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Contents

Explanatory notes

- Three dots (...) indicate that data are not available or are not separately reported.
- A dash (-) indicates that the amount is nil or negligible.
- A full stop (.) is used to indicate decimals.
- The word “dollars” refers to United States dollars, unless otherwise specified.
- A slash (/) between years (e.g. 2013/2014) indicates a 12-month period falling between the two years.
- Individual figures and percentages in tables may not always add up to the corresponding total because of rounding.

The impact of non-contributory cash transfers on poverty in Latin America

Simone Cecchini, Pablo Villatoro and Xavier Mancero

Abstract

This article assesses the impact of conditional cash transfers, social pensions and other non-contributory transfers on different indicators of poverty and extreme poverty in Latin America, based on an analysis of household surveys from 15 countries in the region between 2014 and 2017. It is found that in 2017, the combined effect of non-contributory social protection programmes reduced simple regional averages for poverty by 2.0 percentage points and for extreme poverty by 1.7 percentage points, equivalent to relative decreases of 11.8% and 25.9%, respectively. It is also observed that surveys tend to capture fewer recipients of non-contributory transfers than administrative records. This undercapturing, as calculated for Brazil, may lead to underestimation of the impact of programmes, especially on indicators of severity and depth of poverty.

Keywords

Income, pensions, poverty, poverty mitigation, measurement, household surveys, public welfare, social security, Latin America

JEL classification

I3, I30, I32, I38

Authors

Simone Cecchini is a Senior Social Affairs Officer of the Social Development Division of the Economic Commission for Latin America and the Caribbean (ECLAC). Email: simone.cecchini@un.org.

Pablo Villatoro is a Research Assistant in the Social Statistics Unit of the Statistics Division of ECLAC. Email: pablo.villatoro@un.org.

Xavier Mancero is Chief of the Social Statistics Unit of the Statistics Division of ECLAC. Email: xavier.mancero@un.org.

I. Introduction

In recent decades, many Latin American countries have used non-contributory cash transfers —which do not depend on people's ongoing or historical participation in the formal labour market— to alleviate poverty and reduce households' exposure to various economic and social risks. These transfers are mainly financed with general income taxes —on the principle of solidarity— and resources generated by State-owned enterprises or originating from international cooperation. More recently, in the context of the coronavirus disease (COVID-19) pandemic, emergency cash transfers have been key to helping people cope with declines in labour income.

Non-contributory social protection (social assistance) seeks to guarantee a basic level of consumption for people living in extreme poverty and poverty —although there are also more universalistic programmes— and provide a link to the sectoral public services on offer. Although there is a very broad range of non-contributory social protection actions, two types of programmes are among the most important in the region, owing to their population coverage, their level of public spending and their effects on well-being: conditional cash transfer programmes (CCTs) and social pensions. In their basic format, CCTs provide cash transfers and services to households living in poverty and extreme poverty, under certain conditions, with the aim of improving the capacities of their members (mainly in education and health) and especially those of children and adolescents. Conditional cash transfers may be of a fixed amount, regardless of the structure of the family group (flat-rate transfers), but they are most frequently of a variable amount that is determined according to the structure of recipient households (larger amounts for families with more children) or the characteristics of the individual recipients, such as age, sex or area of residence. Transfers are made at different intervals, ranging from monthly to yearly; in some countries, such as Brazil and Chile, transfers are also provided without conditionalities other than the fact a family is living in extreme poverty.

Social pensions target older persons —mainly those living in poverty or not receiving contributory pensions— and persons with disabilities. The age threshold for being considered an older person varies from country to country and is sometimes different for men and women. Generally, social pensions consist of a fixed monthly amount, to support a basic level of consumption.

All non-contributory social protection programmes have systems for participant information and registration, generally managed by ministries of social development or planning. The records are used to create the roll of payment recipients and, in the case of CCTs, they can provide information on fulfilment of co-responsibilities in education and health (Ibarrarán and others, 2017). The records can also be used to assess the results and impact of programmes, as well as to carry out studies and research on poverty and vulnerability (Irarrázaval, 2011), which can contribute to improving transparency and accountability.

