization and regional economic growth in Colombia are consistent with most recent papers on the subject. Nonetheless, some have argued that this relationship is positive but non-linear, suggesting a hump-shaped association (Akai, Nishimura and Sakata, 2007; Blöchliger, 2013). The "optimal" level of decentralization yielded by this discussion thus fixes a limit beyond which additional decentralization may restrain rather than encourage economic activity. We explored this hypothesis using the Colombian data, but no evidence for it was found, perhaps because the series are not long enough.

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[2] Public spending in region i encompasses both operational and investment spending by the departmental government of i plus expenditures by all municipalities belonging to this region. One important source of financing for regional expenditures consists of transfers from central government, especially for education. For a typical region i, education expenditures financed from transfers averaged 32% of total spending between 2002 and 2012. The remaining expenditure (more than two thirds) was in other areas such as infrastructure, health, debt service, administration, etc.

TABLE 1

Panel data results

Variable Fiscal decentralization	Fiscal autonomy		Fiscal share	
	(1)	(2)	(3)	(4)
Expenditure autonomy, d_{it}	0.0246***			
Tax autonomy, d_{it}		0.1302***		
Expenditure share, d_{it}			1.5404***	
Revenue share, d_{it}				1.5100*
Per capita private capital, k_{it}	0.6159***	0.5946***	0.6026***	0.6110***
Common factors effect, λ_{it}	0.8323***	0.8084***	0.7672***	0.8461***
Constant (regional fixed effect), $\propto_{it}$	-0.0158***	-0.0507***	-0.0325***	-0.0231**

Number of observations = 528
Number of groups = 24

Source: Prepared by the authors.

Note: The dependent variable is the average annual per capita GDP growth rate. The common dynamic process is included as an additional regressor. *** $p<0.01$; ** $p<0.05$; * $p<0.1$.

Regarding the other results, the expected sign of the private capital parameter is confirmed with the highest statistical significance across the models and a reasonable degree of elasticity. However, what is more striking is the positive result for the common unobservable factors that help to explain the economic growth of regions directly, as well as factor accumulation and productivity. In the theoretical setting of Eberhardt and Bond (2009), the TFP of the production function is paramount among the unobservable factors. Nevertheless, some particular differential aspects recognized by the literature as crucial determinants of development across countries (regions), such as culture, habits, climate, geographical aspects, the quality of institutions, etc. (Acemoglu, Johnson and Robinson, 2005), could also be included as unobservable factors. Due to the unavailability of data for these estimations, we were unfortunately unable to distinguish between parameters.

To check the validity of the foregoing results, residual unit root tests and cross-sectional dependence tests were performed for the residuals of each panel estimated. The results in table 2 confirm the rejection of residual unit roots since the p-values of the Levin, Lin and Chu (2002) unit root tests are well below 0.05. Moreover, table 2 also shows strong evidence of a lack of residual cross-dependence, since the p-values of the Pesaran's (2004) cross-dependence tests range from 0.45 to 0.82. As a result, table 2 suggests that our residuals successfully support the assumptions.

Furthermore, a principal components analysis of the residuals of each panel estimated reveals that commonality is greatly reduced. The results in table 3 show a large reduction in the correlation share of the first residual principal component with respect to the common correlation of GDP growth (see annex A2). A large portion of commonality was thus captured by the model, validating our empirical strategy.

TABLE 2

Levin-Lin-Chu unit root test and Pesaran's cross-sectional dependence (CD) tests for panel residuals with different fiscal decentralization indicators

Panel residuals with each fiscal decentralization indicator	Levin-Lin-Chu test[a]		Pesaran CD test[b]	
	Coefficient	p-value	Coefficient	p-value
Expenditure autonomy, d_{it}	-1.14	0.00	-0.23	0.82
Tax autonomy, d_{it}	-1.09	0.00	0.76	0.45
Expenditure share, d_{it}	-1.15	0.00	-0.30	0.76
Revenue share, d_{it}	-1.13	0.00	-0.29	0.77

Source: Prepared by the authors.

[a] Under the null hypothesis of non-stationarity.
[b] Under the null hypothesis of cross-sectional independence, CD ~ N(0.1).

TABLE 3

Principal components analysis of the residuals with different indicators of fiscal decentralization

| Order | Fiscal autonomy | | | | Fiscal share | | | |
| | Expenditure, d_{it} | | Taxes, d_{it} | | Expenditure, d_{it} | | Revenue, d_{it} | |
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
1	0.20	0.20	0.19	0.19	0.19	0.19	0.21	0.21
2	0.13	0.33	0.12	0.31	0.13	0.32	0.13	0.33
3	0.12	0.45	0.12	0.43	0.12	0.44	0.12	0.46
4	0.10	0.55	0.11	0.54	0.09	0.54	0.10	0.56
5	0.09	0.64	0.09	0.63	0.08	0.62	0.08	0.64
6	0.07	0.71	0.07	0.69	0.08	0.70	0.08	0.72
7	0.06	0.77	0.05	0.75	0.06	0.76	0.05	0.77
8	0.05	0.82	0.05	0.80	0.05	0.81	0.05	0.82

Source: Prepared by the authors.

Note: (1) is the proportion of explained variance and (2) is the explained variance.

Table 4 shows the results of the growth regression model, this time in a cross-sectional dimension as an alternative configuration to enable other types of controls to be introduced. Each column represents the model estimated for each fiscal decentralization indicator in different periods. The aim here is to verify the effects of fiscal decentralization on regional economic growth by controlling for the initial levels of output and human capital, measured from the starting level of education coverage. As can be seen, the sign of the fiscal decentralization and private capital parameters continues to have the highest level of statistical significance. Interestingly, the impact of fiscal decentralization on economic growth, as assessed from the expenditure and tax autonomy indicators, has grown in recent times. Also notable is the negative and significant parameter found for the starting level of GDP, suggesting convergence in regional economic growth in Colombia. This subject will be returned to later with formal tests. In addition, an unexpected sign was found for the initial human capital parameter. This is not exclusive to our paper and requires more detailed analysis (see Davoodi and Zou, 1998).

TABLE 4

Cross-sectional results

| Variable | Expenditure autonomy | Tax autonomy | Expenditure share | Revenue share |
	2000-2012	2000-2012	1990-2012	1990-2012
Fiscal decentralization indicator, d_i	0.0906***	0.0312***	0.1588***	0.1324***
Private capital, k_i	1.0679***	0.7697***	0.4127***	0.6260***
Initial per capita GDP level	-8.92e-09**	-9.83e-09**	-1.10e-08***	-1.12e-08***
Initial education coverage level	-0.0787***	-0.0382***	-0.0181***	-0.0307***
Constant	-0.0018	0.0308***	0.0354***	0.0412***
Number of observations	24	23	22	22

Source: Prepared by the authors.

Note: The dependent variable is the average annual per capita GDP growth rate. *** $p<0.01$; ** $p<0.05$.

3. Complementarity between public goods

To empirically assess complementarity between public goods provided by subnational governments (section III.2), we follow the strategy proposed by Akai, Nishimura and Sakata (2007), which starts by linearizing the production function of section III.1.

$$ln\,Y_{i,t} = B + \left(1 - \beta\right)ln\,K_{i,t} + \beta\left(ln\,l_{i,t} + ln\,N_{i,t}\right) \quad (9)$$

where $lnY_{i,t}$ is the logarithm of the per capita GDP of region i, $lnK_{i,t}$ is the logarithm of per capita private capital, and $lnN_{i,t}$ is the number of workers per capita in each region, calculated as the ratio of the economically active population to the total population. In turn, the value of $ln\,l_{i,t}$ is the logarithmic form of equation (4), where $p(j)$ denotes the implementation of public programmes financed by jurisdiction j. That is:

$$ln\,l_{i,t} = \frac{1}{\rho}\,ln\left\{\frac{1}{J}\sum_{j=1}^{J} p_t\left(j\right)^{\rho}\right\} \quad (10)$$

where $\theta = [\beta,\rho]^T$ is the parameter vector. The estimation was carried out by unrestricted numerical minimization of the right-hand term of equation (11) using the SAS/IML software. The data cover the 13 most representative regions of the Colombian labour market for the 2001-2012 period.[3] The results are summarized in table 5 and compared with previous estimations by Akai, Nishimura and Sakata (2007) for the United States.

The null hypothesis of $\rho = 0$ is rejected with a 1% significance level, so that the resulting value of ρ is

For the case of Colombia, we construct $ln\,l_{i,t}$ by defining $p_t(j)=m_j+d_j$, where m_j is spending by municipality j and d_j is the municipality's share (aliquot) of total expenditure in the department to which it belongs. The size of the population (pop) of each municipality relative to its department is used to weight this aliquot, so that $d_j = \frac{pop_j}{pop_i}l_i$. As suggested by the literature, the public expenditure relevant to this calculation includes in particular that associated with capital formation (investment), which has greater potential to generate spillovers. Thus, infrastructure expenditure in region i on roads, electricity, parks, mass transit systems and so on could have beneficial effects on neighbouring regions because of considerations of spatial or geographical dependence, and vice versa. The parameters are estimated from the following second-order non-linear equation using pooled non-linear least squares:

$$\hat{\theta} = \underset{\theta \in R^2}{argmin}\left\{\sum_{t=1}^{T}\sum_{i=1}^{N}\left(ln\,Y_{i,t} - \left[B + \left(1 - \beta\right)ln\,K_{i,t} + \beta\left(ln\,l_{i,t} + ln\,N_{it}\right)\right]\right)^2\right\} \quad (11)$$

significantly positive for Colombia. According to the theory, this is the case when public goods provided at subnational levels are complementary among themselves or have spillover effects across regions, ultimately strengthening economic growth at the national level. From comparison with the United States we conclude that regional public goods in Colombia have a relatively small complementary effect, since the larger parameter ρ is, the smaller its effect (section III.2). The private capital parameter $(1 - \beta)$ is highly significant and close to what was obtained through the panel data regressions. For its part, the value of B must be taken with caution, since this is not a dynamic growth analysis, which means that the implications for the Solow residual are not entirely clear.

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[3] The labour market data were taken from Colombia's National Administrative Department of Statistics (DANE). They report information only for the most representative 13 regions. Because of changes in survey methodology, information is available only from 2001 to 2012.

TABLE 5

Estimation of the public goods complementarity effect

Parameter	Colombia: 13 regions, 2001-2012			United States: 50 states, 1992-1997		
	Estimate	*t*-statistic	*p*-value	Estimate	*t*-statistic	*p*-value
B	3.38	11.63	0.000	3.35	3.67	0.000
β	0.47	5.19	0.000	0.34	5.35	0.000
ρ	0.78	3.26	0.000	0.48	3.98	0.000

Source: Authors' calculations for Colombia and Akai, Nishimura and Sakata (2007) for the United States.

Note: The dependent variable is the log of per capita GDP in the 13 most representative regions.

4. Regional growth convergence

An important feature of this dataset is the large gap in per capita GDP levels between regions in Colombia. In 2010, for instance, per capita GDP was almost seven times as high in the richest regions (Casanare and Meta) than in the poorest (Sucre, Nariño and Chocó), the national average being about Col$ 7.8 million (see Lozano and Martínez, 2013). The natural question is whether such cross-regional differences in per capita incomes are temporary or permanent. If they are temporary, unconditional convergence (to a common long-run level) may be occurring. This situation is usually captured by the unconditional β-convergence test. Now, if income differences are temporary but there remain doubts as to whether their dispersion is declining over time, then the σ-convergence test helps resolve this uncertainty. In contrast, if the differences are permanent, a crucial point to determine is whether this permanence reflects structural heterogeneity between regions or simply the role of initial conditions in determining long-run outcomes. In practice, the conditional β-convergence test requires a large set of controls to be employed in the estimation.[4]

For the convergence hypothesis to be formalized empirically, the initial level of output is typically correlated with its growth rate. For relatively homogeneous groups of economic units at the regional level (such as states in the United States or Australia, provinces in Canada, prefectures in Japan and counties in Sweden), the unconditional β-convergence hypothesis has typically been applied. In this case, controls are not used in estimation. Even though there is some variation in estimated convergence rates at the international level, the range is relatively small: between 1% and 3% per year (Barro and Sala-i-Martin, 1992).

Figure 4 (left panel) and table 6 show the results of the unconditional β-convergence for economic growth in Colombian regions. The average growth rate of each region's per capita income for 1980-2012 is shown on the vertical axis and is negatively related to the log of per capita income in 1980, shown on the horizontal axis. Clearly, there is a phenomenon whereby poor regions tend to catch up with rich ones in terms of per capita income, with the gap being closed at a yearly rate of 0.86%. When public accounts are subtracted from overall GDP to obtain a measure of private-sector GDP, the yearly rate falls to 0.66%.

[4] If initial conditions determine long-run outcomes and countries with similar initial conditions exhibit similar long-run outcomes, then it is possible to talk of convergence clubs (Durlauf, Johnson and Temple, 2005).

Convergence test for regional economic growth, 1980-2012

Unconditional β-convergence   σ-convergence
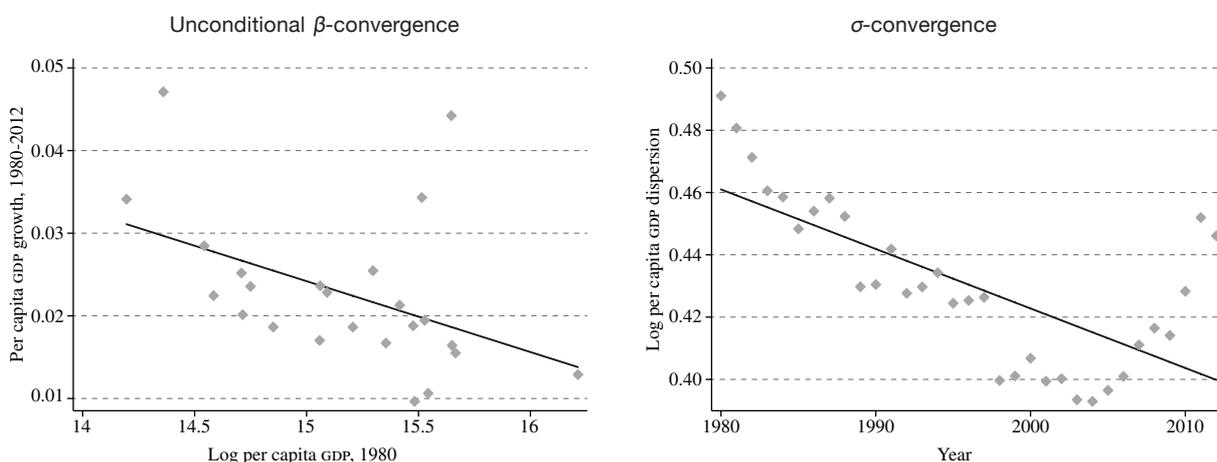
Source: Prepared by the authors.

Note: GDP: Gross domestic product.

TABLE 6

Test of unconditional β-convergence in regional economic growth

	Regional growth 1980-2012		Regional growth 1990-2012	
	Total GDP	Private-sector GDP	Total GDP	Private-sector GDP
Constant	0.15286	0.11871	0.2691	0.20688
β	-0.00857	-0.00656	-0.01611	-0.0124
p-value	0.027	0.097	0.002	0.012
R^2	0.2029	0.1204	0.2812	0.1880

Source: Prepared by the authors.

Note: GDP: Gross domestic product.

The unconditional β-convergence test was also performed for the period after the enactment of the Political Constitution of 1991, which promoted fiscal decentralization in Colombia. Table 6 clearly shows the per capita income gap between poorer and richer regions closing at a higher yearly rate of 1.61% in the more recent period (1.24% when the private sector alone is considered). These simple exercises prompt recognition of the positive contribution of subnational governments to narrowing the differences in economic growth between regions in recent times. As stated at the beginning of the paper, the main argument for decentralization is that

subnational governments have a better understanding of local needs. If local governments have made progress in satisfying unmet needs, then they are playing an important role in regional income convergence.

Lastly, we performed the σ-convergence test, according to which convergence entailed a decline in the standard deviation of the logarithm for per capita output across regions in Colombia from 1980 to 2012. Figure 4 (right panel) clearly shows the dynamic of this dispersion decreasing between 1980 and mid-2000. Curiously, though, it starts to increase again afterwards.

VI

Concluding remarks

This article has provided empirical evidence on the role of fiscal decentralization in Colombia's regional economic growth. The period analysed covers the last two decades, which is appropriate given that the Political Constitution of 1991 sought to encourage regional development. Also around this time, most Latin American countries reinforced the role of regional governments in their development strategies. Decentralization was placed at the heart of institutional reforms in the late twentieth century, especially in developing countries.

The empirical strategy involved the choice of an appropriate technique for the panel data approach which would make it possible to include a large set of factors suggested by the literature as determinants of economic growth, while successfully managing the main econometric problems. The augmented mean group (AMG) estimators proposed by Eberhardt and Bond (2009), Eberhardt and Teal (2010) and Bond and Eberhardt (2013) assisted

in this. The strategy was supplemented with other empirical tools such as the cross-sectional models for different periods, together with other controls, the tests for unconditional convergence in regional income differences and, especially, the proofs of the hypothesis of complementarity between public goods provided by different jurisdictions.

Our results confirm the positive link between fiscal decentralization and economic growth across regions in Colombia, implying that the transfer of fiscal functions to subnational governments has been conducive to economic growth. These results are robust to the four most commonly used indicators of fiscal decentralization, two of them based on expenditure and tax autonomy and two on expenditure and revenue shares. The relationship found is also consistent with recent papers on this subject, even though no evidence was found for non-linearity.

The positive effects of fiscal decentralization on regional growth were also confirmed through cross-sectional models controlling for the initial level of output and human capital. The expected signs of the parameters for the remaining factors explaining growth were confirmed, and their elasticities were shown to be reasonable. The positive result for the common, unobservable factors helping to explain both economic growth directly and factor accumulation was also striking. Among them is total factor productivity, which could be affected in turn by region-differentiated aspects such as culture, habits, climate, geography, the quality of institutions, and so on. Lastly, the hypothesis was confirmed that public goods (especially infrastructure)

supplied by different jurisdictions within Colombia have a significant indirect positive effect on growth in the other regions, although to a lesser extent than in the United States.

Lastly, we tried to assess whether per capita income differences between regions in Colombia had been declining, given the huge discrepancies observed three decades ago. Using unconditional β-convergence and σ-convergence tests, we found that the gap in per capita incomes between poorer and richer regions had been closing at a yearly rate of 1.61% for the most recent period, and that the dispersion of these income differences was declining over time. These results highlight the positive contribution of government activities.

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ANNEXES

ANNEX A1

Dataset description

TABLE A1.1

Panel data models

Variable	Description
$y_{i,t}$	Real per capita regional GDP based on DANE output and population data. $$Y_{it}/P_{it}$$ P_{it}: regional population.
$k_{i,t}$	Per capita private capital. K_{it}/P_{it}
$d_{i,t}$	Expenditure autonomy $$\frac{RE_{it} - T_{it}}{RE_{it}}$$ RE_{it}: government expenditure in region *i*. T_{it}: transfers received from central government by region *i*. **Source**: Authors' calculation based on data from DNP and Ministry of Finance and Public Credit.
$d_{i,t}$	FD-Tax autonomy $$\frac{AT_{i,t}}{TR_{i,t}}$$ $AT_{i,t}$: general government tax revenue over which subnational governments have some degree of autonomy. TR_{it}: total tax revenue of each region. **Source**: Authors' calculation based on DNP data.

Table A1.1 (concluded)

Variable	Description
$d_{i,t}$	Expenditure share $$\frac{RE_{it}}{\sum_{i=1}^{24} RE_{it} + CE_t}$$ RE_{it}: government expenditure in region i. CE_t: central government expenditure. **Source**: Authors' calculation based on DNP data.
$d_{i,t}$	FD-Revenue share $$\frac{T.REV_{it}}{\sum_{i=1}^{24} T.REV_{it} + C.REV}$$ $T.REV_{it}$: total revenue of region i. $C.REV$: total central government revenue. **Source**: Authors' calculation based on DNP data.
Other models	
$lnN_{i,t}$	Number of workers per capita $$\frac{\textit{Economically active population}}{\textit{Total population}}$$ **Source**: DANE.
$lnl_{i,t}$	Logarithm of aggregate public goods in region i $$ln\, l_{i,t} = \frac{1}{\rho} ln\left\{ \frac{1}{J} \sum_{j=1}^{J} p_t(j)^{\rho} \right\}$$ ρ: degree of global (inter-)complementarity between public services.
$p_t(j)$	Implementation of public programmes financed by jurisdiction j $$p_t(j) = m_j + d_j$$ m_j: Expenditure of municipality j. **Source**: Authors' calculation based on DNP data.
d_j	Size of population (pop) of each municipality relative to its department $$d_j = \frac{pop_j}{pop_i} l_i$$ **Source**: DANE.
$d_{i,t}$	Average fiscal decentralization indicator $$\frac{\sum_{t=1}^{22} d_{i,t}}{n}$$ **Source**: Authors' calculation.
Baseline variables	Baseline population level: 1990 population. Baseline education level: 1996 education coverage. **Source**: DANE.

Source: Prepared by the authors, on the basis of data from the National Administrative Department of Statistics (DANE), the National Planning Department (DNP) and the Ministry of Finance and Public Credit.

Unit root and cross-sectional dependence tests for variables included in the panel data models

TABLE A2.1

Levin-Lin-Chu unit root test and Pesaran cross-sectional dependence (CD) test

Variable	Levin-Lin-Chu test[a]			Pesaran CD test[b]	
	Coefficient	p-value	Lags	CD test	p-value
y_{it}	-1.07	0.00	1	21.80	0.00
k_{it}	-1.21	0.00	1	37.31	0.00
Expenditure autonomy, d_{it}	-0.02	0.00	1	52.31	0.00
Tax autonomy, d_{it}	-0.34	0.00	1	38.49	0.00
Expenditure share, d_{it}	-0.27	0.02	3	47.92	0.00
Revenue share, d_{it}	-0.25	0.00	1	38.37	0.00

Source: Prepared by the authors.

[a]   Under the null hypothesis of non-stationarity.
[b]   Under the null hypothesis of cross-sectional independence, CD ~ N(0.1).

The different versions of the variables in equation (5) do not have unit roots, and display short-range autocorrelation and the presence of cross-sectional dependence. In fact, the p-values of the Levin-Lin-Chu (2002) unit root tests (see the third column of table A2.1) are well below 0.05, leading to the rejection of the unit root hypothesis, and thus of the existence of cointegration in equation (5). Furthermore, the number of optimal lags for these tests (see the fourth column of the same table) is small, at three or less, revealing short-term autocorrelation. Finally, Pesaran (2004) cross sectional independence hypothesis p-values (see the last column of the table) are well below 0.05, indicating the presence of dependence among the regions for all versions of the variables in equation (5). These findings were also corroborated with other panel unit root tests (Im, Pesaran

and Shin, 2003) with the same results. Therefore, the different versions of equation (1) correspond to stationary panels with variable-wise cross-sectional dependence among the 24 regions in Colombia.

To explore the existence of unobservable dynamic factors as sources of growth, a principal components analysis (PCA) was performed on all the regional GDP growth series. The results in the table below reveal that the first principal component explains 35% of the correlation between regions, while the second and third components explain 12% and 9%, respectively. All these results suggest that dynamic factors might have to be brought in to explain the total variation of regional economic growth in Colombia, and this is in fact done by the AMG estimator used in this article.

TABLE A2.2

Principal components analysis of regional GDP growth

Order	Eigenvalue	Difference	Proportion	Cumulative
1	8.35	5.51	0.35	0.35
2	2.84	0.78	0.12	0.47
3	2.06	0.09	0.09	0.55
4	1.97	0.41	0.08	0.63
5	1.56	0.17	0.07	0.70
6	1.39	0.36	0.06	0.76
7	1.03	0.14	0.04	0.80
8	0.89	0.19	0.04	0.84

Source: Prepared by the authors.

Note: GDP: Gross domestic product.

In all, the time series panels containing regional per capita output growth, private capital growth and the different fiscal decentralization indicators are stationary. Furthermore, there is clear evidence of cross-regional

dependency, which may be related to spillovers and geographical correlation. Finally, there is evidence for unobserved factors driving output (f_t), which may account for at least some variations in output growth.

The effect of ICTs on academic achievement: the Conectar Igualdad programme in Argentina

María Verónica Alderete and María Marta Formichella

ABSTRACT

The objective of this paper is to determine the "premium," in terms of academic achievement, that accrues to student beneficiaries of the Conectar Igualdad programme with respect to students not participating in the programme. For this purpose, the propensity score matching (PSM) method is used. The programme is described, as is the theoretical framework used to define the explanatory factors of academic achievement, which may affect the likelihood of participation in the programme. The target population are 15-year-old students in Argentina. The study draws on data from the 2012 round of Programme for the International Student Assessment (PISA) tests. The findings indicate that there are statistically significant differences in average academic achievement associated with participation in the Conectar Igualdad programme.

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I

Introduction

In recent decades, education systems have participated in the sweeping changes brought about by the global dissemination of new information and communications technologies (ICTs). The exponential growth of information that is available anywhere to anybody and the ability to access and share this information regardless of the user's physical location have transformed the way in which people work, organize, socialize, create, participate in public forums and use their free time (Castells, 1999, in Claro and others, 2011).

Incorporating ICTs has become a very important priority in the education sector. These technologies can contribute to universal access to education, equality in instruction, quality in teaching and learning and the professional development of teachers, as well as to more efficient management and administration of education systems. Thus, they are essential to achieving more egalitarian societies (UNESCO, 2014).

The analysis of ICTs in the education sector is closely tied to the objectives of quality, equity and efficiency (Sunkel and Trucco, 2012). Integrating these technologies into schools means rethinking both the way in which these institutions are set up and the practices that derive from that configuration. Consideration must also be given to curriculum development and the work of teachers and students in the classroom (Consejo Federal de Educación, 2010).

The repercussions of ICTs can be seen in the education policy agendas of every country in Latin America (SITEAL, 2014), which have implemented various programmes for the mass rollout of these technologies. These models are not standard across the region but rather vary from one country to the next depending on the national context. In Argentina, the *Conectar Igualdad* ("Connecting Equality") programme stands out as a type of digital inclusion policy at the federal level.

The availability of country-level information on the use of ICTs in secondary schools is not exhaustive. The ICT questionnaire that was included as a supplement to the Programme for International Student Assessment (PISA) was administered only in a small group of countries in Latin America (Chile, Panama, Trinidad and Tobago and Uruguay); Argentina was not part of this group.

The objective of this paper is to identify the "premium," in terms of academic achievement, accruing to the student beneficiaries of the Conectar Igualdad programme, compared with their non-beneficiary peers. To this end, the propensity score matching (PSM) technique is used, drawing on data from the PISA test administered in Argentina in 2012. The paper is structured as follows. Section II describes the state of the art in research on the role of ICTs in education and gives an overview of ICT-implementation initiatives, especially in countries in Latin America, with special emphasis on the case of Argentina. Section III presents the analytical framework that describes the theoretical and empirical findings with respect to the effects of ICTs on academic achievement. Section IV explains the propensity score matching methodology that was applied and presents the data and variables. Lastly, Section V discusses the results and presents final considerations.

II

State of the art

ICTs spread opportunities for communication within educational institutions and beyond them, creating new learning possibilities for students, including those for whom the formal education system cannot provide coverage (Becta, 2007). Participating in the information society means not only having access to new technologies but also acquiring the skills needed to use them. Thus, ICTs are an important instrument for promoting inclusive practices (Claro, 2011).

Access to ICTs in the education sector is related to the availability of material resources in the school (Sunkel and Trucco, 2012). Computers enable time and cost savings, faster results, distance learning, assessment of student achievement based on exam scores and

monitoring of classroom progress, among other benefits (Witte and Rogge, 2014; Terzis and Economides, 2011; Parshall and other, 2002).

ICTs can be used to bring training and learning opportunities within reach of a large number of people at a low marginal cost. The savings in travel time and the economies of scale that are achieved lower the cost of learning and lead to cost efficiency (Maguire and Zhang, 2007).

The new ICTs give teachers and students faster and better access to information, reducing the degree of obsolescence of information and making more efficient use of the various information sources available online (Lara and Duart, 2005).

It should be noted that effective use of ICTs in teaching and learning is largely determined by the attitude of school administrators and teachers, who can guarantee that access is accompanied by appropriate use of the resources. However, there is more interest —both in Argentina and in other countries— in using computers for educational purposes, or computer-aided instruction (CAI), than in computer skills training (CST) (Angrist and Lavy, 2002).

In Latin America, the Economic Commission for Latin America and the Caribbean (ECLAC) is working together with the European Union to implement the project "Alliance for the Information Society 2 – Inclusive Policy Dialogue and Exchange of Experiences (@LIS2)." This project is based on the understanding that ICTs are not an end in themselves but rather a means to achieve development objectives and, in the education sector, to achieve educational objectives.

The Plan of Action for the Information Society in Latin America and the Caribbean (eLAC 2010), which establishes a set of strategies to promote the use of ICTs for development, has identified education as a priority for equitable development in the information society (Sunkel and Trucco, 2010).

The World Bank has developed strategies to help the countries of Latin America take advantage of the opportunities created by ICTs in education, providing equipment and facilities, teacher training, distance learning, digital literacy and assessment, among other benefits. Likewise, the Inter-American Development Bank (IDB) is advancing initiatives that incorporate these technologies into education to improve the quality of student achievement (Claro, 2011).

Thus far, the main focus of the efforts made by school systems in Latin America has been to install adequate technology infrastructure in schools on an equitable basis and ensure that students and teachers acquire basic literacy in their use (Sunkel, Trucco and Möller, 2011).

Claro and others (2011) show that the region's school systems have succeeded in partially offsetting inequalities in access to ICTs in the home by expanding coverage at school. Nevertheless, the likelihood that a student will have frequent access to ICTs remains higher in the home than at school, owing to a low ratio of computers to students and lack of Internet connection. In both settings, one of the most frequent uses of ICTs is for schoolwork.

Argentina has lost some of its edge in recent years and is now ranked third in terms of computer access, with Uruguay and Chile in the lead. In terms of Internet access, Brazil, Uruguay and Chile are top-ranked, and Argentina is in fourth position (see figure 1).

According to data provided by PISA for 2009, the gap between Latin America and the OECD in the percentage of 15-year-old students with access to a computer is very similar in magnitude to the gap in access to the Internet (around two-fold) and has remained unchanged over time. Much of the region's youth do not have access to technology at home. However, there has been progress in terms of the number of students per computer and the percentage of computers with Internet access in schools (Claro and others, 2011).

A number of programmes for the mass rollout of ICTs have been implemented, under various models, in Latin American countries. Table 1 lists the programmes that have been implemented in some of the region's countries.

In Argentina, the National Education Law (No. 26,206) incorporates the topic of ICTs under the provisions on national education policy, promotion of educational equality and quality of education. The political importance of a school that supports the integration of ICTs is stated explicitly in Articles 7 and 8 of the law, which establish that "the State guarantees access for all citizens to information and knowledge as a central instrument of participation in a process of economic growth and social justice" and "education shall provide the necessary opportunities to develop and strengthen the full education of individuals throughout their lives and promote in each student the capacity to set the course of his/her own life, based on the values of liberty, peace, solidarity, equality, respect for diversity, justice, accountability and the common good." In recent years, ICT initiatives in Argentine schools have clearly been on the rise.[1]

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[1] Initiatives have been underway in Argentina since the 1990s to install computers and other devices, establish connectivity, provide teacher training and prepare digital resources, with varying scope and success. Although these initiatives have played an important role in familiarizing the educational community with ICTs, they have represented only modest progress and yielded unsatisfactory results in terms of coverage, training and educational resources (UNICEF, 2013a)

FIGURE 1

Latin America and the Caribbean (seven countries): percentage of 15-year-old students with computer and Internet access in the home, 2000-2009

A. With computer access

B. With Internet access

Argentina   Brazil   Chile   Colombia   Mexico   Peru   Uruguay
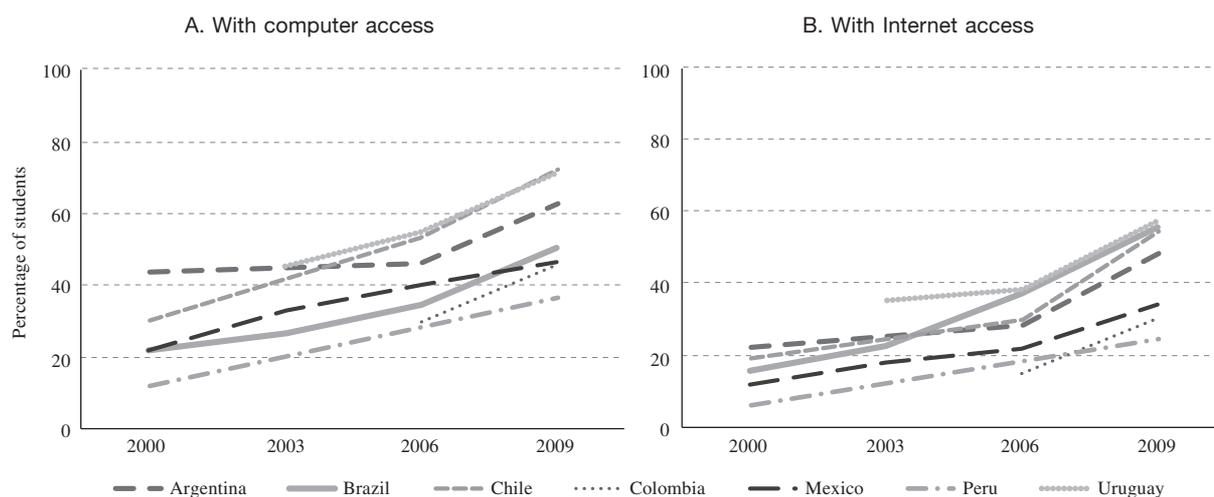
Source: M. Claro and others, "Aporte del sistema educativo a la reducción de las brechas digitales. Una mirada desde las mediciones PISA," *Project Document* (LC/W.456), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2011.

TABLE 1

ICT and Education Programmes in Latin America

Country	Programme name	Participating agency	Scope
Argentina	Conectar Igualdad	Ministry of Education	Secondary education; teacher training
Brazil	EDUCOM programme National Educational Technology Programme (PROINFO) UCA programme	Ministry of Education (MEC)	Basic education (early childhood, primary and secondary education)
Chile	ICTs in the Classroom Enlaces programme Technologies Plan for Quality Education (Plan TEC)	Ministry of Education (MINEDUC)	Basic education
Colombia	"Computadores para educar" Conexión Total programme with the "Red Educativa Nacional" project Programme for use of new technologies for skills development	Ministry of National Education (MEN)	Pre-school, primary, secondary and post-secondary
Peru	Huascarán project One Laptop per Child	Ministry of Education (MINEDU) Directorate General of Educational Technologies (DIGETE)	First stage: primary education Second stage: all levels and teachers

Source: Prepared by the authors, on the basis of the United Nations Children's Fund (UNICEF), *Las políticas TIC en los sistemas educativos de América Latina. Caso Brasil. Programa TIC y Educación Básica*, Buenos Aires, 2014; *Las políticas TIC en los sistemas educativos de América Latina. Caso Colombia. Programa TIC y Educación Básica*, Buenos Aires, 2014; *Las políticas TIC en los sistemas educativos de América Latina: Caso Argentino*, Buenos Aires, 2013; *Las políticas TIC en los sistemas educativos de América Latina. Caso Chile. Programa TIC y Educación Básica*, Buenos Aires, 2013; *Las políticas TIC en los sistemas educativos de América Latina. Caso Perú. Programa TIC y Educación Básica*, Buenos Aires, 2013.

The Conectar Igualdad programme was created in April 2010 by Decree 459/10 for the purpose of reducing digital, educational and social gaps in Argentina. Conceived as a federal policy initiative for digital inclusion, it is run by the National Social Security Administration (ANSES), the Ministry of Federal Planning, Public Investment and Services and the Chief of the Cabinet of Ministers.

Conectar Igualdad is designed to guarantee ICT access and use through the distribution of laptop computers to all students and teachers at secondary schools, special education schools and government-run teacher training institutions. A general objective of the programme is to guarantee a basic level of technological infrastructure, enabling widespread connectivity, the installation of networks and classroom use of computers by students at a 1:1 ratio. This objective is the responsibility of the Ministry of Federal Planning, Public Investment and Services.

To fulfill these objectives, a plan was put in place to gradually distribute netbooks, and as of November 2014 more than 4.5 million had been delivered (ANSES, 2014). Lastly, it should be noted that the programme calls for students and teachers to use the netbooks both at school and at home.

In order to understand the endogenous capacity for technology innovation in Argentina, as well as in adjacent countries, an analysis is needed of the dynamics of the various social actors involved in the projects: the various levels of government, educational institutions, school administrators and teachers, families, ICT firms and the general public. Depending on context and era, tensions may exist between these actors and what motivates them (UNICEF, 2013a). The Conectar Igualdad programme, as State policy, serves to guide and set the agenda of the various institutions and public and private actors. At the same time, the programme encompasses the Argentina Conectada National Plan, which coordinates the various public policies on ICTs that are being executed by the executive branch.

One aspect that illustrates the complexity of the Conectar Igualdad programme is that it has multiple objectives though with the unambiguous aim of supporting processes to improve educational quality in Argentina (UNICEF, 2013a). To enable the programme to meet its objectives to guarantee quality education and incorporate ICTs in teaching and learning processes, the netbooks come equipped with myriad educational resources, most designed through the Educ.ar portal, as well as software that runs on both Windows and Linux operating systems.

III

ICTs and academic achievement

International research shows that to improve student achievement, it is not enough for schools to provide access to ICTs; they must also provide real opportunities to use the technologies as well as adequate quality of access (Selwyn, 2004). Opportunities to use ICTs mean giving students a real chance to interact with the technology, which depends on multiple factors, including the number of Internet-enabled computers that are available to them. Quality of access has to do with the extent to which the available technology is easy to use and how fast and smoothly it operates. This is measured by indicators such as real Internet connection speeds and the ease of startup operations, data exchange and backups of personal data. Ensuring equity in the availability of ICTs is a basic condition for reducing the gap in access, which is the first digital divide (Claro and others, 2011).

Student use of ICTs not only depends on the available opportunities, but also on the type of activity

that the new technologies are supporting in the school environment. Learning models that develop cognitive skills and allow for educationally relevant uses should be created and implemented. This leads to the second digital divide, which has to do not with differences in access but rather with differences in uses of ICTs and the ability to benefit from them (Hargittai, 2002; Robinson, DiMaggio and Hargittai, 2003).

ICTs have been introduced in schools to transform teaching and learning processes and improve strategies for academic achievement (Kozma, 2003 and 2008; Sunkel, 2006; Carneiro, Toscano and Díaz, 2009; Rodríguez, Nussbaum and Dombrovskaia, 2013). Accordingly, a number of studies have looked at the effect of these technologies on school performance (Machin, McNally and Silva, 2006; Aristizabal, Caicedo and Escandón, 2009; Spiezia, 2010; Carrillo, Onofa and Ponce, 2010; Cristia and others, 2012). The literature also includes studies

that have focused on other determinants of educational outcomes but used ICT-related variables as controls.

Research on the determinants of educational outcomes began in the 1960s with the Coleman report (Coleman and others, 1966). Since then, a multitude of studies have looked at personal, family and school factors that affect academic achievement (see Formichella, 2011, or Formichella and Krüger, 2013, for an in-depth review).

Aristizabal, Caicedo and Escandón (2009) analysed the factors that influence school achievement, as measured by the 2006 and 2009 PISA tests, in Colombia. They proposed a structural equation model that allowed them to examine reciprocal and simultaneous dynamics between variables. According to their findings, both ICTs in the home (use of the Internet and related tools, and other devices such as game consoles) and ICTs at school (computers and educational software) have a positive effect on student performance, with the latter making the larger contribution.

However, Spiezia (2010), who analysed the impact of ICTs on average educational outcomes based on the 2006 PISA for all participating countries, highlighted the role of student use of technologies in the home. The author asserted that there was a significant effect on school performance, and in most countries this effect was greater in the case of home use of computers, as opposed to school use. Spiezia thus called into question policies aimed at incorporating the use of computers as a learning tool in the school environment.

Likewise, Machin, McNally and Silva (2006) focused on the case of England, analysing the causal impact of spending to finance ICTs on the educational outcomes of students in various districts. The authors found evidence to support an effect on outcomes in English and science at the primary level, but did not find a similar effect in the case of mathematics.

Meanwhile, Carrillo, Onofa and Ponce (2010) studied the effect of the incorporation of ICTs into the school environment on educational outcomes. Drawing on data for the city of Guayaquil, in Ecuador, the authors analysed a computer-based programme to support mathematics and language teaching at the primary level. They ran an experimental design and concluded that ICTs had a positive impact on mathematics outcomes but no statistically significant impact on language outcomes.

Cristia and others (2012) studied the impact of the "One Laptop per Child" programme in primary schools in the Peruvian countryside and found no evidence of effects on enrolment, dropout or repeat rates. Neither did they find effects on cognitive outcomes in language

or mathematics. However, they did identify a positive effect on students' general skills.

In short, the findings of the research cited above are that ICTs have some type of positive effect on student competencies. However, there are some studies that have come to the opposite conclusion. For example, Angrist and Lavy (2002) found that the use of information technology in teaching and learning processes had no relevant effect on academic achievement. The authors arrived at this conclusion after conducting an in-depth analysis of the case of Israel, where a policy-based programme was implemented to increase the availability of computers in a large number of schools in order to improve scholastic outcomes.

Meanwhile, Goolsbee and Guryan (2006) researched the effects of a subsidy programme for Internet use in schools in the state of California, in the United States (known as the E-Rate Program). Drawing on a large set of variables to measure scholastic outcomes, the authors demonstrated that the programme had succeeded in expanding Internet access in the classroom, but found no evidence that this expansion had any effect on academic achievement.

More recent studies have also failed to establish a definitive link between ICTs and academic achievement. Sprietsma (2012) estimated the effect of the availability and use of computers and the Internet as pedagogical tools on the math and reading scores of eighth-grade students in Brazil and found that ICTs, paradoxically, had a negative effect on academic achievement. Witte and Rogge (2014) analysed the effect of ICTs on the academic performance of students in Holland, drawing on data from the 2011 "Trends in International Mathematics and Science Study" (TIMSS). Applying a score matching methodology, the authors found no statistically significant difference between the outcomes obtained by students who had access to technology and made use of it and those who did not.

However, Sprietsma (2012) noted that these unfavourable results could be explained by looking at the way in which students use the technology, which may represent a distraction more than a tool that facilitates learning. Other authors, too, have raised questions about the use of ICTs and described the prerequisites that should be met to ensure that their incorporation into the school environment has positive effects on student academic performance. For example, Barrera-Osorio and Linden (2009) studied the impact of the "Computers for Education" programme in Colombia and analysed the effect of computer use in the school by running an experimental design, with some schools participating in

the programme and others that were not (control group). The authors found that the incorporation of computers had no effect on learning outcomes, owing to poor use of the technology. This problem, they determined, was related to the fact that even though the programme provided technical assistance and training to teachers, they failed to apply the new techniques in the classroom.

Similarly, the main conclusion of Severín and others (2011), in their analysis of the impact of the "One Laptop per Child" programme in Peru, was that technology is a necessary but insufficient condition for improving educational outcomes. They point to the critical importance of strengthening technological tools with complementary instruments, as well as strengthening the way in which technology is used.

Lastly, the studies conducted by Córdoba Gómez and Herrera Mejía (2013) and by Muñoz and Ortega (2014) are worthy of mention. The former explored the link between ICTs and student performance in mathematics and represents a valuable contribution to the discussion on the effect of use of technologies on educational outcomes. The study looked at student data from two schools in Colombia, in the municipios of Medellín and Duitama. The authors concluded that the incorporation of these technologies in the classroom leads to improvements in academic performance only if teachers receive support from specialists to help them change their teaching practices.

Meanwhile, Muñoz and Ortega (2014) analysed the impact of two plans that were implemented in

Chile for the purpose of incorporating the use of ICTs into instruction. The authors studied the determinants of academic achievement as measured by national standardized achievement tests, using the PSM methodology. In general, Muñoz and Ortega concluded that the plans did not have a significant effect on test scores, although they did observe an impact on the language scores in some specific groups of students. They concluded that a necessary goal is to optimize the incorporation of ICTs in the classroom, while taking into account other variables that also affect academic achievement.

In Argentina, there do not appear to be any studies on determinants of academic achievement that have focused on ICTs as a variable. There are, however, studies that have used the variable as a control and found it to have a statistically significant effect. For example, Santos (2007) found that the variable "computers per student" had a positive effect on academic achievement. Decándido (2011) determined that students performed better if they used the Internet to do their work. Formichella and Krüger (2013), Krüger (2013) and Formichella and Ibáñez (2014) identified a positive correlation between the percentage of computers connected to the Internet at a school (Internet access) and academic achievement. Lastly, Formichella and Ibáñez (2014) used an index to represent the ICT-related resources that a student has in the home (including whether he or she has access to educational software, an Internet connection and a computer) and found a positive relationship between that index and academic achievement.

IV

Methodology

There may be an endogeneity problem with the premise of a relationship between participation in Conectar Igualdad and academic achievement. In other words, the schools that participate in the programme may be different from the schools that do not participate in the programme, and that difference may correlate with academic achievement. Ideally, the potential impact of the Conectar Igualdad programme on the academic achievement of middle-school students would be studied by running an experiment in which participation in the programme was isolated from certain characteristics specific to the schools. However, performing this type of experiment is not feasible.

Therefore, a quasi-experimental design suffices when there is no way to control how an individual is assigned to participate in a group (the group of beneficiaries of the Conectar Igualdad programme, in this case) or any of the other factors under analysis.

Because computers are being delivered on a gradual basis under the programme, in 2012 some schools had received them and some had not. With this in mind, the objective of this paper is to determine what would have happened, in terms of academic achievement, to students in schools benefitted by the programme if the schools had not participated. To do this, improvements in the academic performance of students at schools

participating in the Conectar Igualdad programme must be measured, with performance prior to the intervention as the baseline, and where an improvement in academic performance is the difference between the outcomes obtained by students covered by Conectar Igualdad and the outcomes obtained by students not covered by the programme. A well-known methodology for conducting this type of analysis that is used extensively in impact evaluations is the propensity score matching (PSM) technique of Rosembaum and Rubin (1983), in which a match is artificially constructed for each one of the individuals studied who have identical characteristics but one difference: participation or non-participation in the Conectar Igualdad programme.

PSM can be summarized as follows: (i) the probability that a student will receive treatment (participate in the Conectar Igualdad programme) is estimated and expressed as the student's score; (ii) the sample is divided into two groups —the treatment group (those who receive treatment) and the control group (those who do not receive treatment)— and the two sample groups are arranged in descending order, and (iii) for each individual in the treatment group, an individual with a similar score (probability or propensity) in the control group is identified and pairs are formed (note that one individual in the control group can be matched with more than one individual in the treatment group).

The next step is to calculate the difference in the levels of academic achievement in each pair and the average difference for the sample as a whole. This result is known as the average treatment effect (ATE). Based on the standard error of difference between each pair, a t-test can be run to contrast the null hypothesis of null ATE. If the hypothesis is rejected, it proves that the ATE is statistically different from zero; otherwise, it is not.

In analytical terms, the average effect of a binary treatment on a continuous scale outcome is estimated. For student i, $i = 1, \ldots, N$, with all units interchangeable, $(Y_i(0), Y_i(1))$ is defined as the two potential outcomes, such that $Y_i(0)$ is the academic achievement of student i when the student does not participate in the Conectar Igualdad programme and $Y_i(1)$ is the academic achievement of student i when the student is exposed to treatment.

Academic achievement can be measured based on the results obtained by students on any standardized learning test.

If academic achievement when the student participates in the Conectar Igualdad programme, $Y_i(1)$, and when the student does not participate, $Y_i(0)$, could be observed, the effect of participation in the programme (treatment) on student i would be the difference between $Y_i(1)$ and $Y_i(0)$. The problem arises because only one of these outcomes can be observed.

$$Y_i = Y_i\left(W_i\right) = \begin{cases} Y_i\left(0\right) & if \ \ D_i = 0 \\ Y_i\left(1\right) & if \ \ D_i = 1 \end{cases}$$

where D_i indicates participation or non-participation in the Conectar Igualdad programme. According to the models used by Roy (1957), Quandt (1972) and Rubin (1978), it is assumed that the academic achievement of students would be:

$$Y_1 = \mu_1\left(X\right) + U_1$$

$$Y_0 = \mu_0\left(X\right) + U_0$$

The gain in terms of academic achievement is expressed as $\Delta = Y_1 - Y_0$. If Y_1 and Y_0 were observable for each student, evaluating the impact of treatment (participation in the Conectar Igualdad programme) would not be a problem. However, it is not often the case that both variables can be observed at the same time for the same student. To resolve this problem, policies are evaluated using different versions of averages of variations on the target population. One method is the average treatment effect (ATE) on the cases receiving treatment.

A comparison of the averages of academic results by participation or non-participation in the programme reveals something about potential achievement, while not necessarily explaining the phenomenon. A comparison of average academic performance, considering the condition "programme participation," is formally related to the average causal effect expressed by the following equation:

$$\underbrace{E\left(Y_i\,|\,D_i = 1\right) - E\left(Y_i\,|\,D_i = 0\right)}_{} = \underbrace{\left[E\left(Y_{1i}\,|\,D_i = 1\right) - E\left(Y_{0i}\,|\,D_i = 1\right)\right]}_{} + \underbrace{\left[E\left(Y_{0i}\,|\,D_i = 1\right) - E\left(Y_{0i}\,|\,D_i = 0\right)\right]}_{}$$

| Difference observed in average academic achievement | ATT: average treatment effect of programme participation on the treated | Selection bias |

In terms of the treatment effect on the treated, there is a problem in that the data do not usually include observations of academic achievement Y_0 for students participating in the programme (D = 1). The problem of selection bias (Heckman, 1990) is a result of this lack of information. The matching method resolves the selection bias problem by replacing randomization with the conditionalizationof regressors. Selection bias is eliminated only if treatment has been purely random among students with the same propensity score.

The PSM process serves to reduce selection bias, making it possible to estimate treatment effects with observable data. To this end, an estimate is made from a logit or probit model, where the function of maximum likelihood is more important than the significance of the estimators (Heckman, Lalonde y Smith, 1999).

There are various methods for estimating the impact on the treatment effect based on PSM, which differ basically depending on the way in which the distance between the treatment and control is defined. These methods include the following:

(i) Nearest neighbor matching, an estimator that matches students in the treatment and control groups, taking a treated unit for every control unit based on the closest propensity score. A control-group student j is selected as a match for student i, so that formally the control group for student i, C^o (pi) with PSM pi, is a single student j that meets this condition: $C(i) = \min j \| P_i - P_j \|$. The control student j selected from the control group is the student that minimizes the difference between his/her propensity score and the propensity score of the student in the treatment group. For this estimator, one student from the control group (those not participating in the Conectar Igualdad programme) is used for comparisons with each student in the treatment group. In this case, the average treatment effect on the treated (ATT) is called ATTND (N for nearest neighbor).

(ii) Kernel estimator, a method in which treated students (i.e. students who received netbooks) are matched with a weighted average of all students in the control group, using weights that are inversely proportional to the distance between the propensity score of the treated students and the propensity score of the control students. In this case, the ATT is known as ATTK (K for Kernel).

(iii) Stratification, a method for matching between cases and controls based on a variable that contains the block number (strata) to which the common support region pertains. The common support region involves giving consideration in the estimate of the

average effect of treatment on the treated (ATT) to the students that fall within the range bounded by minimum and maximum propensity scores of the students in the treatment group. This ensures that the defined region has values with positive density for students in both the treatment and control groups (Smith and Todd, 2005). In this case, the ATT is known as ATTS (s for stratification matching).

1. Data

This study draws on data from the PISA tests, which have been administered by the OECD every three years since 2000 in order to assess the competencies of 15-year-old students in various countries. The PISA tests cover mathematics, science and language, with one of these subjects chosen as an area of focus on a rotating basis for each round of testing. As part of the PISA test, information is also gathered on the social context of the students and schools that they attend (OECD, 2009).

Argentina participated in the 2000, 2006, 2009 and 2012 rounds of PISA testing. This paper draws on the 2012 data set, which is the most recent and contains information subsequent to the implementation of the Conectar Igualdad programme, the focal point of this study.[2]

Scoring on PISA tests is designed for a mean of 500 and a standard deviation of 100. The results of the assessments are presented using plausible values, which are a representation of a student's competencies. Given that the objective of the PISA tests is to evaluate the skills of an entire population group, as opposed to the individuals within it, each student answers a certain number of items, from which an extrapolation is made as to how he or she would have answered the rest of the items. The PISA team prepares five plausible values for each area based on the information obtained (OECD, 2009).

As a result, the correct method for consistently estimating any statistical value and thus any parameter of a model consists in calculating each one of the five values separately and then obtaining the average (OECD, 2009). This is the procedure that has been followed for this study.

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[2] It should be noted that there is no way to ascertain the academic achievement of individual students over time, because the PISA tests are only administered to 15-year-old students, which means that a new set of students is assessed during each round, yielding transversal information only. Moreover, use of the matching methodology is justified by the fact that there is no way to track the academic achievement of an individual student in both scenarios (with the Conectar Igualdad programme and without it) over the same period of time. Matching provides a way to artifically compare achievement in both scenarios.

2. Variables

The main variable of interest for this study is a binary variable known as Conectar that assigns a value of 1 if the student attends a school covered by the Conectar Igualdad programme and a value of 0 otherwise. In other words, it assigns treatment to students at schools that participated in the programme in 2012. For this purpose, the school identifier was SCHOOLID and the student identifier was STIDSTD.

Inasmuch as Argentina has not participated in the PISA special module on ICTs, the database does not provide any information on which schools are participating in the Conectar Igualdad programme and which are not. Therefore, the Conectar variable is constructed by inference in this study.

As mentioned, the programme has been implemented only in public schools, so a value of 0 is assigned for the variable in all cases in which a student attends a private school. In the case of public schools, other variables are used to determine whether the school was or was not covered by the programme.

The following two questions on the questionnaire completed by school administrators were considered:
(i) Number of students in the 15-year-old age group (SC11Q01).
(ii) Number of computers available for educational purposes for 15-year-old students (SC11Q02).

Based on these variables, the total number of students was divided by the number of available computers to calculate the number of computers per student. Public schools in which at least 95% of 15-year-old students had a computer were assumed to participate in the Conectar Igualdad programme.[3]

The foregoing assumption makes more sense upon observing the same information for 2009, prior to implementation of the programme. At that time, the aforementioned condition was met only in the case of 1.5% of the students attending public schools. Meanwhile, in 2012, two years after programme startup, the percentage had risen to 19.9%, an improvement of 18 percentage points, or a 12% increase.[4]

As described in section II of this paper, the Conectar Igualdad programme calls for the use of netbooks not only at school but also in the home, such that students can take them home to do their homework. The PISA survey contains information on the availability of computers in the home. Participants in the Conectar Igualdad programme include students attending schools that issue computers to at least 95% of the student body and students with a computer in the home (provided that programme conditions are met).

The variables considered for calculating the likelihood of programme participation are as follows:
- Repeater: a dichotomous variable that takes a value of 1 if the student has repeated a grade in primary or secondary school.
- Secondary studies: a dichotomous variable that takes a value of 1 if the highest educational level achieved by the parents is a secondary-level diploma or preparatory cycles (middle or upper grade).
- Tertiary studies: a dichotomous variable that takes a value of 1 if the highest educational level achieved by the parents is a university degree.
- Auto2: a dichotomous variable that takes a value of 1 if the student's family has two or more automobiles.
- Unemployed: a dichotomous variable that takes a value of 1 if the student's mother or father does not have a job.
- Urban: a dichotomous variable that takes a value of 1 if the school is located in an area with a population of 15,000 people or more, and 0 otherwise.
- ESCS average: a continuous variable that reflects the social composition of the student. It is calculated as the average of the economic, social and cultural status index (ESCS)[5] of the school. The PISA team at the OECD prepares an ESCS indicator for each student that summarizes the information on parental occupational status, parental educational level and household cultural and material possessions (OECD, 2009).

The ESCS is calculated using other indexes also presented by the PISA team: the index of highest occupational status of parents (HISEI), the number of years of schooling of parents (PARED) and the index of home

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[3] Although the programme called for every student to have access to a computer to study at school (which would mean considering only those schools with a computer-student ratio equal to 100% or greater), a decision was made to relax this condition (95%) on the recommendation of key informants who pointed out some operational issues that produced a situation in which a small fraction of students attending schools covered by the programme would not have a computer.

[4] The assumption also makes more sense considering the situation in private schools, where the condition was met in the case of 9% of

students in 2009 and 22% in 2012, an improvement of 13 percentage points, or just 1.4%. In short, the overall increase in the percentage of students for whom the condition was met (from 4.5% to 15.9%) can be attributed, above all, to the change that occurred in the public schools with the Conectar Igualdad programme.

[5] This index and the others described in this section have been constructed by the PISA team such that a positive value signifies that the household level is above the average of the OECD countries and a negative value signifies that the household level is below the average.

possessions (HOMEPOS). The information summarized in each index is described below:

HISEI: this index represents the occupational status of the students' parents, and the value corresponds to the higher value between the mother and father.

PARED: this index represents the educational level of the parents, measured as the number of years of schooling, and the value corresponds to the highest level achieved by the mother or father.

HOMEPOS: this index summarizes information on the number of books in the home and the wealth (WEALTH), home educational resources (HEDRES) and cultural possessions (CULTPOS) indexes.

WEALTH represents the quantity of material possessions, HEDRES the quantity of education resources; and CULTPOS the quantity of cultural possessions in the student's home.

- Internet_home: a dichotomous variable that takes a value of 1 if the student has Internet service at home.
- COMPWEB: a continuous variable that is defined as the proportion of Internet-enabled computers for educational purposes at the school.

3. Descriptive analysis

The 2012 PISA sample for Argentina consists of 5,908 observations, of which 15.9% correspond to students attending schools covered by the Conectar Igualdad programme. However, the decision was made to exclude from the analysis those students who have a computer at home but do not participate in the programme. This decision was made in response to the fact that in order to accurately assess the effect of treatment on the treated, academic achievement in the control group must be independent of the assignment of treatment. The availability of computers in the home could affect the academic achievement among the control group.

Working with subsamples has been observed in other studies (Dehejia and Wahba, 2002; Johar, 2009). The latter evaluates the effectiveness of a national health programme in Indonesia, for which it selected only adults (older than 15 years) from the sample inasmuch as children's health would be very difficult to interpret. As children become adults, the frequency of regular checkups naturally declines. Johar (2009) also runs PSM for subgroups (heads of household, children and others) so that the groups have more characteristics in common.

Based on the PISA data, 1,922 students were selected, 938 of whom participated in the Conectar Igualdad programme (see figure 2).

As illustrated in table 2, the average achievement scores are greater in the programme beneficiary group for the three competencies evaluated by PISA.

However, the problem with running a simple comparison of averages of student academic performance with and without the Conectar Igualdad programme is that the programme assignment process has not been random. As a result, differences in academic performance may be the result of characteristics specific to the students (individual, scholastic, sociodemographic and other characteristics) that induce certain individuals to participate in the Conectar Igualdad programme while others do not. Table 3 shows the main characteristics of both groups of students, i.e. with Conectar Igualdad and without Conectar Igualdad, prior to matching. The data are from the PISA 2012 test.

The observation can be made that among the students in schools participating in the Conectar Igualdad programme, there are fewer students who repeat grades, a larger proportion of parents with tertiary education, a smaller proportion of unemployed parents, a larger proportion of homes with Internet access, a larger proportion of Internet-enabled computers at the school and a larger proportion of schools with a high socioeconomic level. These average differences between the two groups are statistically significant according to the analysis of variance (ANOVA). The average difference between the two groups with respect to the proportion of parents with secondary schooling is the only difference that is not statistically significant.

FIGURE 2

Students participating in the Conectar Igualdad programme

49% 51%

■ Not covered ■ Covered
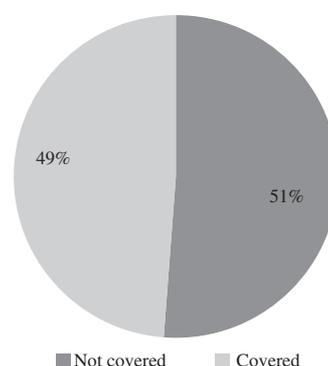
Source: Prepared by the authors, on the basis of data from PISA 2012 test.

TABLE 2

Differences in averages of academic achievement

Competencies	With Conectar Igualdad	Without Conectar Igualdad	Difference in averages
Mathematics	397.033576	351.374268	45.6593081*
Reading	402.013162	347.956902	54.056261*
Science	409.325116	361.588903	47.736213*

Source: Prepared by the authors.

Note: * statistically significant at 1%.

TABLE 3

Descriptive statistics

Variable	Group (with or without Conectar)	Observations	Average	Standard deviation	Minimum	Maximum	ANOVA
Repeater	With	750	0.21466	0.41085	0	1	***
	Without	654	0.39908	0.49005	0	1	
Secondary studies	With	906	0.20529	0.40412	0	1	Ns
	Without	914	0.22100	0.41512	0	1	
Tertiary studies	With	906	0.53200	0.49925	0	1	***
	Without	914	0.30087	0.45889	0	1	
Auto2	With	891	0.18967	0.39224	0	1	***
	Without	877	0.08208	0.27461	0	1	
Unemployed	With	800	0.14875	0.35605	0	1	***
	Without	726	0.27415	0.44637	0	1	
Urban	With	938	0.59483	0.49117	0	1	***
	Without	957	0.61651	0.48649	0	1	
Average socioeconomic level	With	938	-0.55933	0.71468	-1.8635	1.075	***
	Without	984	-1.09734	0.63107	-2.695	1.075	
Internet_home	With	884	0.85857	0.34864	0	1	***
	Without	845	0.19526	0.39664	0	1	
COMPWEB	With	851	0.90307	0.25583	0	1	***
	Without	885	0.93442	0.21881	0	1	

Source: Prepared by the authors.

Note: Auto2: Dichotomous variable that takes a value of 1 if the student's family has two or more automobiles; ANOVA: Analysis of variance; COMPWEB: A continuous variable that is defined as the proportion of Internet-enabled computers for educational purposes at the school; Ns = Not significant.

V

Results

First, the PSM is estimated using a probit model that includes the explanatory variables for participation in the Conectar Igualdad programme. For the estimate of likelihood, only those variables that simultaneously affect the decision to participate and the outcome variable should be included (Bernal and Peña, 2011).

The dependent variable is:

Conectar Igualdad: this is a binary variable that takes the value of 1 if the student attends a school that is already covered by the programme, and 0 otherwise. It is assumed that if the school is covered by the programme, all students have a computer that has been issued to them under the programme.

The probit model used by the programme, STATA 12, comes from a latent or non-observable variable in the model, y*, which indicates the likelihood that a student will participate in the programme. This variable is explained by a series of observable independent variables in the following structural equation:

$$y^* = \beta 0 + x\beta + e \, . \, y = 1 \left[y^* > 0 \right]$$

The relationship between the binary observable variable (if the school has been benefitted by the programme) and the latent variable y* (likelihood to participate in the programme) is represented by the following equation:

$$y = 1 \quad if \ y^* > 0$$
$$y = 0 \quad if \ y^* \leq 0$$

Studies on implementation of the Conectar Igualdad programme, as well as assessments of academic achievement, provide information on the factors that influence programme participation.

1. Treatment effect: participation in the Conectar Igualdad programme

The objective is to identify the average effect of programme participation on the academic achievement of 15-year-old students in Argentina.

The PSM is valid if the observed variables are understood to determine participation (in the Conectar programme), i.e., if there is no bias due to non-observable variables or if the non-observable or unavailable variables are not a fundamental determinant of either participation in the programme or of the potential outcome variables, such as academic achievement (Bernal and Peña, 2011).

Estimating the propensity score using STATA 12 produces the results presented in table 4. The model is a good fit. Overall, the model is significant in accordance with the likelihood ratio statistic (prob>chi2=0.0000) and Pseudo R^2.

Subsequently, the matching technique is used to define a region of common support. The selected region has been [0.05431384, 0.9742593]. Figure 3 shows the Kernel density of the estimated propensity score, in which the region of common support can be seen.

Figure 3 shows two density functions, one for the treatment group (grey line) and another for the control group (black line). This function suggests that the average likelihood of programme participation for the treatment group is higher than the average for the control group.

TABLE 4

Determinants of participation in the Conectar Igualdad programme

Variables	Coefficient	Standard error	Level of significance
Repeater	-0.2720347	0.1163132	**
Secondary studies	-0.1118963	0.139605	Ns
Tertiary studies	0.1032862	0.1257226	Ns
Auto2	0.1476435	0.1469592	Ns
Unemployed	-0.2393344	0.1326774	*
Urban	-0.1304947	0.1059158	Ns
Average socioeconomic level	0.1754671	0.0850824	**
Internet_home	1.774768	0.1109653	***
COMPWEB	-0.4561941	0.2155834	**
_Constant	-0.0674548	0.2647191	Ns
No. of observations	951		
LR chi2 (9)	495.93		
Prob>chi2	0.0000		
Pseudo R^2	0.3844		

Source: Prepared by the authors.

Note: ***, ** significant to 1% and 5% respectively; Ns = Not significant.
COMPWEB: A continuous variable that is defined as the proportion of Internet-enabled computers for educational purposes at the school; Auto2: Dichotomous variable that takes a value of 1 if the student's family has two or more automobiles.

FIGURE 3

Kernel density

Type of Kernel function: Epanechnikov, bandwidth: 0.0316.
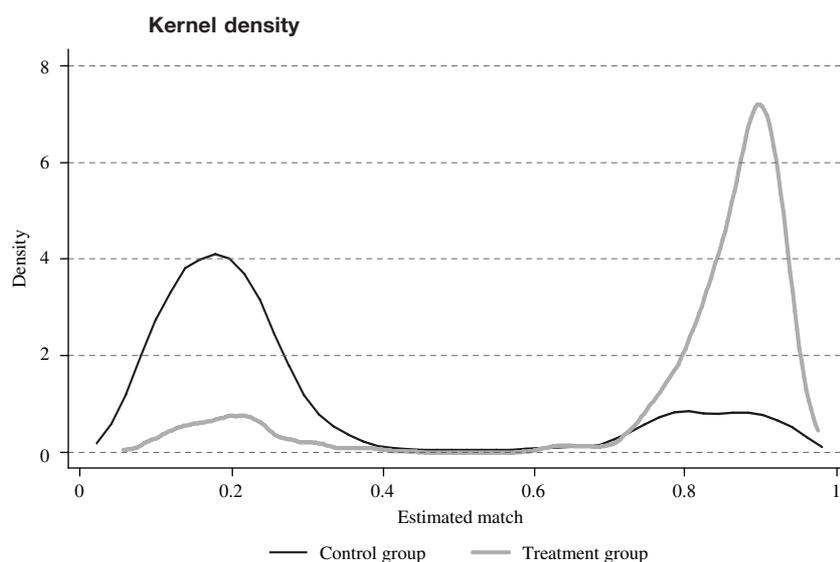
Source: Prepared by the authors.

Of the 1,922 fifteen-year-old students in Argentina, 949 are confirmed to correspond to the region of common support. Of the students in this region, 557 are in the treatment group and 392 are in the control group (see table 5).

TABLE 5
Distribution of cases

Students	No. of observations	Percentage	Cumulative percentage
Control	392	41.31	41.31
Treatment	557	58.69	100
Total	949	100	

Source: Prepared by the authors.

As observed, the control group is large (392 students), which is a necessary condition for the fit of the model. The results indicate that the socioeconomic level of the school, as well as the availability of Internet in the home, have a significant positive effect on the likelihood of participation in the programme. Meanwhile, students who repeat grades and have unemployed parents are significantly less likely to participate in the programme. The COMPWEB variable has a significant negative effect, as schools with a large proportion of Internet-enabled computers are less likely to participate in the programme.

Therefore, in principle, the schools that are most in need of the programme —that is, those without Internet-enabled computers, with a lower average socioeconomic level, with a larger proportion of students who repeat grades and are more likely to have unemployed parents and no Internet access at home— are less likely to participate in the programme.[6]

Subsequently, the score estimated with the PSM method was used. The differences in the levels of academic achievement predicted by the model using the various matching techniques to estimate the average effect of treatment on the treated (ATT) can be observed in table 6: the difference in the average academic achievement between students attending schools benefitted by the Conectar Igualdad programme and students without access to the programme is statistically significant under the stratification and Kernel methods. However, the nearest neighbor technique does not yield any statistically significant evidence.

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[6] This assertion is based on an examination of the variables that have been used for the student matching exercise and that were found to be statistically significant. The reason why schools with unfavourable socioeconomic conditions do not participate in the programme or delay in doing so is beyond the scope of this study. However, based on communication with key informants, one possible hypothesis follows. To participate in the programme, school administrators must file a formal request with the National Social Security Administration (ANSES), but administrators at the schools with the most challenging social problems have less time and energy to devote to such endeavors. This does not exclude their schools from the programme, but it does mean that they take longer to join than do schools with more resources that serve students in better socioeconomic conditions. This hypothesis will be tested in future studies.

TABLE 6

Estimate of ATT in tests

Test	PSM	Treatment group	Control group	ATT	Value of student t-statistic
Mathematics	ATTS	557	392	18.9468	2.1874
	ATTK	557	392	22.2852	2.9056
	ATTND	557	135	11.1794	1.1474
Reading	ATTS	557	392	25.1496	2.6202
	ATTK	557	392	28.8056	3.0984
	ATTND	557	135	19.8906	1.6596
Science	ATTS	557	392	18.2304	1.7668
	ATTK	557	392	20.7718	2.4338
	ATTND	557	135	12.2406	1.245

Source: Prepared by the authors, on the basis of data from PISA 2012 test.

Note: ATT: Average treatment on the treated; ATTK: Average treatment on the treated, Kernel method; ATTND: Average treatment on the treated, nearest neighbor method; ATTS: Average treatment on the treated, stratification method; PSM: *Propensity score matching*.

Therefore, the hypothesis that there are no differences in academic achievement between students in the treatment group (i.e. students participating in the Conectar Igualdad programme) and students in the control group is rejected. Although the difference in the tests is statistically significant, its average size is small. This minimal impact on academic achievement is evidence that the programme, though still in the early stages, is not being used to its full potential. As specified in the programme, making appropriate use of the netbooks requires more than just putting them into the hands of students. Teachers must incorporate them into the way that they teach and the way that students learn. In addition, distribution of the netbooks must by complemented by a minimum level of Internet access and installation of these computers at the schools. In other words, in addition to distributing the computers, the programme calls for support to be provided by trained technical personnel, as well as training for teachers to put the technology to educational use in the classroom.

Evidence that the programme has not yet moved beyond the stage of mere access to computers at school is the fact that the impact of the programme on academic achievement is very similar to the impact seen when computers are available in the home. The PSM estimate of the effect of computers in the home on student performance yields average treatment effect (ATE) results that are very similar to those obtained in the case of participation in the Conectar Igualdad programme. Although the target populations are different —in the latter case, all 15-year-old students in Argentina are studied based on PISA test data— the differences between the two groups are minimal (see Table 7).[7]

Lastly, according to Nannincini (2007), the estimated model is demonstrably robust, inasmuch as estimates of the average effect of treatment on the treated (ATT) have been specified under different possible scenarios that deviate from the assumption of conditional independence. In other words, the proposal is to simulate the capacity of a non-observable variable (not included in the probability estimate) to generate bias. To this end, alternative ATT estimates were calculated, incorporating additional binary variables, and none yielded results that were different than the ATT obtained with the model. Neither were differences found between the original impact and the impacts on academic achievement with the incorporation of additional variables.

[7] The study presented in this paper focuses on a subsample consisting of 1,922 observations, whereas the proposed study that would research the impact of the computer variable is based on the total 2012 PISA sample for the Argentina. The fact that both samples include students who benefit from Conectar Igualdad does not condition the results obtained the proposed exercise because the percentage of students in that situation is low (18%).

TABLE 7

ATT comparison between access to a computer at home and participation in the Conectar Igualdad programme

PSM	ATT computer	ATT Conectar	Difference
	Mathematics		
ATTS	19.7312	18.9468	0.7844
ATTK	36.8288	22.2852	14.5436
ATTND	18.1634	11.1794	6.984
	Reading		
ATTS	24.9462	25.1496	-0.2034
ATTK	49.9536	28.8056	21.148
ATTND	27.2636	19.8906	7.373
	Science		
ATTS	16.9556	18.2304	-1.2748
ATTK	38.7098	20.7718	17.938
ATTND	18.9388	12.2406	6.6982

Source: Prepared by the authors.

Note: PSM: *Propensity score matching*; ATT: Average treatment on the treated; ATTK: Average treatment on the treated, Kernel method; ATTND: Average treatment on the treated, nearest neighbor method; ATTS: Average treatment on the treated, stratification method; PSM: *Propensity score matching*.

2. Final considerations

This paper has explored the role of ICTs in education and, in particular, their effect as a determinant of academic achievement. Specifically, it has analysed the impact of the Conectar Igualdad programme in Argentina from a quantitative perspective, in order to complement the qualitative studies that have already been carried out and contribute to a better understanding of the use and effect of ICTs on the learning process.

In summary, this paper has made two contributions: it has expanded the base of knowledge on the role of ICTs in education, and it has evaluated the impact of the Conectar Igualdad programme in Argentina.

With respect to the results, using the propensity score matching (PSM) technique and drawing on data from the corresponding PISA tests to 2012 for Argentina, a statistically significant difference in average academic achievement was found between the group of students who were beneficiaries of the programme and those who were not. However, this difference does not necessarily translate into a major qualitative difference in academic achievement inasmuch as the absolute value of the average differences is low. Accordingly, future studies should explore whether participation in the Conectar Igualdad programme leads to a decrease in the rate of academic failure.

The lack of explicit data on the participation of schools in the Conectar Igualdad programme is not considered to be an important limiting factor in the study because the variables used to corroborate programme participation have been found to be logical and consistent, a fact borne out by comparisons with data from 2009 prior to implementation of the programme.

The effect that ICTs have on academic achievement has also been analysed, using the availability of computers in students' homes as a treatment variable. The observation is that participation in the programme, the scope of which goes beyond simply making computers available, yields similar results in terms of academic achievement. This suggests the need to tap the full potential of the programme, the results of which have not yet gone beyond access to computers.

The majority of studies analysing the impact of ICTs on education are based on weak indicators. A typical indicator of ICTs in schools has been the number of available computers.

Lastly, it should be noted that ICTs in education is a new area of inquiry, so further analysis and discussion is needed. In addition, research on the impact of public policies for universal access to ICTs requires long-term monitoring to track the effects of implementation of the programme over time.

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Brazil: capital goods industry during the 2003-2008 boom and following the global crisis

Guilherme Riccioppo Magacho

ABSTRACT

The capital goods industry is essential for technological development and long-term economic growth without external restrictions. After a long period of stagnation, investment growth resumed in Brazil in 2003 and brought renewed vigor to the capital goods industry. Nevertheless, the industry is very diverse, and some sectors have failed to meet rising demand where others have succeeded, namely those with high technological potential such as suppliers of machinery for the oil, mining and construction industries and makers of transportation and electrical generation and distribution equipment. Those sectors continued to expand even in the wake of the 2008 global crisis and have been barely touched by foreign competition.

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I

Introduction

The capital goods industry manufactures the machinery needed to produce other goods, which makes it essential for economic development. This industry plays an important role in disseminating technological progress —while also bringing technology users closer to producers— and is vitally important to the technological progress of an economy (Lundvall, 1988). In addition, it reduces external vulnerability inasmuch as economic growth, in the absence of relevant parts of the capital goods sector, becomes more dependent on the net exports of other sectors of the economy, or on foreign capital flows to provide the foreign currency needed to increase investment.[1]

From these two perspectives, evaluating the capital goods sector is an important step in assessing economic growth prospects in the years ahead, whether under favourable external conditions, such as between 2003 and 2008, or under conditions less conducive to productive expansion, such as prevailed in the wake of the 2008 global financial crisis.

Following a first disruption to the supply structure in the 1980s (when micro-electronics were introduced in manufacturing processes and products) and a second one in the 1990s (trade liberalization and low growth

rates), the machinery and equipment manufacturing industry experienced a third disruption with the cycle of economic expansion that began in 2003. The ensuing boom years have appeared to reverse the stagnation trend that had lasted for at least two decades, ushering in a considerable increase in investment and, by extension, in demand for capital goods.

In order to facilitate sector expansion in the event that the economic growth continues, the sector and its component industries have been analysed in terms of capacity to meet domestic demand and production and competitiveness structure. The proposal is to consolidate the necessary data on the structure of the various segments of the capital goods industry, to support an analysis of its repercussions on the country's economic growth and technological development.

This paper has five sections, including this Introduction. The second section gives a brief description of the recent cycle of expansion, noting its origins and immediate consequences for the Brazilian economy and, in particular, its repercussions on sector investments. The third section presents the methodology used to evaluate the industry and the way in which it has been segmented. The fourth section gives a brief overview of current conditions in the capital goods industry and analyses its main segments, noting their discrepancies with respect to sector demand. Lastly, in conclusion, the main findings of the analysis are presented with a view to developing an effective industrial policy for the capital goods sector.

II

The 2003-2008 boom cycle and the new postcrisis dynamic

In Brazil, the 1980s and 1990s were characterized first and foremost by a flat economy. Weak growth was accompanied by high unemployment and low fixed capital investment. Although there were some expansionary cycles, such as in 1995-1997 (a period referred to by Bielschowsky (1999) as the "modernization mini-cycle"), the overall

trend during those two decades was one of weakening economic activity, rising numbers of unemployed workers and falling levels of global investment in the economy.

That period of stagnation came to an end in 2004, when Brazil's economy resumed a sustained economic

growth path: average annual growth rates rose from 2.1% in 1999-2002 to 3.5% in 2003-2006 and 4.5% in 2007-2010. However, the economy lost steam when

the 2008 crisis hit, and in the three years from 2011 to 2013 the growth rate fell to 1999-2002 levels (annual average rate of 2.1%) (see figure 1).

FIGURE 1

Brazil: annual rate of economic growth, 1990-2013
(Annual variation, in percentages)
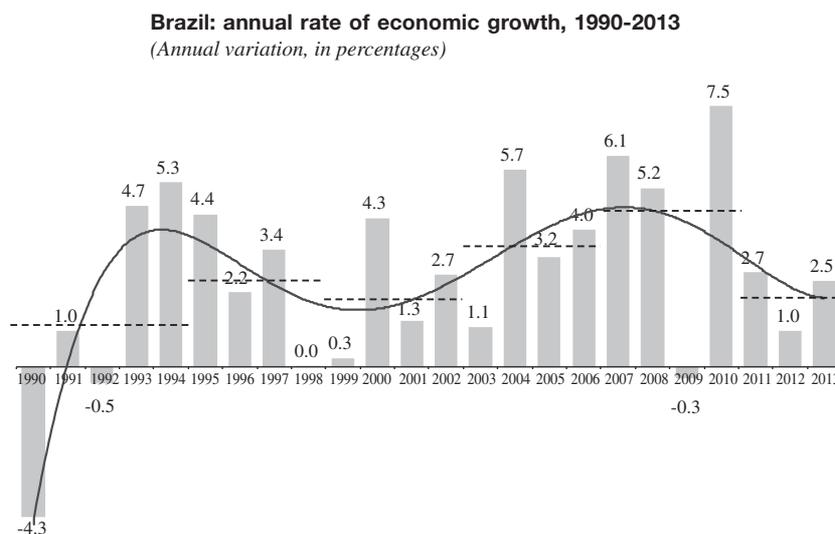
Source: Prepared by the author, on the basis of the National Accounts System of the Brazilian Geographical and Statistical Institute (IBGE).

1. Overview of the 2003-2008 expansionary cycle and post-crisis stagnation

The resumption of growth and the rapid expansion of international trade that followed the recovery of liquidity levels and rising demand in China changed some aspects that had hitherto characterized the global economy. Dollar-denominated commodity prices began to recover in 2003, reversing the downward trend of the previous years, and capital flows were redirected towards emerging countries, which saw considerable improvements in their balance of payments as interest rate spreads on their sovereign debt narrowed and trade flows reversed (Serrano and Summa, 2011).

Better external conditions for the emerging countries (especially net commodity exporters) propelled a course change in those economies, which began to grow at a faster clip than in previous years. Brazil was no exception. Once the crisis associated with the change in government had ended, the national economy began to benefit from the improved external environment.

As illustrated in figure 2, installed capacity utilization began to increase in 2004, rising from 80.3% in 2003 to 83.3% in 2006. This translated into an increase in the investment rate, especially in the machinery and equipment sector, which grew from 7.2% to 8.5% of gross domestic product (GDP) over the same period. The

trend strengthened in 2007 and 2008, when installed capacity utilization surpassed 85% and demand appeared to be sustainable, driving the rate of investment —the main component of which became machinery and equipment— to 19.1%.

However, a sharp deterioration in the utilization rate beginning in 2010, owing to uncertainty about external and domestic demand, precipitated a decline in the rate of investment in machinery and equipment, from 10.2% to 9.0% in 2012, followed by an increase to 9.5% in 2013.

This new environment represented a significant departure from the boom cycle of 2003-2008. Starting in 2008, the emerging economies began to experience much lower growth rates, and the developed economies recorded negative or virtually zero growth.[2] This had major repercussions for the Brazilian economy. Despite the countercyclical measures adopted in response to the crisis, growth sank and demand for imported products rose owing to the real appreciation in the Brazilian currency starting in 2011 and an oversupply of manufactured goods in a context of flagging global demand.

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[2] According to the World Bank (World Development Indicators), the advanced economies grew at an average annual rate of 2.5% in the period 2003-2008 but just 0.8% in the period 2008-2013, whereas the annual growth rate in emerging countries slipped from 7.4% to 5.3% over the same period.

FIGURE 2

Brazil: rate of investment and installed capacity utilization, 2003-2013
(Percentage of gdp and percentages, respectively)
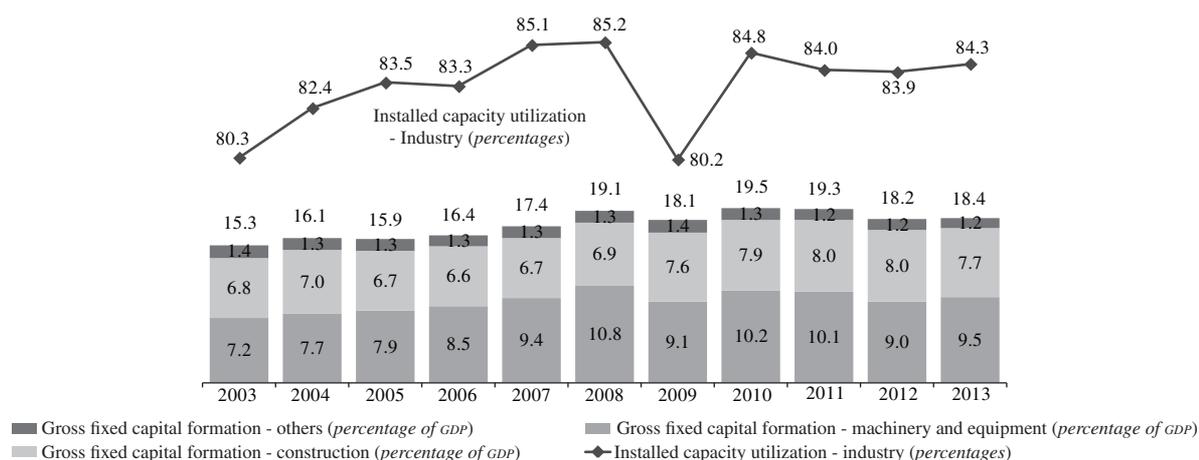
Source: Prepared by the author, on the basis of data from the National Accounts System of the Brazilian Geographical and Statistical Institute (IBGE) and the Getulio Vargas Foundation.

Note: GDP: Gross domestic product.

2.   Effects of the growth cycle on sector investments

Despite the fact that the increases in production, and especially in investment, in the period 2003-2008 were seen industry-wide, the gains did not extend to all sectors. Some groups of industrial activities drove the increase in business investment in that period, either through export activity (as previously seen) or because they were largely unaffected by the penetration of imported products.[3] Analogously, the economic slowdown that began in 2008 also had varying effects on the different sectors and their investments.

Some sectors stand out as the main drivers of rising investment activity during the period. As illustrated in table 1, the oil and gas, agro-industry, metallurgy, mining and paper and pulp sectors were the main beneficiaries of the growth cycle and saw larger increases in investment, especially comparing 2006-2008 against 2003-2005.

The oil and gas, agro-industry, metallurgy, mining and paper and pulp sectors, which together accounted for less than half of total investment in the 2000-2002 period, came to represent 66.6% of the total in 2006-2008. The investments of this group of sectors rose from R$ 111.1 billion to R$ 246.9 billion between the first and last quarters under analysis (in 2009 values), or a 122.3% increase (i.e. 14.2% per year).

However, the sector distribution of investments changed significantly following the 2008 crisis. While in some sectors, such as oil and gas, agro-industry and mining, investments continued to trend upwards (total investment grew from R$ 161.1 billion in 2006-2008 to R$ 249.6 billion in 2010-2012), in others, such as metallurgy and paper and pulp, investments fell dramatically (total investments for these two sectors decreased from R$ 65.8 billion to R$ 46.4 billion over the same period). As a result, the post-crisis period was characterized by an even greater concentration of investments, with 56% of industry investment going to just three sectors: oil and gas, agro-industry and mining.

[3] The penetration of imported products was explained, above all, by exchange rate appreciation and, in parallel, by more imports of products from Asian countries (especially China).