Non-contributory social protection programmes, especially CCTs, have been the subject of multiple impact assessments, which have sought to determine their effects on the recipient population, particularly in terms of income and consumption, use of social services, educational level and health and nutritional status. Quantitative methods have been the most common, such as quasi-experimental methods (Cecchini and Madariaga, 2011), which use data from administrative records, surveys specifically designed for this purpose or multipurpose household surveys conducted by the national statistical offices of the countries of the region on a periodic basis.

While there is great heterogeneity across countries and programmes, analyses based on household surveys have generally found that the poverty reduction effects and redistributive impact are both limited. In their analysis of nine countries in around 2010, Cruces and Gasparini (2013) found that the poverty headcount ratio, measured with a U$ 4 a day poverty line, declined by between 0.2 and 3.6 percentage points because of non-contributory social protection programmes, including conditional cash transfers and social pensions. They concluded that the impact is greater when poverty is measured

with indicators that give greater weight to the lowest strata of the income distribution. Similarly, for eight Latin American countries, Amarante and Brun (2018) found that around 2013 the poverty headcount ratio fell by between 0.02 and 2.84 percentage points because of CCTs.

One reason for these limited effects may be the low amounts transferred. Another may be inadequate coverage. Robles, Rubio and Stampini (2015), based on household survey data, found considerable exclusion errors in CCTs and social pensions in the region in relation to the total population living in extreme monetary poverty and monetary poverty. This is because of the design of the programmes —which tend to exclude households without children or older people— their small size, imperfect targeting mechanisms (especially in relation to the characteristics of urban poverty) and difficulty reaching the poorest households (Robles, Rubio and Stampini, 2015).

In the context of the COVID-19 pandemic, emergency cash transfers have covered large sectors of the population and have played an important role in containing the increase in poverty and extreme poverty resulting from the loss of income from work.[1] According to projections by the Economic Commission for Latin America and the Caribbean (ECLAC) (2021), taking into account emergency cash transfers, the headcount ratios for poverty and extreme poverty in Latin America in 2020 were, respectively, 3.5 and 3.3 percentage points lower than projected without taking these particular transfers into account. These are reductions in relative terms of 9.4% in poverty and of 20.9% in extreme poverty, with respect to the values that would have been reached without the transfers.[2] In some countries, such as Brazil, the extent and coverage of the transfers appear to have resulted in lower poverty than in the prior year, despite the declines in labour income.

With respect to existing studies, this article expands geographic and temporal coverage by analysing data from 15 countries for the period from 2014 to 2017. It also explores the extent to which the coverage of social programmes in household surveys has a bearing on the undercapturing of their impact on poverty and extreme poverty. As Villatoro and Cecchini (2018) argue, there are discrepancies between surveys and administrative records in the capturing of recipients and amounts of non-contributory transfers. Indeed, there is conclusive information that surveys tend to capture fewer recipients and less total income transferred than administrative records.

The rest of the article is divided into five sections. Section II provides a regional overview of coverage and amounts of non-contributory cash transfers. Section III presents the observed values for the headcount indicator, the gaps and severity for poverty and extreme poverty, and the values that would be observed in the absence of non-contributory transfers in the countries covered, using the poverty and extreme poverty lines calculated by ECLAC in order to provide comparable measurements (ECLAC, 2018a and 2019). Section IV analyses the discrepancies between the number of recipients of non-contributory transfers captured by administrative records and the number captured by surveys. Section V measures the effect of non-contributory cash transfers on the various indicators of poverty and extreme poverty for Brazil, adjusting the information collected in the surveys to take into account the number of recipients and the amount of transfers reported in administrative records. Section VI presents the conclusions of the study.

[1] ECLAC (2021) has estimated that emergency cash transfers, together with in-kind transfers, reached 60.8% of the population of Latin America in 2020, with expenditure of 1.55% of GDP. However, the amounts, duration and population coverage of transfer programmes have varied greatly from country to country.

[2] The values presented by ECLAC (2021) correspond to a simulation (weighted average of 18 countries) and are not comparable with the results presented in table 2 of this study, which lists direct measurements (simple average of 15 countries).