TABLE 1

Brazil: investments[a] by industrial sectors

(Billions of 2012 reais, percentage of total invested by industry and cumulative percentage)

	2000-2002			2003-2005			2006-2008			2010-2012		
	Reais	Percentage	Cumulative percentage	Reais	Percentage	Cumulative percentage	Reais	Percentage	Cumulative percentage	Reais	Percentage	Cumulative percentage
Oil and gas	28.6	12.7	12.7	48.7	18.9	18.9	82.0	22.1	22.1	136.8	30.7	30.7
Agro-industry	33.9	15.1	27.8	40.0	15.5	34.4	71.8	19.4	41.5	75.2	16.9	47.6
Metallurgy	20.8	9.3	37.1	28.2	10.9	45.3	41.0	11.1	52.6	28.2	6.3	53.9
Mining	9.1	4.0	41.1	17.7	6.8	52.1	27.3	7.4	59.9	37.5	8.4	62.3
Paper and pulp	18.6	8.3	49.4	15.5	6.0	58.1	24.8	6.7	66.6	18.2	4.1	66.4
Chemicals	19.8	8.8	58.2	18.5	7.2	65.3	23.5	6.4	73.0	24.3	5.4	71.8
Vehicles	26.4	11.7	70.0	26.9	10.4	75.7	20.8	5.6	78.6	26.2	5.9	77.7
Textiles, apparel and footwear	10.7	4.7	74.7	9.0	3.5	79.1	9.2	2.5	81.1	10.0	2.2	80.0
Household appliances and electronics	7.1	3.2	77.9	4.6	1.9	81.0	6.0	1.6	82.7	6.8	1.5	81.5
Other	49.7	22.1	100	49,1	19.0	100	64.2	17.3	100	82.6	18.5	100

Source: Prepared by the author, on the basis of data from the Brazilian Geographical and Statistical Institute (IBGE).

[a] Purchase and improvement of fixed assets.

III

Analysis of the capital goods industry: methodological aspects

The capital goods industry is easily defined by the function of the products it makes: capital goods are used to produce other goods and, unlike inputs, are used repeatedly and are not transformed in the production process.

Defining capital goods is simple, but selecting a typology to analyse the capital goods manufacturing sector is not, nor can it be comprehensive. Because the sector is not composed of a specific industry but rather a number of industries that link up based on the end use of the manufactured goods, the results of a sector analysis depend above all on the typology used to distinguish it, which must fit the purpose of the study.

1. Classification of the capital goods industry

The capital goods industry has traditionally been classified based on a characteristic of the process by which the goods are manufactured: they can be mass-produced or made to order. The mass production of capital goods is standardized, subject to important static economies of scale and tends, in most cases, to require minimum production scales that are quite high. Capital goods that are made to order are produced according to the specifications of the industry that will use them, in most cases in association with the maker of the goods. Robust economies of scale, derived from extensive experience with planning and making similar goods, are important in order for this industry to perform well (Nassif, 2008; Vermulm and Erber, 2002).

However, this type of segmentation is unsuited to the purposes of this study. Inasmuch as the objective is to analyse the performance of the capital goods industry in the face of changes in the structure of demand, the traditional classification is discarded in favour of a demand-based classification. This alternative typology seeks to capture the segmentation of this industry based on the investor sector, with special attention paid to the reliance of these sectors on the domestic production of capital goods for the expansion, generation and absorption of technology.

In this paper, the capital goods industry is divided into five large groups based on the National Classification of Economic Activities (CNAE) of the Brazilian Geographical

and Statistical Institute (IBGE).[4] Subsequently, an analysis will be carried out, within the industrial machinery and equipment segment, to identify the potential differences that may exist in the supply of capital goods based on the demand sectors.

2. Structure, source of data and indicators used for the analysis

For purposes of analysing the capital goods industry, its main segments and the sectors of the industrial machinery and equipment segment, this study examines the evolution of national production and domestic demand. In the first case, the key aspect is the source of demand (domestic or external market), and in the second case, it is the origin of the product (local or imported). To look at these aspects, data on industrial transformation value and gross value of industrial output was gathered from the IBGE Annual Survey of Industry-Enterprise (research unit: local unit) for the five segments, and also on the value of output from the IBGE Annual Survey of Industry-Product, for sectors in the industrial machinery and equipment segment.

Import and export data, expressed in kilograms and dollars, was taken from *AliceWeb*, a trade data analysis system run by the Ministry of Industry, Foreign Trade and Services (MDIC). Based on the data, calculations were made of apparent consumption (production plus imports minus exports), the export ratio (ratio of exports to production) and the import penetration ratio (ratio of imports to apparent consumption).

In the case of sectors with relatively high levels of imports and exports, the Grubel-Lloyd index[5] is evaluated to measure the extent to which trade is inter- or intra-industrial.[6] Based on this evaluation, it can be

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[4] See annex A1 for the list of sectors comprising the groups.

[5] Calculated for the eight-digit level of the MERCOSUR Common Nomenclature (MCN).

[6] The Grubel-Lloyd index is calculated as the ratio of the sum of the difference between exports and imports of each product in the numerator to the sum of exports and imports in the denominator. Values closer to the unit indicate the predominance of intra-industry trade, and conversely, values closer to zero indicate the predominance of inter-industry trade.

determined whether the national industry would or would not be able to replace the capital goods that have been imported. The ratio between the export unit value and the import unit value, measured in dollars per kilogram, suggests the size of the technological gap between the local products and imports, to establish whether trade is horizontal or vertical.[7]

These data are used to assess the current and potential capacity of each segment of Brazil's industrial sector to supply the capital goods required by the national manufacturing sector. The focus on the indicators has

to do with the suspicion that a large portion of the goods imported for national investment are not very different, in terms of technological level, from goods produced in the country.

With this in mind, the proposal is to analyse whether local industry would, in fact, be unable to meet domestic demand due to lack of technological development, or whether it is instead the case that robust growth in investment following decades of stagnation is generating demand that the national capital goods industry does not have enough installed capacity to meet, causing a mismatch between domestic supply and demand for these goods and driving imports. The main objective is to identify the segments where this is frequently the case and where the national capital goods industry would not be able to supply other national industries, including from a technological point of view.

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[7] According to Resende y Anderson (1999), Feltrin (2005) and Baltar (2007), the literature in economics considers intra-industry trade to be horizontal when the ratio between the export unit value and the import unit value falls between 0.85 and 1.15, and vertical otherwise.

IV

Overview of the capital goods industry in Brazil

The size of Brazil's capital goods industry is reflected in the GDP of the industrial sector, which was R$ 88.3 billion in 2012. No less important is its capacity to create jobs. According to the IBGE Annual Survey of Industry-Enterprise, as of 31 December 2012, makers of capital goods directly employed over 690,000 workers, or 10.7% of the manufacturing workforce. Against this backdrop, the factors that have driven capital goods production and trade relations must be understood as part of an analysis of the sector.

1. General characteristics of the capital goods industry

With demand on the rise between 2003 and 2008 (and especially after 2006), the output of the capital goods industry outpaced GDP. Sector GDP, measured using the industrial transformation value, grew at a real annual rate of 8.8%, while national GDP growth, although high, was nevertheless lower than 5%. Albeit at a slower pace, the capital goods sector continued to expand despite the slowdown in GDP growth after 2008. In terms of production, for example, annual growth cooled to 5.5% between 2008 and 2012, a relative slowdown, as illustrated in figure 3.

The increase in production of capital goods in the period 2003-2012 was characterized by three distinct

cycles. In the first, between 2003 and 2004, there was a sudden jump in external demand for investment goods, such that the sector —which had low production capacity after many years of scarce investment in the Brazilian economy— came to use nearly its full installed capacity. In the second, between 2006 and 2008, the intensity and duration of domestic demand for machinery and equipment grew, providing assurance of the continued use of production capacity, which translated into investments aimed at increasing the sector's supply capacity. Lastly, in the third cycle, between 2008 and 2012, the economic slowdown and weaker investment precipitated a decline in the growth rate of the capital goods sector, which continued to grow despite the loss of momentum.

As illustrated in figure 4, while national investment (measured as apparent consumption of machinery and equipment) posted slight increases from mid-2003 to 2004, installed capacity utilization in the sector peaked (85.6%) in October 2004, mainly owing to rising external demand for machinery and equipment, from R$ 30.6 billion in 2003 to R$ 51 billion in 2005.[8]

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[8] Exports of capital goods grew from R$ 20.6 billion to R$ 51 billion between 2000 and 2004 (annual growth of 25.4%), and the sector's export ratio increased from 32.5% to 40.0%, well above its historic average.

FIGURE 3

Brazil: output and employment in the capital goods industry, 2000-2012
(Billions of 2012 reais[a] and thousands, respectively)
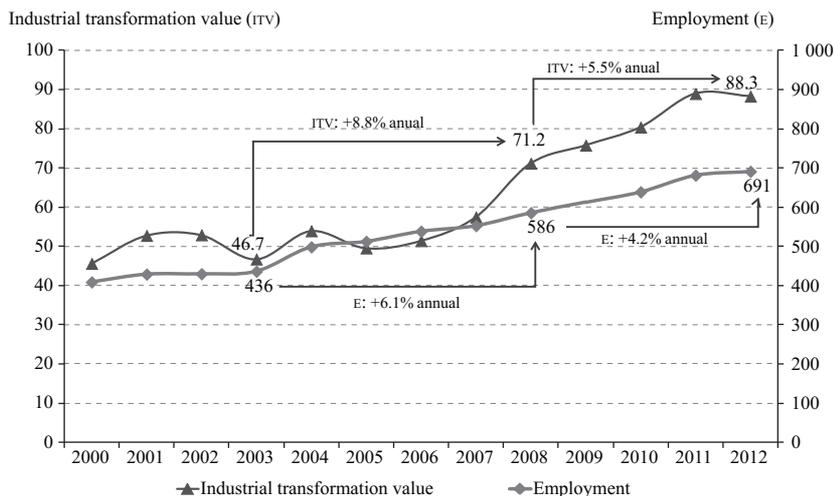
Industrial transformation value (ITV)   Employment (E)

Industrial transformation value   Employment

Source: Prepared by the author, on the basis of data from the Brazilian Geographical and Statistical Institute (IBGE) and the Getulio Vargas Foundation.

[a] Deflated using the Getulio Vargas Foundation's wholesale price index-global supply corresponding to the sector. Data from 2009 were excluded to facilitate the visualization.

FIGURE 4

Brazil: apparent consumption and installed capacity utilization in the machinery and equipment sector, 2003-2011
(Percentages and index number: average 1996 = 100, respectively)

Installed capacity utilization (ICU)   Apparent consumption of machinery
                                              12 month rolling average
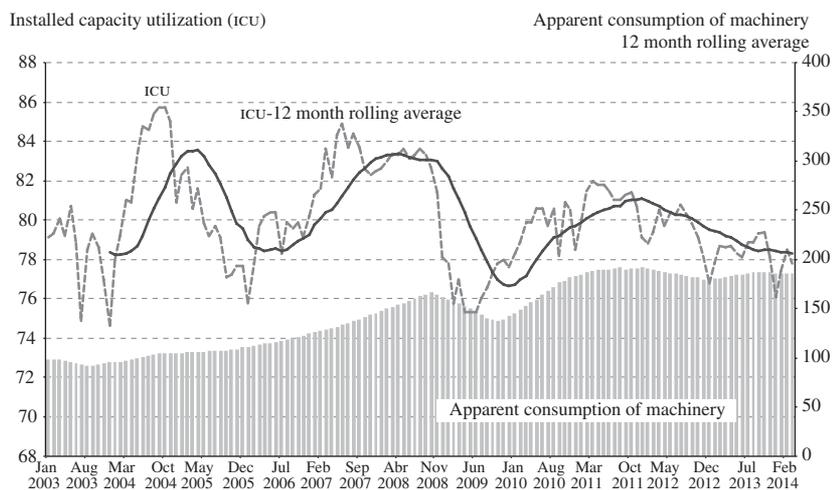
Source: Prepared by the author, on the basis of data from the Institute of Applied Economic Research (IPEA) and the National Confederation of Industry (CNI).

However, there was a fairly dramatic shift in the following period. Starting in 2006, investment in machinery and equipment in the country climbed sharply, driving up the rate of installed capacity utilization in the capital goods industry, which remained high for successive years (84.6% in August 2007 and 84.1% in July 2008, and above 82% between January 2007 and October 2008).

Following the decline in activity in 2009, investment rebounded but at a weaker pace than in the earlier period of robust growth. By the end of 2011, investment had

stalled, and the capacity utilization rate in the sector, which had not returned to the pre-crisis level (remaining below 82%), began to fall.

The increase in demand for capital goods between 2006 and 2008, propelled mainly by higher industrial and public investment,[9] had a major impact on Brazil's trade in capital goods. National production of these goods —which during the period of weak investment was subject to an exportoriented restructuring process— was reoriented to the domestic market, particularly after 2005, when national investment rose and the exchange rate began to appreciate (making exports less competitive).

Inasmuch as less use was made of installed capacity and demand for investment goods rose, the 2003-2008 period of economic growth in Brazil had major repercussions for production and sales of capital goods in the country. After several decades of stagnation, the demand shock prompted makers of machinery and equipment to rapidly bring nearly all of their production capacity on line and resume the capacity to use, make and buy inputs to sustain the growth cycle.

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[9] According to data from the Institute of Applied Economic Research (IPEA), public investment (including state investment) rose from 2.7% to 3.7% of GDP between 2005 and 2008.

In 2008, the capital goods industry entered a new phase as domestic demand for machinery and equipment waned on falling growth and flat investment in the country. Exports, which had become less competitive in the 2006-2008 cycle, weakened further, as the slowdown in the global economy and the appreciation in the exchange rate impeded access to foreign markets. Imports, meanwhile, continued to grow, curtailing sector growth and causing further deterioration to the trade balance.

2. Main segments of the capital goods industry

As mentioned previously, the production of capital goods, measured as the industrial transformation value, totaled R$ 88.275 billion in 2012. The industrial machinery and equipment and the transportation equipment segments stood out, with production totaling R$ 34.126 billion and R$ 24.665 billion, respectively, followed by the computer, electronics and optical equipment segment, with production valued at R$ 13.554 billion in 2012. Lastly, the production totals for the electrical equipment and farm machinery and equipment segments were lower but still significant at R$ 8.379 billion and R$ 7.551 billion, respectively (see figure 5).

FIGURE 5

Brazil: industrial transformation value (ITV) by segment, 2000-2012
(Billions of 2012 reais[a])
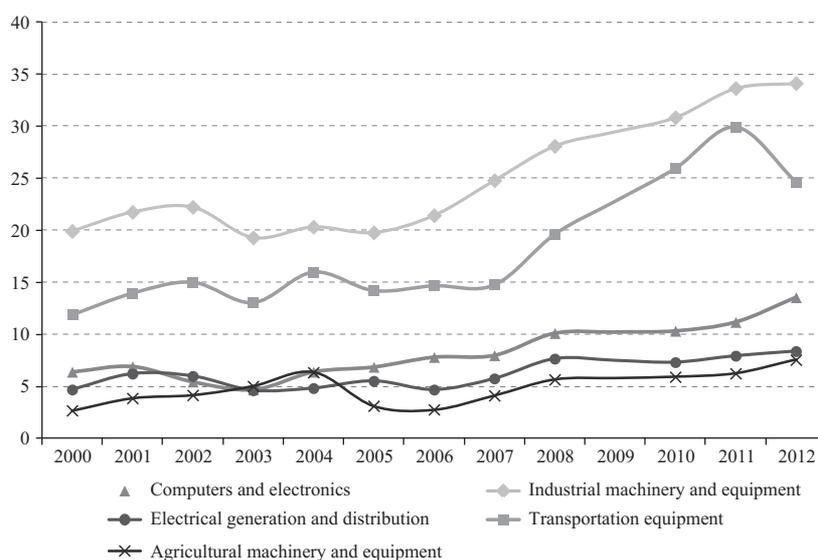
- ▲ Computers and electronics
- ◆ Industrial machinery and equipment
- ● Electrical generation and distribution
- ■ Transportation equipment
- ✕ Agricultural machinery and equipment

Source: Prepared by the author, on the basis of data from the Brazilian Geographical and Statistical Institute (IBGE) and the Getulio Vargas Foundation.

[a] Deflated using the Getulio Vargas Foundation's wholesale price index-global supply corresponding to the sector. Data from 2009 were excluded to facilitate the visualization.

Although production rose in all segments between 2003 and 2012, the growth process and phases differed significantly from one segment to another. As mentioned, external demand was the driving force in the first cycle of growth. Not coincidentally, the segments that were more export-oriented (computer, electronics and optical equipment, farm machinery and equipment and transportation equipment) posted the strongest growth in 2004 (and also continued to grow in the subsequent cycle).[10]

Growth in the second cycle (2006-2008) was more propelled by expansion in the domestic market, especially in industrial investment. Indeed, growth in the industrial machinery and equipment and electrical equipment segments, both heavily reliant on domestic demand, was concentrated in the second half of the 2000s.

Starting in 2008, the export-oriented segments of the capital goods industry found it harder to expand because in addition to the appreciation in the exchange rate that had curbed growth in the previous cycle, demand among trade partners fell. Thus, expansion in the post-crisis period was driven by the local market, albeit at a much slower pace.

As illustrated in figure 6, which disaggregates the increase in total production (measured as the gross value of industrial output) by exports and domestic demand, growth in the capital goods sector between 2002 and 2004 was largely driven by external demand. In the transportation equipment and farm machinery and equipment segments, which had nominal growth rates of 81% and 114%, respectively, during this period, over half of the growth was directly attributable to external demand. This was also the case in the industrial machinery and equipment sector, which nevertheless had stronger growth in the second and third cycles, when demand for investment goods was primarily driven by domestic demand.

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[10] The exception is the computer, electronics and optical equipment segment, which relied heavily on the domestic market, but as a supplier for export sectors nevertheless posted virtually uninterrupted growth from 2003-2012.

FIGURE 6

Brazil: changes in production, disaggregated by exports and domestic market, 2002-2012

(Billions of reais)
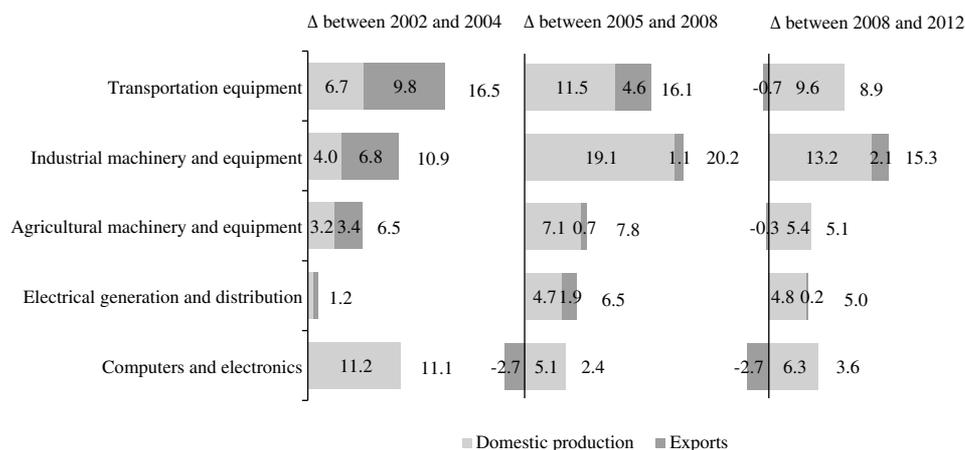
■ Domestic production   ■ Exports

Source: Prepared by the author, on the basis of data from *AliceWeb* of the Ministry of Industry, Foreign Trade and Services.

In addition to the impact on production analysed earlier, higher investment levels, especially after 2006, had a major impact on imports, strengthened by greater utilization of installed capacity (which acted as an upper limit on further increases in national production) and

by appreciation in the exchange rate (which facilitated the penetration of imported products).

As illustrated in figure 7, imports covered much of the increase in domestic demand for capital goods, both in the second cycle of growth (2005-2008) and in

the subsequent post-crisis cycle (2008-2012). In the industrial machinery and equipment and the computer, electronics and optical equipment segments, imports covered a larger share. In the industrial machinery and equipment sector, owing to the high rate of capacity utilization in Brazilian industry in the second cycle, imports supplemented the national supply in some cases and ended up replacing it in others. In the case of computer, electronics and optical equipment, domestic production was largely replaced by imports, despite idle capacity in the sector.[11] In this sector of the capital goods industry, which was undoubtedly the hardest hit by imports, lower prices for imported products and the real appreciation in the local currency undermined the domestic and foreign competitiveness of national production, precluding any expansion of this industry in the country. However, inasmuch as this segment mainly produces parts and components for machinery and equipment in other national sectors, replacing domestic supply with cheaper imports could be seen as facilitating growth in other sectors.

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[11] According to data from the Getulio Vargas Foundation, the rate of utilization of installed capacity in the electrical and communications equipment sectors increased between 2002 and 2005, from 65.4% to 80.3%, and hovered near 80% in subsequent years. It was only during the 2008 crisis that the rate dropped.

FIGURE 7

Brazil: changes in apparent consumption, disaggregated by imports and domestic production, 2002-2012
(Billions of reais)
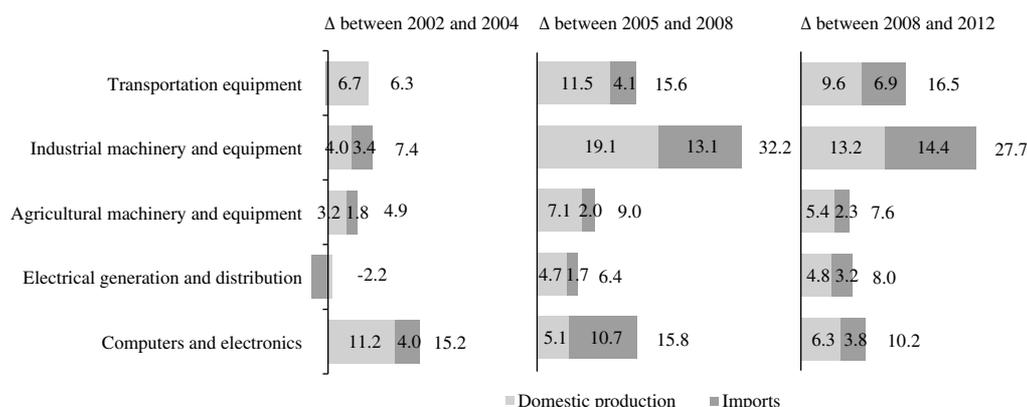
Source: Prepared by the author, on the basis of data from the Brazilian Geographical and Statistical Institute (IBGE) and *AliceWeb* of the Ministry of Industry, Foreign Trade and Services.

In the three other segments (transportation equipment, electrical generation and distribution equipment and farm machinery and equipment), imports covered a smaller share of the demand for investment goods, despite the fact that nearly all of the nation's industrial production capacity was in use.[12]

Analysing the capital goods industry by its main segments leads to the conclusion that it is a very diverse industry, affected variously by demand shocks arising from the recent cycle of growth in the Brazilian economy and by investments made in the post-crisis period of the cycle.

The segments of the industry that manufacture agricultural machinery and equipment and transportation equipment grew during the three periods of the cycle: initially (2003-2004) driven by exports and subsequently

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[12] In the sector that makes machinery and equipment for the generation and distribution of electricity, the rate of utilization of installed capacity was 90.3% in 2007 (the highest level since at least the 1990s), while in the sector that makes transportation equipment, it was 88.5% in 2005, where it remained in subsequent years. In the sectors that make equipment for agriculture and rural industries and tractors and machinery for earthmoving, the installed capacity utilization rate rose sharply in 2004, only to fall and rise again between 2007 and 2008, when it reached higher levels than in the past.

(2006-2008 and 2008-2012) by an increase in domestic investment. These segments, as well as the segment that makes electrical generation and distribution equipment (demand for which grew only in the second and third periods of the cycle), were able to cover the increase in domestic demand. They were not greatly affected by imports, and once the maximum rate of installed capacity utilization had been achieved, they began to invest heavily to maintain their position as the main suppliers in the local market. The post-crisis slowdown did not fundamentally change this dynamic though it did moderate its intensity: the segments continued to grow on the back of the domestic market, albeit at a slower pace, while imported products gained a stronger foothold.

Conditions for the computer, electronics and optical equipment sector were much less favourable: unlike in the other sectors, the 2003-2004 expansion was propelled not by exports but rather by demand in the local market. However, in 2005, the supply for this demand started to come from imports, which had the effect of displacing national production and dampening investment.

Lastly, the industrial machinery and equipment segment faced the most difficult conditions. In response to robust domestic demand in the second period of the cycle, it ramped up growth but did not succeed in meeting all of the demand. In 2007, when it had put nearly all its production capacity to use, much of the demand in the local market was instead supplied by imports, which were benefitted by exchange rate appreciation. The situation deteriorated even further after the crisis, as sector investment fell and imports took a larger share of the local market. This called into question whether the sector had the capacity to meet a future increase in demand in the Brazilian economy, as discussed below.

3. The machinery and equipment industry and industrial investments

According to IBGE data, the sectors accounting for the highest levels of industrial investment were as follows: oil and gas, agro-industry, mining and, until 2008, paper and pulp and metallurgy. These sectors, which collectively represented 49.4% of investment in 2000-2002, came to account for 66.6% of investment in 2006-2008. In all, these industries more than doubled their level of investment in six years, to an average annual rate of 16%, while the average annual investment rate of the other industries fell to 2.1%. The concentration of investments continued after 2008 but only in the oil and gas, agro-

industry and mining sectors, which accounted for 48.9% of investment in 2006-2008 and 56.0% in 2010-2012.

An expansion in investment in some sectors after a long period of stagnation —accompanied by more limited growth, and even contraction, in others— led to some important differences within the industrial machinery and equipment sector that are worth noting and analysing. This subsection analyses the machinery and equipment industry supplying the sectors that posted the strongest investment growth, in order to assess the restrictions that the Brazilian economy may face if its growth continues to be driven by these sectors.

(a) *Machinery and equipment for petroleum exploration and production*

The sector that manufactures machinery and equipment for oil and gas exploration and production[13] sells nearly all its products on the domestic market (see figure 8). Not coincidentally, this industry was virtually stalled until 2004,[14] despite the increase in the export ratio from 8.8% in 2000 to 18.0% in 2004. However, starting in 2005, with domestic consumption growing, sector production for the national market began to rise, and as a result the export ratio fell from 18.0% in 2004 to 13.8% in 2012 (despite an increase in 2009). Of an increase of R$ 5.01 billion in the value of sector production between 2004 and 2012, only R$ 605 million (12%) corresponded to exports; the remaining R$ 4.4 billion (88% of production) corresponded to supply for the domestic market.

Although imports rose over the period of study, the import penetration ratio (in current prices) remained quite stable and relatively low (25.6% in 2005, 25.7% in 2008 and 24.9% in 2012). The conclusion, therefore, is that demand in the petroleum exploration and production sector was largely met by the national industry, though the increase in imported products was not negligible.

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[13] The IBGE classifies the sectors of Brazil's economy in accordance with the National Classification of Economic Activities (CNAE), of which there are two versions: CNAE 1.0 and CNAE 2.0. In addition to the products listed for activity 2851 (CNAE 2.0), which correspond to machinery and equipment for petroleum exploration and production, other products that are primarily used in this activity are included: 2813.2040, 2813.2050, 2813.2030, 2813.2060, 2813.2090, 2813.2100, 2813.2080, 2813.2110, 2813.2070, 2813.2130, 2813.2010 (CNAE 2.0).

[14] Deflated using the Getulio Vargas Foundation's wholesale price index-global supply, sector production grew by 8.7% between 2000 and 2004 (2.1% per annum).

FIGURE 8

Brazil: production by destination and apparent consumption by origin in the machinery and equipment sector for petroleum exploration and production, 2000-2012
(Billions of reais)
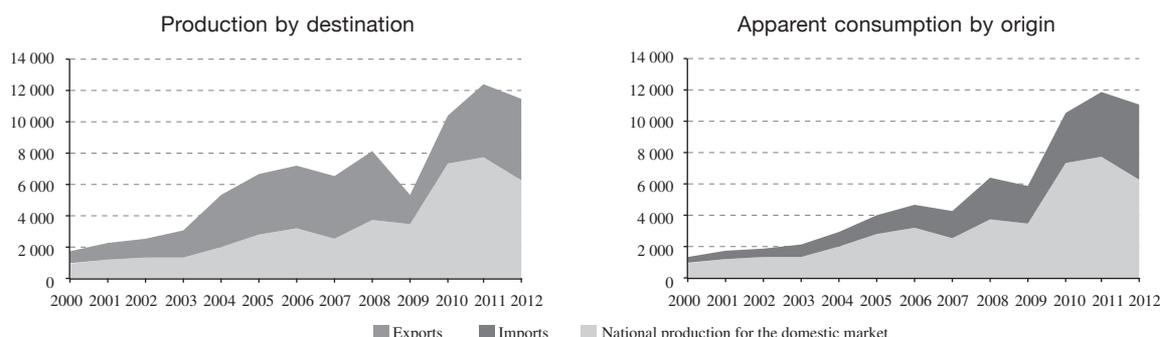
Production by destination

Apparent consumption by origin

Exports   Imports   National production for the domestic market

Source: Prepared by the author, on the basis of data from the Brazilian Geographical and Statistical Institute (IBGE) and *AliceWeb* of the Ministry of Industry, Foreign Trade and Services.

It should be noted that despite stable import penetration ratios, the sector is characterized by a high level of intra-industry trade, which has become increasingly vertical in favour of the national industry. This means that the sector increasingly makes products with an array of technological values and that national products have more technology content than imports.[15]

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[15] Despite a slight contraction in recent years (from 0.56 in 2008 to 0.46 in 2012), the Grubel-Lloyd index for the sector is relatively high by virtue of Brazil's technology structure in the period under study. This indicates strong intra-industry trade. The ratio between the export unit value and the import unit value rose from 0.43 to 1.03 in 2008, which means that the sector went from being vertical to horizontal. This ratio continued to evolve and stood at 1.58 in 2012, indicating that trade returned to being vertical but with national products characterized by a high level of technological sophistication (see annex A2).

The conclusion is that the national industry has been able to absorb much of the increase in demand, particularly for machinery that is more technologically sophisticated.

(b) *Machinery and equipment for mining and construction*

Unlike the machinery and equipment segment for petroleum exploration and production, exports are a major source of demand for machinery and equipment for mining and construction (see figure 9). Production in this segment climbed sharply in the first half of the 2000s (43.6% in real terms between 2002 and 2004), primarily on external demand, and the export ratio rose from 42.6% in 2000 to 60.7% in 2004.

FIGURE 9

Brazil: production by destination and apparent consumption by origin in the machinery and equipment sector for mining and construction, 2000-2012
(Billions of reais)
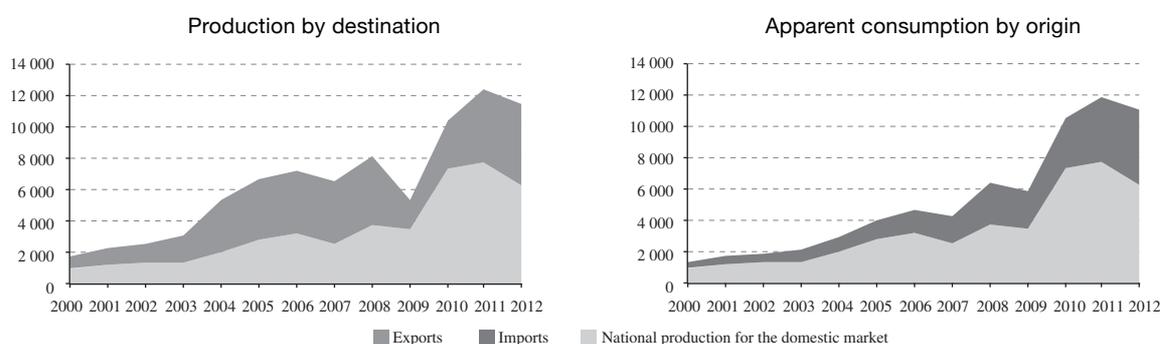
Production by destination

Apparent consumption by origin

Exports   Imports   National production for the domestic market

Source: Prepared by the author, on the basis of data from the Brazilian Geographical and Statistical Institute (IBGE) and *AliceWeb* of the Ministry of Industry, Foreign Trade and Services.

However, starting in 2004, the domestic market became a more significant source of demand for these goods, especially in the post-crisis period, causing the export ratio to fall to around 45% in 2012. Domestic consumption began to place upward pressure on demand, which grew at a faster pace than sector capacity to meet it.[16] Essentially, due to its large export business, the sector was unable to meet domestic demand. The resulting dependence on imports led to substantial growth in that segment (at a rate of 435% between 2004 and 2008, as

measured in reais), and as a result the import penetration ratio, which had climbed from 30.2% in 2004 to 42.0% in 2008, rose to 43.7% in 2012.

Thus, the machinery and equipment sector for mining and construction had the technological potential to meet domestic demand, given the verticalization of trade in favour of national production, but could not absorb it entirely due to the disproportionate increase in demand between 2006 and 2011, which prompted a jump in imports.

(c) *Machinery and equipment for the food, beverage and tobacco industries*

National production of machinery and equipment for the food, beverage and tobacco industries is sold almost exclusively on the domestic market (see figure 10). This industry has a low export ratio (around 15% through 2006 and falling to 6.8% in 2008), and unsurprisingly it posted significant growth in the second half of the 2000s, buoyed by the local market.

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[16] This substitution of national products for imported products, in response to insufficient capacity in the national industry, is clearly indicated by the Grubel-Lloyd index for the sector, which increased from 0.20 in 2004 to 0.40 in 2008, where it remained, demonstrating an intensification of intra-industry trade. This intra-industry trade was primarily horizontal until 2008, as evidenced by the proximity to one of the ratio between the export unit value and the import unit value (with the ratio rising from 0.90 in 2004 to 1.12 in 2008), but then became vertical in favour of national supply (the export-import ratio increased to 1.43 in 2012) (see annex A2).

FIGURE 10

Brazil: production by destination and apparent consumption by origin in the machinery and equipment sector for the food, beverage and tobacco industries, 2000-2012
(Billions of reais)
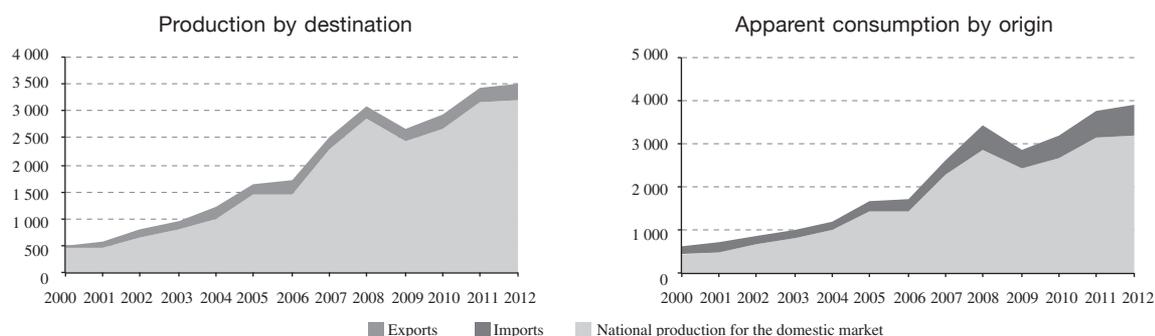
Production by destination

Apparent consumption by origin

■ Exports ■ Imports ▫ National production for the domestic market

Source: Prepared by the author, on the basis of data from the Brazilian Geographical and Statistical Institute (IBGE) and *AliceWeb* of the Ministry of Industry, Foreign Trade and Services.

Rising investment levels in the agro-industrial sectors led to an increase in sector production at a real rate of 19.3% in 2005 and 68.4% between 2006 and 2008. Demand growth prompted greater import activity, a segment that more than tripled in the period 2004-2008.[17] However, due to appreciation in the Brazilian

real and proportional growth in apparent consumption, the expansion in imports did not translate into a larger import penetration ratio. After falling from 29.8% in 2000 to 15.5% in 2004, the ratio stabilized around 15% between 2004 and 2008.

Starting that year, the slower pace of investment had major repercussions for the machinery and equipment sector for the food industry, with production levels coming in lower in 2012 than in 2008, in real terms. A

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[17] The rate of increase, measured in reais, kilograms and dollars, was 197%, 213% and 374%, respectively.

sharp increase in the import ratio notwithstanding, the production decline was not due to the competitiveness factor but rather to shrinking demand.

(d) *Machinery and equipment for the paper and pulp industries*

Despite a high export ratio, Brazil's machinery and equipment industry for paper and pulp production was virtually stalled during the first half of the 2000s, growing just 3.8% in real terms between 2002 and 2005. The

only thing that prevented the industry from contracting during that period was export activity, which more than tripled (both in kilograms and dollars),[18] underpinning the expansion in those years (see figure 11).

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[18] The result in reais was less significant, especially owing to the devaluation of the currency between 2002 and 2003. However, between 2003 and 2005, growth was 85%.

FIGURE 11

Brazil: production by destination and apparent consumption by origin in the machinery and equipment sector for the paper and pulp industries, 2000-2012
(Millions of reais)
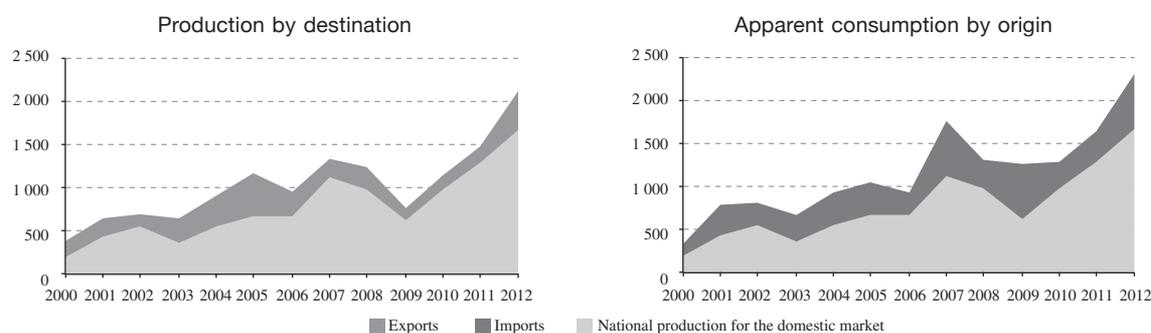
Source: Prepared by the author, on the basis of data from the Brazilian Geographical and Statistical Institute (IBGE) and *AliceWeb* of the Ministry of Industry, Foreign Trade and Services.

Unlike the other segments analysed, the domestic market for machinery and equipment for the paper and pulp industry experienced its strongest growth in 2007, when apparent consumption (which was virtually stable) rose by 89.3%. However, the increase in demand meant a significant loss of market share to imported products, as illustrated by an import penetration ratio that increased in current terms from 26.4% to 36.3%.

The Grubel-Lloyd index for the sector indicated that trade was primarily inter-industrial in 2007 (0.29).[19] And the domestic supply of machinery and equipment for the paper and pulp industries was unable to absorb the growth in domestic demand, owing to lack of production capacity as well as lack of diversification in the goods produced.

(e) *Machinery and equipment for metallurgy, excluding machine tools*

Although exports were up at the start of the post-2003 expansion cycle, activity in the machinery and equipment sector for metallurgy remained nearly flat[20] (see figure 12). However, sector production soared by 84.2% in real terms between 2005 and 2006, following a sharp increase in domestic demand. The jump in production, though, was not sufficient to meet domestic demand, especially because the goods made by Brazilian companies were technologically inferior to imports (with less unit value) and trade was primarily inter-industrial and vertical.[21]

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[20] Between 2002 and 2004, sector production fell by 30.1% in real terms (value of production deflated using the Getulio Vargas Foundation's wholesale price index–global supply–machinery and equipment).

[21] In 2008, the Grubel-Lloyd index for the machinery and equipment sector for the metallurgy industry was 0.28, and the ratio between the export unit value and the import unit value was 0.41. This indicates primarily inter-industry and vertical trade (see annex A2).

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[19] See annex A2.

FIGURE 12

Brazil: production by destination and apparent consumption by origin in the machinery and equipment sector for metallurgy, excluding machine tools, 2000-2012
(Billions of reais)
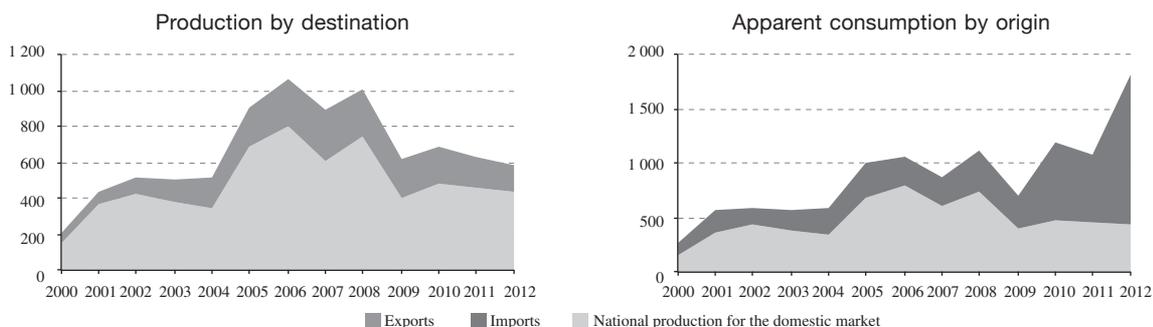
Production by destination

Apparent consumption by origin

■ Exports ■ Imports ☐ National production for the domestic market

Source: Prepared by the author, on the basis of data from the Brazilian Geographical and Statistical Institute (IBGE) and *AliceWeb* of the Ministry of Industry, Foreign Trade and Services.

As a result, much of the increase in domestic demand for capital goods in the metallurgy industry, especially in 2008, was met with imports, inasmuch as local manufacturers had little import substitution capacity.

Starting in 2008, the technological inferiority of Brazilian products in this sector became even more evident, and flat investment in metallurgy further impaired the national machinery and equipment industry for metallurgy. The import penetration ratio stood at 76.1% in 2012, and the national industry, already stalled since 2006, began to shrink.

(f) *Machinery and equipment for the textile, apparel and footwear industries*

The machinery sector for the production of textiles, apparel and footwear was virtually stagnant

for throughout the entire period of economic expansion (see figure 13). Although exports grew in relative terms through 2003, export activity began to drop off in 2004 and the domestic market was unable to sustain demand for Brazilian-made machinery. The expansion in the domestic market, though relatively small, was almost completely absorbed by imports.[22] As a result, the import penetration ratio in the sector, which was already high, rose even higher, from 60.8% in 2005 to 72.4% in 2008.

Against that backdrop, the national machinery and equipment industry for the production of textiles, apparel and footwear was unable to meet demand —actual or

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[22] Between 2005 and 2008 (the period of strongest investment growth in the sector), apparent consumption in the sector grew by R$ 656 million, of which R$ 632.6 million (96%) was met with imports.

FIGURE 13

Brazil: production by destination and apparent consumption by origin in the machinery and equipment sector for the textile, apparel and footwear industries, 2000-2012
(Billions of reais)
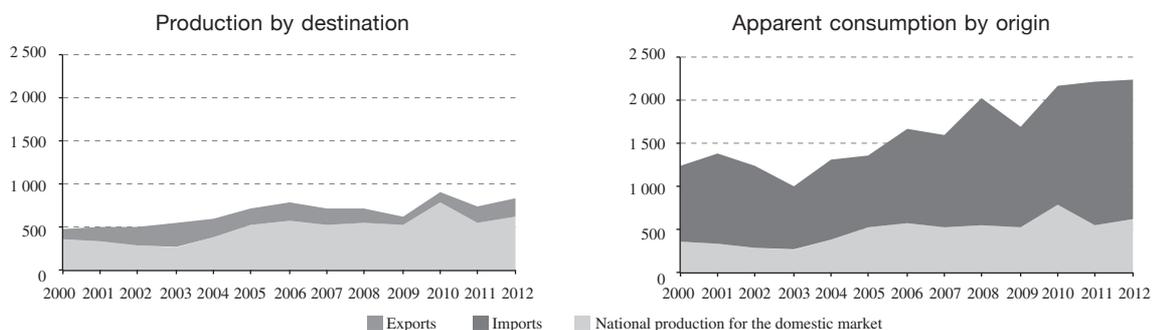
Production by destination

Apparent consumption by origin

■ Exports ■ Imports ☐ National production for the domestic market

Source: Prepared by the author, on the basis of data from the Brazilian Geographical and Statistical Institute (IBGE) and *AliceWeb* of the Ministry of Industry, Foreign Trade and Services.

potential— in related sectors, pointing to near total dependence on machinery imports for expansion.

(g) *Summary of performance in the industrial machinery and equipment sector*[23]

Performance in the industrial machinery and equipment sector varies by segment and period of analysis. Three distinct periods can be identified: the first, from 2002 to 2004, was characterized by export-driven growth; the second, from 2005 to 2008, by a more lasting expansion that largely extended to all sectors; and the third, from 2008 to 2012, by demand that continued to grow in some sectors and started to contract in others.

The main driver of demand in the first period was the foreign market. In those years, the machinery and equipment sector for mining and construction excelled, posting strong growth. Though less intense, the growth in the sector supplying the paper and pulp industry was notable too and almost entirely fuelled by the foreign market.

In contrast, demand in the second period was primarily driven by domestic investments in the industry. Although these investments stimulated production in sectors mainly oriented towards the local market, they also spurred imports. With the exception of the sector making machinery and equipment for the textile, apparel and footwear industries, in which domestic demand was covered almost entirely by imports due to lack of diversification in the national supply, all sectors took advantage of the demand in the second period to expand.

Lastly, the main driver of demand in the third period was the domestic market, but this was concentrated in the petroleum and gas and mining and construction sectors and so the benefits accrued above all to manufacturers

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[23] See the summary of performance by period in the table in annex A3.

of machinery and equipment for those industries. This led to stagnation in the other sectors, and in the less competitive cases, to expansion in the import sector, with imported products replacing national products.

The sectors that supply machinery and equipment for petroleum exploration and production and mining and construction grew in parallel with the imports that supplemented national supply, creating a horizontal intra-industry trade, i.e. the same types of products with similar technological content. Starting in 2008, trade in these sectors, which continued to expand, became vertical in favour of national production. In other words, national products came to have greater technological content than imported products.

Meanwhile, in the sectors that manufacture machinery and equipment for the paper and pulp, metallurgy and textiles, apparel and footwear industries, there was strong import growth. In the case of the sector supplying the paper and pulp industry, growth was evident above all in the supply of non-national products (inter-industry trade), due to lack of diversification in national supply. In the metallurgy and textile industries, the growth of imports replacing national products could be attributed to the fact that foreign products had significantly higher technological value than national products.

The sector supplying the food, beverages and tobacco industries was a unique case in the sense that there was little penetration by imported products, as well as low export ratios. Development in that sector was closely tied to the increase in demand from the second period (2006-2008), with lower demand in the post-crisis period directly affecting sector production. In short, this sector had sufficient potential to absorb domestic demand (both in technological and productive terms), but it is also very dependent on it.

V

Conclusion: important considerations for an effective industrial policy for the capital goods sector

The capital goods industry, when defined not by its productive aspects but rather its end purpose, is very diverse and includes a variety of sectors with distinct characteristics. In general, two groups can be distinguished based on their capacity to meet domestic demand: the sectors characterized by national production possessing the technological potential to absorb expansion in the domestic

market, and the sectors with poorly diversified national production lacking the productive and technological capacity to compete with imported products.

As mentioned previously, the first group encompasses the sectors that manufacture transportation equipment, farm machinery and equipment, electrical generation and distribution equipment and machinery and equipment

for petroleum exploration and production, for mining and construction, and, lastly, for the production of food, beverages and tobacco. These industries were largely able to meet domestic demand during the investment expansion cycle, and in the post-crisis period they experienced growth fuelled by domestic demand. The parallel expansion of imports, especially between 2005 and 2008, can be attributed not to the lack of technological diversification in the national productive apparatus but rather to lack of prior investment (which led to insufficient installed capacity) and macroeconomic imbalances, particularly exchange rate appreciation that favoured imports to the detriment of national production.

The second group consists of the sectors that manufacture machinery and equipment for the paper and pulp, metallurgy and textiles, apparel and footwear industries. In these branches of the capital goods industry, imports covered a disproportionate share of the expansion in domestic demand, owing especially to the lack of technological potential among national producers. For these industries, lack of national supply cannot be entirely explained by macroeconomic imbalances or lack of prior investment, which suggests that these segments would only be able to serve the internal market through policies targeted to and coordinated with the demand sectors for their products.

The computer, electronics and communications sector is an exceptional case in this second group. This sector's loss of competitiveness in the local market and the absorption of an increasing share of demand by imports should be understood as fairly unique inasmuch as this sector makes parts and components for other machinery and equipment industries. Thus, when import prices fell and these products displaced domestic supply, it was an opportunity for the other industries to expand.

In the case of the sectors of the capital goods industry that have the technological potential to cover expanded demand, industrial policy should focus on both coordination of investments (so demand for machinery does not overwhelm the national supply capacity) and scaling (to stimulate the creation of supply in the sectors of the machinery and equipment industry for which there will be demand in the future).[24] To this end, the Brazilian government must position itself as an agent

in the investment coordination and orientation process (either directly, as producer, or indirectly, as inducer),[25] such that the sectors of the capital goods industry with technological potential can meet the demand that will be created. In the absence of coordination of supply and demand for investment goods, the sectors that currently have the potential to meet demand —such as the machinery and equipment sectors for the oil and gas, mining and food industries— will not be able to take advantage of the opportunities that emerge.

Furthermore, specifically in relation to these sectors with potential to meet domestic demand, industrial policy must be complemented by development-oriented macroeconomic policy that does not counteract industrial policy through abnormally high interest rates with respect to international patterns or a currency that appreciates cyclically in real terms. Such conditions are a perennial hindrance to the efficacy of financing instruments and make the business sector more risk averse, discouraging the creation of supply (Cano and Silva, 2010, p. 21). It is important to understand that these sectors can be competitive, even in foreign markets, if domestic demand is used to support their expansion. To ensure that opportunities for current growth are not wasted, efforts should be made to consolidate an "authentic competitiveness," supporting the absorption of domestic demand and promoting export activity, through tariff neutrality and exchange rates that are slightly depreciated in real terms, taking care that they remain stable over the long run (ECLAC, 2000, p. 906).

As noted by Coutinho (2011, pp. 33-34), lead or "anchor" companies and programmes have an important role to play in mobilizing funding for research, which translates into technology development for the country. According to Coutinho, the examples set by Petrobras (with major technological advances in deepwater exploration) and some agribusiness firms (which, with the support of the Brazilian Agricultural Research Enterprise (EMBRAPA), have enabled technological development at a number of Brazilian companies) demonstrate that there is generally a powerful company taking the lead in sectors where major advances are being made.

As mentioned, the opportunities available at present in the Brazilian economy require an effective policy for

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[24] As explained by Rodrik (2004, p. 13), the coordination of investments and production decisions (by an organized private sector or at government initiative) is an important industrial policy mechanism, inasmuch as investments by company A often depend on the demand and investments of company B, and vice versa (simultaneous investing increases the profitability of all investments). This is not a new theory in the so-called "economics of development;" it was pioneered in the seminal article published by Rosenstein-Rodan (1943).

[25] Responsibility for coordinating investments should not necessarily fall to the government. According to Almeida (2009), the formation of national groups promotes the formation of a chain of national suppliers, through the coordination of investments and an industrial policy. Moreover, as noted by Laplane (2004), orientation and coordination also require a foreign policy focused on the regional integration strategy of the supply chains, given the importance of demand in the neighbouring countries.

the capital goods sector. The recent expansion in the domestic market (especially, its impact on investment), the enhanced capacity of the government to use its procurement and financing power (with respect to the fiscal crisis that began in the 1980s), the direction of foreign capital flows (which can spur direct investments with technology transfer), higher commodity prices (which would avoid external constraints, at least in the short run) and the presence of firms with technological potential are some of the factors that should be considered in the consolidation of a policy to promote sector competitiveness.

If the country fails to take advantage of the expansion in the domestic market as a strategic variable for shoring up a national industry vulnerable to swings in demand —as is the case with the capital goods industry— and also fails to consider the systemic factors cited in this paper (which would promote an orderly and selective process), the lack of supply capacity in the capital goods sector could impose future constraints on the development of the economy, in terms of both the balance of payments and technological dependence. If that were to happen, economic growth could again be hindered by a reversal in external conditions.

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ANNEXES

ANNEX A1

Brazil: segmentation of the capital goods industry[a]

Groups and subgroups	CNAE 2.0[b]	CNAE 1.0[b]
Computer, electronics, instruments and optical equipment		
Computer and peripheral equipment	262	302
Communication equipment	263	322
Metering, testing and control devices and equipment	2651	332 and 333
Electromedical and electrotherapy devices and radiation equipment	266	331
Optical, photographic and cinematographic instruments and equipment	267	334
Electrical generation, distribution and control equipment		
Electric generators, transformers and motors	271	311
Electrical distribution and control devices and equipment	2731	3121
Tractors, machinery and equipment for agro-industry		
Tractors, machinery and equipment for agro-industry	283	293
Industrial machinery and equipment		
Motors, pumps, compressors and transmission equipment	281	291
General use machinery and equipment	282	292 and 301
Machine tools	284	294
Machinery and equipment for petroleum exploration and production	2851	2951
Tractors, except farm	2853	2953
Machinery and equipment for mining and construction	2852 and 2854	2952 and 2954
Machinery for the metallurgy industry, except machine tools	2861	2961
Machinery and equipment for the food, beverage and tobacco industries	2862	2962
Machinery and equipment for the textile industry	2863	2963
Machinery and equipment for the apparel, leather and footwear industries	2864	2964
Machinery and equipment for the pulp, paper, cardboard and packaging industries	2865	2965
Machinery and equipment for specific industrial uses not specified above	2866 and 2869	2969
Transportation equipment		
Trucks, buses, cabins, trailers and hitches	292 and 293	342 and 343
Boats and floating structures	3011	3511
Trains, railroad cars and other rolling stock	3031	3521
Airplanes	304	3531

Source: Prepared by the author, on the basis of data from the National Classification Commission (CONCLA)-Brazilian Geographical and Statistical Institute (IBGE).

[a] Versions 1.0 and 2.0 of the National Classification of Economic Activities (CNAE) were harmonized based on data from the National Classification Commission (CONCLA) of the Brazilian Geographical and Statistical Institute (IBGE) for the purpose of extending the comparison to the entire period of analysis. Harmonization of the two versions is necessary inasmuch as data are taken from the Annual Survey of Industry-Enterprise and the Annual Survey of Industry-Product, both prepared by IBGE, which were published at different times: the first between 1996 and 2007, in the framework of CNAE 1.0, and the second between 2007 and 2012, in the framework of CNAE 2.0. For the analysis, data on foreign trade were also collected from the Centre for Foreign Trade Studies Foundation (FUNCEX) and *AliceWeb* of the Ministry of Industry, Foreign Trade and Services (MDIC). In this case, the harmonization was based on the MERCOSUR Common Nomenclature (MCN), which is the classification used by the MDIC for trade data.

[b] Versions 1.0 and 2.0 of the CNAE do not necessarily yield the same results, as some of the products in one classification are not included in the harmonized group of the other classification.

ANNEX A2

Brazil: other indicators of trade in industrial machinery and equipment sectors

A. Ratio between export and import unit values

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Petroleum exploration and production	0.54	0.52	0.58	0.60	0.43	0.50	0.60	0.64	1.03	1.34
Mining and construction	0.79	0.96	0.97	0.77	0.90	0.90	0.84	0.99	1.12	1.00
Metallurgy, excluding machine tools	0.21	0.18	0.25	0.28	0.36	0.29	0.41	0.44	0.41	0.44
Food, beverages and tobacco	0.29	0.19	0.27	0.30	0.24	0.35	0.32	0.43	0.29	0.31
Textiles, apparel and footwear	0.60	0.58	0.57	0.62	0.62	0.72	0.75	0.81	0.96	0.83
Paper and pulp	0.69	0.78	0.60	0.63	0.54	0.60	0.82	0.81	0.91	0.64

Source: Prepared by the author, on the basis of data from *AliceWeb* of the Ministry of Industry, Foreign Trade and Services.

B. Grubel-Lloyd index

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Petroleum exploration and production	0.37	0.36	0.52	0.54	0.55	0.62	0.65	0.57	0.56	0.42
Mining and construction	0.36	0.31	0.33	0.28	0.20	0.25	0.29	0.38	0.39	0.40
Metallurgy, excluding machine tools	0.39	0.21	0.32	0.32	0.38	0.35	0.35	0.32	0.28	0.28
Food, beverages and tobacco	0.37	0.46	0.56	0.56	0.52	0.49	0.40	0.55	0.45	0.43
Textiles, apparel and footwear	0.09	0.10	0.13	0.15	0.16	0.21	0.15	0.16	0.18	0.16
Paper and pulp	0.31	0.25	0.38	0.39	0.51	0.37	0.48	0.29	0.51	0.26

Source: Prepared by the author, on the basis of data from *AliceWeb* of the Ministry of Industry, Foreign Trade and Services.

ANNEX A3

Brazil: summary of performance in the industrial machinery and equipment sector

Segment	1st period (2002-2004)	2nd period (2005-2008)	3rd period (2008-2012)
Petroleum exploration and production	Stagnant domestic market and low export ratio	Growth based on the domestic market, but in parallel with imports (horizontal intra-industry trade)	Growth based on the domestic market, with intensification of technological content
Mining and construction	Export-driven growth	Growth based on exports and the domestic market, but with a sharp increase in imports (horizontal intra-industry trade)	Growth based on exports and the domestic market, with intensification of technological content
Food, beverages and tobacco	Stagnant domestic market and low export ratio	Growth based on the domestic market, but in parallel with imports (horizontal intra-industry trade)	Stagnation due to lower investments and difficult access to external market
Paper and pulp	Low growth despite high export ratio	Growth based on the domestic market in 2007, but with a sharp increase in imports (inter-industry trade: lack of diversification in the national supply)	Stagnation due to lower investments and lack of diversification, which favoured the penetration of imports
Metallurgy, excluding machine tools	Low growth based almost exclusively on exports	Growth based on the domestic market, but with a sharp increase in imports, especially with high technological value (vertical trade)	Contraction due to lower investments and an increase in imports with greater technological content
Textiles, apparel and footwear	Stagnation and an increase in the export ratio	Low growth, with the domestic market absorbed almost completely by imports (inter-industry trade: lack of diversification in the national supply)	Contraction due to lower investments and an increase in imports with greater technological content

Source: Prepared by the author.

Socioeconomic school segregation in Chile: parental choice and a theoretical counterfactual analysis

Humberto Santos and Gregory Elacqua

ABSTRACT

In this article, we examine the hypothesis that the policy of parental school choice in Chile has increased socioeconomic school segregation. We use a georeferenced database of students and schools in the Greater Metropolitan Area of Santiago to compare actual segregation with the segregation that would occur in the hypothetical case that students attended the school nearest to their place of residence. The results indicate that school segregation is higher in the actual scenario than in the counterfactual scenario, which suggests that the interaction between family preferences and school entry barriers (tuition and selective admission process) tend to increase school segregation beyond the city's underlying residential segregation.

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I

Introduction

In 1981, the Chilean school system underwent a structural reform enacted by the military regime (1973-1989). First, the government decentralized the administration of public schools, transferring their management from the central government to municipalities. Second, it changed the funding formula for public and private schools. Public schools continued to receive funding from the central government, but municipalities were now paid a subsidy (voucher) for each student enrolled in their schools. Private schools —non-profit and for-profit— that did not charge tuition fees received the same per-pupil subsidy for every student as public schools. These policies were introduced as a way to increase the autonomy of public schools and promote efficiency by encouraging competition to attract larger numbers of students.

The essential components of the universal system of school choice have remained in place for over three decades. The only significant changes to the rules under which the voucher programme operates were introduced in 1994, when the government enacted a law allowing private voucher schools and public high schools to charge limited tuition, and in 2008 when the government banned primary schools from using parental interviews as part of admissions procedures. Also in 2008, the government introduced an additional voucher (50% over the base voucher) for students classified as disadvantaged by the Ministry of Education. These modifications were meant to improve the design of the vouchers programme by providing schools with incentives to attract a diverse student body and providing parents with more access to a diverse set of schooling options and objective information on schools.

There is an extensive body of literature in Chile that has explored the effects of the country's national voucher programme on student achievement (see, for example, Auguste and Valenzuela, 2004; Gallego, 2002; Hsieh and Urquiola, 2006). However, the question of whether school choice has an effect on socioeconomic segregation (SES) has been addressed only recently (for example, Bellei, De los Ríos and Valenzuela, 2014; Elacqua, 2012). This issue has emerged as a concern for two main reasons. First, there is evidence to suggest that the Chilean school system has one of the highest levels of socioeconomic school segregation among the

countries participating in the Programme for International Student Assessment (PISA) (OECD, 2011). Second, a considerable body of international literature shows that school segregation has adverse effects on different outcomes, such as educational achievement (Hanushek, Kain and Rivkin, 2009; Hoxby, 2002; Kahlenberg, 2001; Zimmer and Toma, 2000), adolescent pregnancy, the probability of school dropout (Guryan, 2004), the educational environment at the school (Hanushek and others, 2004), non-cognitive outcomes such as intellectual engagement and motivation (Crain and Strauss, 1985; Rothstein, 2004; Wells and others, 2008), and civic engagement indices (Levinson and Levinson, 2003). Although there is relative consensus about the high levels of school segregation and its negative effects, there is less agreement about the extent to which Chile's national voucher programme contributes to this outcome. On the one hand, critics argue that the interaction between the preferences exercised by families and the entry barriers erected by schools tends to increase school segregation (Bellei, De los Ríos and Valenzuela, 2014). On the other hand, proponents assert that school segregation is explained mainly by Chile's unequal income distribution and the high levels of residential segregation typical of its cities and neighbourhoods (Beyer and Eyzaguirre, 2014).

To advance this debate, we have constructed a unique data set using georeferenced information on the students and schools in the Greater Metropolitan Area of Santiago to study the effect of school choice on socioeconomic segregation. Specifically, in this article we compare actual school segregation with the level of segregation that would occur in the hypothetical case that students attended the school closest to their place of residence. If school choice and other structural components of the system (as opposed to residential segregation) are the driving force behind school segregation, then actual school segregation should be greater than school segregation in the hypothetical (non-choice) scenario. One of the most interesting features of the Chilean case is the co-existence of different types of education providers, which allows researchers to analyse differences in the behaviour of public, for-profit and non-profit private voucher schools. There is limited evidence on this point, because most school systems do not provide public funding to for-

profit schools. In most countries, schools continue to be funded and managed primarily by the government, and private schools are usually required to have non-profit status (Elacqua, 2012; James, 1993).

This article is organized in sections, including the Introduction. The second section presents a literature review on the effects of school choice on segregation in Chile. Section III describes the methodology for the study. Section IV presents the data used and section V discusses the main findings. Lastly, section VI offers conclusions and discusses the study's implications for public policy.

II

Literature review

Voucher advocates argue that, given the high levels of residential segregation in most cities, school choice can reduce school segregation by providing low-income parents with access to more integrated schools outside their neighbourhoods (Moe, 2001). Some have also argued that since parents may have more objective information about school quality (e.g. standardized test scores) than about neighbourhood quality, school choice may depend less on family sociodemographic profiles than the choice of neighbourhood in which to live (Krysan, 2002). As a result, advocates maintain that voucher policies are more effective than traditional proximity assignment programmes at reducing socioeconomic school segregation.[1]

Critics of school choice have cited education service demand and supply factors that can influence the concentration of students from similar socioeconomic levels within schools. On the demand side, sceptics maintain that a school's social composition is an attribute valued by families. For example, Elacqua, Buckley and Schneider (2006) find that families in Santiago are more likely to choose a school on the basis of its socioeconomic composition than objective indicators of academic performance. However, if family assessment of school attributes varies according to their own characteristics, then students from different socioeconomic levels will not choose to attend the same type of school. For example, Gallego and Hernando (2009) find that, in choosing a school, higher-income families afford less importance to distance than other families, and more importance to academic quality (measured by test score results). Lastly, there is concern that parents of lower socioeconomic status do not have the resources to choose their children's school (e.g. information about available alternatives,

networks, time, the ability to process the information, and so forth). Elacqua and Fábrega (2004), for example, find that parents with a low level of education are more likely to form their opinions based on information they receive from their social networks (family, neighbours, friends, church members, colleagues and neighbourhood associations) compared with parents with a higher level of education. However, the quality of their networks —measured by the members' level of education— is low compared with those of higher-income parents.

On the supply side, voucher critics argue that competition leads some schools to select more advantaged students who are less costly to educate. For instance, Hsieh and Urquiola (2006) find that the flat voucher introduced in Chile in 1981 led to an increase in school stratification, mainly through the exodus of middle-class students from public schools into the private voucher schools.[2] One of the major effects of the 1981 reform was to diversify the supply of private schools, especially through the emergence of for-profit suppliers, a sector that today accounts for a third of total enrolments (Elacqua, Martínez and Santos, 2015).

There is a heated debate on for-profit schooling. The main argument in favour of these schools is that the profit motive requires them to focus on the client, leading to a better balance between parent preferences and school mission. Although a diversity of alternatives is fundamental to a school choice system, critics claim that this differentiation reduces the integration of students from distinct social and cultural origins (Bellei, 2010). Critics have argued that since for-profit schools are oriented towards gaining economic rents, they will try to

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[1] For a discussion of the factors that influence school and neighborhood choices, see Bifulco, Ladd and Ross (2009).

[2] The preferential school subsidy (SEP), introduced in 2008, changed the incentives for schools. It introduced an additional subsidy for vulnerable students and prohibited schools from collecting fees from these students. The General Education Law (LGE), also enacted in 2008, banned selection practices in primary grades (first to sixth grade).

cut costs by targeting students who are more advantaged and less expensive to educate (Levin, 2002). Some scholars have also argued that non-profit schools, which enrol approximately 15% of the student body in Chile, are better positioned to serve disadvantaged students than for-profit schools because they are often able to rely on grants and lower labour costs (such as volunteers) to finance the large investment involved in educating low-income students (Rose-Ackerman, 1996). Only recently have studies begun to analyse behavioural differences between the various types of private providers in the Chilean education system. For example, Elacqua (2012) shows that, contrary to expectations, for-profit schools enrol a higher percentage of low-income students than non-profit schools. Nonetheless, school segregation is higher within the for-profit sector, which suggests that these schools seek market niches in different socioeconomic groups.

There are two mechanisms that Chilean schools can use to shape their student bodies: charging school fees and screening students. The main argument against charging school fees is that mandatory tuition would segment the private voucher sector based on family ability-to-pay. In fact, Bellei, De los Ríos and Valenzuela (2014) find that, on average, the larger the number of fee-paying schools in a neighbourhood, the higher the level of socioeconomic segregation in that neighbourhood's schools. Elacqua (2012) shows that schools that charge tuition enrol a smaller proportion of low-income students than free private voucher schools and public schools. This study also finds that the private voucher school sector that charges tuition is more internally segregated than the public sector and the free private voucher school sector. However, other researchers question these results. For example, Gallego and Hernando (2008) argue that

segregation can be better explained by factors associated with family preferences and that banning tuition fees would have only moderate effects on school segregation.

Regarding the school admission process in Chile, the evidence suggests that although the General Education Law (LGE) prohibits selection in primary grades, many schools still conduct interviews with parents and require them to provide proof of income and affinity with certain religious beliefs (e.g. christening or religious marriage certificates), especially in the private voucher sector. Many schools also require students to sit entrance exams (Bustos, Contreras and Sepúlveda, 2010; Carrasco and others, 2014; Elacqua, Martínez and Santos, 2011).

In addition to factors directly related to supply and demand, in most school systems —regardless of the degree of parental choice— residential segregation in cities is linked to school segregation. In the case of Chile, there is evidence that a significant percentage of parents tend to choose schools close to where they live —especially pre-primary and primary school— which creates a direct relationship between the social makeup of the neighbourhood and that of the school. For instance, Alves and others (2012) find that 70% of fourth-grade students enrolled in public and private voucher schools in the Greater Metropolitan Area of Santiago travel less than 1.5 km to get to school. Thus, some have concluded that residential segregation is the main driver of increased school segregation (Beyer and Eyzaguirre, 2014; *El Mercurio*, 2013).

In this paper, we examine the hypothesis that the policy of parental school choice has increased socioeconomic segregation in Chile, by comparing actual segregation with the hypothetical segregation that would occur if students attended the school closest to where they live.

III

Methodology

The empirical strategy of this article is based on two principal components. First, we define the concept of segregation and analyse the various indices used to measure it, which are derived from the literature developed to study residential and school segregation among racial minorities (Duncan and Duncan, 1955; James and Taeuber, 1985; Massey and Denton, 1988; White, 1986; Zoloth, 1976). Second, we present the

design of the counterfactual scenario and the assumptions on which it is based.

1. Segregation indices

In very general terms, segregation is the degree to which two or more groups are isolated from each other within a certain geographical space. According to Massey and

Denton (1988), there are five dimensions by which different groups can be segregated: evenness, exposure, concentration, centralization and clustering. Of these dimensions, evenness and exposure have been more methodologically resolved in the literature, and there are various alternative indices for each measure.

First, we used the two-group (Duncan and Duncan, 1955) and multigroup (Reardon and Firebaugh, 2002) versions of the dissimilarity index or Duncan index (D). Assuming two groups,[3] one defined as the minority group (e.g. socioeconomically disadvantaged students or students belonging to an ethnic group) and the other as the majority group (rest of students), and defining T and P as the total population size and proportion of the minority group in the city, respectively, with t_i and p_i denoting the same values for school i, this index is mathematically defined as:

$$D = \sum t_i \left| p_i - P \right| \Big/ 2TP(1 - P)$$

where D is the weighted average deviation of the proportion of minority students in each school from P, expressed as a fraction of its maximum. Therefore, D is a value between 0 (no segregation) and 1 (complete segregation). D can be interpreted as the proportion of all students in either group to be transferred so that p_i is equal to P for all i, or in other words, for every school in the city to have the same social composition (Duncan and Duncan, 1955).

Second, we use the exposure index (X), which is defined as:

$$E = \sum t_i (1 - p_i) \Big/ T$$

where T is the total number of minority students in the city and t_i and p_i are the number and proportion of students belonging to minority groups in school i. The index can be interpreted as the percentage of students from the majority group that exists in the average school attended by a minority student. Unlike the Duncan index, this index depends on the relative size of the groups, which implies that it is sensitive to the definition of minority group and thus is not symmetrical (i.e. the

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[3] The mathematical expression for the multigroup dissimilarity index can be found in Reardon and Firebaugh (2002). Interpretation of this index is similar to that of the two-group version. The difference is that in this case the distribution is in n groups, instead of dividing the population into two mutually exclusive categories.

index does not necessarily have the same value for the minority and majority groups).

We use the Duncan index because it meets the key criteria for a segregation index (James and Taeuber, 1985), insofar it is widely used in the empirical literature and because it has a direct interpretation, facilitating comparison with national and international studies. We use the exposure index because it is simpler to interpret, which facilitates analysis of our results. Although there are other segregation indices used in the literature that fulfil more stringent properties, they are generally not simple to interpret and are used mainly for comparisons over time and between cities (Reardon and Firebaugh, 2002).

2. The design of the counterfactual scenario

There are several studies that compare the observed level of school segregation with the level simulated in different counterfactual scenarios in which all students attend the public school to which they are geographically assigned (Bifulco, Ladd and Ross, 2009, for the school district of Durham, North Carolina; Sohoni and Saporito, 2009, for the 22 largest school districts in the United States; Riedel and others, 2010, for the city of Wuppertal, Germany) or the school closest to their place of residence (Allen, 2007, for England; Östh, Andersson and Malmberg, 2013, for Sweden), using available georeferenced information on schools and families. Although they analyse systems with different degrees of school choice, all five studies show that the level of school segregation by race, ethnicity, socioeconomic level and/or ability is greater in the actual scenario —i.e. where families can choose a school different from the one assigned to them or the one closest to their place of residence— than in the counterfactual scenario. Thus, they conclude that school choice exacerbates school segregation.

We employ a method similar to the one used by Allen (2007), who simulates a counterfactual scenario where students attend the school closest to their place of residence. The level of school segregation in this case is explained entirely by the geographical distribution of students from different socioeconomic levels within the city (residential segregation) and by school location. The difference between this segregation level and the actual level is what Allen (2007) terms post-residential segregation, because it measures the additional effect of the choices of families who send their children to a school other than the one closest to their residence, whether by their own decision or because that school is not accessible to the student.

We acknowledge that this counterfactual may not be exactly what would occur in the absence of a school choice policy. First, it assumes that families cannot change their place of residence. Yet there is evidence that the decision of where to live depends on the available educational supply.[4] Hence, in a hypothetical scenario where students must attend the closest school, one would expect, at least in the long term, greater residential mobility among parents seeking access to the schools that best match their preferences. Since a change of residence is costly, this choice mechanism would be available mainly to high-income families, which would increase levels of residential and school segregation. Second, the counterfactual assumes that schools do not use any kind of selection mechanism and, therefore, that the distribution of students is based exclusively on place of residence. Third, it assumes that there are no new schools and that existing schools remain within the system. Finally, the counterfactual analyses do not consider school capacity restrictions given their current facilities.

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[4] For example, researchers have consistently found that public school performance has a significant impact on housing prices in school systems where students are assigned to schools based on their place of residence (Black, 1999; Bayer, Ferreira and McMillan, 2007; Reback, 2005, for the United States; Gibbons and Machin, 2003 and 2006, for the United Kingdom; and Fack and Grenet, 2010, for France).

IV

Data

Our empirical analysis uses data on fourth-grade students in the Greater Metropolitan Area of Santiago during the 2010 school year. The data are drawn from four sources. First, the national standardized test (SIMCE) parent survey contains information on the student's socioeconomic level, including the highest level of education obtained by the student's parents.[5] Second, the General Student Information System (SIGE) of the Ministry of Education (MINEDUC) includes an address for most public and private voucher school students.[6] Third, MINEDUC administrative information contains information on the school characteristics, including ownership type (for-profit, non-profit) and tuition fees. Finally, the MINEDUC website carries an address for every preschool, primary school and secondary school in Chile.[7]

The target population consisted of students attending public and private voucher schools in the Greater Metropolitan Area of Santiago (69,014). From this universe, we were able to georeference the addresses of 31,645 students (46%).[8] The majority of students without addresses were cases where the SIGE database showed the address field as empty, while a smaller percentage corresponded to addresses that could not be located.[9] After eliminating a group of students whose place of residence was outside the Greater Metropolitan Area of Santiago, we had a sample of 31,371 students distributed among 1,240 schools. Using the coordinates of the place of residence of each student and the coordinates of all schools in Santiago, we were able to determine the nearest

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[5] According to data from fourth-grade SIMCE 2010, 95.2% of households returned the questionnaire to the school. To test whether there are significant differences between students with and without information, we compared the 2010 fourth-grade SIMCE test score in reading, mathematics and history and the socioeconomic level of the school of attendance for both groups. The results indicated that, on average, students with questionnaires scored 10 points higher in reading, 8.5 points higher in mathematics, and 8.5 points higher in history than those without questionnaires. However, we also found that students whose households did not return the questionnaires tended to go to lower-socioeconomic schools. Both results indicate that low-SES students are slightly underrepresented in the sample.

[6] Our database does not contain any other personal data that would reveal a student's identity (e.g. name and ID number).

[7] The database in .kmz format (Google Earth) is available at http://www.mineduc.cl.

[8] Private non-voucher schools were not considered due to the low percentage of students with address data. The normalization, validation and geocodification (obtaining the geographical coordinates) of the addresses was done by Infomatic (http://www.infomatic.cl/).

[9] One weakness of SIGE is that there is no precise information about the process of collecting addresses within each school because it is not mandatory to collect this information. In order to determine if there was any bias in the sample of students with coordinates, we calculated means difference tests for the parents' years of schooling, household income, SIMCE results and household size for students with and without coordinates. The results indicate that the differences, although significant in some cases, are of a very low magnitude. In order to see the results by school, we calculated the mother's average years of schooling by school, first using the sample with coordinates and then using the total student population. In 80% of schools, the difference between these figures is greater than -1 (the sample underestimates the mother's average years of schooling by less than a year) and less than 1 (the sample overestimates the mother's average years of schooling by less than a year).

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school for each student, which we used to construct the counterfactual scenario. We used the information on the school actually attended by each student to build the actual segregation indices for this same sample.

Each student's socioeconomic status (SES) was determined by the highest level of education obtained by either of the student's parents.[10] Based on that information, the students were then classified into three categories: low socioeconomic status (low-SES), for less than 12 years of education or incomplete high school education; middle socioeconomic status (middle-SES) for 12 years of education or high school graduates; and high socioeconomic status (high-SES) for over 12 years of education or tertiary education, whether complete or incomplete.

Schools were classified by two criteria. First, they were divided into three categories based on ownership type: (i) public; (ii) for-profit voucher, and (iii) non-profit voucher.[11] Second, schools were divided into four categories based on the entry barriers that they establish for families: (i) low price and low selectivity; (ii) high price and low selectivity; (iii) low price and high selectivity, and (iv) high price and high selectivity. A school was considered low-price when the monthly tuition charged

during the 2009 school year was US$ 15 or less.[12] A school was considered to be low-selectivity when fell within the first seven deciles of an index constructed from information about the requirements and records that parents must present when applying for enrolment, which was obtained from the national standardized test (SIMCE) fourth-grade parent survey.[13] Table 1 presents the descriptive statistics of the final sample.

TABLE 1

Descriptive statistics of the final sample
(Percentages)

Student socioeconomic status	
Low	25.1
Middle	39.6
High	35.3
School ownership types	
Public	35.1
Private for-profit voucher	46.6
Private non-profit voucher	18.4
Entry barriers	
Low price/low selectivity	52.8
High price/low selectivity	13.6
Low price/high selectivity	11.5
High price/high selectivity	22.1
Attend the nearest school	19.1

Source: Prepared by the authors.

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[10] That is, either the father's years of schooling or the mother's years of schooling. Parents' schooling has been widely used in other research to construct indicators of students' socioeconomic status. For a review of various definitions, see Sirin (2005).

[11] The for-profit owners include individuals and legal entities. In the latter case, this may be a public limited company, a limited liability company or an individual limited liability company. Meanwhile, non-profit owners include organizations such as foundations, religious congregations, trade associations, unions, neighbourhood associations, community organizations and cooperatives.

[12] Schools that charge up to US$ 15 are equivalent to free schools since they do not have any discounts applied to the per student voucher.

[13] Using principal components analysis, we calculated an index that combines five variables, which correspond to the percentage of parents who said they had been required to: (i) present a christening and/or religious marriage certificate; (ii) present report cards from the previous school; (iii) present a salary statement; (iv) attend an interview, and (v) have their child take an entrance exam.

V

Results

The results are presented in four subsections. In the first one, we compare various segregation indices in the actual scenario versus the counterfactual scenario. In the two following subsections, we compute the segregation level between school sectors (i.e. differences in the proportion of students of different socioeconomic status that enrol in each school type) and within each sector (i.e. differences in student distribution within each school type) in each scenario. Finally, the last subsection explores the extent

to which entry barriers —tuition and school selection— influence the outcomes.

1. Segregation in actual versus counterfactual scenarios

Table 2 shows a comparison between different indices of socioeconomic segregation in the actual and counterfactual scenarios. What is evident from this table

is that socioeconomic segregation among students of low socioeconomic status is lower in the counterfactual scenario, given that the dissimilarity index between this category of students and the rest falls by 12 points (from 0.481 to 0.360).[14] In terms of exposure, this implies that the average student of low socioeconomic status attends a school where 56% of his or her peers are of middle or high socioeconomic status, despite the fact that in the entire Greater Metropolitan Area of Santiago 75% of students belong to one of these two groups (see table 1). When the distribution is based exclusively on the student's place of residence, exposure increases to 64.4%.

Considering the results of the indices that compare the groups (low-SES/middle-SES, low-SES/high-SES, and middle-SES/high-SES), we observe that the largest effect is in the distribution of the two extreme groups (low-SES and high-SES). In this case, the Duncan index falls by almost 15 points (from 0.657 to 0.511). However, interestingly, the Duncan index for the low-SES and high-SES group has a value of 0.511 in the counterfactual scenario, which means that the level of residential segregation is high in both groups.

Finally, the multigroup Duncan index shows a smaller decline than the low-SES/rest Duncan index (9 points) because it considers the distribution of all three groups simultaneously. In this case, the Duncan index falls from 0.417 to 0.332. This suggests that middle-SES and high-SES students may be less concentrated than low-SES students.

These results suggest that schools are more segregated than neighbourhoods. The findings are consistent with those reported by Bellei, De los Ríos and Valenzuela (2014) using a different methodology and data. In the following two subsections, we show that the lower level of school segregation in the counterfactual scenario is explained by lower levels of segregation both between and within different school types.

TABLE 2

A comparison of segregation indices in the actual and counterfactual scenarios

Segregation index	Actual situation	Counterfactual: all students attend the school closest to their place of residence
Low-SES/rest		
Dissimilarity index (D)	0.481	0.360
Exposure index (X)	0.564	0.644
Low-SES/middle-SES		
Dissimilarity index (D)	0.362	0.274
Exposure index (X)	0.501	0.544
Low-SES/high-SES		
Dissimilarity index (D)	0.657	0.511
Exposure index (X)	0.282	0.389
Middle-SES/high-SES		
Dissimilarity index (D)	0.445	0.379
Exposure index (X)	0.339	0.372
Multigroup		
Duncan index (D)	0.417	0.332

Source: Prepared by the authors.

2. Segregation between sectors in the actual and counterfactual scenarios

Consistently with most of the previous literature, figure 1 illustrates that the public sector currently enrols a greater percentage of low-SES students and a smaller percentage of high-SES students than does the private voucher school sector. Yet, within the private sector, the for-profit sector enrols a greater percentage of low-SES and middle-SES students and a smaller percentage of high-SES students than the non-profit sector. These results are consistent with those presented in Elacqua (2012).

Under the counterfactual scenario, where students attend the school closest to their residence, in the public sector, the percentage of high-SES students would increase by 10 points (from 19.9% to 29.9%) and the percentage of low-SES students would decline by 10 points (from 40.0% to 29.3%). By contrast, in the non-profit sector, the percentage of low-SES students would increase by 11 points (from 15.2% to 26.2%) and the percentage of high-SES students would decrease by 16 points (from 50.2% to 34.3%). The changes are less pronounced in the for-profit sector.

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[14] In order to analyse the indices' sensitivity to our sample of students, we compared the value from table 2 for the Duncan index for the low-SES/rest group in the actual scenario (0.481) with the index constructed from the full student population (with and without coordinates). The value of the index in this case was 0.46. These results are available upon request.

These findings suggest that in the public and non-profit sectors, schools systematically tend to enrol a student body that does not mirror the social composition of the neighbourhood where they are located. They either enrol students with a lower SES than that of the neighbourhood (public schools) or they enrol students with a higher SES than that of the neighbourhood (non-profit schools). The fact that the social composition of schools in the for-profit sector does not change significantly between the two scenarios suggests greater heterogeneity within this sector.

FIGURE 1

Enrolment distribution in actual and counterfactual scenarios by school type
(Percentages)
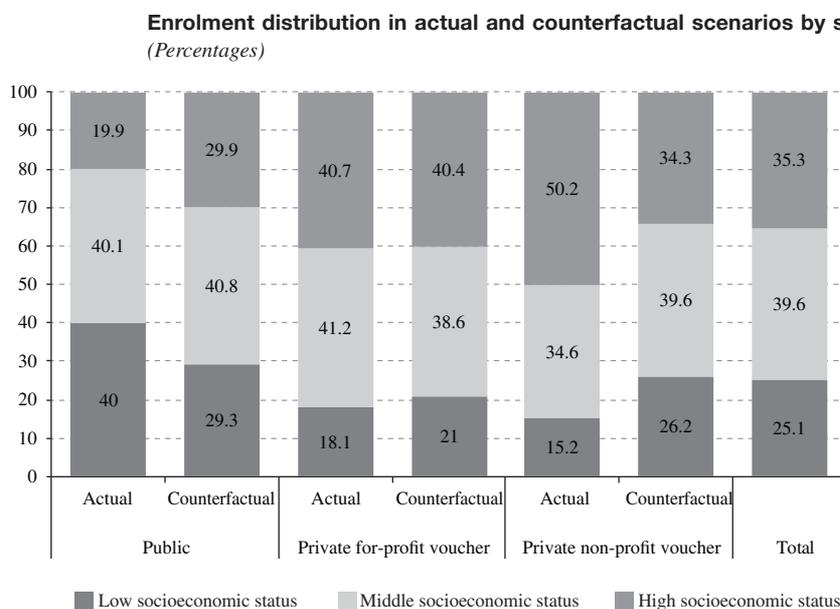
Source: Prepared by the authors.

3. Segregation within sectors in the actual and counterfactual scenarios

Figure 2 shows that the public sector is currently the least segregated in terms of socioeconomic status, while the non-profit sector is the most segregated.

Socioeconomic segregation declines under the counterfactual scenario in all sectors, but the effect is greater among private voucher schools, especially in the non-profit sector. The interpretation of these changes is interesting. Under the counterfactual scenario, the distribution of students from different SES groups within each sector depends on residential segregation and the geographic location of the schools. Therefore, the level of segregation that persists under this scenario is explained by the fact that schools are located in neighbourhoods with different social compositions. The higher level of actual segregation in relation to the level in the counterfactual scenario suggests that the preferences exercised by parents and the entry barriers instituted by schools increase the concentration of students from similar socioeconomic levels beyond what can be explained by the schools' choice of location, especially in the non-profit sector.