II. Background: coverage and amounts of non-contributory transfers

Table 1 lists the non-contributory transfer programmes analysed and the data sources used. The study covers 15 countries in the region with information for the period from 2014 to 2017, and includes conditional cash transfers, social pensions and other non-contributory programmes.

Table 1
Latin America and the Caribbean (15 countries): household surveys used and non-contributory transfer programmes analysed

Country	Survey and years	Programmes[a]		
		Conditional cash transfers	Social pensions	Other
Argentina	Permanent Household Survey, 2013, 2014, 2016 and 2017	Universal Child Allowance (AUH)		Other State transfers[b]
Bolivia (Plurinational State of)	Continuous Household Survey, 2012, 2013, 2014 and 2015	Juancito Pinto Grant Juana Azurduy Grant	Renta Dignidad (old-age pension)	
Brazil[c]	National Household Survey (PNAD), 2014, 2015, 2016 and 2017	Bolsa Família	Continuous Benefit Programme (BPC)	Other State transfers
Chile	National Socioeconomic Survey (CASEN), 2011, 2013, 2015 and 2017	Ethical Family Income Chile Solidario	Basic Solidarity Old-Age Pension Basic Solidarity Disability Pension	Consolidated Household Subsidy (SUF) Subsidy for Payment of Drinking Water Consumed Ongoing Family Grant Winter Grant Youth Employment Subsidy Family allowances (mother, newborn, disability, mental disability) Other government subsidies
Colombia	Large-scale Integrated Household Survey (GEIH), 2014, 2015, 2016 and 2017	Más Familias en Acción (family grant) Jóvenes en Acción (youth grant)	Colombia Mayor (older adult social protection programme)	
Costa Rica	Multipurpose Household Survey, 2014, 2015, 2016 and 2017	Avancemos	Non-contributory Pension Scheme	Joint Institute for Social Aid (IMAS) Transfers (excluding Avancemos) State education grants Subsidies
Dominican Republic	Continuous National Labour Force Survey (ENCFT), 2014, 2015, 2016 and 2017	Progresando con Solidaridad[d]	Solidarity Programme for the Protection of Older Persons	
Ecuador	National Survey of Employment, Unemployment and Underemployment (ENEMDU), 2014, 2015, 2016 and 2017	Human Development Grant (BDH)	Human Development Grant — Older Persons	Joaquín Gallegos Grant for persons with disabilities
El Salvador	Multipurpose Household Survey, 2014, 2015, 2016 and 2017	Comunidades Solidarias	Basic Universal Pension	Other State transfers
Honduras	Permanent Multipurpose Household Survey, 2013, 2014, 2015 and 2016	Better Life Grant Family Allowance Programme (PRAF)		Grant for persons with disabilities, grants, other government programmes
Mexico	Household Income and Expenditure Survey (ENIGH), 2010, 2012, 2014 and 2016	Prospera (formerly Progresa and Oportunidades)	Old-age Pension	Programme of Direct Rural Support (PROCAMPO) Temporary Employment Programme (PET) Government grants No Hunger Card Other programs for older persons Other social programmes
Panama	Labour Market Survey, 2014, 2015, 2016 and 2017	Opportunities Network Grant for Food Purchase programme	120 a los 65 programme	Guardian Angel Programme Universal Grant Public Institution grants
Paraguay	Permanent Household Survey, 2013, 2014, 2016 and 2017	Tekoporã	Food Allowance for Older Persons Living in Poverty	

Table 1 (concluded)

Country	Survey and years	Programmes[a]		
		Conditional cash transfers	Social pensions	Other
Peru	National Survey of Households, Living Conditions and Poverty, 2014, 2015, 2016 and 2017	National Programme of Direct Support for the Poorest (Juntos)	Pension 65	
Uruguay	Continuous Household Survey, 2014, 2015, 2016 and 2017	Family Allowances–Equity Plan Uruguay Social Card	Old-age Pension Disability Pension	

Source: Prepared by the authors.

[a] Not all transfer programmes are included in all survey rounds. In some cases, the names do not identify programmes, but income streams.