FIGURE 2

Dissimilarity index in actual and counterfactual scenarios by school type
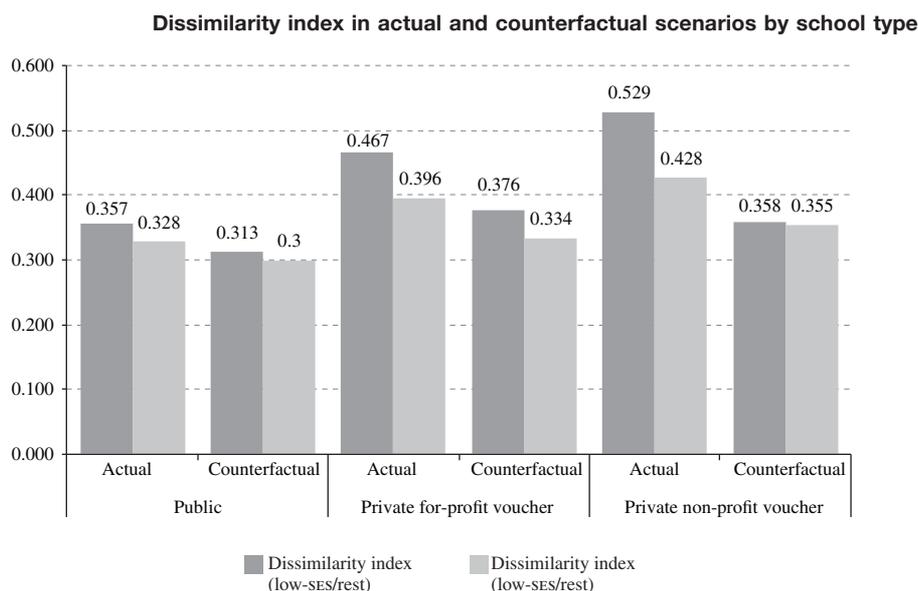
Source: Prepared by the authors.

4. The role of entry barriers

In order to explore how these results are related to the entry barriers that schools establish, this subsection categorizes schools by the amount of tuition they charge and the requirements they make of families during the admission process. Figure 3 shows the distribution of schools within each sector according to entry barriers. It illustrates that the public sector has the lowest barriers to entry, while the non-profit voucher sector has the highest. Within the for-profit sector, we observe more heterogeneity.

To analyse how the heterogeneity within the for-profit sector influences school segregation, in figure 4 we compare the socioeconomic composition of schools

in the actual and counterfactual scenarios. The x-axis corresponds to the percentage of low-SES students who would enrol in the school in the counterfactual scenario, and the y-axis corresponds to the percentage of low-SES students actually enrolled in the school. The 45° line represents the point at which these proportions are equal.[15] In order to avoid extreme values, this analysis is limited to those schools that have more than ten students in both scenarios.[16]

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[15] If all schools were above the 45° line, then actual and counterfactual segregation would be the same.

[16] When we apply this restriction, 62.4% of the total student sample remains.

FIGURE 3

School type and entry barriers
(Percentages)

Source: Prepared by the authors.

FIGURE 4

For-profit voucher school socioeconomic composition in actual versus counterfactual scenarios, grouped by entry barriers
(Percentages)
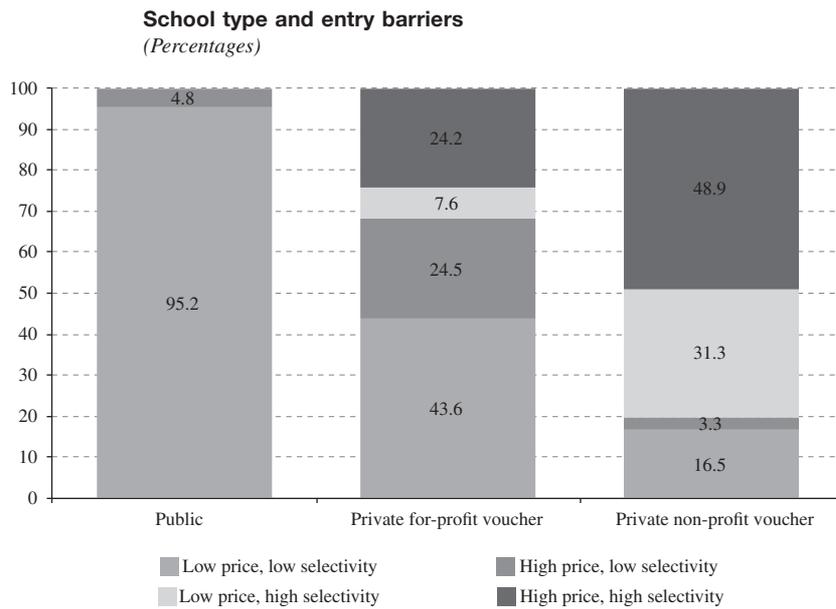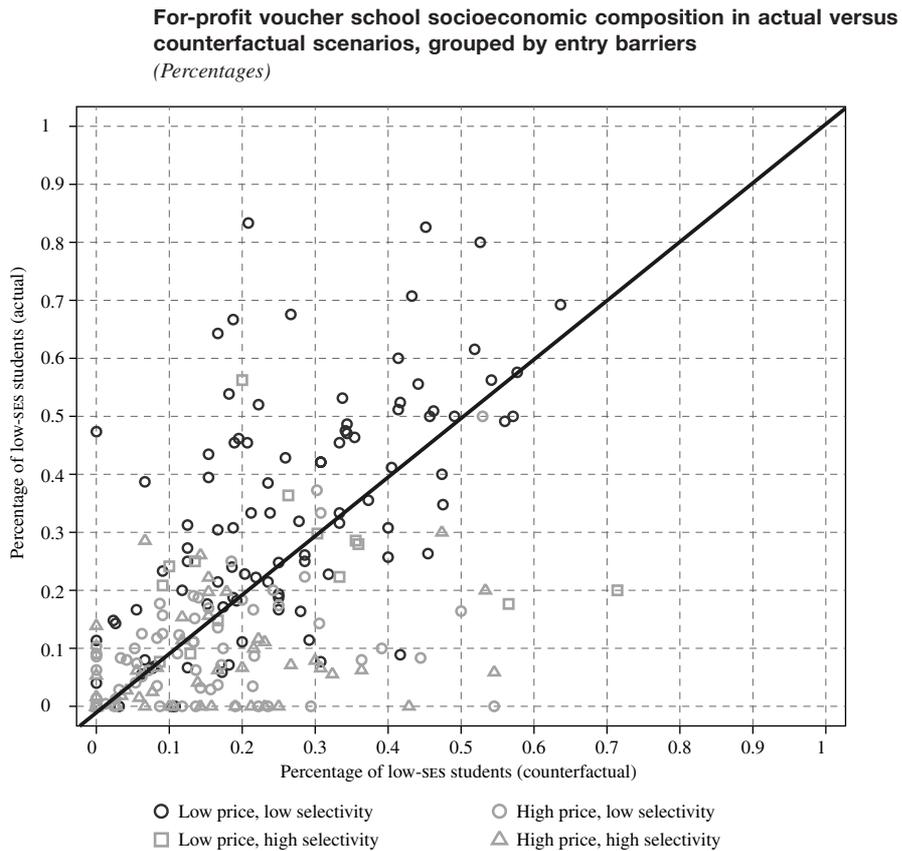
Source: Prepared by the authors.

Note: Analysis is confined to those schools with more than ten students in both scenarios.

On the one hand, there is a group of schools (the majority of them in the low-selectivity/low-price category) that, similarly to public schools, enrol a greater percentage of low-SES students than would attend under the counterfactual scenario, suggesting that they likely compete for the same students. On the other hand, there is a set of schools that enrol a smaller percentage of low-

SES students than would attend under the counterfactual scenario. This group consists mostly of schools that charge high tuition and in some cases are very selective (grey triangles). These results are consistent with other studies that find that the for-profit sector tends to seek market niches with families of different socioeconomic levels through price differentiation (Elacqua, 2012).

VI

Conclusions and implications for public policy

In order to advance the debate about the effects of school choice on socioeconomic segregation, in this article we use a unique and detailed data set with student and school addresses in the Greater Metropolitan Area of Santiago to compare actual school segregation with the segregation that would occur in the hypothetical case that students attended the school closest to their place of residence.

Consistent with earlier studies in other countries, the results indicate that regardless of the index used, school segregation is greater in the actual scenario than in the counterfactual one. This indicates that schools are more segregated than neighbourhoods and suggests that the interaction between family preferences and the entry barriers established by schools increases school segregation beyond the effect of residential segregation. This finding contradicts the argument that the concentration of students from a similar socioeconomic level is simply a reflection of the residential segregation that exists in Santiago. Our findings demonstrate that there are schools whose social composition is very different from that of the neighbourhood where they are located.

The lower segregation levels seen in the counterfactual scenario can be explained by two complementary effects. First, if students attended the school closest to their residence, segregation would decrease between the public and non-profit sectors. This contradicts the argument of some non-profit school owners —mainly Catholic schools— who argue that their lower disadvantaged student enrolment is a result of the rising socioeconomic level of the neighbourhoods where they have been historically located (Elacqua, 2012). In practice, the majority of these schools behave very similarly to what school choice critics predict for profit-seeking schools, inasmuch as they establish entry barriers that exclude low-SES families, even in socioeconomically diverse neighbourhoods. This finding is not limited to the Chilean

education system. In the United States, for example, there are several studies that find that competitive pressure leads non-profit schools (and even some public schools) to use location and admission strategies that exclude the most disadvantaged students (see Lubienski, Gulosino and Weitzel, 2009; Miron, Urschel and Mathis, 2010).

Second, the results indicate that school segregation within the for-profit and non-profit sectors would decline if student distribution were based exclusively on place of residence. This implies that parental preferences and the entry barriers applied by schools increase the concentration of students from a similar socioeconomic level beyond what can be explained by the schools' location and residential segregation. The even lower levels seen in the non-profit sector are explained by the high percentage of schools of this type that combine high prices with selective admission procedures. However, the for-profit sector is almost three times the size of the non-profit sector, thus any changes made in the for-profit sector would have a greater impact on overall segregation.

The challenge in terms of developing policies to promote a more equal distribution of students is that school segregation is the equilibrium result of individual decisions made by various agents (families and schools) who probably do not internalize the aggregate effects of their actions. From this perspective, segregation is a market failure that justifies government action. Although it is not one of the objectives of this article, determining how much of this result is attributable to parent preferences and how much to strategic decisions by schools is key for designing public policies to reduce segregation.

On the supply side, the use of entry barriers to schools is clearly incompatible with parental choice and school vouchers. In other countries with similar programmes, such as the Netherlands, Belgium and Sweden, subsidized education (public and private) is free and schools are prohibited from selecting their students. Therefore, in

order to guarantee a system where parents have true freedom of choice, such restrictions should be banned. This assertion is supported by recent studies that find that much of school segregation in Chile is explained by the supply side (Flores and Carrasco, 2013; Arteaga, Paredes and Paredes, 2014). For example, Flores and Carrasco (2013) find that the preferences exercised by parents depend on the choice restrictions they face, mainly the price of local schools, and that differences in quality-based preferences between parents of different socioeconomic levels diminish when such restrictions are considered (also see Elacqua, Buckley and Schneider, 2006). In fact, supply-oriented public policies would have lower implementation costs than those that restrict families' school options, since parental choice is perceived as a right by many stakeholders and has long been a feature of the Chilean education system (Aedo, 2000). However, on the demand side, it is important to improve the quantity and quality of information available to families, which is a factor that also likely drives school segregation beyond the differences in preferences between families from different SES groups. Most school choice systems around the world have information systems in place to support families.

The fundamental question then is how to effectively ban entry barriers. On the one hand, school tuition fees could be gradually eliminated. Compared with other OECD countries, per-student spending is still low in Chile, despite a steady rise over the last 20 years. Therefore, the challenge is to gradually replace the private resources contributed by families while keeping resources targeted on the most disadvantaged students. This proposal is consistent with a legislative initiative recently enacted by Chile's Congress (Oficio No. 11.712, 2015).[17] In

terms of the admission process, although the General Education Law (LGE) prohibits selection in primary grades, the evidence presented in this article demonstrates that the use of selection mechanisms continues to be common practice in private voucher schools. Recent research suggests that this is due to lack of enforcement (Carrasco and others, 2014). In response to this problem, the current Administration has decided to create a blind and more centralized system of student admission for subsidized schools (public and private). Under the new system, which will be gradually implemented starting in 2016, families must choose and rank the schools of their choice on a computer platform administered by the Ministry of Education. When schools chosen by families have enough open slots, all students will automatically be admitted. When schools are oversubscribed, they will be required to use a random selection procedure (i.e. lottery) to ensure that there will be no arbitrary selection. This process will give priority to students with siblings already enrolled in the school, disadvantaged children and children of school employees.[18] The system will also take into account parent preferences in the school assignment process (Oficio No. 11.712, 2015).

Although the characteristics of the Chilean education system do contribute to school segregation, the results of this research indicate that residential segregation in the Greater Metropolitan Area of Santiago also plays a part in limiting the integration of students from different socioeconomic levels. Hence, urban policies can play a fundamental role in reducing school segregation. Equally important are policies aimed at improving access to and the quality of public transportation, since this influences the number of options available to families, especially the most disadvantaged (Asahi, 2014).

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[17] Of course, the social impact of this policy should consider that public resources invested have an opportunity cost (for example, investment in preschool education).

[18] Abdulkadiroğlu and Sönmez (2003) present the economic theory and a review of several United States school districts that have adopted centralized school admission processes.

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Income inequality in Costa Rica according to the national household income and expenditure surveys of 2004 and 2013

Andrés Fernández Aráuz

ABSTRACT

Labour income inequality declined in most of the Latin American countries in the early years of the twenty-first century. Costa Rica, however, is one of the few countries in which this measure has not fallen, but has indeed continued to rise. By comparing 2004 and 2013, dispersion by hours worked and wage differences between public and private sector workers are identified as the main causes of this rise in inequality.

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I

Introduction[1]

Labour income inequality declined considerably in the Latin American region in the period following the year 2000. However, this has not been the trend observed in Costa Rica.

Azevedo and others (2013) found that over a period of 15 years (from 1995 to 2010) the region has seen a significant fall in labour income inequality, as measured by the Gini and Theil coefficients. Not all the countries have registered the same downtrend, however: the Gini coefficient rose in Costa Rica, Honduras and Uruguay; the Theil index, meanwhile, rose in these same three countries and in El Salvador and Peru, as well.

ECLAC (2012) finds that the tendency towards growing inequality began to go into reverse in Latin America early in the 2000 decade and Gini coefficients began to fall. ECLAC (2014) also finds that: "[…] This marks a major shift in the inequality trend in the region, with the turning point coming between 2002 and 2003. The change has created a promising scenario, particularly after distribution indicators failed to improve in the 1990s. Even though Latin America and the Caribbean has kept its position as the world's most unequal region, 15 of 17 countries in the region show distributive improvements in the 2002-2011 period. Of the 17 countries studied,

the (relative) Gini index rose between 2002 and 2011 in just two." These two countries are Costa Rica and the Dominican Republic.

The finding of a rise in labour income inequality in Costa Rica over the past decade was also observed by Fernández and Del Valle (2011). However, labour earnings are not the only type of income that can be used to examine inequality.

For example, the National Institute of Statistics and Censuses of Costa Rica (INEC, 2014), using data from the national household income and expenditure survey (ENIGH), found no substantial variation between 2004 and 2013 in per capita income inequality in Costa Rica, measured by the Gini coefficient.

This work aims to determine whether income inequality in Costa Rica, estimated for three different types of income, varied between 2004 and 2013, and to establish whether the change in inequality occurred in the same direction for all three types of income. It also aims to establish the effect of wage formation variables on the change in labour income inequality.

The article is organized as follows: section II explains the type of inequality to be analysed with the data available and how this relates to inequality of opportunities. It also introduces the concept of the measures of inequality used to compare the years 2004 and 2013, and describes human capital theory as a determinant of labour income.

Section III describes the data sources and the three types of income analysed, as well as the methodology used to obtain the estimates. Section IV analyses the results, and section V concludes.

II

Inequality

Economic inequalities may be understood as inequalities in the distribution of assets that have an economic impact on individuals or that are economic in origin, such that economic inequalities are either the outcome or a determinant of resource allocation.

Income distribution is undoubtedly the key variable for studying economic inequality, and has been the focus of much of the economic research conducted on the subject. However, the flow of income is only part of the complex sphere of economic inequalities.

In order to understand the importance of income inequality, it is crucial to realize that inequality per se is not the main concern, but rather the inequality of opportunities that income inequity can cause.

From the point of view of well-being, income is assumed to be a proxy for the measurement of individual well-being, although this may be better measured by consumption. It must likewise be borne in mind that the income measurement leaves out the benefits derived from the enjoyment of public goods and assets, such as public parks, libraries, public safety, social benefits, and so forth.

However, income has two characteristics that give it an advantage over others as a variable: the data are quantifiable and relatively easy to obtain, and income comparisons can be made between individuals and periods of time.

For these two reasons, this research concentrates on inequality of outcomes, measured by family and personal income, but it should be recalled that a comprehensive analysis of inequality should take into account inequalities of opportunities and their close relationship with income inequality.

1. Determinants of inequality in labour income

Because labour income is a category of personal income, inequality in its distribution can be analysed jointly with other personal variables, something that is not possible with family income.

In economic theory and the empirical evidence, the analysis of labour income inequality is based on human capital theory, whereby spending on education and training to raise an individual's productivity and future earnings in the labour market can be viewed as a human capital investment decision. Thus, the investment is not limited to years of formal education, but also includes all types of specific training or learning of additional languages that can enhance a worker's productivity.

Another component often used to analyse the explanatory factors of wage formation is the experience that individuals build up over the course of their working lives.

The type of working day or the variability of hours worked can also have an effect on inequality and it is important to analyse the impact of these hours on wages for the study of income distribution. The length of the working day is conditioned by several factors, such as the time individuals need to care for children, the shortage of jobs available with the length of working day preferred, or other needs that limit the time people have available to devote to paid work.

This basic human capital theory of disparities in earnings may not fully explain the determinants of income distribution. McConnell, Brue and Macpherson (2003) take an approach to distribution of earnings based on multiple factors apart from education and training, such as discrimination (be it on the basis of ethnicity, gender, political or religious ideology, or other reasons), labour mobility and compensatory wage differentials.

Economic discrimination exists where women with the same abilities, level of education, training and experience as men face worse conditions in hiring, access to employment, promotions, wages or working conditions.

Meanwhile, immigration or labour mobility can affect income distribution: a flow of working-age immigrants who are less educated than the average worker in the destination country expands the supply of unskilled labour, which can widen the income gap and worsen income distribution indicators.

Lastly, the theory of compensatory differentials holds that non-wage aspects of jobs vary enormously and can give rise to compensatory wage differentials, consisting of extra payment an employer must provide to compensate a worker for a particular characteristic not present in other jobs. Such wage differentials are measured by including in the model variables such as the branch of economic activity, the institutional sector (public or private), firm size or area of residence.

III

Data and methodology

1. Measurement of income

The literature on economic inequality does not yield a clear consensus on whether total household income or per capita income is the most appropriate variable for evaluating income concentration.

According to Medina (2001), it is valid to affirm that either variable may be appropriate, depending on the aims of the research in hand. Accordingly, the purpose of the measurement must be specified before proceeding to choose the corresponding variable.

The use of total household income can sometimes be justified on the basis that the family is the unit of consumption that drives its members' income perceptions and decisions on resource allocation.

In recent years, however, a number of studies have shifted the discussion towards individual well-being and, thus, the analysis focuses on the individual, especially in terms of the design and delivery of social policy.

The number of household members thus becomes an important factor in the measurement of inequality and poverty, owing to the empirical observation that lower-income households have a larger numbers of members than those at the upper end of the income distribution.[2] This is related to their greater needs, but also to economies of scale generated in the use of public goods within households.[3]

2. Data

The data used in this research come from Costa Rica's national household income and expenditure survey (ENIGH), which is conducted by the National Institute of Statistics and Censuses (INEC).

The last three surveys were conducted in 1988, 2004 and 2013, but this study uses only those of 2004

and 2013, owing to issues of comparability between the 1988 and 2013 surveys.

The surveys provide updated information on the composition of the budget of national and resident households, by enquiring into income and its use in the acquisition of goods and services.

All the information obtained in this type of survey is essential for establishing the structure of household income and expenditure, and for guiding development policies and programmes to maximize society's well-being. ENIGH also allows updating of the weightings of spending on the goods and services that make up the consumer price index (CPI) and the basic food basket, which is used in poverty measurement. It also provides information for the compilation and sequencing of household sector accounts for the System of National Accounts (SNA) and for updating the spending structures implicit in the base year of the accounts.

In 2013, the ENIGH survey was carried out for the sixth time in Costa Rica. It began on 1 October 2012 and concluded on 19 October and was carried out by INEC.

ENIGH used a two-stage, stratified area probability sampling design, which was replicated for the following domains: national, urban area, rural area and planning region. The selection unit was the individual households within the national territory and the units of analysis were dwellings, households and individuals residing permanently in those dwellings. A total of 7,020 households were selected, of which final information is available for 5,705. Data collection was conducted by means of household visits and personal interviews, as well as through survey questionnaires for respondents to complete with their personal and household expenditure.

Three types of income will be used for inequality analysis: total gross current household income, per capita gross current household income, and gross income of income-earners.

The gross income of income-earners (or labour income) is based on the measurement of gross income from work, which consists of gross monetary and non-monetary income (gross wage, additional wages, payment in kind from the main and secondary occupation, and by the employer or own-account worker, plus self-supply by the employer or own-account worker). This income

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[2] In the case of Costa Rica, according to the ENIGH conducted in 2013, households in the lowest income quintile had an average of 4.2 members, whereas those in the highest income quintile had an average of 2.6.

[3] However, per capita income would not be the most appropriate variable for studying individual well-being either, because its calculation does not take into account the fact that minors and adults have different needs (Medina, 2001).

represented 63% of the total gross current income of Costa Rican households in 2013.

The total gross current household income includes this labour income plus the income received by all the household members in the form of:[4]

- Autonomous income: income from profits and self-supply from independent work (owners or own account) not formally constituted into a company, whether agricultural or non-agricultural.
- Net rental income: all type of income from rentals; as well as income such as interest, dividends and benefits from cooperatives.
- Transfers received in cash.
- Self-supply.
- Other labour income: other income from previous employment or income of those aged under 15 who are working.

3. Methodology

As described thus far, this work analyses changes in income inequality using three different types of income and three different measures of inequality (Gini and Theil coefficients and the variance of log income), as well as an initial analysis of the Lorenz curve.

An important consideration often overlooked in studies on inequality is the fact that the calculation of inequality indicators is obtained from data that were generated from a survey and that are thus derived from a prior survey design.

The omission lies in the fact that any estimate derived from a survey based on probability sampling is simply one possibility for the true value in the population overall, and it is therefore necessary to calculate standard errors in order to establish intervals in which the true value for the overall population can be established with a certain degree of confidence.

However, some inequality indicators, such as the Gini coefficient, do not come from a known probability distribution, hence other techniques must be used to obtain that confidence interval.

This study uses the *bootstrap* technique, a method that employs resampling procedures to generate a large number of samples as a basis to study the behaviour of certain statistics.[5] For this work, 5,000 samples were generated based on the data.

Once the 5,000 iterations had been performed for each year (for the same income indicator), and two vectors had been obtained for the distribution of the indicator, a test was applied to analyse the differences between the distributions.

The Mann-Whitney-Wilcoxon test is a non-parametric rank-sum test for independent samples. Given that the vectors of the inequality coefficients cannot be assumed to be normally distributed, this is an appropriate test, because the null hypothesis is that both distributions (in this case, that of 2004 and that of 2013) come from identical populations (this is also known as a median equality test).

It should be noted that the Jarque-Bera test for normality of errors yielded very high values in all cases; consequently, a means difference test such as a t test cannot be performed, since the errors are not distributed normally. This bears out the suitability of the Mann-Whitney-Wilcoxon test, which is in fact the non-parametric version of the usual t test.

4. Fields decomposition technique

To break down the contribution of each explanatory variable to total inequality in labour income, we use the technique developed by Gary S. Fields.[6]

This decomposition technique is based on the Mincer wage equation, which may be rewritten as follows:

$$ln\left(Y_{it}\right) = \sum_{j=1}^{n} a_{it} * X_{itj} + \varepsilon_{it} = \sum_{j=1}^{n} a_{it} * Z_{itj}$$

where:

$ln(Y_{it})$ is the natural logarithm of monthly income, X_{itj} are the variables j associated with person i in year t,

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[4] According to INEC recommendations, in the databases for 2013, gifts in kind, barter goods and social contributions and taxes were deducted from the income of formal sector independent workers, because they had not been included under this Item in 2004. In addition, for the base year 2004, net household profits and payments made by formal sector independent workers' firms were deducted from income from property rentals, and added to income from independent work and to wages in kind, respectively, since they are treated as labour income in the conceptual framework used in 2013 (INEC, 2014).

[5] Procedures based on the bootstrap technique imply disregarding statisticians' suppositions regarding the theoretical distribution. Instead, the distribution of the statistic is determined by simulating a high number of random samples built directly on the basis of the observed data (eliminating one element each time). That is, the original sample is used to generate new samples that serve as a basis for inductive estimation of statistical sample distribution, rather than starting with a theoretical distribution assumed *a priori* (Flores, 2005).

[6] This method and the Yun decomposition technique are developed as described in Fields (2003).

a_{it} are the coefficients that accompany each variable, and e_{it} is the part of income variation between workers that cannot be explained by the variation in the variables included in the equation.

Taking the variance in both sides of the equation of income change, on the left side we obtain one of the measures of inequality used in this work: the variance of the natural logarithm of income, while the variance on the right side can be manipulated to obtain the following:[7]

$$1 = \frac{\sum_j Cov[a_j z_j, ln\,Y]}{Var\,ln\,Y} \cong \sum_j S_j$$

where each S_j is termed "factor relative weight in inequality," and is given by:

$$s_j = \frac{Cov[a_j z_j, ln\,Y]}{Var(ln\,Y)}$$

The above equation may be interpreted as the measure in the proportion of the variance of log income that is explained by each regressor variable j.

Shorrocks (1982) shows that it is not necessary to decompose each measure of inequality separately, because the same percentage weight is obtained for each explanatory variable using log income. These measures include the Gini coefficient, the Atkinson index and the Theil coefficient.[8]

However, the percentage contributions to changes in inequality —whether it increases or decreases— depend on the measure of inequality being used.

For any given measure of inequality $I(t)$, the change in inequality can be written in terms of the weights and measures of inequality for each period:

$$I(2) - I(1) = \sum_j \left[S_{j2} * I(2) - S_{j1} * I(1) \right]$$

This equation may be used to calculate the contribution to change in income inequality made by each regressor variable for any inequality index.

5. Yun decomposition technique

Another possible type of decomposition using the variance of log income as the measure of inequality is the technique developed by Yun (2002), following the procedure developed by Juhn, Murphy and Pierce (1993).

Juhn, Murphy and Pierce (1993) define the price effect of a variable on the size of the change in an "income distribution 1" and "income distribution 2" as the difference between the inequality of distribution 2 and the inequality of an auxiliary distribution that uses the prices of distribution 1 and the quantities and residuals of distribution 2:

$$ln\,Y_{aux} = \sum_j a_{1j} * X_{i2j} + \varepsilon_{j2} = \sum_j a_{1j} * Z_{i2j} = I_{aux}$$

The variance of the logarithm of the auxiliary income regression may be decomposed as:

$$\sigma^2(ln\,Y_{aux}) = \sum_j a_{j1}\sigma(Z_{j2})Cor(Z_{j2}, ln\,Y_{aux})\sigma(ln\,Y_{aux})$$

Using the auxiliary distribution, the difference obtained in inequality between periods 1 and 2 may be expressed as:

$$I_2 - I_1 = (I_2 - I_{aux}) + (I_{aux} - I_1)$$

which, for the variance of the logarithm, is decomposed as:

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[7] The decomposition is obtained as follows: given that $ln(Y) = \sum_{j=1}^{j+2} a_j z_j$, then $Cov\left[\sum_{j=1}^{j+2} a_j z_j, ln\,Y\right] = \sum_{j=1}^{j+2} Cov[a_j z_j, ln\,Y]$; since the left side of this equation is the covariance between the income logarithm and itself, it is simply the variance of lnY. Thus: $Var\,ln\,Y = \sum_{j=1}^{j+2} Cov[a_j z_j, ln\,Y]$ dividing both sides by the log variance gives: $1 = \frac{\sum_{j=1}^{j+2} Cov[a_j z_j, ln\,Y]}{Var\,ln\,Y} \cong \sum_{j=1}^{j+2} S_j$.

[8] The decomposition works only if the variables are strictly linear. This is why we exclude the possibility of using interaction between regressor variables.

$$Var\left(ln\,Y_2\right) - Var\left(ln\,Y_1\right)$$

$$= \sum_j \left[a_{j2}\sigma\left(Z_{j2}\right)Cor\left(Z_{j2}, ln\,Y_2\right)\sigma\left(ln\,Y_2\right) - a_{j1}\sigma\left(Z_{j2}\right)Cor\left(Z_{j2}, ln\,Y_{aux}\right)\sigma\left(ln\,Y_{aux}\right) \right]$$

$$+ \sum_j \left[a_{j1}\sigma\left(Z_{j2}\right)Cor\left(Z_{j2}, ln\,Y_{aux}\right)\sigma\left(ln\,Y_{aux}\right) - a_{j1}\sigma\left(Z_{j1}\right)Cor\left(Z_{j1}, ln\,Y_1\right)\sigma\left(ln\,Y_1\right) \right]$$

where the variables of the previous equation are interpreted as follows: each term in the first summation is the price effect of the *j*-th variable, while each term in the second summation is the quantity effect of the *j*-th variable, i.e. of each regressor.

Lastly, to ascertain what fraction of the weight of each regressor's inequality is attributable to the price effect of that regressor, and what fraction to the quantity effect, the terms of the *j*-th variable are divided by the change in the weight of that factor's inequality:

$$1 = \frac{\left[a_{j2}\sigma\left(Z_{j2}\right)Cor\left(Z_{j2}, ln\,Y_2\right)\sigma\left(ln\,Y_2\right) - a_{j1}\sigma\left(Z_{j2}\right)Cor\left(Z_{j2}, ln\,Y_{aux}\right)\sigma\left(ln\,Y_{aux}\right) \right]}{S_{j2} - S_{j1}}$$

$$+ \frac{\left[a_{j1}\sigma\left(Z_{j2}\right)Cor\left(Z_{j2}, ln\,Y_{aux}\right)\sigma\left(ln\,Y_{aux}\right) - a_{j1}\sigma\left(Z_{j1}\right)Cor\left(Z_{j1}, ln\,Y_1\right)\sigma\left(ln\,Y_1\right) \right]}{S_{j2} - S_{j1}}$$

where the first term is the percentage contribution of the price effect and the second is the percentage contribution of the quantity effect.

IV

Results

The analysis of the results from examination of the behaviour of income inequality in Costa Rica for 2004 and 2013 is presented by type of income, including, in each case, the different measures of inequality set forth in the first part.

1. Inequality in total gross current household income

In this case, the unit of analysis is the household. In 2004, ENIGH estimated 1,152,588 households in Costa Rica, and in 2013, a total of 1,396,747 households.

Figure 1 shows the Lorenz curve for this type of income.

It may be seen clearly that the area of the Lorenz curve for 2013 (thin black line) is completely contained within the Lorenz curve for 2004. In this case, it may be concluded from the graph that inequality of total gross current household income dropped between 2004 and 2013.

The situation in which the two Lorenz curves do not intersect (except at the extreme) is not very common, but when it does occur it supports a direct analysis of inequality.

However, it is important to clarify that although income inequality declined as measured by total gross current household income, the distribution remains highly unequal: the richest 20% of households in Costa Rica account for over 55% of total current income.

The Gini coefficient confirms the observations thus far. This coefficient represents the area between the equidistribution and the Lorenz curve. The Gini coefficient estimated fell from 0.5189 in 2004 to 0.5041 in 2013.

When the Mann-Whitney-Wilcoxon test is applied, it may be concluded at a 5% significance level that the data for the Gini coefficient do not come from identical populations for 2004 and 2013 (see annex A1 with the estimates).

FIGURE 1

Costa Rica: Lorenz curve of total gross current household income, 2004 and 2013
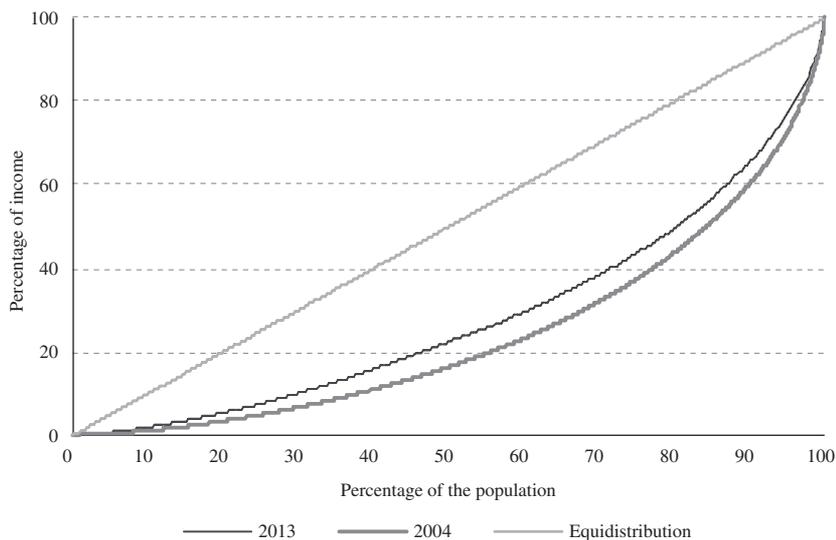
Source: Prepared by the author.

The Theil index estimated for this income distribution also shows a significant decline in the measure of inequality, from 0.517 to 0.477 in the two years studied; the same occurs with the other measure of inequality used, variance of log income, which drops from 0.99 to 0.87 (see annex A1).

2. Inequality in per capita gross current household income

In this case, the unit of analysis is each individual in Costa Rica, since each household's income is divided proportionally between its members. In 2004, ENIGH estimated a population of 4,267,262 inhabitants in Costa Rica, while in 2013 the estimate was 4,697,002.

Figure 2 shows the Lorenz curve for this type of income.

At first sight, the situation with per capita gross current household income is less clear-cut. Accordingly, conclusions about inequality cannot be drawn on the basis of the Lorenz curves alone.

The Gini coefficient for per capita gross current household income is 0.5348 in 2004 and 0.5338 in 2013. This means that the area underneath the Lorenz curve remained practically unchanged between the two years, although with a slight decline in 2013.

The Mann-Whitney-Wilcoxon test shows no difference in the results (for the one-tailed test), so the null hypothesis that both sets of data come from the same distribution may be rejected.

The Gini coefficient is an area, and can thus be expressed in terms of percentages. Thus, the Gini coefficient for per capita gross current household income edged down from 53.4% to 53.3%, which in practical terms does not represent a large drop in inequality, as was borne out by the Mann-Whitney-Wilcoxon test.

Using the Theil entropy coefficient to analyse inequality yields a statistically significant reduction in the index, from 0.574 to 0.547.

Calculation of the variance of log income, by contrast, gives a slight rise in the estimated value, from 0.957 to 0.965; however, as with the Gini coefficient for this type of income, the variation is not statistically significant (see annex A1).

In sum, the results from using per capita gross current household income to analyse the variation in income inequality between 2004 and 2013 do not support any firm conclusion, although it can be observed that by this measure of income distribution, inequality did not rise or remained at levels that for practical purposes showed no variation.

3. Inequality in the labour income of earners

In this case, the unit of analysis is the individual, but only earners of labour income aged between 15 and 65. In 2004, these were estimated to number 1,397,128, and in 2013, there were an estimated 1,542,150 workers in the Costa Rican labour market.

Figure 3 shows the Lorenz curve for this type of income.

FIGURE 2

Costa Rica: Lorenz curve of per capita gross current household income, 2004 and 2013
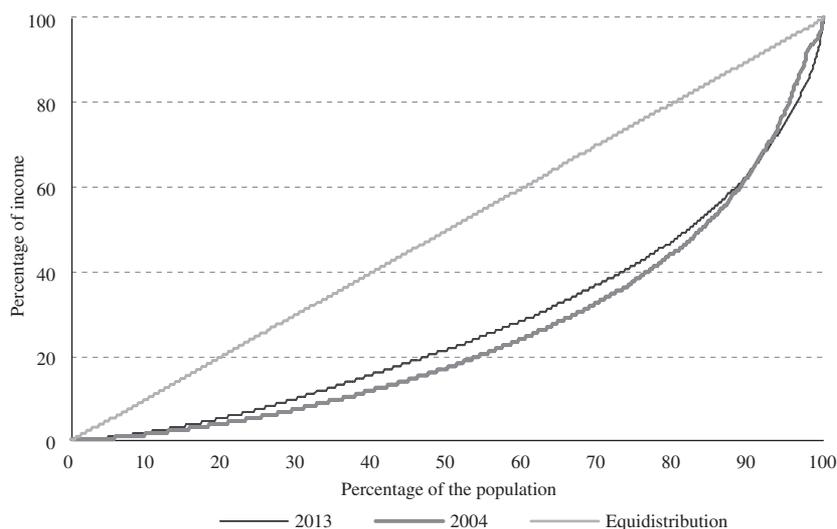
Source: Prepared by the author.

FIGURE 3

Costa Rica: Lorenz curve for labour income of earners, 2004 and 2013
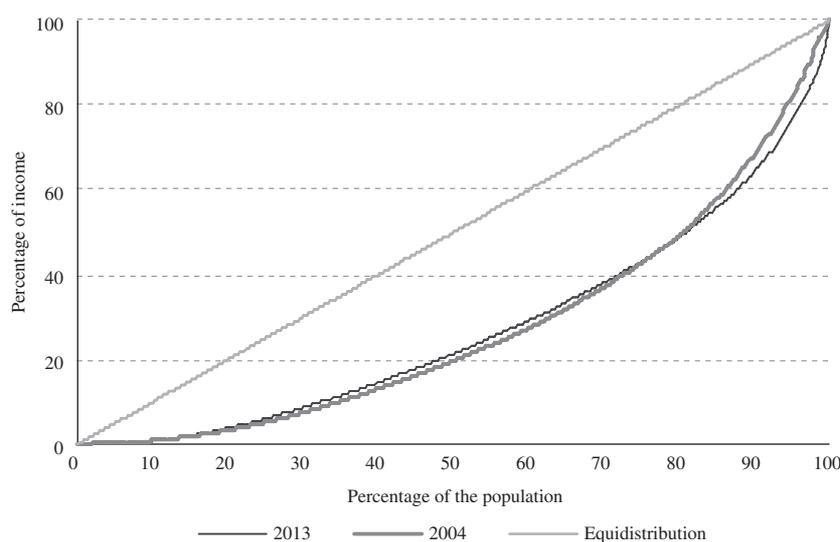
Source: Prepared by the author.

As in the previous case, the curves cannot be compared at first sight.

The Gini coefficient rises in the analysis of labour income distribution, from 0.5027 to 0.5218, a large jump of almost two basis points. The Lorenz curve shows that before the intersection of the two curves, the largest area corresponds to 2004, but after the intersection the curve for 2013 is furthest from the equidistribution, and —consistently with the findings for the Gini coefficients— the difference in the area of the curves is larger for the population after the intersection than before.

The difference is statistically significant, according to the Mann-Whitney-Wilcoxon test.

The Theil index and the labour income logarithm variance confirm the tendency towards a rise in inequality between 2004 and 2013 (see annex A1).

4. Why does labour income inequality rise between 2004 and 2013?

As discussed in section II, unlike household income, individuals' labour income may be related to a series of variables associated with income level.

The model presented below includes the following variables: education, monthly hours worked, firm size, years of experience, sector (public/private), sex, area of residence (urban/rural) and immigration status.

Table 1 shows the results of applying the Fields decomposition technique for this model.[9]

TABLE 1

Costa Rica: contribution of each variable to explaining the variability in labour income inequality, 2004 and 2013
(Percentages)

Variable	2004	2013
Education level	17.6	16.9
Hours worked	16.4	18.0
Firm size	7.3	8.0
Years of experience	5.4	5.8
Public/private sector	4.3	5.6
Sex	3.0	2.9
Area of residence	1.8	1.3
Immigrant status	0.0	0.0
Total explained	*55.8*	*58.6*
Total unexplained	*44.2*	*41.4*
Total	100.0	100.0

Source: Prepared by the author, on the basis of the 2004 and 2013 editions of the national household income and expenditure survey (ENIGH) of Costa Rica.

As in previous studies for Costa Rica (see Gindling and Trejos, 2003 and 2006; Fernández and Del Valle, 2011), education level and type of working day are the two main variables explaining variability in labour income (without taking into account the error term), since the

two combined account for a third of the variability in this type of income.

A second group of variables contribute quite a sizeable portion of labour income inequality: differences in firm size (small firms with between 1 and 19 employees, medium-sized firms with between 10 and 29 employees, and large firms with over 30 employees), an individual's years of work experience (with age used as a proxy for this) and sector of employment (civil servants earn higher wages on average than private sector workers).

The variability in labour income by sex is small after controlling for other factors (3%), as are differences in urban or rural residence, while the variable capturing immigration status was included in the model solely to show that is it not significant in explaining labour income in Costa Rica (see annex A2 with the results of the regression model estimation).

As has been shown, labour income inequality among earners (wage-earners, employers and own-account workers) rose between 2004 and 2013 for the three indicators used: the Gini coefficient rose from 0.503 to 0.522; the Theil coefficient from 0.479 to 0.515, and the variance of the natural logarithm of labour income, from 1.256 to 1.499.

Yun's decomposition technique may be used to estimate the relative weight of each of the factors shown in table 1 in the increase in labour income inequality for each of the indicators. Figure 4 shows the results of this procedure.

Leaving out the factor of immigrant status (which was not statistically significant), four factors made a positive percentage contribution to the rise in inequality for all three indicators: dispersion by hours worked, sector of work (public/private), firm size and work experience.

Conversely, only one factor made a negative percentage contribution to the rise in inequality for the three indicators: area of residence, i.e. the area in which individual members of the working-age population lived contributed to reducing inequality (though this was logically offset by the other factors, since the net effect was a rise in labour income inequality).

Unlike the five factors mentioned above, two had an ambiguous effect, that is, they either increased or reduced inequality depending on the indicator used. These two are education and sex (the residual, or unidentified, factors had a similar effect).

Figure 4 shows that each factor can have a different effect on the variation in inequality depending on the indicator used; for this reason, each must be analysed separately. To this end, table 2 shows the percentage contribution of each variable to the rise in inequality.

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[9] According to the Akaike information criterion (AIC) and the Bayesian information criterion, of the exponential family of generalized linear models, the data used fit a Gaussian model with an identity link function better than the Gamma distribution.

FIGURE 4

Costa Rica: percentage contribution of each factor to the rise in labour income inequality between 2004 and 2013, by indicator
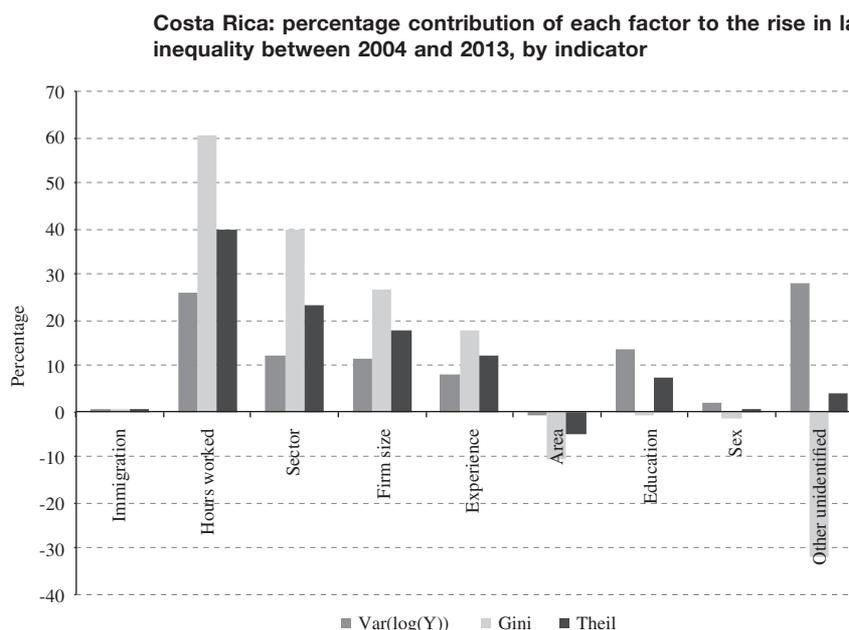
Source: Prepared by the author.

TABLE 2

Costa Rica: percentage contribution of each factor to the rise in labour income inequality between 2004 and 2013, by indicator

(Percentages)

Variable	Var(log(Y))	Gini	Theil
Hours worked	25.8	60.2	39.5
Sector	11.9	39.5	22.9
Firm size	11.6	26.9	17.7
Experience	8.1	17.8	11.9
Area	-0.9	-10.5	-4.7
Education	13.5	-1.2	7.7
Sex	2.1	-1.5	0.6
Other unidentified	27.8	-31.6	4.1
Immigration	0.1	0.4	0.2
Total	100.0	100.0	100.0

Source: Prepared by the author, on the basis of the 2004 and 2013 editions of the national household income and expenditure survey (ENIGH) of Costa Rica.

With respect to the variance of the natural logarithm of income, practically all the variables had a positive effect on inequality, that is, all contributed to increasing inequality as measured by this indicator. The variables included in the model explain 72% of the rise in inequality, with hours worked and education having the strongest effects.

In the case of the Gini coefficient, however, not all the variables had a positive effect on inequality. Four contributed to its rise: dispersion in hours worked, sector of work, firm size and work experience; while area of residence and, to a lesser extent, sex had the opposite effect, i.e. helped to reduce inequality as measured by the Gini coefficient.

In the case of the Theil index, practically all the variables increased inequality, especially dispersion in hours worked, sector of work and firm size.

This analysis yields a number of considerations which should be borne in mind when studying the behaviour of income inequality in Costa Rica.

Whatever the indicator used, dispersion in hours worked is the factor carrying most weight in the increase in labour income inequality. This was not the result of wage rises differentiated by type of working day, but rather the shift in the distribution of workers, because the proportion of those working full days and overtime increased.

Unlike in previous research (Gindling and Trejos, 2003 and 2006; Fernández and Del Valle, 2011), the variability in income from the labour sector had a notable effect on pushing up inequality in Costa Rica, especially as measured by the Gini coefficient. In this case, the influence was the result not of a change in the distribution of the variable (the proportion of public sector workers rose from 15% to 18% of the Costa Rican labour market during this period), but of the price effect or "public sector premium"

which is nothing more or less than wage differences between sectors.

According to ENIGH, real wages grew in both the public and private sectors, but much faster in the former case (27% compared to 15%, see annex A4). This occurred both because of half-yearly wage rises and incentives available to virtually all public servants in the Costa Rica,[10] and because of a policy of wage adjustments implemented between 2007 and 2010, which was intended to raise the wages of public servants at the lower end of the wage scale to bring them into line with other workers with similar functions in institutions with higher wage scales.[11]

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[10] For example, the *anualidad* is an incentive that increases public servants' wages simply for having worked a full year in the public institution and is not linked to any sort of productivity criterion or rigorous performance assessment. Exclusive dedication or prohibition of outside work are incentives that increase the base salary by 20%, 55% or 65%, with the aim of having workers devote themselves exclusively to the particular public institution, and refrain from employment for other work or in other firms. However, this benefit has been extended to practically all professional staff in the public sector without analysis of the real need for such an incentive.

[11] The "percentile 50" policy, which was adopted in 2007 and ended in 2010, consisted of raising central government wages in line with

Although education level is one of the factors that best explains income inequality in any given year (see table 2), it was one of the main drivers of inequality growth between 2004 and 2013 only when measured by the variance of log income, and in the case of the Gini coefficient its contribution to the variation in inequality was virtually nil.

Most of the inequality relating to educational qualifications is generated at the tertiary level, since the price effect or premium of a university degree exceeds the effects of the other levels of education (see annex A2).

However, the true effect of education level can be biased, owing to its high correlation with the public sector employment; in fact, while only 20% of workers in the private sector have tertiary education, 66% of workers in the public sector have at least one year of university studies, and they registered real wage rises of 25%, much more than the 5% average real wage gain of workers with university degrees in the private sector (see annex A5).

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percentile 50 of the non-financial autonomous public sector (see Loría and Umaña, 2014).

V

Conclusions

The comparison of data for 2004 and 2013 does not support the affirmation of a generalized increase or decrease in inequality; on the contrary, thought needs to be given to which type of income distribution is to be analysed to obtain conclusions regarding the change in inequality.

The results of this research show that the variation in income inequality differs depending on the type of income analysed.

If social policymaking is to be directed towards improving the situation of Costa Rican households, taking the household as the unit of measure and policy target (regardless of the number of members in each household), it may be affirmed that income distribution between the poorest and wealthiest households improved, comparing exclusively the years 2004 and 2013, which translates into a reduction in inequality.

If the focus, conversely, is placed on the labour market and income-earners, then there is solid evidence

that labour income inequality worsened between 2004 and 2013.

In the case of per capita income, certain considerations must be borne in mind when using it as a measure of inequality. First, it is a proxy income, in the sense that no household member actually receives it; rather it represents an equitable division of the household's total income among its members, assigning this fictitious amount both to members of the household in the labour force, and to those who are not part of the economically active population, such as infants, children and older persons.

Second, and as a result of the first consideration, per capita income does not take into account the fact that the needs of minors may differ from those of adults. The use of the per capita variable implies the supposition that income generates the same utility for everyone, i.e. that the cost of achieving a given level of well-being is the same for anyone in the household, regardless of aspects such as the number of its members, their sex or their age.

However, studies that have attempted to correct this problem of economies of scale by using equivalence scales still base their estimates on a series of suppositions that do not allow the per capita component to be completely removed either, because equivalence scales tend to be highly sensitive to model specifications (see Alonzo and Mancero, 2011; Trejos and Oviedo, 2006 and 2012).

In addition to the theoretical issues involved in using per capita income, the results of the variation in income distribution for Costa Rica for 2004 and 2013 show no clear movement either up or down. The only affirmation that these very small variations support is that inequality did not rise as measured by this type of income.

The decomposition techniques used show that the type of working day (dispersion by hours worked) and

education level continue to be the main factors explaining labour income inequality in any given year.

Even more revealing is the fact that the rise in inequality measured by labour income is strongly driven by wage differences in the public and private sectors, and is reinforced by real wage rises in the public sector far exceeding those in the private sector, especially among workers with university level education.

It is normal and even healthy in an economy for the labour market to reward the effort of a higher level of education and training with a higher wage —providing that at least a threshold of wage conditions is maintained for workers who do not have tertiary education, and that labour guarantees are respected— but the existence of an additional, artificially created premium generates distortions that have an impact on inequality.

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ANNEXES

ANNEX A1

Costa Rica: estimate of income inequality measured by type of income, 2004 and 2013

Year	Per capita gross current income without lease value			Total gross current income without lease value			Gross wage income		
	L.low	Estimate	L.up	L.low	Estimate	L.up	L.low	Estimate	L.up
	Gini coefficien *			Gini coefficient			Gini coefficient		
2004	0.525	0.535	0.544	0.504	0.519	0.534	0.489	0.503	0.516
2013	0.524	0.534	0.544	0.487	0.504	0.521	0.506	0.522	0.538
Variation	*0.00*	*0.00*	*0.00*	*-0.02*	*-0.01*	*-0.01*	*0.02*	*0.02*	*0.02*
Year	Theil entropy index			Theil entropy index			Theil entropy index		
2004	0.542	0.574	0.606	0.465	0.517	0.569	0.440	0.479	0.518
2013	0.525	0.547	0.569	0.441	0.477	0.514	0.485	0.515	0.544
Variation	*-0.02*	*-0.03*	*-0.04*	*-0.02*	*-0.04*	*-0.06*	*0.04*	*0.04*	*0.03*
Year	Variance of log income*			Variance of log income			Variance of log income		
2004	0.931	0.957	0.983	0.942	0.993	1.044	1.185	1.256	1.326
2013	0.944	0.965	0.986	0.837	0.870	0.903	1.423	1.499	1.575
Variation	*0.01*	*0.01*	*0.00*	*-0.10*	*-0.12*	*-0.14*	*0.24*	*0.24*	*0.25*

Source: Prepared by the author, on the basis of the 2004 and 2013 editions of the national household income and expenditure survey (ENIGH) of Costa Rica.

Note: Lease value is another source of non-monetary income and consists of the imputed rental value of an owned dwelling, which is not an income received in cash, but provides a benefit to the household through the service of accommodation provided to its owners. L.low and L.up are the lower and upper limits of the 95% confidence interval calculated using the bootstrap technique.
* The variation in the indicator between 2004 and 2013 is not statistically significant.

ANNEX A2

Coefficients of estimated linear regressions

Variable	2004		2013	
	Coefficient	s.e.	Coefficient	s.e.
Constant	6.5134	(0.1391)	6.4270	(0.1384)
Women	-0.3669	(0.0242)	-0.4060	(0.0232)
Age	0.0804	(0.0056)	0.1185	(0.0058)
Age squared	-0.0009	(0.00007)	-0.0013	(0.00007)
Urban	0.1762	(0.0241)	0.1794	(0.0236)
Incomplete primary	0.3094	(0.0757)	0.2156	(0.0747)
Complete primary	0.4073	(0.0732)	0.2792	(0.0717)
Incomplete secondary	0.5603	(0.0755)	0.4757	(0.0730)
Complete secondary	0.7738	(0.0782)	0.6822	(0.0748)
Tertiary	1.3889	(0.0762)	1.3716	(0.0746)
Hours (logarithm)	0.6849	(0.0199)	0.7060	(0.0178)
Public	0.3700	(0.0344)	0.4471	(0.0316)
10 to 29 employees	0.3347	(0.0326)	0.3425	(0.0305)
30 or more employees	0.4293	(0.0257)	0.4840	(0.0254)
Immigrant*	-0.0471	(0.0354)	-0.0019	(0.0327)
R^2: proportion of total variability explained by covariance	0.5577		0.5855	
Mean square error	0.57		0.65	
No. observations	4 990		5 955	

Source: Prepared by the author, on the basis of the 2004 and 2013 editions of the national household income and expenditure survey (ENIGH) of Costa Rica.

Note: s.e.: Standard error of coefficient; * variable not significant at 1% for both years.

ANNEX A3

Results of the inequality change decomposition, using the Yun decomposition technique

Variable	Price effect	Quantity effect	Total effect
Residual	-0.00002	0.07318	0.07316
Woman	-0.00708	0.01249	0.00540
Age	0.11294	-0.03984	0.07310
Age squared	-0.06262	0.01071	-0.05190
Urban	0.00947	-0.01184	-0.00237
Incomplete primary	-0.00071	0.00887	0.00816
Complete primary	-0.03006	0.04595	0.01589
Incomplete secondary	-0.05766	0.04852	-0.00914
Complete secondary	-0.00019	-0.01380	-0.01399
Tertiary	0.36127	-0.32655	0.03472
Hours (logarithm)	0.10418	-0.03619	0.06800
Public	0.05215	-0.02075	0.03141
10 to 29 employees	0.00905	-0.00830	0.00075
30 or more employees	0.02933	0.00037	0.02969
Immigrant	0.00738	-0.00720	0.00019
Total	0.52744	-0.26437	0.26307

Source: Prepared by the author, on the basis of the 2004 and 2013 editions of the national household income and expenditure survey (ENIGH) of Costa Rica.

ANNEX A4

Costa Rica: distribution of workers in the labour market and average real wage, 2004 and 2013

Category	Proportion of workers			Average real wage		
	2004	2013	Variation (*percentages*)	2004	2013	Variation (*percentages*)
By sex						
Men	64.3	59.0	-5.3	426 370	505 979	18.7
Women	35.7	41.0	5.3	301 653	414 330	37.4
Total	100.0	100.0	0.0			
By sector						
Private	84.6	81.6	-3.1	319 985	366 614	14.6
Public	15.4	18.4	3.1	722 252	918 402	27.2
Total	100.0	100.0	0.0			
By education level						
No education	2.2	1.9	-0.3	153 333	174 702	13.9
Incomplete primary	12.9	8.6	-4.3	180 547	197 284	9.3
Complete primary	30.2	25.2	-5.0	219 422	238 256	8.6
Incomplete secondary	18.8	20.3	1.5	270 566	271 190	0.2
Complete secondary	13.2	15.5	2.2	366 089	374 609	2.3
Tertiary	22.6	28.6	5.9	837 238	963 502	15.1
Total	100.0	100.0	0.0			
By firm size						
Fewer than 10 employees	47.0	39.7	-7.3	250 746	256 113	2.1
10 to 29 employees	14.6	17.8	3.2	421 438	469 786	11.5
30 or more employees	38.4	42.5	4.0	527 106	666 382	26.4
Total	100.0	100.0	0.0			

Source: Prepared by the author, on the basis of the 2004 and 2013 editions of the national household income and expenditure survey (ENIGH) of Costa Rica.

Note: Real wages refer to Costa Rican colones at April 2013.

ANNEX A5

Costa Rica: distribution of workers and average real wage by sector of work and by level of education, 2004 and 2013

Level of education	Proportion of workers (*percentages*)				Average real wage			
	2004		2013		2004		2013	
	Private	Public	Private	Public	Private	Public	Private	Public
No education	2.6	0.2	2.3	0.0	151 058	290 044	174 446	245 055
Incomplete primary	15.1	0.9	10.3	1.2	177 751	429 939	188 726	525 825
Complete primary	33.7	10.9	29.0	8.0	206 912	431 878	228 986	386 151
Incomplete secondary	20.4	10.1	22.8	9.4	255 844	434 643	249 309	505 665
Complete secondary	12.1	19.7	15.6	14.8	317 376	529 937	335 361	558 198
Tertiary	16.2	58.1	20.0	66.6	797 368	898 361	839 152	1 128 372
Total	100.0	100.0	100.0	100.0				

Source: Prepared by the author, on the basis of the 2004 and 2013 editions of the national household income and expenditure survey (ENIGH) of Costa Rica.

Note: Real wages refer to Costa Rican colones at April 2013.

The labour content of Mexican manufactures, 2008 and 2012

Gerardo Fujii G., Rosario Cervantes M.
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ABSTRACT

This study presents estimates of the number of jobs created by Mexican exports of manufactured goods in 2008 and 2012 based on the input-output matrices developed by the National Institute of Statistics and Geography (INEGI). Data are given for direct labour (the labour needed to produce the exports) and indirect labour (the labour involved in producing the Mexican-made inputs embedded in those exports, plus the jobs created by all the indirect repercussions of the production of the intermediate goods that are incorporated into those exports). Employment in export production is disaggregated into manufacturing export sectors and sectors in which related jobs are created. In addition, since every export sector requires intermediate goods, some of which are produced in the same sector and some of which are produced in others, the indirect labour embedded in exports is divided into its intrasectoral and intersectoral components.

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I

Introduction

Starting in the late 1980s, Mexico embarked on a series of major structural reforms, one of which was focused on liberalizing the country's external trade flows by rolling back the protective barriers that had been shielding Mexican economic activities. This inevitably led to the disappearance of activities that were unable to compete with imports, but the expectation was that their disappearance would be offset by a stronger export orientation in branches of production in which the country had a comparative advantage. This trade reform effort prompted the country to become a party to the General Agreement on Tariffs and Trade (GATT) in 1987 and paved the way for the entry into force of the North American Free Trade Agreement (NAFTA) in 1994, which was designed to spur exports, in particular to the United States. The ultimate objective of this policy shift was to galvanize economic growth and create more jobs. Given the country's relatively abundant labour supply and in the light of the findings of Heckscher and Ohlin, it was expected that the country's comparative advantages would be concentrated in goods whose production was intensive in fairly unskilled labour and that the upswing in exports would therefore drive up employment.

During the time that the terms of NAFTA were being negotiated, a heated debate was raging in the United States about the effects that trade liberalization would have on employment. Some argued that the opportunity to site facilities in Mexico, where labour costs were lower, to produce duty-free exports for the United States market would cause capital to shift to Mexico, which would have both negative and positive effects on employment. They also contended that, given the fact that the comparative advantages of Mexico are in products that are intensive in unskilled labour, the ratio between unskilled and skilled workers' wages would drop, thereby exacerbating the inequality of income distribution in the United States. People on the other side of the argument insisted that trade liberalization would boost both countries' exports, which would offset the negative impact of increased imports on employment (Hufbauer and Schott (1993) review the literature generated at the time of the agreement's

negotiation about the repercussions on the United States' labour market.) By contrast, most people in Mexico were optimistic about the benefits that the trade agreement with the United States would yield in terms of growth and employment (see, for example, Lustig, Bosworth and Lawrence, 1993).

As trade liberalization initiatives have been embraced by more and more countries around the world, numerous researchers have sought to assess their effects on labour. Three of the main lines of research have been the following: (i) exports and job creation; (ii) imports and job destruction, and (iii) the effects of increased external trade on wages and income distribution. This study focuses on the first of these areas of enquiry.

The specific aim of this study is to estimate the amount of employment (measured in numbers of jobs) that is represented by Mexican manufactured exports. The production of an export requires labour which —in the terminology that will be used here— is the direct labour content of the export. The production of export goods also requires the use of raw materials, inputs, parts and components whose production (if it takes place in the country) embodies those exports' indirect national labour content. The greater the linkages between direct exporters and the rest of the economy, the greater the indirect labour content of those exports will be. The raw materials needed to produce given export products may be harvested by economic activities in the same sector as the exporters or in different sectors. The labour content of the former can be referred to as the "indirect intrasectoral labour content" and that of the latter as "indirect intersectoral labour content." In addition, since the production of manufactures for export requires the use of inputs from the manufacturing sector and from other sectors, exports of manufactures indirectly create jobs in the manufacturing sector and in non-manufacturing sectors. Three methods have been used to estimate the effect that exports have on the use of labour as a factor of production: regressions, which are the most commonly used technique; the factor content of trade (Wood, 1994); and input-output matrices. The publication in recent years of aligned input-output matrices for various countries has made it possible to arrive at comparable estimates of the labour content of exports for a number of different countries.

This study will rely on previous research that has employed this latter method. The literature on the subject has expanded exponentially over the last three years, as is illustrated by this partial list of recent studies: Irawan and Welfens (2014), who study the possible effects for Germany, the European Union and the United States of the trade and investment agreement between the United States and the European Union that is now under discussion; Kupfer and others (2013) on the effects for Brazil; Chen and others (2012) and Los, Timmer and De Vires (2012) on the effects on the Chinese economy; Sousa and others (2012) on the impact on the European Union; Aswicahyono, Brooks and Manning (2011) on the effects on Indonesia; Brautzsch and Ludwig (2011) and Lurweg, Oelgemöller and Westermeier (2010) on the implications for the German economy; Koller and Stehrer (2010) on the repercussions for Austria; and Kiyota (2011) on the effects on Japan.

This method has been used to explore the issue of exports and employment in Mexico in three studies: Ruiz-Nápoles (2004), Cardero and Aroche (2008) and Cervantes and Fujii (2012). These three studies all cover long periods of time, from the closing decades of the last century to the early years of the 2000s, and they share the objective of determining what impact trade liberalization has had on employment. However, their more specific objectives differ somewhat. Cardero and Aroche (2008) focus on calculating the trends, disaggregated by sector, in employment multipliers and coefficients under trade liberalization and the sectoral trends in export growth, along with the change in the export product mix. Ruiz-Nápoles (2004) attempts to estimate the percentages of the jobs created in the period under study that are attributable to export activity and to the domestic sector of the economy. In that study, the labour content of exports is divided into direct and indirect employment. In addition to calculating the total amount of direct and indirect employment embedded in the country's exports in absolute terms, Cervantes and Fujii (2012) give estimates, based on highly restrictive assumptions, of the amount of employment embedded in

its imports. On this basis, they then arrive at an estimate of the net result of trade liberalization on employment.

This study differs from the three above-mentioned studies on the impact of trade liberalization in Mexico on employment in a number of ways. First, it focuses on two specific years (2008 and 2012). Second, it employs a symmetric domestic input-output matrix for 79 subsectors of economic activity developed by the National Institute of Statistics and Geography (INEGI), whereas the earlier studies used the matrices created by INEGI for 1980 and 1985, while the data for the following years were drawn from the Stata matrix built by the Consultoría Internacional Especializada, S.A. based on extrapolations of the matrices for the 1980s. A third difference is that this study focuses on the labour content of exports of manufactured goods, which account for 80% of the country's total exports. Finally, the indirect labour content of manufactured exports is divided into its intrasectoral and intersectoral components. To our knowledge, this is the first study that draws that distinction when analysing the indirect labour content of exports.

Employment is an extremely important issue for the Mexican economy, given the challenges that it faces in this area: as of 2012, a full 60% of employed persons were working informally, with 31% employed under informal conditions in the formal sector and 29% working in the informal sector as such (INEGI, 2012). The various export subsectors exhibit different labour intensities and different ratios for the direct and indirect labour content of their exports. Consequently, more specific information about the employment content and characteristics of different exports can be used by policymakers to maximize the job-creation impact of export policies.

This study is organized as follows: section II offers an overview of the strong growth trends seen in the Mexican export sector and the sweeping changes that it has undergone in the last 25 years. Section III describes the methodology used to arrive at the estimates. Section IV presents the empirical findings. Section V presents the main conclusions.

II

Mexican export growth and trends

Between 1992 and 2012, Mexico's total exports soared from somewhat less than US\$ 50 billion to some US\$ 375 billion. Its export coefficient also jumped from 13% to over 30% during that same timespan (Banco de Mexico, 2013).

The country's export growth was coupled with changes in the composition of its exports of goods and, by 2013, manufactures made up 84% of its total exports (INEGI, 2014).

An analysis of industrial exports based on their intensiveness in different factors of production —and specifically in natural resources or in low, intermediate or high technology— shows that products that are intensive in intermediate and high technology accounted for 62% of the country industrial exports in 2012 (United Nations, 2014). These data should be taken with a grain of salt, however, because they are based on a classification of exports by their technological level, and it may well be that a country may be specialized in a technologically unsophisticated stage of production of a high-technology product. This is important to bear in mind when looking at countries in which a significant portion of manufactured exports are linked to global value chains such as those in which Mexico is heavily involved. In 2003, 62% of the country's manufactured exports came from the maquila industry (Cervantes and Fujii, 2012, p. 152). This observation is relevant here for two reasons: first, because Mexico's position in these value chains is in labour-intensive production processes, and it is therefore to be expected that those of its manufacturing activities that form part of those chains will directly create a significant number of jobs; and, second, these activities are import-intensive, which means that their impact in terms of indirect job creation will not be especially strong.

III

Methodology

Assuming that the techniques used to produce exports and goods destined for the domestic market are generally similar, then the level of output associated with exports can be expressed as follows:

$$x_e^d = \left(I - A^d\right)^{-1} f^e \qquad (1)$$

where x_e^d is the vector of the total (direct and indirect) production of exports, f^e, and $\left(I - A^d\right)^{-1}$ is the Leontief inverse matrix, with I being the identity matrix of dimension $n´n$, in which n is the number of economic sectors and A^d is the matrix of technical coefficients.

Total direct and indirect employment generated by exports (l_e) can be obtained by multiplying the vector of the labour coefficients (λ) by the gross output value of exported goods:

$$l_e = \lambda \hat{X}_e \qquad (2)$$

$$\lambda = \left\{l_j / x_j\right\} \qquad (3)$$

where λ is the row vector of coefficients for employment by sector, whose typical elements are obtained by dividing the total number of jobs in sector j (l_j) by the total value of that sector's output (x_j), and is the diagonaized matrix of the gross output of exports (x_e^d).

The direct job creation attributable to exports (ld_e) is calculated by multiplying the labour coefficient vector by the diagonalized matrix of the value of exports, $\hat{E}$.

$$ld_e = \lambda \hat{E} \qquad (4)$$

Indirect job creation attributable to exports, by sector of origin of national inputs, is equal to:

$$li_e = l_e - ld_e \qquad (5)$$

Finally, in order to arrive at a breakdown of the employment indirectly generated in other sectors of the economy by exports, in equation (6) we use the matrix of indirect employment, by sector of origin and destination of the domestic inputs contained in export goods:

$$li_e = \left[\hat{\lambda} \left(I - A^d \right)^{-1} \hat{E} \right] \qquad (6)$$

where $\hat{\lambda}$ and ld_e are the diagonalized matrices of the technical coefficients of employment (λ) and of direct employment (ld_e). Since the matrix of indirect employment (li_e) is a matrix of order n, the elements of its principal diagonal represent intrasectoral indirect employment, i.e., when the sector of origin of intermediate inputs is also the sector of destination ($i = j$). All the elements that

are not on the principal diagonal represent the amount of indirect employment derived from intersectoral links (i.e., when the sector of origin of the inputs differs from the sector of destination ($i \neq j$)).

The main limitations of this method have to do with the level of aggregation of the information for each branch of economic activity and the assumption of a fixed-proportion production function, which, via the Leontief inverse, could result in an overestimation of the number of jobs associated with export activity owing to the failure to take into account the possibility that some (large) firms could achieve economies of scale. On the other hand, by failing to consider the positive effect that each newly created job will have on final domestic demand, we will be underestimating the impact that exports have on job creation.

IV

The total, direct and indirect labour content of manufactured exports

Table A1.1 (see the annex) shows the labour content of Mexico's exports of manufactures in 2012. A vertical reading of that table shows the total number of direct and indirect jobs created by exports for each of the sectors given in the column headings, thereby affording a view of both intrasectoral and intersectoral job creation and the overall sectoral distribution of those jobs. A horizontal reading shows, for each of the sectors given in the headings for the rows, the total employment in each sector generated by manufactured exports, their breakdown between direct and indirect and intrasectoral and intersectoral job creation, and their distribution across the various job-creating export sectors. The last two rows and columns of table A1.1 show the sectoral distribution of the total employment attributable to exports of manufactures. The rows show the total labour content of the exports of the manufacturing sectors identified in the column headings and their share of the total labour content of these exports. The figures in the last columns correspond to the sectors in which the jobs represented by manufactured exports have been created and the distribution of those jobs among the different manufacturing export sectors.

The total direct and indirect labour content of manufactured exports amounted to 3,892,269 jobs, or 9.2% of the total number of jobs in the input-output matrix for 2012. The sum of jobs corresponding to direct plus intrasectoral indirect job creation (1,966,000) for manufactured exports represents 36.5% of the manufacturing jobs in the matrix. The data for 2008 show that the corresponding figures for that year were 3,633,000 jobs (7.7% of the total in the 2008 matrix) and 1,707,000 (30% of manufacturing jobs), respectively. The figures thus indicate that the percentage of manufacturing jobs created by manufacturing export activities is both significant and on the rise.

While nearly all the cells in table A1.1 are filled in, in most cases relatively few jobs have been created in the manufacturing sectors that are actually exporting the goods in question. In order to provide a clearer illustration of the most important sectoral linkages in terms of job creation, table 1 shows the same matrix, but in this case it is filled in only with those figures that amount to at least 0.3% of total export labour content (11,677 jobs). As the reader will see, export-created jobs reached or exceeded this threshold in only 49 of the 1,659 cells in

the matrix. The sum of the figures shown in these cells is equivalent to 2,840,339 jobs (73% of the total labour content of manufactured exports). Table A1.2 gives the same information for 2008 using the same cut-off in percentage terms, which in this case translates into 10,899 jobs. The biggest changes seen between 2008 and 2012 are the following:

(i)   The number of cells that are filled in dropped from 54 to 49, which signals a decline in manufacturing exporters' ability to create enough jobs in other sectors of the economy to exceed the threshold figure.

(ii) Whereas, in 2008, the exports of 20 of the 21 branches of the manufacturing industry created over 0.3% of the total labour content of manufactured exports (whether in the same sector or in others), the number of such branches had fallen to 18 by 2012. In 2008, the only branch of activity that did not reach the threshold figure was No. 23 (petroleum products and coal); in 2012, this branch of industry was joined by No. 20 (wood manufactures) and No. 22 (printing).

(iii) On the other hand, between 2008 and 2012 the total number of jobs created by manufacturing exporters rose by 7%, which indicates that the manufacturing sector's capacity for creating jobs whose total number falls below the 0.3% threshold has become more diversified in both intrasectoral and intersectoral terms.

1. Jobs created by exports of manufactures, by sector of employment and by job-creating sector

Table 2 covers the sectors included in table 1 that account for over 5% of the total number of jobs created by exports of manufactures and those in which 4.6% or more of those jobs were located in 2012.

As can be seen from the table, just 6 of the 21 manufacturing sectors shown in the matrix create a number of jobs that exceeds the thresholds discussed in the preceding paragraph. On the other hand, of the 79 sectors in the complete matrix, only 7 surpass the threshold of 4.6% of total employment in manufacturing export sectors.

The rows in table 2 in which the figures are shown in italics provide the following data: (i) the consolidated data for total employment content in the manufacturing export sectors identified in the column headings; (ii) the percentage of the total labour content of exports represented by each sector; (iii) the share of total employment in the sector represented by the labour content of exports; (iv) the

breakdown of employment into its direct and indirect components and the breakdown of indirect employment into its intrasectoral and intersectoral components; (v) the sectoral employment coefficient (number of jobs per million pesos worth of gross output), and (vi) the percentage of manufactured exports provided by each sector. The breakdowns of job creation into its direct and indirect components and of the employment coefficient will be discussed at greater length in subsections 2 and 3 below. In the remainder of this subsection, the discussion will focus on the other information presented in table 2.

The labour content of the exports of the six sectors mentioned above account for 70% of the total, and those sectors' exports represent 77% of the country's total exports of manufactures.

Exports of transport equipment (28% of manufactured exports) account for the largest share of employment (25% of the total), followed by exports of electronics (12% of employment), although that industry's share of total manufactured exports is only a few percentage points lower (26%). Electrical equipment (8.4% of exports and 7.6% of their labour content) comes in third place. The fact that there is no significant difference between the export and employment shares of the transport equipment and electrical equipment industries, whereas there is a notable difference in the case of the shares accounted for by the electronics industry, is due to the fact that the employment coefficients (total number of jobs per million pesos worth of gross output) of the first two sectors are equal to 1, whereas the coefficient for the electronics industry is much lower (0.5).

The only sector in which the share of manufacturing exports' labour content is significantly greater than its share of exports is the food industry (2.8% of manufactured exports and 11% of the labour content of manufactured exports). This can be attributed to this sector's very high employment coefficient (4.2).

The sum of intrasectoral indirect jobs and direct jobs embedded in the exports for some of these sectors (machinery and equipment, electronics,[1] electrical equipment and transport equipment) represents over 70% of employment in those sectors.

The last two columns in table 2 show the seven sectors in which manufactured exports created the most jobs (63% of the total labour content). The largest percentage of the

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[1] For the electronics sector, the 112% value shown is based on the information provided in the 2012 matrix, which indicates that the sector's final demand exceeded its exports. This could be due to the very large statistical discrepancy that appears in the matrix (17% of exports). The matrix does not provide explicit information on this subject, however.

TABLE 1

Mexico: labour content of manufactured exports, 2012

(Only figures over the threshold of 0.3% of the total (11.677 jobs) are shown)

Sector	Food 14	Beverages and tobacco 15	Textile inputs 16	Textiles other than clothing 17	Clothing 18	Products other than clothing made of leather, fur or artificial leather or fur 19	Paper 21	Chemicals 24	Plastic and rubber 25	Non-metal mineral products 26	Basic metals 27	Metal products 28	Machinery and equipment 29	Electronics 30	Electrical equipment 31	Transport equipment 32	Furniture 33	Other manufactures 34	Jobs	Percentage
1 Agriculture	234 202	36 083	29 131																299 416	10.5
2 Livestock	27 321																		27 321	1.0
3 Forestry									13 392										13 392	0.5
7 Mining other than petroleum and natural gas											20 207								20 207	0.7
14 Food	80 579																		80 579	2.8
15 Beverages and tobacco		32 465																	32 465	1.1
16 Textile inputs			20 006																20 006	0.7
17 Textiles other than clothing				23 353															23 353	0.8
18 Clothing					110 562														110 562	3.9
19 Products other than clothing made of leather, fur or artificial leather or fur						32 401													32 401	1.1
20 Wood																			0	0.0
21 Paper							15 815												15 815	0.6
22 Printing																			0	0.0
24 Chemicals								60 859											60 859	2.1
25 Plastic and rubber									63 372							23 458			86 831	3.1
26 Non-metal mineral products										60 378									60 378	2.1
27 Basic metals											46 233					12 547			58 779	2.1
28 Metal products												102 279							102 279	3.6
29 Machinery and equipment													175 094						175 094	6.2
30 Electronics														344 215					344 215	12.1
31 Electrical equipment															180 953				180 953	6.4
32 Transport equipment																435 766			435 766	15.3
33 Furniture																	40 195		40 195	1.4
34 Other manufactures																		122 951	122 951	4.3
35 Commerce	22 130							28 858	13 846		17 635	19 907	62 199	19 298	28 377	209 342		13 875	435 467	15.3
39 Trucking																26 619			26 619	0.9
60 Professional, scientific and technical services														17 313		17 125			34 437	1.2
62 Business services	19 979							25 750	19 079		15 559	26 175	63 128	38 078	35 940	159 267		20 111	423 066	14.9
Labour content of exports, by manufacturing export sector	364 232	68 548	49 137	23 353	110 562	32 401	15 815	89 717	90 610	60 378	84 074	122 186	237 292	380 827	209 330	724 856	40 195	136 826	2 840 339	100
Labour content of exports, by manufacturing export sector (%)	12.8	2.4	1.7	0.8	3.9	1.1	0.6	3.2	3.2	2.1	3.0	4.3	8.4	13.4	7.4	25.5	1.4	4.8		100

Source: Prepared by the authors, on the basis of National Institute of Statistics and Geography (INEGI), "Matriz de insumo-producto 2012" [online] http://www.inegi.org.mx/est/contenidos/proyectos/cn/mip12/.

TABLE 2

Mexico: jobs created by manufacturing exporters, by job-creating export sector and by sector of employment, 2012
(*Selected sectors*)

		Food	Machinery and equipment	Electronics	Electrical equipment	Transport equipment	Other manufactures	Jobs created by manufacturing exporters	Percentage of jobs created by manufacturing exporters, by sector of employment
		14	29	30	31	32	34		
1	Agriculture	234 202	1 037	887	790	7 668	11 614	349 859.5	9.0
29	Machinery and equipment	101	175 094	510	484	4 402	34	181 024.1	4.7
30	Electronics	28	294	344 215	603	990	129	346 454.2	8.9
31	Electrical equipment	14	371	695	180 953	1 289	71	183 637.6	4.7
32	Transport equipment	137	514	133	236	435 766	75	437 525.8	11.2
35	Commerce	22 130	62 199	19 298	28 377	209 342	13 875	479 458.5	12.3
62	Business services	19 979	63 128	38 078	35 940	159 267	20 111	472 065.3	12.1
								3 892 269 [a] / 2 450 025 [b]	62.9
	Total labour content of manufactured exports, by export sector	414 246	363 453	459 877	295 435	989 737	199 104	3 892 269 [a] / 2 721 852 [b]	
	Total labour content of manufactured exports, by export sector (%)	10.6	9.3	11.8	7.6	25.4	5.1		69.9 [c]
	Direct plus indirect employment attributable to exports in the sector (%)	6.0	79.5	111.3 [d]	84.9	71.9	55.2		
	Direct employment	73 628	171 321	340 340	178 789	396 987	119 325	1 885 699 [a] / 1 280 391 [b]	
	Indirect employment	340 617	192 132	119 537	116 646	592 750	79 779	2 006 570 [a] / 1 441 461 [b]	
	Indirect intrasectoral employment	6 951	3 773	3 875	2 164	38 779	3 625	83 471 [a] / 59 167 [b]	
	Indirect intersectoral employment	333 667	188 359	115 662	114 482	553 971	76 153	1 923 099 [a] / 1 382 295 [b]	
	Direct employment (%)	17.8	47.1	74.0	60.5	40.1	59.9		
	Indirect employment (%)	82.2	52.9	26.0	39.5	59.9	40.1		
	Indirect employment/direct employment	4.63	1.12	0.35	0.65	1.49	0.67		
	Total employment coefficient	4.2	1.3	0.5	1.0	1.0	1.9	1,06	
	Manufactured exports (%)	2.8	8.1	25.9	8.4	28.4	3.0		76.6 [c]

Source: Prepared by the authors, on the basis of National Institute of Statistics and Geography (INEGI), "Matriz de insumo-producto 2012" [online] http://www.inegi.org.mx/est/contenidos/proyectos/cn/mip12/.

[a] Total for the manufacturing sector.
[b] Total for the selected sectors.
[c] Horizontal total.
[d] See footnote 1.

employment (29.5%) created by manufactured exports is in the manufacturing sector itself: 11% in transport equipment, 9% in electronics and 4.7 % in machinery and electrical equipment. But since manufactured exports incorporate inputs produced by other sectors, they also create a significant number of jobs in the commercial sector and in business services. In addition, 9% of the jobs created by manufactured exports are in agriculture, especially in the food industry.

Table A1.3 gives the same information for 2008. A comparison of the data shown in that table with those shown in table 2, which gives the corresponding information for 2012, provides a basis for the following conclusions:

(i)   Between 2008 and 2012, the number of manufacturing sectors with the largest share of employment associated with exports of manufactures fell from seven to six (the clothing and metal products sectors disappeared from the top-rated sectors but the category of "other manufactures" was added). The number of sectors in which manufactured exports create a number of jobs over the cut-off value rose from six to seven (with the addition of the machinery and equipment sector);

(ii) These manufacturing export sectors accounted for 77.5% of total manufactured exports in 2008 and for 76.6% in 2012 and for 72% and 70% of the labour content of manufactured exports in those years, respectively;

(iii) The labour content of the manufactured exports produced by these sectors climbed from 2.62 million to 2.72 million jobs. The most notable changes in individual manufacturing export sectors were as follows: increases in the labour content of the exports of the food industry (from 296,000 to 414,000 jobs), in the exports of the machinery and equipment industry (from 254,000 to 363,000 jobs) and in those of the transport equipment industry (from 776,000 to 990,000 jobs), which were offset to some extent by decreases in the labour content of the exports of the electrical equipment industry (from 330,000 to 295,000 jobs) and of electronics (from 582,000 to 460,000 jobs).[2] The disappearance of the clothing and metal products export sectors from the list of the sectors having the highest coefficients of labour content was due to the fact that the number of jobs provided by these sectors fell from 198,000 to 110,000 jobs (see table 1) and

from 192,000 to 122,000 jobs, respectively, while the labour content of the exports from the other manufacturing export sectors on the list rose from 149,500 to 199,000;

(iv) As of 2008, there were three manufacturing industries in which the direct employment plus the intrasectoral indirect employment generated by exports amounted to over 70% of the jobs provided by those industries; in 2012, the transport equipment industry joined the list;

(v)   The jobs created by exports of manufactures from the selected sectors climbed from 2.19 million to 2.45 million thanks to strong upswings in agricultural employment and employment in the electrical equipment and transport equipment industries. Export-generated employment was down in the electronics industry and in commerce, however.

2. The direct and indirect labour content of exports

Of the 3.9 million jobs associated with exports, 1.9 million (48%) of those jobs correspond to direct employment while the other 2 million have been created indirectly. A perusal of the cells in table 1 that contain figures for the total labour content of exports of manufactures above 0.3% (11,677 jobs) reveals that direct employment plus intrasectoral indirect employment surpass that figure in all the manufacturing industries listed there, whereas very few cells that are not on that diagonal are filled in. The large number of empty cells indicates, first of all, how weak the linkages are between export sectors and the other branches of economic activity and, second, that the indirect labour content of exports of manufactures —almost all of which is intersectoral (96% of their indirect labour content)— is accounted for by just a few branches of activity (see table 2). The main ones are the food industry and the beverages and tobacco industry, whose exports created 234,000 and 36,000 jobs, respectively, in agriculture (see table A1.2), and the jobs in commerce created by exports of manufactures (479,000), of which 209,000 are accounted for by exports of transport equipment. Exports of machinery and equipment also create a considerable number of jobs (62,000) in commerce. Exports of manufactures create 472,000 jobs in business services as well, with the largest shares corresponding to exports of transport equipment (159,000 jobs) and exports of machinery and equipment (63,000 jobs).

The lower section of table 2 shows the breakdown of the labour content of exports of manufactures into its direct and indirect components. As may be seen from the

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[2]   There is a large statistical discrepancy here that is similar to the one mentioned in footnote No. 1.

table, 47% of the labour content of these sectors' exports is direct, which means that exports of manufactures indirectly create 1.06 jobs for each job that they create directly. The percentage varies widely from one sector to the next, however. The food industry's exports create 4.63 jobs indirectly for each directly created job, with that industry's impact on farm employment accounting for the bulk of that figure. Exports of transport equipment are also an important source of indirect job creation (1.49 indirectly created jobs for each directly created one). By contrast, the electronics industry, which is a huge exporter, created just 0.35 jobs indirectly for each directly created job. These data indicate that the food industry's exports and those of transport equipment producers have much stronger linkages with the domestic economy than the electronics industry does. As a result, even though the electronic industry accounts for only three percentage points fewer manufacturing exports than the transport equipment industry does, the latter's contribution in terms of export-sector employment is 2.1 times greater than the electronics industry's.

A comparison of the figures given in table 2 and table A1.3 shows how the ratio of the indirect to direct labour content of exports of manufactures has changed. That ratio in the selected sectors has fallen (from 1.21 to 1.06), and, in three of the five biggest export industries, the drop between 2008 and 2012 was significant: from 0.62 to 0.35 in the electronics industry; from 1.01 to 0.65 in the electrical equipment industry; and from 2.14 to 1.49 in the transport equipment industry. In the two other industries in question, the ratio rose: from 3.82 to 4.63, for the exports of the food industry, and from 1.02 to 1.12 for those of the machinery and equipment sector. This means that the indirect job-creation capacity of the sectors that, taken together, account for 63% of the country's exports of manufactures, which is clearly related to their linkages with other sectors of the economy, had weakened considerably by 2012.

3. Exports and employment, by the labour intensity of manufacturing sectors

Labour intensity is gauged on the basis of the total employment coefficient of a given industry (jobs per millions of pesos worth of gross output) and varies widely across the various manufacturing sectors. In table 3, the employment coefficients for 2008 and 2012 for each sector are grouped into the following categories: high (over 4), fairly high (between 3 and 4), intermediate (from 2 to 3), fairly low (from 1 to 2) and low (less than 1). It becomes clear that the country's export structure differs a great deal from the Heckscher-Ohlin model. The manufacturing sectors with high and fairly high employment coefficients (i.e., the labour-intensive sectors) accounted for just 4% of exports of manufactures as of 2012, which, in turn, accounted for 15.4% of their total labour content. At the other extreme, over half of exports of manufactures came from branches of activity with fairly low employment coefficients that account for 56% of the employment generated by manufactured exports. If the sectors with low employment coefficients are added to this latter group, then together they account for 91% of total exports of manufactures and 75% of manufactured exports' labour content. What is more, during the period under study, the country's export structure has diverged even further from the Heckscher-Ohlin model as both the share of manufactured exports and the share of total labour content of labour-intensive sectors have shrunk.

In two of the five categories defined in table 3 —those with high and fairly high employment coefficients— the ratio of indirect to direct employment is greater than one (1). The latter of these categories is, as noted earlier, highly influential because of the share of total manufactured exports that it represents, with much of that share corresponding to the transport equipment sector, whose employment coefficient is equal to one (1).

TABLE 3

Mexico: exports of manufactures and employment, by employment coefficient, 2008 and 2012

Coefficients	Exports of manufactures (*percentages*)	Jobs (*thousands*)			Percentages		
		Total	Direct	Indirect	Total	Direct	Indirect
High (greater than 4)	3.21	392.0	108.6	283.5	10.8	27.7	72.3
Fairly high (3-4)	6.00	497.8	296.1	201.8	13.7	59.5	40.5
Intermediate (2-3)	9.32	492.6	283.6	208.9	13.6	57.6	42.4
Fairly low (1-2)	49.26	1 647.8	594.1	1 053.7	45.4	36.1	63.9
Low (less than 1)	32.21	602.8	362.4	240.3	16.6	60.1	39.9
Total	100	3 633.01	1 644.82	1 988.20	100.0	45.3	54.7

Table 3 (concluded)

Coefficients	Exports of manufactures (*percentages*)	2012 Jobs (*thousands*)			Percentages		
		Total	Direct	Indirect	Total	Direct	Indirect
High (greater than 4)	3.20	474.1	92.7	381.5	12.2	19.5	80.5
Fairly high (3-4)	1.09	125.9	78.9	47.0	3.2	62.6	37.4
Intermediate (2-3)	4.40	391.4	229.5	161.9	10.1	58.6	41.4
Fairly low (1-2)	53.67	2 171.7	1 042.5	1 129.2	55.8	48.0	52.0
Low (less than 1)	37.64	729.1	442.1	287.0	18.7	60.6	39.4
Total	100	3 892.3	1 885.7	2 006.6	100.0	48.4	51.6

Source: Prepared by the authors, on the basis of National Institute of Statistics and Geography (INEGI), "Matriz de insumo-producto 2008" [online] http://www.inegi.org.mx/est/contenidos/proyectos/cn/mip/; and "Matriz de insumo-producto 2012" [online] http://www.inegi.org.mx/est/contenidos/proyectos/cn/mip12.

V

Conclusions and policy recommendations

Between 2008 and 2012, the labour content of exports of manufactures climbed from 3.6 million to 3.9 million jobs, thereby increasing their share of total employment in the economy from 7.7% to 9.2%, while the sum of direct employment plus intrasectoral indirect job creation corresponding to exports of manufactures rose from 30% to 36.5% of manufacturing jobs reported in the matrix.

The structure of the country's manufacturing exports is far from what it would be expected to be according to the Heckscher-Ohlin model. While low-skilled and intermediate-skilled labour is relatively abundant in Mexico, exports of manufactures are concentrated in sectors that have fairly low and low coefficients of labour intensity. The biggest export sectors —transport equipment and electronics— have fairly low and low employment coefficients, respectively, whereas the labour-intensive export sectors —such as the food industry— do not account for a large share of exports of manuactures.

These results serve as the basis for a number of policy proposals that could leverage the employment effect of exports. The discussion here will not centre on horizontal policies that have been examined in other studies (OECD, 2014), but rather on lines of policy that could serve as a framework for horizontal policies designed to strengthen the connection between exports and employment:

(i)   This study has shown that employment coefficients vary a great deal across the various sectors of the economy; consequently, placing greater emphasis on labour-intensive export sectors will generate a

closer link between these variables. The sectors whose exports create a larger number of jobs (using 50,000 jobs as the cut-off) include: the food industry, beverages and tobacco, textile inputs, clothing, leather products, non-metal mineral products and furniture (employment coefficients greater than two (2)). They are followed by the plastic and rubber, metal products and machinery and equipment sectors (employment coefficients of between one (1) and two (2)).

In addition to the direct job-creation effect of these activities, they also have a substantial impact in terms of indirect job creation in Mexico, since most of them process natural resources that are in abundant supply in the country. Consequently, their exports can have a strong impact on employment in the sectors that extract those resources. The manufacturing activities that create at least one job indirectly for every job that they create directly are the food industry, beverages and tobacco, textile inputs, plastic and rubber, and basic metals sectors. Therefore, a policy that focuses on the exports of these products will indirectly have a noticeable impact on farm and mining employment. In order to leverage the linkages between these sectors, policymakers need to focus on boosting the efficiency of raw material producers so that they will be able to meet exporting sectors' quality standards.

(ii)   It is well known that medium-sized and small firms generally have higher employment coefficients than

big businesses do. Thus, in order to heighten the employment effect of exports, policies have been directed towards helping these smaller companies to become direct exporters. The findings of this study suggest that these policies need to be redirected towards helping these firms to export indirectly, as well as directly, by supplying production inputs for direct exporters. Since agriculture is a sector in which there are a very large number of small-scale producers, a policy that strengthens their linkages with businesses that process and market their export products will have a strong indirect effect on agricultural employment. This also entails overhauling small-scale agriculture so that small agricultural enterprises will be in a position to become part of these value chains.

(iii) Because the in-bond assembly industry plays such an important part in the production of Mexican exports —exports that make use of large amounts of imported inputs— industrial policies have focused on developing the production of parts and components as a means of boosting these exports' indirect job-creation capacity. The best example of this is the electronics industry, which accounted for 28.9% of the country's exports of manufactures in 2003 (Fujii and Cervantes, 2013) and which has the lowest coefficients for employment per unit of production and for indirect employment as a ratio of direct employment. Efforts to boost the domestic production of electronic parts and components run up against a number of formidable challenges because the electronics industry is part of an internationally fragmented global value chain; decisions regarding each country's place in the production process are taken by the firms that head up these value chains based on the advantages enjoyed by each country in the production of parts and the operation of each of the various phases of production. This line of effort is therefore subject not only to decisions taken at the national level but also to the criteria used by large companies when deciding how to distribute or apportion their production processes around the globe.

Another approach to strengthening the employment effect of production activities that form part of global value chains is founded on the fact that, in order for a product to reach consumers, it has to go through a number of different production phases which, in many cases, include research and development (R&D), product design, the production and procurement logistics for components, parts and materials, assembly, product distribution logistics, marketing and after-sale service. These phases may be involved in the production of both technologically unsophisticated products, such as clothing, for example, and technology-intensive goods, such as electronics and transport equipment. For some other products, such as iron and steel, the chain may be shorter.

Highly specialized firms deal with some of these activities and may outsource related tasks to dense clusters of firms surrounding portions of these chains. In the context of the issues of concern to us here, then, another course of action will be to explore the possibility of Mexican firms' entry into specific areas of activity associated with global value chains in the broader sense of the term and, if that proves to be a viable course of action, to design targeted industrial policies to help turn that possibility into a reality.

Value chains also include service activities, and service companies may also be able to expand their operations within that framework. One of those activities is transport, in which medium-sized and small companies tend to predominate. Hence the need for policies aimed at helping transport and logistics firms to modernize their operations.

(iv) As pointed out by ECLAC (2013, p. 167), employment effects are quantitatively different from one destination market to another. In the case of Latin America, the most labour-intensive exports are primarily sold on other Latin American markets and in the United States. As is well known, most of Mexico's exports go to the United States, with the Canadian market coming in as a distant second. Therefore, it would be beneficial in terms of employment for Mexico to diversify its export markets by expanding into South America.

(v) If microeconomic and mesoeconomic policies designed to leverage the employment effect of exports are successful, they will have a positive multiplier effect at the macroeconomic level. An increase in the labour content of exports will translate into an increase in the domestic value added embedded in exports, which will in turn spur aggregate demand and, hence, aggregate output and employment.

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ANNEX A1

TABLE A1.1

Mexico: labour content in manufactured exports and jobs created by exports of manufactures, 2012
(Jobs)

Sector	Food	Beverages and tobacco	Textile inputs	Textiles other than clothing	Clothing	Products other than clothing made of leather, fur or artificial leather or fur	Wood	Paper	Printing	Petroleum and coal products	Chemicals	Plastic and rubber	Non-metallic mineral products	Basic metals	Metal products	Machinery and equipment	Electronics	Electrical equipment	Transport equipment	Furniture	Other manufactures	Jobs	Percentage
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34		
1 Agriculture	234 202	36 083	29 131	3 129	11 504	3 836	1 579	730	95	27	4 767	1 404	293	263	495	1 037	887	790	7 668	325	11 614	349 860	9.0
2 Livestock	27 321	404	839	65	469	4 899	4	34	5	8	1 425	96	29	66	85	237	212	192	3 186	62	164	39 803	1.0
3 Forestry	958	115	562	9	92	888	454	87	16	8	927	13 392	56	59	700	762	162	195	2 406	820	742	23 409	0.6
4 Fishing and hunting	11 267	1	0	0	54	2	0	4	2	0	38	3	1	4	3	11	4	4	18	1	93	11 510	0.3
5 Agricultural and forestry services	444	73	861	63	481	33	147	91	3	2	40	28	18	12	31	86	57	46	804	332	196	3 849	0.1
6 Petroleum and natural gas	84	33	12	6	20	7	4	19	5	1 155	579	51	63	85	48	120	85	74	260	15	76	2 800	0.1
7 Mining other than petroleum and natural gas	430	178	41	11	33	18	5	90	15	77	3 336	141	3 902	20 207	804	1 388	682	3 276	2 588	52	623	37 896	1.0
8 Mining services	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0
9 Electricity	299	156	113	43	122	47	12	134	28	24	370	339	216	776	373	696	293	521	2 087	62	279	6 991	0.2
10 Piped water and natural gas for final consumption	1 448	1 711	165	49	212	138	12	172	37	27	740	357	182	737	570	973	583	527	2 097	72	754	11 562	0.3
11 Building	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0
12 Civil engineering works	1	0	0	0	0	0	0	0	0	0	0	0	0	1	3	1	1	1	3	0	0	13	0.0
13 Specialized construction works	254	56	26	44	277	34	13	50	20	11	153	297	47	357	285	611	2 980	2 213	1 251	45	1 007	10 029	0.3
14 Food	80 579	3 883	16	9	62	1 404	2	54	8	6	244	56	43	49	62	185	190	157	1 321	24	80	88 434	2.3
15 Beverages and tobacco	74	32 465	3	4	6	2	0	3	1	2	49	8	4	10	10	28	16	20	86	2	10	32 801	0.8
16 Textile inputs	61	22	20 006	1 033	7 036	298	16	655	9	3	84	194	42	22	52	159	123	98	5 492	329	876	36 610	0.9
17 Textiles other than clothing	217	28	62	23 353	449	38	2	6	2	2	25	348	7	15	33	69	25	30	229	66	218	25 224	0.6
18 Clothing	41	11	5	180	110 562	6	1	17	6	13	50	22	27	28	86	294	189	172	828	12	176	112 725	2.9
19 Products other than clothing made of leather, fur or artificial leather or fur	128	42	3	3	262	32 401	8	5	1	33	66	75	20	106	131	152	92	114	4 880	103	110	38 736	1.0
20 Wood	497	416	41	37	89	50	9 784	260	35	56	452	298	388	231	885	1 974	1 536	1 102	3 817	5 679	3 118	30 746	0.8
21 Paper	732	260	70	34	182	67	6	15 815	454	17	1 242	364	434	91	375	1 186	1 309	665	2 601	62	990	26 958	0.7
22 Printing	207	81	27	20	104	45	8	53	9 746	22	477	184	88	152	213	481	385	294	1 302	35	225	14 151	0.4
23 Petroleum and coal	135	50	17	7	32	11	6	28	7	2 164	128	54	94	136	76	201	148	121	409	25	75	3 926	0.1

Table A1.1 (continued)

Sector	14 Food	15 Beverages and tobacco	16 Textile inputs	17 Textiles other than clothing	18 Clothing	19 Products other than clothing made of leather, fur or artificial leather or fur	20 Wood	21 Paper	22 Printing	23 Petroleum and coal products	24 Chemicals	25 Plastic and rubber	26 Non-metallic mineral products	27 Basic metals	28 Metal products	29 Machinery and equipment	30 Electronics	31 Electrical equipment	32 Transport equipment	33 Furniture	34 Other manufactures	Jobs, by sector, created by exports of manufactures — Jobs	Percentage
24 Chemicals	621	270	361	224	259	147	78	270	235	193	60 859	3 427	687	693	738	872	802	981	4 543	215	1 336	77 811	2.0
25 Plastic and rubber	1 410	1 494	57	27	109	322	61	139	102	29	1 487	63 372	115	109	940	1 783	2 908	3 653	23 458	659	1 107	103 342	2.7
26 Non-metallic mineral products	799	2 216	6	3	13	5	3	7	5	16	172	47	60 378	77	371	649	2 064	1 403	3 517	167	993	72 910	1.9
27 Basic metals	47	40	3	3	11	7	1	7	2	30	42	48	33	46 233	4 092	11 497	1 330	6 398	12 547	155	1 509	84 033	2.2
28 Metal products	583	674	19	21	59	49	15	38	11	1 030	540	486	118	410	102 279	4 874	1 577	2 753	10 467	219	460	126 681	3.3
29 Machinery and equipment	101	16	4	2	9	7	2	10	2	4	38	18	54	111	113	175 094	510	484	4 402	8	34	181 024	4.7
30 Electronics	28	26	3	2	11	3	3	5	4	4	25	17	8	25	50	294	344 215	603	990	9	129	346 454	8.9
31 Electrical equipment	14	5	2	2	6	2	0	3	2	3	18	10	7	113	58	371	695	180 953	1 289	16	71	183 638	4.7
32 Transport equipment	137	111	10	9	27	13	3	25	7	9	122	55	58	96	107	514	133	236	435 766	14	75	437 526	11.2
33 Furniture	16	5	2	1	6	3	1	4	1	2	21	10	5	13	18	45	17	21	149	40 195	12	40 546	1.0
34 Other manufactures	67	21	10	10	307	40	3	17	16	8	80	51	48	50	124	510	954	730	926	46	122 951	126 968	3.3
35 Commerce	22 130	7 349	2 787	1 604	8 721	3 567	678	5 720	1 438	2 227	28 858	13 846	6 091	17 635	19 907	62 199	19 298	28 377	209 342	3 808	13 875	479 459	12.3
36 Air cargo	42	21	8	17	63	13	3	10	4	5	59	41	26	112	166	794	1 830	830	1 340	34	354	5 773	0.1
37 Railway cargo	34	12	5	2	9	4	1	3	2	7	60	27	9	27	31	108	31	51	395	5	24	851	0.0
38 Waterway cargo	17	6	2	1	4	2	1	4	1	3	30	14	5	14	16	54	15	26	197	3	12	425	0.0
39 Trucking	2 369	824	315	154	593	278	84	529	126	455	4 079	1 844	650	1 891	2 180	7 321	2 049	3 508	26 619	376	1 631	57 876	1.5
40 Overland passenger transport other than by rail	129	51	21	10	384	15	2	27	9	8	194	134	156	174	235	361	193	313	1 101	19	207	3 741	0.1
41 Pipeline transport	13	4	2	1	3	2	0	3	1	2	22	10	4	10	12	40	11	19	146	2	9	317	0.0
42 Tourism transportation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3	0.0
43 Transport-related services	186	55	21	21	482	22	6	47	12	27	260	131	62	303	236	1 141	808	569	2 800	37	483	7 709	0.2
44 Postal services	6	3	1	0	2	1	0	2	1	2	8	6	3	7	7	15	15	10	44	1	45	180	0.0
45 Messenger and packaging services	68	22	13	10	72	10	2	15	20	5	98	63	38	37	123	308	2 122	495	451	15	203	4 190	0.1
46 Storage	294	175	64	30	129	30	11	87	18	35	505	535	109	242	429	908	293	303	2 404	62	993	7 656	0.2
47 Editing of publications and software other than by Internet	100	87	9	8	36	10	2	28	7	4	190	65	33	58	78	169	82	98	644	28	108	1 844	0.0
48 Film, video and sound editing	12	11	1	1	3	1	0	1	0	1	14	2	2	6	6	14	25	16	42	1	7	165	0.0
49 Radio and television	1	0	0	0	0	0	0	0	0	0	1	1	0	0	1	2	0	0	5	0	1	18	0.0
50 Other telecommunications	191	56	18	13	59	19	5	27	15	65	201	96	57	91	136	384	504	307	1 044	29	193	3 512	0.1
51 Electronic data processing, hosting and other related services	126	45	14	13	53	12	2	19	12	9	119	89	42	65	106	273	140	162	674	25	126	2 127	0.1

Table A1.1 (continued)

Sector	Food (14)	Beverages and tobacco (15)	Textile inputs (16)	Textiles other than clothing (17)	Clothing (18)	Products other than clothing made of leather, fur or artificial leather or fur (19)	Wood (20)	Paper (21)	Printing (22)	Petroleum and coal products (23)	Chemicals (24)	Plastic and rubber (25)	Non-metallic mineral products (26)	Basic metals (27)	Metal products (28)	Machinery and equipment (29)	Electronics (30)	Electrical equipment (31)	Transport equipment (32)	Furniture (33)	Other manufactures (34)	Jobs	Percentage
52 Other information services	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	1	0	0	8	0.0
53 Central bank	2	1	0	0	1	0	0	1	0	1	3	2	1	3	3	6	4	4	18	0	2	53	0.0
54 Credit and financial institutions not listed on the stock market	258	114	40	16	84	40	7	41	11	96	295	190	161	313	322	590	342	373	1 803	43	208	5 346	0.1
55 Stock market gtransactions, currency exchange and financial investments	80	30	3	3	22	1	1	15	1	4	156	53	73	154	28	129	37	45	530	3	16	1 384	0.0
56 Finance, insurance and pensions	113	35	11	14	51	11	5	36	6	18	194	121	84	159	144	473	1 899	709	1 060	24	293	5 460	0.1
57 Real estate services	206	58	19	18	129	32	7	46	16	12	190	125	87	96	195	423	447	305	1 203	54	288	3 955	0.1
58 Furniture rentals	213	62	19	15	96	19	6	54	30	6	227	180	105	367	258	945	1 301	747	1 914	41	348	6 954	0.2
59 Trademark, patent and franchise leases	5	9	2	1	9	1	0	10	1	6	29	4	3	163	55	90	34	67	716	10	33	1 247	0.0
60 Professional scientific and technical services	2 676	1 536	278	278	1 333	227	60	475	271	430	3 176	1 144	731	2 123	2 456	10 855	17 313	7 595	17 125	475	5 875	76 432	2.0
61 Corporate	177	86	16	12	65	17	2	24	14	201	361	84	63	83	115	443	187	208	672	27	114	2 971	0.1
62 Business services	19 979	8 861	3 524	2 034	8 770	4 168	433	3 885	1 642	1 173	25 750	19 079	11 062	15 559	26 175	63 128	38 078	35 940	159 267	3 447	20 111	472 065	12.1
63 Waste management and remediation services	2	1	1	1	3	1	0	1	0	11	21	6	2	8	19	43	52	10	61	1	53	297	0.0
64 Education services	23	9	3	2	10	2	1	6	3	4	32	19	16	27	55	140	56	57	314	4	66	848	0.0
65 Out-patient medical serices	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0
66 Hospitals	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0
67 Social housing and special health-care residences	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0
68 Other social welfare services	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0
69 Artistic, cultural, sports and other services	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0	0	5	0.0
70 Museums, historical sites, zoos and similar attractions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.0
71 Services provided in recreational and similar sites	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0
72 Short-stay lodgings	119	56	16	8	43	17	3	41	25	59	268	88	60	185	153	454	215	268	1 201	33	175	3 486	0.1

Table A1.1 (concluded)

Sector	14 Food	15 Beverages and tobacco	16 Textile inputs	17 Textiles other than clothing	18 Clothing	19 Products other than clothing made of leather, fur or artificial leather, fur or fur	20 Wood	21 Paper	22 Printing	23 Petroleum and coal products	24 Chemicals	25 Plastic and rubber	26 Non-metallic mineral products	27 Basic metals	28 Metal products	29 Machinery and equipment	30 Electronics	31 Electrical equipment	32 Transport equipment	33 Furniture	34 Other manufactures	Jobs, by sector, created by exports of manufactures (Jobs)	Jobs, by sector, created by exports of manufactures (Percentage)
73 Food and beverage preparation services	525	155	61	53	296	67	10	142	35	105	826	389	219	619	615	2 147	4 517	3 299	7 179	109	1 432	22 802	0.6
74 Repair and maintenance services	849	300	122	204	264	124	33	296	59	47	1 020	375	600	1 254	869	2 113	2 676	1 728	7 063	197	1 607	21 800	0.6
75 Personal servies	11	5	1	1	4	1	0	3	2	3	18	7	5	13	11	31	22	23	92	2	12	268	0.0
76 Associations and organizations	85	23	13	8	22	13	2	34	5	8	94	47	56	127	82	189	111	143	858	15	90	2 023	0.1
77 Homes with domestic servants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0
78 Government activities	2	1	0	0	1	0	0	1	0	0	3	1	1	2	2	6	2	3	22	0	1	50	0.0
79 International and extraterritorial organizations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0
Labour content of exports, by manufacturing export sector	414 246	101 011	59 885	32 957	154 679	53 549	13 604	30 471	14 671	10 025	145 958	124 070	88 082	113 263	169 436	363 453	459 877	295 435	989 737	58 755	199 104	3 892 269	100.0
Labour content of exports, by manufacturing export sector (%)	10.6	2.6	1.5	0.8	4.0	1.4	0.3	0.8	0.4	0.3	3.7	3.2	2.3	2.9	4.4	9.3	11.8	7.6	25.4	1.5	5.1	100	
Direct employment	73 628	32 382	19 051	23 161	106 023	30 613	8 172	13 869	9 485	2 126	56 150	62 322	58 474	43 484	99 922	171 321	340 340	178 789	396 987	40 075	119 325	1 885 699	
Indirect employment	340 617	68 629	40 835	9 796	48 656	22 937	5 432	16 602	5 186	7 899	89 808	61 748	29 608	69 779	69 514	192 132	119 537	116 646	592 750	18 680	79 779	2 006 570	
Intrasectoral indirect employment	6 951	83	955	191	4 539	1 789	1 612	1 947	261	38	4 709	1 050	1 904	2 749	2 357	3 773	3 875	2 164	38 779	120	3 625	83 471	
Intersectoral indirect employment	333 667	68 546	39 879	9 605	44 117	21 148	3 820	14 655	4 925	7 861	85 098	60 697	27 704	67 030	67 158	188 359	115 662	114 482	553 971	18 560	76 153	1 923 099	
Total employment coefficient	4.2	2.4	4.3	2.4	2.8	3.6	3.5	1.6	2.6	0.2	0.9	1.7	2.3	0.6	1.5	1.3	0.5	1.0	1.0	3.0	1.9	1	
Indirect/direct employment	4.6	2.1	2.1	0.4	0.5	0.7	0.7	1.2	0.5	3.7	1.6	1.0	0.5	1.6	0.7	1.1	0.4	0.7	1.5	0.5	0.7	1	

Source: Prepared by the authors, on the basis of National Institute of Statistics and Geography (INEGI), "Matriz de insumo-producto 2012" [online] http://www.inegi.org.mx/est/contenidos/proyectos/cn/mip12/.

TABLE A1.2

Mexico: labour content of exports of manufactures, 2008
(*Coefficients above 0.3% of the total: 10,899 jobs*)

Sector	14 Food	15 Beverages and tobacco	16 Textile inputs	17 Textiles other than clothing	18 Clothing	19 Products other than clothing made of leather, fur or artificial leather or fur	20 Wood	21 Paper	22 Printing	24 Chemicals	25 Plastic and rubber	26 Non-metallic mineral products	27 Basic metals	28 Metal products	29 Machinery and equipment	30 Electronics	31 Electrical equipment	32 Transport equipment	33 Furniture	34 Other manufactures	Jobs	Percentage
1 Agriculture	152 019	32 368	12 423																		196 810	6.4
2 Livestock	13 956																				13 956	0.5
7 Mining other than petroleum and natural gas													12 678								12 678	0.4
14 Food	66 421																				66 421	2.2
15 Beverages and tobacco		24 413																			24 413	0.8
16 Textile inputs			16 006																		16 006	0.5
17 Textiles other than clothing				22 978																	22 978	0.7
18 Clothing					147 038																147 038	4.8
19 Products other than clothing made of leather, fur or artificial leather or fur						22 152															22 152	0.7
20 Wood							12 865														12 865	0.4
21 Paper								13 506													13 506	0.4
22 Printing									13 188												13 188	0.4
24 Chemicals										40 477											40 477	1.3
25 Plastic and rubber											43 872							13 159			57 030	1.8
26 Non-metallic mineral products												58 171									58 171	1.9
27 Basic metals													21 628								21 628	0.7
28 Metal products														109 657							109 657	3.6
29 Machinery and equipment															126 926						126 926	4.1
30 Electronics																362 418					362 418	11.7
31 Electrical equipment																	166 189				166 189	5.4
32 Transport equipment																		279 288			279 288	9.1
33 Furniture																			36 565		36 565	1.2
34 Other manufactures																				121 359	121 359	3.9
35 Commerce	22 731				14 871					45 799	16 525		59 691	32 369	50 360	50 072	52 221	243 399		14 401	602 438	19.5
39 Trucking																		18 950			18 950	0.6
60 Professional, scientific and technical services																25 221	11 024	13 481			49 726	1.6
62 Business services	17 431				12 042					28 364	18 292	14 168	25 871	28 230	41 614	77 089	55 156	128 692		13 735	460 684	14.9
73 Food and beverage preparation services																12 414					12 414	0.4
Labour content of exports, by manufacturing export sector	272 557	56 781	28 429	22 978	173 952	22 152	12 865	13 506	13 188	114 640	78 688	72 339	119 868	170 256	218 900	527 213	284 590	696 968	36 565	149 495	3 085 930	100.0
Labour content of exports, by manufacturing export sector (%)	8.8	1.8	0.9	0.7	5.6	0.7	0.4	0.4	0.4	3.7	2.5	2.3	3.9	5.5	7.1	17.1	9.2	22.6	1.2	4.8	100.0	

Source: Prepared by the authors, on the basis of National Institute of Statistics and Geography (INEGI), "Matriz de insumo-producto 2008" [online] http://www.inegi.org.mx/est/contenidos/proyectos/cn/mip/.

TABLE A1.3

Mexico: jobs in exports of manufactures, by exporting sectors and by branches of activity in which jobs are created, 2008
(Selected sectors)

	Food	Clothing	Metal products	Machinery and equipment	Electronics	Electrical equipment	Transport equipment	Jobs created by export of manufactures	Percentage of jobs created by exports of manufactures, by branch of activity
	14	18	28	29	30	31	32		
1 Agriculture	152 019	6 993	638	519	1 319	772	3 446	228 121	6.3
30 Electronics	7	5	18	46	362 418	338	188	363 104	10.0
31 Electrical equipment	6	4	25	106	896	166 189	472	167 832	4.6
32 Transport equipment	57	21	66	126	174	139	279 288	280 336	7.7
35 Commerce	22 731	14 871	32 369	50 360	50 072	52 221	243 399	659 593	18.2
62 Business services	17 431	12 042	28 230	41 614	77 089	55 156	128 692	496 519	13.7
								2 195 504[b] / 3 633 015[a]	60.4
Total labour content of manufactured exports, by export sector	296 344	198 299	191 990	253 928	581 595	330 252	775 985	2 628 393[b] / 3 633 015[a]	
Total labour content of exports, by export sector (%)	8.2	5.5	5.3	7.0	16.0	9.1	21.4		72.3[c]
Direct plus indirect labour content of exports, by sector of employment (%)	4.0	45.5	30.9	97.3	102.7[d]	86.1	58.4		
Direct employment	61 518	143 209	107 552	125 417	359 732	164 351	247 471	1 644 818[a] / 2 209 252[b]	
Indirect employment	234 825	55 090	84 438	128 510	221 863	165 900	528 514	1 988 196[a] / 1 419 141[b]	
Indirect, intrasectoral	4 902	3 829	2 105	1 509	2 685	1 837	31 817	63 061[a] / 48 684[b]	
Indirect, intersectoral	229 923	51 261	82 333	127 001	219 178	164 063	496 697	1 925 135[a] / 1 370 456[b]	
Direct employment (%)	20.8	72.2	56.0	49.4	61.9	49.8	31.9		
Indirect employment (%)	79.2	27.8	44.0	50.6	38.1	50.2	68.1		
Indirect employment/direct employment	3.82	0.38	0.79	1.02	0.62	1.01	2.14	1.21	
Total employment coefficient	5.3	3.8	2.3	1.5	0.8	1.4	1.4		
Exports of manufactures (%)	2.3	2.2	3.5	7.1	29.5	9.7	23.1		77.5[c]

Source: Prepared by the authors, on the basis of National Institute of Statistics and Geography (INEGI), "Matriz de insumo-producto 2008" [online] http://www.inegi.org.mx/est/contenidos/proyectos/cn/mip/.

[a] Total for the manufacturing sector.
[b] Total for selected sectors.
[c] Horizontal sum.
[d] See footnote No. 1.

Tertiarization in Chile: cultural inequality and occupational structure

Modesto Gayo, María Luisa Méndez and Berta Teitelboim

ABSTRACT

Tertiarization, or the shift to service economies with an increasing prevalence of non-manual occupations, has been identified as a central phenomenon in contemporary societies. With the purported numerical and political decline of traditional working-class sectors, the middle class has come to be seen in recent decades as the dominant one. This understanding of the way society has evolved has gone along with a growing interest in forms of social differentiation other than the occupational one of industrial societies, including cultural differentiation. This paper briefly reconstructs the debate and shows that while there may have been growth in non-manual occupations, prompting the notion of a progressive shift towards a middle-class society, some important findings make it difficult simply to accept the claim that Chile has become this kind of mesocratic society.

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I

Introduction

The advent of the post-industrial society, foretold since the 1960s by leading intellectuals such as Daniel Bell (1974) and John Galbraith (1967), is considered to have had a number of consequences. The main one is a transformation in the production apparatus of the most advanced societies involving a more or less abrupt transition from an industrial or goods-producing society to a post-industrial or service-producing one. This transition is held to have brought with it another consequence, the reshaping of the social structure. From an eminently working-class society which was dominated by manual work or occupations, and where socialism in politics accordingly played a key role in representing this class's interests, there was a shift to a society in which class membership became less clear-cut as many children of the working class abandoned the living patterns that had characterized it. In other words, the post-industrial society prompted the advent of middle-class society.[1]

The middle class is understood as a variegated grouping of professionals, managers, technicians and administrators (Gayo, 2013a and 2013c) that looks quite different from the membership of the working class. Irrespective of its internal differences (Gayo, Teitelboim and Méndez, 2013), one effect of the emphasis on the importance of this new class was a progressive loss of interest in the working class. The growing marginalization of that class, which now fulfilled the same role as Marx had assigned to a property-owning middle class at the outset of capitalism (Marx and Engels, 1971), in that it was first treated as a leading actor in history but then relegated to the status of a residual social category left over from the earlier capitalist regime, was due not only to the success (both socially and in terms of discourse) of the middle class, but to a deeper process: the apparent dissolution of the class structure that had characterized industrial society since its very origins (Pakulski and Waters, 1996; Beck and Beck-Gernsheim, 2002).

Within this broad framework of analysis, the last two decades have seen a sustained revitalization of studies on social stratification in Latin America, and much of this research has concentrated on defining, delimiting and measuring the middle classes (Filgueira, 2001; Atria, Franco and León, 2007; among others). This group of studies has illustrated the growth of middle-class sectors in countries such as Brazil (O'Dougherty, 2002), Chile (León and Martínez, 2004) and Mexico (Torche and López-Calva, 2013), focusing mainly on the shift in the social structure resulting from so-called "tertiarization" or the transition to a service economy. Thus, argument has turned on the burgeoning of the non-manual sector (Filgueira, 2001; Atria, 2004), increased consumption capacity (Knowledge@Wharton, 2008) and rising incomes (Ferreira and others, 2013) and education levels (Daude, 2012). Some studies have also linked the growth of the middle classes to the strengthening of democratic systems (Paramio and Güemes, 2013)[2] and to economic development (Ferreira and others, 2013). However, there is no consensus as to whether a general shift towards middle-class societies is actually taking place in the Latin America region. Indeed, there is a body of literature that has demonstrated a reluctance to radically accept this phenomenon: notwithstanding the improvements the middle classes may be enjoying, both by their own standards and relative to poorer groups, they are still vulnerable strata that have been unable to

[1] Within the historical framework of the industrial societies, social classes have usually been conceived and configured on the basis of the occupational structure. More contemporary conceptions of class that have been widely followed in the sociological tradition over the last three decades take the position, in accordance with Marxist thinking, that members of the working class are those working in organizations as non-owners in low-level occupations for which little intellectual training is required, while members of the middle class are likewise employees but are more highly educated and organized (Wright, 1978 and especially 1985), while in another approach generally understood as more Weberian, Erikson and Goldthorpe (1993) can be said to equate the working class with manual, less prestigious occupations, with the middle classes encompassing the whole range from those engaged in non-manual intermediate or routine occupations to the so-called service class, which includes sectors with high social status at the higher service levels.

[2] Paramio and Güemes (2013) note that countries with a large and well-established middle class tend to have sounder democracies, better governance, a stable credit system and higher public-sector health and education spending, the implication being that the middle class plays a fundamental role in economic development and political stability.

consolidate their structural position over time (OECD, 2011; López-Calva and Ortiz-Juárez, 2012; Paramio and Güemes, 2013).

An additional dimension in the global study of the middle classes is the cultural sphere, understood as patterns of cultural participation and taste, with sociological research in this area having been undertaken within an essentially Bourdieusian framework over the last three decades (Bourdieu, 1979). In these studies, the middle class is not just defined by its occupations or its education or income levels, but is characterized as a social group that is culturally active or has a particular propensity towards intense cultural activity (Bennett and others, 2009; Bennett, Bustamente and Frow, 2013; Gerhards, Hans and Mutz, 2013; Roberts, 2004). Some authors argue that this class is active not only in high culture but in mass culture too, which could imply a weakening of symbolic class boundaries as a result of its members' growing adoption of cultural practices usually considered closer to the habits and tastes of lower-class sectors (Peterson and Kern, 1996).

In their attempts at explanation, these studies have generally employed class-based occupational classifications that have repeatedly proved their worth when it comes to understanding cultural inequalities. The present paper, instead of opting for a particular class classification (Gerhards, Hans and Mutz, 2013) based on occupational groupings that draw on other studies from the outset, adopts a Bourdieusian perspective whereby such groupings arise inductively from the analysis of similarities between individuals as derived from their cultural behaviour. In other words, the contribution of this study to the evaluation of the current state of Chilean society necessarily involves an examination of cultural patterns, with occupation coming later as a manifestation of the complex structural ties to which these are subject (Pinto, 2013). Rather than subjecting cultural participation to particular determinants like (occupational) class, a constituent element of this approach is that it opens up the possibility of there being other dividing lines that are as or more important and that might serve to relegate the class interpretation of society to the background.

This study echoes these debates, additionally bringing in, as already mentioned, a dimension crucial to an understanding of the formation of the middle classes in Latin America: cultural tastes and participation practices. The hypothesis is that if tertiarization has become entrenched in Chile, and society there is now dominated by the middle class, there should be patterns of cultural participation that reflect this. What is mainly focused on here is the following. First, the nature of cultural participation profiles and their rough percentage shares are observed in order to gauge the extent and relative weight of different types of cultural activity. Next to be studied is the relationship between this activity and a set of variables that would be expected to influence it, such as education level, socioeconomic group, occupation, age, geographical area and sex. In a middle-class society, a significant erosion of cultural or symbolic class boundaries would be expected, i.e., one would expect to find variables as important as the one that distinguishes people by socioeconomic level and, similarly, by occupation. Once the data are analysed, however, the findings for cultural participation in Chile show a clearly differentiated society with polarization features. To synthesize, on the one hand there is a majority composed of people with low-paid manual and non-manual occupations requiring limited education, while on the other there is a group whose occupations are better paid and usually call for higher levels of education. Considering this, the European or tertiarization model of post-industrialization described for the Latin American case needs to be explored in some depth and not taken for granted as though it would come about through historical momentum. Today's Chile is markedly unequal, and this inequality is manifested in the cultural practices of its citizens, rather producing the impression of a country with serious limitations when it comes to cultural and, by extension, social performance.

To work through these arguments, the present article uses data from the second National Survey on Cultural Participation and Consumption conducted by the National Council for Culture and the Arts (CNCA) in 2009. This study was carried out in Chile's 15 regions among residents aged over 15, with 4,000 people from this population ultimately being surveyed. The survey questionnaire addressed different subjects, among them: attendance at cultural events, book reading and related activities, ownership of cultural equipment in the home, use of communications media, participation in activities connected with the cultural heritage and active participation in cultural and artistic activities (CNCA, 2011a).

Following this Introduction, the document is structured as follows. Section II deals with research conducted in Chile. Section III discusses the activities studied and the research methods. Section IV investigates cultural inequality in Chilean society. Section V looks at culture, employment and tertiarization. Lastly, section VI gives the conclusions of the study.

II

Research in Chile

In recent years, there has been a burgeoning of Chilean media and academic interest in understanding the country's society as one dominated by the middle class. However, the foundations on which this interpretation has arisen are different from those that allowed these ideas to emerge in more developed countries. First, there has been a progressive emphasis on poverty in the Chilean case. Once it was established that the country had progressed socially and economically and that poverty indices had fallen considerably in quantitative terms, there was a shift (beginning in the late 1990s) towards an interpretation of society that set out from the presence of the middle class, as had been increasingly happening in more advanced countries for several decades. This was important because, in an accelerated intellectual journey, it implied a completely seamless transition, not from working-class industrialization to middle-class post-industrialization, but from poverty to the middle class.[3] Yet not only does inequality in Chile remain an everyday factor in the structuring of social relationships, but there is ample evidence that social class is still a key variable shaping the behaviour of the country's citizens.[4]

Be this as it may, it is not only interest in the middle class that has grown (Méndez, 2007 and 2010; Espinoza and Barozet, 2009), as the attention paid to cultural practices has been on the increase as well (Gayo, Teitelboim and Méndez, 2013). Thus, it is considered that the quality of membership in a society should be understood in terms not just of economic success, but also of participation in cultural activities (CNCA, 2011b; Güell, Peters and Morales, 2012), something that has been linked on occasion to human development (UNDP, 2002; Délano, 2011). How has this phenomenon been described in the literature on Chile?

As background, it should be noted that some research into cultural consumption has been done in Chile, but it could hardly be claimed that there has been a profound and wide-ranging debate on the subject so far. There are some studies, most of them recent, whose data are mainly drawn from CNCA surveys, and there is still a long way to go before a body of well-grounded, thoroughgoing and systematic knowledge is established.

It is also important to understand two phenomena associated with recent studies of cultural practices. First, there is a remarkable degree of acceptance of the tertiarization framework for understanding contemporary Chilean society (Brunner, Barrios and Catalán, 1989). The rejection of the class outlook as an explanatory approach, the acceptance that there is a progressive movement towards a middle-class society, the way status is dwelt on as against social class and the recognition of individualization as a key to understanding society are all evidence of this. Again, although this follows on from the previous point, there has been an evident interest in interpreting the Chilean situation from the perspective of research agendas currently fashionable in institutions in the United States and the more developed parts of Europe (Torche, 2007; Nazif, 2007). The knowledge that has been generated on these aspects to date will now be presented, drawing on the main sociological contributions to the study of cultural practices in Chilean society over recent decades. This brief review will bring to light some of the more important patterns identified so far.

First, there is general agreement about a key phenomenon that is considered to have reconfigured Chileans' cultural participation in the past two or three decades. This is the expansion or massification of cultural and non-cultural consumption since at least the early 1980s (Brunner, Barrios and Catalán, 1989; UNDP, 2002; Catalán, 2009).[5] A study by the Ministry of Social Development shows spending by Chilean households growing substantially in the decade from 1988 to 1997 (Bernasconi and Puentes, 2001). Nonetheless, it is important to realize that massification has been asymmetrical, as Catalán and Sunkel (1990) observed some time ago. These authors argue that two types of mass activity need to be distinguished. First, there are the most massified pastimes, pursued by all social groups and strata (television, music, radio). Then there is another type of massification involving activities that are very

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[3] An article by Manuel Canales (2007) reflects on stratification in today's Chilean society, subsequent to the period when poverty was emphasized.

[4] A study that acknowledges both inequality and the general increase in wealth among the Chilean population is the one by Rasse, Salcedo and Pardo (2009), who argue for a rethink of inequality and the classifications used to represent it, given the obvious changes undergone by Chilean society in the last 20 years.

[5] This article deals with consumption generally and not just that of cultural goods or services.

common but practised to degrees that differ in line with education and income levels. They include reading the press, magazines and books, and cinema-going.

In the second place, notwithstanding the consensus about the growing massification of cultural practices, it is also generally agreed that there are major differences in cultural tastes and participation associated with sociological variables habitually used in analyses of this type (Catalán and Sunkel, 1990; CNCA, 2007; Torche, 2007; Nazif, 2007; Gayo, Teitelboim and Méndez, 2009 and 2013; Güell and Peters, 2012; Gayo, 2013b). They include sex,[6] occupation or socioeconomic group, region of residence, age, education and status. There is thus full awareness of inequality or inequalities when it comes to cultural consumption or participation.[7]

From a comparative perspective, it has been noted as a third element of analysis that levels of cultural participation are lower in Chile than in many other countries of Latin America. The introduction to a recent CNCA report states: "Cultural consumption is low in Chile… especially by comparison with countries such as Argentina, Uruguay, Colombia, Mexico and Brazil" (CNCA, 2007, p. 6). If participation is higher in the region's main countries, the implication would seem to be that there is something problematic about

Chile. In other words, it is felt that there is work to be done to attain levels similar to those of other countries in the region. Yet this could be said even though it is not clear that there is solid evidence for Chile lagging behind in this way (Nivón and Sánchez, 2012; OEI, 2014). Furthermore, the report of the Ministry of Social Development (MIDEPLAN) (Bernasconi and Puentes, 2001) that was cited earlier shows two additional patterns when it comes to international comparison. One is that the proportion of household spending going on culture is similar in Santiago and Montevideo, while in Buenos Aires it is higher. The other is that Buenos Aires has the highest level of spending inequality, while consumption in Montevideo is most egalitarian, with Santiago being in the middle where culture spending is concerned.

In the fourth place, it has been shown that empirical research has been fairly plentiful, whereas theoretical work has been much thinner on the ground. The contribution of Brunner, Barrios and Catalán (1989), although it is now somewhat dated and does not engage much with data on cultural consumption, is perhaps an exception (at least in its explanatory ambition) in a framework of modernization theory with a Bourdieusian cast. Some studies with greater empirical depth (Bernasconi and Puentes, 2001; Nazif, 2007; Torche, 2007; Güell and Peters, 2012) are weaker in their treatment of the theoretical and explanatory dimension. Between these two poles, in terms of the combination of whole society coverage and depth of data analysis, stands the report of the United Nations Development Programme (UNDP), which incorporates qualitative methodologies in a substantive way, thereby constructing a narrative that looks beyond surveys (UNDP, 2002).

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[6] It is now more common to speak of "gender," but the information routinely gathered refers to the respondent's sex.

[7] As a limitation on such quantitative studies, some authors have argued that a qualitative or more ethnographic approach is required to reach a better understanding of the symbolic distinction or differentiation processes associated with the practice of culture (Aguilar, 2009; Gayo, Teitelboim and Méndez, 2009; Gayo and others, 2011).

III

Activities studied and research methods

Studies in Chile have hitherto been characterized by at least three features. First, variables have been categorized in the standard way, i.e., the patterns normally taken for Chile and other countries have been kept to. A clear example of this is the way respondents have been sorted using well-known class categorizations, such as that of Erikson and Goldthorpe (Torche, 2007; Nazif, 2007). The rationale for this proceeding has usually been the needs of comparison, whether or not this actually takes place, with little attention being paid to the fact that the

pattern used as the basis for comparison generally comes from studies conducted in a very small group of highly developed countries. The second feature concerns the use of statistical techniques, as preference is given to those that distinguish between independent and dependent variables, with both linear and logistic regressions featuring prominently. The third feature, related to this, is that different cultural tastes and consumption or participation practices have been dealt with separately, which means that it has not been the rule for this dimension of the

cultural field to be considered holistically, owing to the inclusion of a large set of variables.[8] A clear example illustrating this is the article by F. Torche (2007) on reading; the same could be said of the chapters of the books edited by Catalán and P. Torche (2005) and Güell and Peters (2012) dealing with cultural consumption.

Processing the data differently, the present study incorporates a very extensive list of cultural activities and preferences that reflects the information available from the National Survey on Cultural Participation and Consumption in Chile conducted in 2009 (see table A1.1 of annex A1). To integrate these variables into a combined analysis, use is made of a statistical technique known as multiple correspondence analysis, which Bourdieu's work, and especially his best-known book, *La distinction* (1979), was crucial in popularizing, especially in the field of sociology. This technique makes it possible to represent in an n-dimensional space (usually the two most statistically relevant dimensions are chosen) the positions of the respondents as determined by their cultural tastes and behaviour. This allows the relative distances between the latter to be ascertained. Likewise, it can be understood that a set of similar preferences and activities that are fairly close together in the space will represent a differentiated lifestyle. Besides the study of proximity between practices and tastes, multiple correspondence analysis can be used in an attempt to learn what variables might be structuring or influencing the configuration of this particular social space; in other words, what variables might have been contributing to the different lifestyles or cultural participation patterns. Both this and the previous effort are, in principle, limited only by the availability of categorical variables.[9]

Since this study focuses particularly on tertiarization, the occupation variable is especially important. Accordingly, it seemed advisable to keep this variable as disaggregated as possible, since this would allow a renewed discussion of the social structure in modern Chile to be conducted on the basis of a study with a marked inductive component. The idea, ultimately, was to move towards an evaluation of the view of Chile as a tertiarized society, confined, however, to the area of cultural tastes and participation.

When occupation is spoken of, it is important to stress that this does not entail here an attempt to provide

or construct a system of class like those generally employed in sociology by specialists who have made it their business to study the structure of society. It needs to be made clear that this will be only partially the case. Why partially? Because, to classify respondents, this study sets out (following a common practice) from the International Labour Organization (ILO) International Standard Classification of Occupations (ISCO-88), but with the difference that it tries to leave the classification as disaggregated as possible (see table A2.1 of annex A2). Initially, this meant leaving out all those who had an unregistered occupation or none, usually because they formed part of what has often been called the "passive" population (retirees, students, housewives, etc.). To deal with this, and to avoid using mediated classes, i.e., allocating class in accordance with that of the household head, a classification was produced for those with no occupation, i.e., for people who were unclassified or were repeatedly classified as "passive." To classify them, a distinction was made between the unemployed, students, retirees and housewives, and they were assigned a category reflecting a combination of their level of education and household income, with each variable having four categories. Following this exercise, classification alternatives yielding fewer than 20 cases were grouped under the "other" category and excluded from the analysis. This means that occupation served as a classifying criterion at the outset, but had to be supplemented by other criteria for all the individuals surveyed to have their own class category (see table A2.1 of annex A2), or at least, one that would be intelligible and sociologically substantive from the point of view of understanding the inequalities that are also manifested in occupations (Pinto, 2013).

The purpose of this is to deal with the following problems. First, there is the fact that so-called "informal" work is more prevalent or widespread in Chile than in countries with a higher level of industrial development. Second, the aim was to be in a position to observe what happens within the working and middle classes without setting out from an assumption of internal homogeneity in the former or of a particular heterogeneity, derived especially from the distinction between managerial and professional workers, in the latter. Lastly, it also seemed important, especially considering the changes in families (divorce rates, relationship with and care of older adults, etc.), to include people with no occupation in their own class position, something that was done, as mentioned, on the basis of personal education and household income.

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[8] Articles by Gayo, Teitelboim and Méndez (2009 and 2013) and Gayo (2013b) are exceptions.

[9] Two examples of the use of this statistical technique are Gayo, Savage and Warde (2006) for the United Kingdom and Gayo, Teitelboim and Méndez (2009) for Chile.

IV

Cultural inequality

Chile has well-defined patterns of cultural participation that are closely linked to structural variables such as occupation, income, education and age. It is vital to appreciate that these patterns are essentially the outcome of the combination of economic and educational capital, which are closely and positively correlated, plus age.

What are these patterns of cultural participation and taste, how many of them are there, and what sociodemographic variables are they associated with? Setting out from a cluster analysis, not presented here for reasons of space, six types of cultural profiles have been identified using the coordinate axes derived from a multiple correspondence analysis. The original map of practices that these coordinates relate to can be seen in figure A2.1, where the relative association between the categories can be studied: the closer together they are, the more likely it is that an individual engages in both practices, always relative to other alternatives. Figure A2.2 explores the variables that could be associated with the axes of this category map or space, highlighting the variables mentioned above: education and socioeconomic levels, and age. Figure A2.3 provides a picture of the average positions in the social space and the relative size of the six cultural profiles referred to, constructed from the coordinates of figure A2.1. By analysing the patterns of cultural activity presented below, we attempt to synthesize the information in figures A2.1, A2.2 and A2.3, as the social and geometric space is the same.

The first pattern encompasses 6.8% of the sample and is represented by an individual who visits heritage sites, attends lectures, travels abroad, visits museums and the theatre fairly often, goes to the cinema and owns a substantial number of books. This individual is likely to be a young office worker or professional who has studied at university or higher technical level and belongs to socioeconomic group ABC1 or C2.

The second pattern, accounting for 9.6% of the sample, is represented by people who are particular accumulators of cultural items, including collector's editions of books, original paintings, prints and sculptures. Their sociodemographic traits are similar to those of the first pattern, but they may be professionals with a rather longer employment history and thus greater financial security. These two patterns of behaviour may be defined as belonging to the "cultural elite."

The third pattern is qualitatively different from the first two, and its profile is one of mass activity. The main pastimes may include juggling shows, pantomime and magic acts, visits to amusement parks, travel inside Chile, trips to the zoo, communication via the Internet and stadium outings, among other things. This pattern is shared by 8.5% of respondents, most of them young people with secondary or technical higher education belonging to socioeconomic groups C3 and above.

The fourth pattern is the working-class version of the previous one, with a greater tendency towards non-participation in the activities named but similar preferences. These include: frequent video or DVD watching, stadium outings, ownership of a reasonable number of books and a taste for rock music. This pattern covers 27.1% of the sample. This group is also young in the main, although rather less so than the previous one, and belongs to a slightly lower stratum, although its lower bound is also socioeconomic group C3. Its members are mainly employed as drivers, personal service workers, technicians and operators, housewives and the like, have secondary education, and live in households with incomes of at least Ch$ 250,000 to Ch$ 500,000 a month. This pattern is somewhat male-dominated.

Lastly, the fifth and sixth patterns are most genuinely representative of the working-class world, or of those catalogued by another study as representatives of cultural inactivity and passivity (Gayo, Teitelboim and Méndez, 2009) from the point of view of participation in culture-related activities that surveys of cultural consumption in Chile have taken an interest in. Passivity is the keynote in the fifth pattern, which accounts for 28.5% of the sample and is thus the largest of all. Its representatives own few books, preferring religious ones, and their taste in cinema runs to romantic films. From a sociodemographic perspective, they are middle-aged or older people (a majority are women) who have little education and belong to socioeconomic level D or E, dominated by unskilled workers, housewives and retirees with secondary or primary education and household incomes of less than Ch$ 250,000 a month in both cases. The sixth pattern comprises 19.6% of respondents and shows a clear profile of inactivity. What stands out, as with the previous group but even more strikingly, is its very limited cultural participation or consumption. Its sociodemographic and occupational features present

the expected profile: a low educational and economic level, a high degree of ageing, and unskilled work. In general, too, it should be noted that the profiles showing a higher level of cultural activity are usually associated with the Metropolitan Region, while the opposite is true of cultural inactivity or passivity.[10]

To sum up, what can be concluded from this description? Basically, that culturally active behaviour is restricted and diverse. Restricted, first, because at most 50% of the population engage in it. Excluding the fourth pattern, whose activity is very weak, the figure is no more than 25%, with the most elite pattern, combining the percentages of patterns 1 and 2, standing at around 17%. In other words, the majority of the Chilean population do not participate, or barely participate, in cultural activities, meaning not just the most elite activities but many that are often regarded as mass events. Second, the

pattern is diverse because there are different participation profiles. Cultural involvement takes various forms whose diversity primarily correlates with people's accumulated economic and educational resources. It could be said that participating or not participating is a function of economic and educational capital, with the pattern indicating that the more such capital has been accumulated, the greater the degree of cultural participation and distinction. Here, it is important to bear in mind that the two types of capital are strongly and positively correlated, which makes it hard to distinguish between them. Thus, economic and cultural resources would appear to explain much of people's propensity to take part in cultural activities generally and certain ones in particular, or to show a preference for particular aesthetic experiences or content. However, an explanation that referred solely to these kinds of capital would necessarily be incomplete, and patterns of cultural consumption in Chile cannot be properly understood without bringing in the age variable (Gayo, Teitelboim and Méndez, 2009).[11] Tastes and consumption patterns are directly associated with people's age. Table A2.2 presents in dichotomous terms, and for the purpose of simplifying the large amount of information provided above, the structure of the patterns of cultural practice represented by three of the main ones.

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[10] The terms "inactivity" and "passivity" are not at all meant to imply that the behaviour patterns of people thus described are almost devoid of cultural activity in a broad sense. They are descriptions whose main or closest point of reference are the indicators provided by the survey. It may be debated whether the questions are too restrictive in relation to the behaviour types people are ultimately classified by. This study sets great store by the contributions made by survey measurements both in Chile and internationally, especially during the last four decades of studies on cultural behaviour, a tradition to which this research subscribes. Lastly, the use of terms like "passive" or "inactive" is not meant to ascribe responsibility to the individuals thus described. On the contrary, it is intended as an instrument for engaging in a critical dialogue with a social situation that has very probably oppressed them or left them behind.

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[11] This certainly does not happen only in Chile. Two studies that have also shown the importance of age in the case of the United Kingdom are Bennett and others (2009) and Gayo (2006).

V

Culture, occupation and tertiarization

The notion of post-industrial or tertiarized society alerted us to a radical shift that was taking place in advanced or more prosperous societies. The old manual worker in his rough clothes was now donning a white collar and working with his mind. Firms were no longer as focused as formerly on producing objects, and service-oriented businesses were expanding unstoppably. The main ingredients of industry now were no longer natural resources to be processed and the energy sources needed to do this. Now the raw material was the intellect of human resources.

All this was associated with two equally significant phenomena. First, the conditions seemed to be in place

for a resounding triumph of individuals' cognitive abilities and intelligence. At last it would be possible to satisfy, even if only in part, one of the great promises of modernity, namely individual achievement, personal success through merit, which would be measured and rewarded, on the whole, in accordance with people's degree of practical intelligence or the productive potential of their knowledge. Consistently with this, a group of people already known as the "middle class" would expand strongly, and its growth suggested the progressive emergence of a society where differences would not be a direct product of the industrial and occupational structure.

Thus, the framework of employment tertiarization seemed to favour individuals rather than social classes, intelligence and merit rather than ownership of the means of production, social mobility rather than reproduction shaped by family origin, and occupational indifferentiation rather than the obviously hierarchical structures of societies originating in the early stages of industrialization. In other words, tertiarized society could be understood as a more advanced stage of modernity, in which its guiding ideal seemed to have more prospect of being realized.

Is it from this perspective, which came into view 40 years ago, that the behaviour of Chilean society in the early twenty-first century can best be understood? Economically, the answer may be more ambiguous, but in the sphere of cultural practice this is not the model we now have—far from it. Tertiarization in Chile, if it has taken place, has been accompanied by marked cultural inequality, partially analysed in the previous section. The present section will concentrate on the occupational or work dimension, focusing on the findings observed in figure A2.4 of annex 2.

From the point of view of the occupational structure, Chilean society does not seem to have been shaped according to a pattern of integration around a large middle class. This is not to deny that an ever larger number of its members have acquired increasing wealth. Rather, it is to recognize that the prevailing pattern is one of polarization between two major groups of occupations, which would at least partially explain the division between participation and inactivity that characterizes the structure of the social space in the country (Gayo, Teitelboim and Méndez, 2013). In other words, there is a group of occupations comprising professionals in particular, high-level executives, engineering technicians and office workers that is associated collectively with more or less elite versions of cultural participation. On the other hand, those employed as labourers in the primary sector, unskilled workers, drivers, workers in the metal and textile industries, machinery operators, shop assistants and personal service workers form a group characterized chiefly by low cultural participation—two broad occupational categories that it would surely not be difficult to associate with different levels of income and education, with the averages being lower in the second group than in the first. Accordingly, it can be appreciated that Chile has two major occupational groupings or clusters whose experiences are bound up both with their economic circumstances and with highly differentiated aesthetic practices and orientations. Society is not dominated by the middle class, but is strikingly polarized.

Figure A2.4 shows beyond doubt that these groups are not completely homogeneous, as differences can be identified in both occupational blocs (Gayo, Teitelboim and Méndez, 2013). These differences include the following. In the occupational grouping that is less culturally active, those participating least are the least qualified, namely primary-sector labourers and unskilled workers, while more skilled people, including shop assistants and personal service workers, participate more. As regards the more active group, what stands out is that professionals have a more elite profile than high-level executives, showing that education is at least as important as money, certainly when it comes to cultural activity or the accumulation of cultural capital in a broad sense.

But what about the groups so far unmentioned, namely housewives, retirees, students and the unemployed? Research does not normally include these categories, much less to the level of complexity they are developed to in this study, so that little is known in detail about the patterns characterizing them, and this is both effect and cause of the lack of reflection around the subject. The findings of the present research clearly indicate a need to make distinctions within each of these groups. Among the most interesting conclusions that it has been possible to draw are the following:

(i)   There is great stratification in all cases. For example, retirees with higher education and monthly household incomes of over Ch$ 1 million seem to have little in common with those who state they have studied only at the primary level and have monthly incomes of less than Ch$ 250,000.

(ii) Education seems to be a key variable when it comes to understanding the position in the social space of the class categories analysed here. There are cases where cultural behaviour is clearly participatory even when incomes are moderate. This is true, for instance, of unemployed people with higher education and incomes of between Ch$ 500,000 and Ch$ 1 million a month and housewives with higher education and household incomes in the range of Ch$ 250,000 to Ch$ 500,000. This seems to indicate that the key to participatory behaviour is education, subject to the conditions determined by the availability of a minimum of financial resources, with the threshold seeming to be a household income of between Ch$ 250,000 and Ch$ 500,000 a month.

(iii) The categories with incomes below Ch$ 250,000 a month and secondary education or less seem to form part of the same grouping, comprising occupations associated with a lower level of cultural activity.

VI

Conclusions

This article has presented a critical discussion of the characteristics of the tertiarization process in Chilean society: although there has been an increase in non-manual occupations, suggesting the notion of a progressive movement towards a middle-class society, some major findings make it difficult to simply accept the claim that Chile has turned into this kind of mesocratic society.

In the first place, the expected collapse of cultural or symbolic class boundaries has not occurred. The evidence shows that we are living in societies where, at least as far as culture goes, most citizens could hardly be classified as members of the middle class. If being culturally active is what characterizes this class, a bare 17% of the sample of respondents really fit the description, and the level of activity drops very substantially in the other types of cultural profile found.

In the second place, the effects of variables that might traditionally be considered in the study of inequality are far from being a thing of the past. In fact, explaining inequality (which becomes manifest in the cultural practices of citizens) requires a large set of these variables to be considered in combination, chief among them education, financial resources and, to a lesser degree, age.

In the third place, and partly as a way of summarizing the contributions of these variables, it is important to stress the key role played by occupational structure. One pattern that goes a long way towards explaining the findings of this study reveals a society polarized around two major occupational blocs, which can be regarded as "homologous"[12] or as corresponding to two major patterns of cultural participation. On the one hand, there are people with low-paid jobs requiring little education, examples being the different types of industrial and service workers. This set of occupations evinces very limited cultural participation. On the other, there are jobs that are better paid and usually demand higher levels of education, namely those of high-level executives, technicians of various kinds and, above all, professionals.

Lastly, by way of synthesis, and accepting that Chile has undergone partial tertiarization of its production and occupational structure, a proper understanding of this society requires the following conclusions to be accepted. First, that tertiarization has had a clearly restricted character, with its beneficiaries being above all the higher socioeconomic groups, which enjoy distinctive lifestyles available only to a very limited portion of the population. Second, that the traditional underpinnings of inequality, such as income and education, are still present, and this comes out very strongly in the way people live and behave. And third, that occupations are still key indicators of behaviour patterns, and their cultural profile shows that Chile is a divided society, both economically and culturally.

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[12] In Bourdieu's work, the "homology" thesis means two things. First, if social fields are understood to be structured by a logic of domination, the implication is that individuals will tend to be situated in similar positions in different fields. Second, this thesis also maintains that there is a correspondence between cultural patterns and social structure, i.e., cultural tastes and practices are structured by social variables, especially economic and cultural capital.

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ANNEX A1

Activities studied

TABLE A1.1

Cultural practices analysed

Label	Relative weight (*percentages*)	Square distance to the origin	Axis 1		Axis 2	
			Coordinates	Contributions	Coordinates	Contributions
Exhibitions						
Painting	0.333	7.593	0.99	1.86	-0.60	1.76
Photography	0.135	20.091	1.00	0.76	-0.31	0.20
Other visual arts	0.109	25.100	1.13	0.79	0.07	0.01
No exhibitions	2.280	0.253	-0.26	0.86	0.10	0.35
Theatre						
More than 4 times	0.111	24.778	1.42	1.26	-0.63	0.64
2 or 3 times	0.207	12.828	1.05	1.30	-0.77	1.78
Once	0.165	16.328	0.58	0.31	-0.22	0.11
Has not been	2.375	0.203	-0.20	0.53	0.11	0.43
Dance						
Ballet and dance	0.132	20.637	1.11	0.93	-0.73	1.03
Folk dance	0.509	4.613	0.44	0.55	-0.05	0.02
Doesn't go to dance	2.152	0.328	-0.19	0.46	0.05	0.07
Recitals						
Folk music	0.157	17.236	0.55	0.26	-0.34	0.26
Rock music	0.265	9.791	1.03	1.60	-0.06	0.01
Has not been to concerts	2.044	0.398	-0.26	0.80	0.04	0.05
Pantomime						
Yes	0.263	9.847	1.28	2.46	1.59	9.80
No	2.594	0.102	-0.13	0.25	-0.16	1.00
Juggling						
Yes	0.442	5.464	1.15	3.32	1.20	9.31
No	2.415	0.183	-0.21	0.61	-0.22	1.70
Puppetry						
Yes	0.207	12.782	1.51	2.69	1.59	7.73
No	2.650	0.078	-0.12	0.21	-0.12	0.61
Magic						
Yes	0.133	20.415	1.73	2.28	1.92	7.23
No	2.724	0.049	-0.08	0.11	-0.09	0.35
Humour						
Yes	0.359	6.969	1.29	3.39	1.31	8.96
No	2.499	0.143	-0.19	0.49	-0.19	1.29
Cinema						
More than 7 times	0.140	19.471	1.45	1.67	-0.56	0.64
From 4 to 6	0.178	15.062	1.00	1.02	-0.43	0.49
3 times	0.183	14.640	0.76	0.59	-0.17	0.08
Twice	0.165	16.328	0.48	0.22	0.19	0.09
Once	0.138	19.673	0.42	0.14	-0.01	0.00
Has not been to cinema	2.054	0.391	-0.32	1.19	0.08	0.18
Type of cinema						
Action	0.844	2.384	-0.01	0.00	0.16	0.31
Comedy/humour	0.472	5.052	0.01	0.00	-0.03	0.01
Drama	0.153	17.643	0.15	0.02	-0.36	0.30
Romantic	0.388	6.365	-0.26	0.15	0.00	0.00
Science fiction	0.200	13.253	0.39	0.18	-0.01	0.00
Documentary	0.127	21.452	0.11	0.01	-0.62	0.71
Children's	0.118	23.279	0.25	0.04	0.07	0.01
Suspense	0.156	17.316	0.46	0.19	0.31	0.22
Other type of cinema	0.278	9.260	-0.68	0.73	0.11	0.05

Table A1.1 (continued)

Label	Relative weight (*percentages*)	Square distance to the origin	Axis 1		Axis 2	
			Coordinates	Contributions	Coordinates	Contributions
Frequency video						
2 or 3 DVDs a week	0.595	3.800	0.54	0.97	0.13	0.15
1 DVD a week	0.536	4.333	0.25	0.18	-0.01	0.00
1 DVD a fortnight	0.305	8.363	0.17	0.05	-0.05	0.01
DVD every 1-3 months	0.508	4.620	0.06	0.01	-0.13	0.12
DVD almost never	0.166	16.185	-0.30	0.08	0.01	0.00
Doesn't watch videos	0.746	2.828	-0.65	1.77	0.00	0.00
Frequency books						
Books daily	0.398	6.175	0.58	0.77	-0.83	4.03
Books every fortnight	0.249	10.473	0.56	0.44	-0.43	0.66
Book every 1-3 months	0.272	9.492	0.80	0.99	-0.29	0.34
Book once a year	0.226	11.616	0.43	0.24	0.08	0.02
Doesn't read books	1.711	0.670	-0.40	1.56	0.29	2.13
Type of books						
Novels	0.813	2.512	0.24	0.26	-0.21	0.53
Short stories	0.272	9.519	0.09	0.01	0.22	0.20
Self-help	0.190	14.076	0.51	0.28	-0.42	0.49
History and biography	0.213	12.428	0.28	0.09	-0.25	0.19
Technology, science	0.112	24.463	0.54	0.19	-0.32	0.17
Religious	0.207	12.828	-0.44	0.23	-0.32	0.32
Other	0.248	10.536	-0.17	0.04	0.04	0.01
None, doesn't read	0.597	3.789	-0.62	1.30	0.56	2.77
Museums						
Art museums	0.120	22.727	1.46	1.46	-0.74	0.97
Historical museums	0.288	8.919	0.82	1.09	-0.12	0.06
Doesn't go to museums	2.285	0.250	-0.24	0.72	0.06	0.12
Frequency TV						
Daily	2.286	0.250	-0.02	0.01	0.06	0.14
Almost daily	0.293	8.757	0.14	0.03	-0.29	0.35
1 to 3 days a week	0.228	11.541	0.06	0.00	-0.22	0.15
Craftwork						
Yes	1.638	0.744	0.34	1.05	-0.08	0.15
No	1.219	1.343	-0.45	1.41	0.11	0.20
Original paintings						
Yes	0.406	6.030	1.02	2.42	-0.39	0.90
No	2.451	0.166	-0.17	0.40	0.06	0.15
Sculptures						
Yes	0.183	14.640	1.36	1.92	-0.50	0.68
No	2.674	0.068	-0.09	0.13	0.03	0.05
Prints						
Yes	0.197	13.500	1.29	1.87	-0.40	0.46
No	2.660	0.074	-0.10	0.14	0.03	0.03
Collector's books						
Yes	0.363	6.879	1.15	2.71	-0.46	1.12
No	2.495	0.145	-0.17	0.39	0.07	0.16
Newspaper sections						
International news	0.187	14.297	0.21	0.05	-0.63	1.07
Chilean reportage	0.289	8.896	0.15	0.04	-0.05	0.01
Chilean politics	0.119	23.000	0.36	0.09	-0.36	0.22
Chilean crime	0.259	10.048	0.07	0.01	0.18	0.12
Sport	0.200	13.301	0.14	0.02	0.48	0.68
Social pages	0.124	22.072	0.14	0.01	0.31	0.18
Reads all sections	0.466	5.132	0.27	0.19	-0.24	0.40
Doesn't read newspapers	0.863	2.309	-0.50	1.25	0.20	0.50
Radio programming						
Music	1.808	0.581	0.01	0.00	0.05	0.06
News	0.436	5.556	-0.11	0.03	-0.31	0.60
Opinion programmes	0.135	20.198	0.22	0.04	0.01	0.00
Doesn't listen to radio	0.304	8.384	0.07	0.01	0.11	0.05

Table A1.1 (concluded)

Label	Relative weight (*percentages*)	Square distance to the origin	Axis 1		Axis 2	
			Coordinates	Contributions	Coordinates	Contributions
Type of magazines						
Design and decoration	0.129	21.213	0.43	0.14	-0.48	0.44
Sport	0.138	19.776	0.59	0.27	0.49	0.48
Current affairs (politics)	0.187	14.241	0.71	0.54	-0.74	1.52
General interest	0.363	6.879	0.45	0.42	0.05	0.01
Other	0.183	14.582	0.32	0.11	-0.24	0.16
Doesn't read magazines	1.608	0.777	-0.40	1.48	0.15	0.52
Internet use						
Internet communication	0.694	3.118	0.54	1.16	0.03	0.01
Internet information searches	0.436	5.556	0.54	0.72	-0.46	1.33
Internet music downloading	0.122	22.461	0.43	0.13	0.31	0.17
Other Internet	0.193	13.809	0.62	0.42	-0.05	0.01
Doesn't use Internet	1.413	1.022	-0.55	2.47	0.11	0.24
Number of books						
Has no books	0.445	5.425	-0.89	1.99	0.47	1.46
1-10 books	0.838	2.409	-0.34	0.55	0.13	0.20
11-25 books	0.501	4.705	0.12	0.04	0.15	0.16
26-50 books	0.459	5.224	0.34	0.31	-0.25	0.42
51-100 books	0.309	8.239	0.67	0.78	-0.38	0.66
Over 100 books	0.229	11.466	1.24	2.00	-0.76	1.95
dk/da books	0.076	36.622	-0.39	0.06	0.20	0.04
Travel abroad						
Yes	0.185	14.410	1.15	1.39	-0.46	0.57
No	2.672	0.069	-0.08	0.10	0.03	0.04
Travel within Chile						
Yes	0.923	2.096	0.72	2.73	0.05	0.04
No	1.934	0.477	-0.34	1.30	-0.02	0.02
Stadium outings						
Yes	0.373	6.662	0.63	0.85	0.48	1.27
No	2.484	0.150	-0.10	0.13	-0.07	0.19
Visiting heritage sites						
Yes	0.275	9.388	1.61	4.06	-0.09	0.03
No	2.582	0.107	-0.17	0.43	0.01	0.00
Craft fairs						
Yes	0.762	2.749	0.79	2.70	0.13	0.17
No	2.095	0.364	-0.29	0.98	-0.05	0.06
Lectures						
Yes	0.167	16.115	1.77	2.95	-0.39	0.36
No	2.690	0.062	-0.11	0.18	0.02	0.02
Amusement parks						
Yes	0.372	6.676	1.10	2.53	0.79	3.43
No	2.485	0.150	-0.16	0.38	-0.12	0.51
Zoo						
Yes	0.178	15.062	1.41	2.02	0.84	1.84
No	2.679	0.066	-0.09	0.13	-0.06	0.12
Sporting activities						
Yes	0.464	5.159	0.87	1.98	0.50	1.69
No	2.393	0.194	-0.17	0.38	-0.10	0.33

Source: Prepared by the authors, on the basis of data from the National Survey on Cultural Participation and Consumption.

Class categories

TABLE A2.1

Categorization of class categories used in the analysis

Activity or occupation	Frequency	Percentage
High-level executives	32	0.78
Professionals	225	5.39
Engineering, health-care and other technicians	56	1.33
Primary school teachers	9	0.23
Other intermediate-level technicians and professionals	120	2.88
Office workers	109	2.61
Customer service staff	58	1.38
Personal service workers	142	3.40
Shop assistants	269	6.45
Skilled agricultural and fisheries workers	22	0.52
Extraction and construction industry workers	148	3.55
Metal and mechanical industry workers	91	2.17
Precision mechanics and artisans	116	2.78
Machinery operators	49	1.17
Drivers	149	3.56
Unskilled sales and service workers	174	4.17
Labourers in the primary and secondary sectors	150	3.59
Employed s/o	33	0.80
UNEMP-PRI-<250	29	0.69
UNEMP-SEC-<250	45	1.09
UNEMP-SEC-250 to 500	21	0.51
UNEMP-UNIHIGH-250 to 500	22	0.54
UNEMP-SEC-500 to 1M	24	0.57
UNEMP-UNIHIGH-500 to 1M	25	0.59
HOU-PRI-<250	193	4.62
HOU-SEC-<250	168	4.03
HOU-TECPR-<250	41	0.97
HOU-PRI-250 to 500	35	0.85
HOU-SEC-250 to 500	150	3.59
HOU-TECPR-250 to 500	28	0.68
HOU- HIGHPR -250 to 500	22	0.54
HOU-SEC-500 to 1M	22	0.54
STU-SEC-<250	54	1.30
STU-SEC-250 to 500	64	1.54
STU-TECPR-250 to 500	22	0.52
STU-UNIHIGH-250 to 500	39	0.94
STU-SEC-500 to 1M	31	0.75
STU-UNIHIGH-500 to 1M	37	0.87
STU-UNIHIGH-+1M	57	1.37
RET-PRI-<250	131	3.15
RET-SEC-<250	65	1.55
RET-PRI-250 to 500	26	0.62
RET-UNIHIGH-+1M	30	0.73
OTHER-NON-EMP	840	20.11
Total	4 176	100.00

Source: Prepared by the authors, on the basis of data from the National Survey on Cultural Participation and Consumption.

Note: UNEMP: Unemployed; HOU: Housework; STU: Student; RET: Retired; OTHER-NON-EMP: Other non-employed; PRI: Primary education; SEC: Secondary education; UNIHIGH: University higher education; TECPR: Technical and professional education; HIGHPR: Higher professional education; <250: Household income below Ch$ 250,000; 250 to 500: Household income between Ch$ 250,000 and Ch$ 500,000; 500 to 1M: Household income between Ch$ 500,000 and Ch$ 1 million; +1M: Household income over Ch$ 1 million.

TABLE A2.2

Types of cultural practice

	Young	Adult
Low status[a]	Little cultural participation	
High status	Youth culture	Elite culture
	Highly active	Highly active

Source: Prepared by the authors, on the basis of data from the National Survey on Cultural Participation and Consumption.

[a] By "status" here is only meant the accumulation of economic and educational resources.

FIGURE A2.1

Social space of cultural practices and tastes

Source: Prepared by the authors, on the basis of data from the National Survey on Cultural Participation and Consumption.
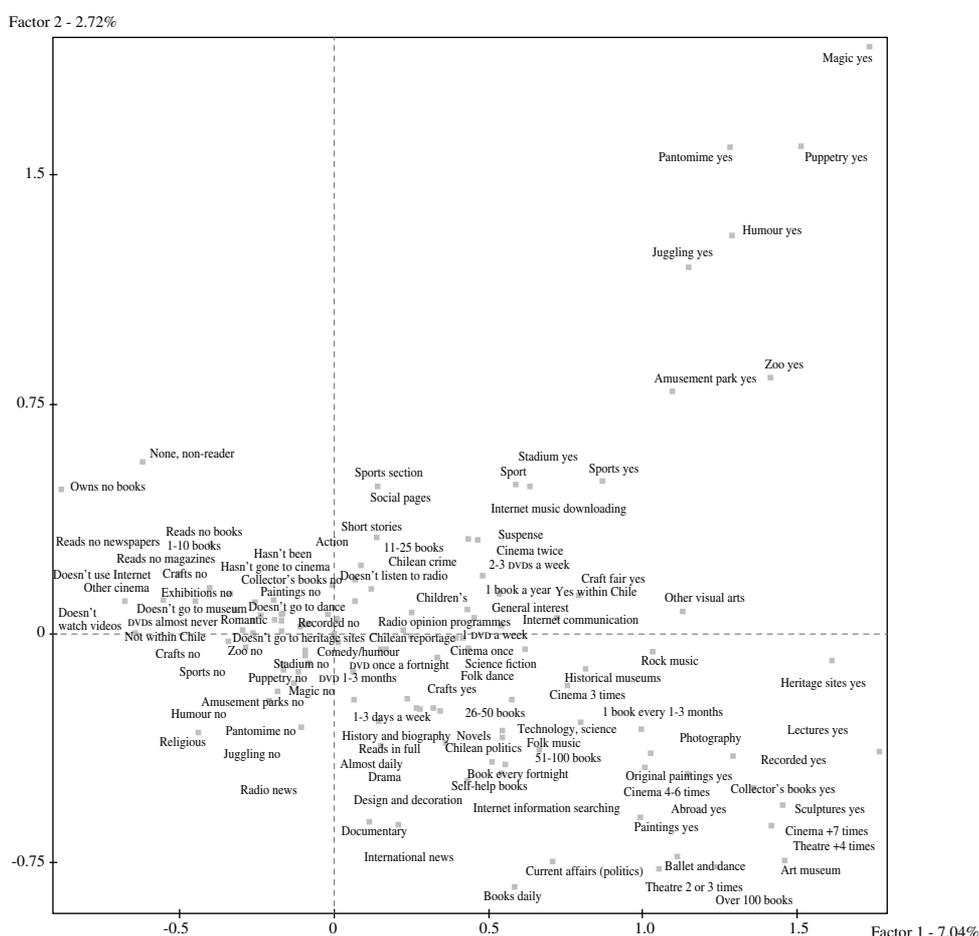
FIGURE A2.2

Sociodemographic variables that structure the sociocultural space
(Trajectory lines for education level, socioeconomic group and age)
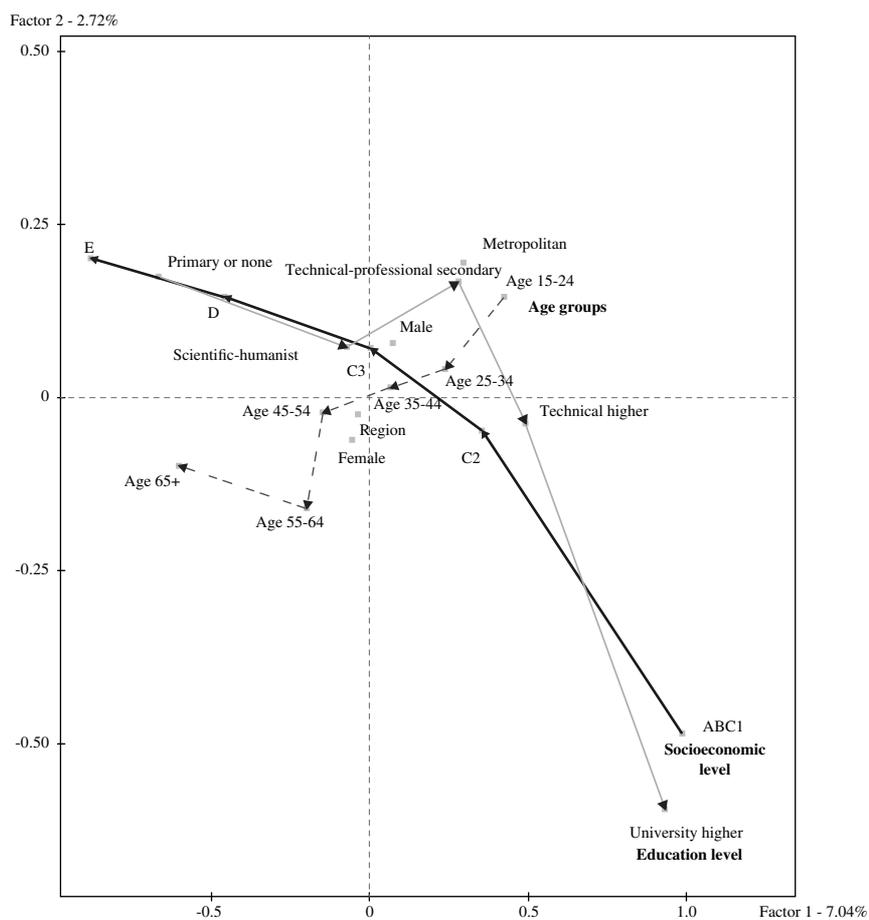
Source: Prepared by the authors, on the basis of data from the National Survey on Cultural Participation and Consumption.

FIGURE A2.3

Spatial representation of the typology of cultural consumers
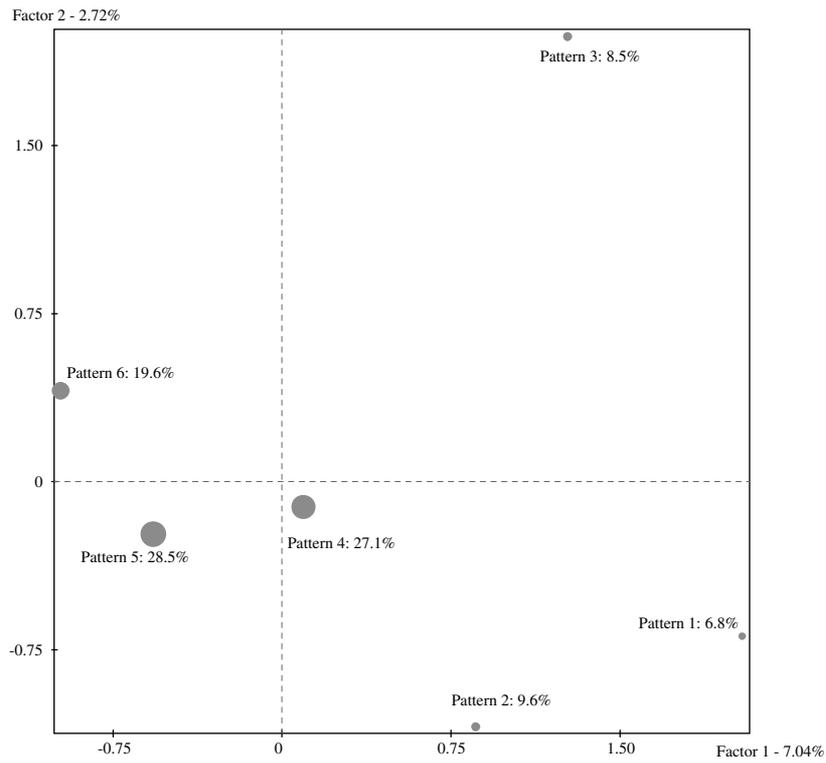
Source: Prepared by the authors, on the basis of data from the National Survey on Cultural Participation and Consumption.

FIGURE A2.4

Variables structuring the sociocultural space: occupational dimension
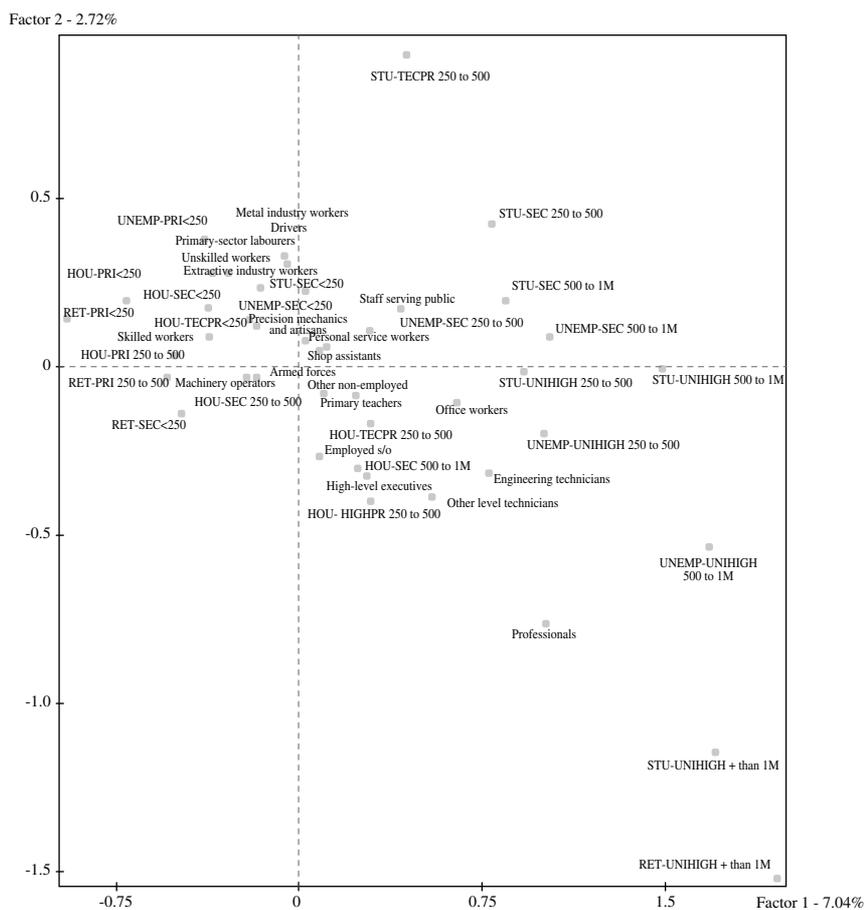
Source: Prepared by the authors, on the basis of data from the National Survey on Cultural Participation and Consumption.

Note: STU: Student; UNEMP: Unemployed; HOU: Housework; RET: Retired; PRI: Primary education; SEC: Secondary education; TECPR: Technical and professional education; UNIHIGH: University higher education; HIGHPR: Higher professional education; <250: Household income below Ch$ 250,000; 250 to 500: Household income between Ch$ 250,000 and Ch$ 500,000; 500 to 1M: Household income between Ch$ 500,000 and Ch$ 1 million; +1M: Household income over Ch$ 1 million.

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