[b] The survey asks about receipt of government aid, without identifying specific programmes.

[c] The survey only captured Bolsa Família, the Continuous Benefit Programme (BPC) and other State transfers separately in 2016 and 2017. For 2014 and 2015, recipients of these two programmes were identified using an indirect method.

[d] To identify the recipients of Progresando con Solidaridad in 2014 and 2015 it was assumed that all income from the government aid stream came from that programme.

To estimate the coverage and amounts of non-contributory transfers in countries where surveys do not include direct questions to identify recipients, indirect identification was used, a procedure employed in some previous studies.[3] This entailed: (i) determining the income stream containing the transfers; (ii) setting transfer values that approximate or match the amounts delivered by the programme; and (iii) establishing filter criteria to exclude ineligible households or individuals.[4]

Based on household surveys, the coverage of non-contributory transfer programmes in the region is estimated to be significant. Around 2017, the population living in households receiving non-contributory transfers represented 28% of the total population of the 15 countries covered (simple average).[5]

There is also considerable heterogeneity across countries in terms of coverage of non-contributory transfers. In the 2014–2017 period, the Plurinational State of Bolivia, Panama and Chile were the countries with the highest coverage of the population through non-contributory transfers, while El Salvador, Honduras and Paraguay had the lowest (see figure 1).

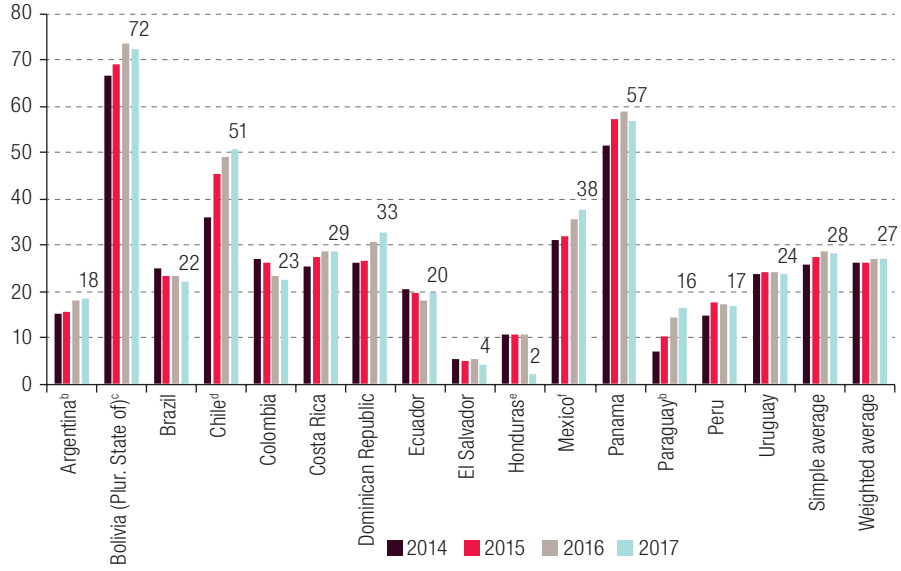
Figure 2 shows the coverage of conditional cash transfers, social pensions and other transfers, as well as the amounts of transfers as a proportion of total income of recipient households, considering values in around 2017. In the vast majority of countries, conditional cash transfers have higher coverage of the total population than social pensions, while the amounts of social pensions tend to be higher than those of conditional cash transfers. Transfer amounts are low across the board, despite considerable differences between countries.

[3] For Brazil see Paes de Barros, de Carvalho and Franco (2007), Soares and others (2007) and Guimarães Ferreira de Souza (2013), and for Argentina see Bustos and Villafañe (2011).

[4] For details on the questions included in the surveys and the procedures used for measuring non-contributory transfers, see table A1.1 of the annex.

[5] The coverage of the programmes may actually be higher, owing to the problems of undercapturing of recipients that affect the surveys (see section IV of this article).

Figure 1
Latin America (15 countries): coverage of non-contributory transfers, on the basis of information from household surveys, around 2014 to around 2017
(Percentages of the total population)[a]

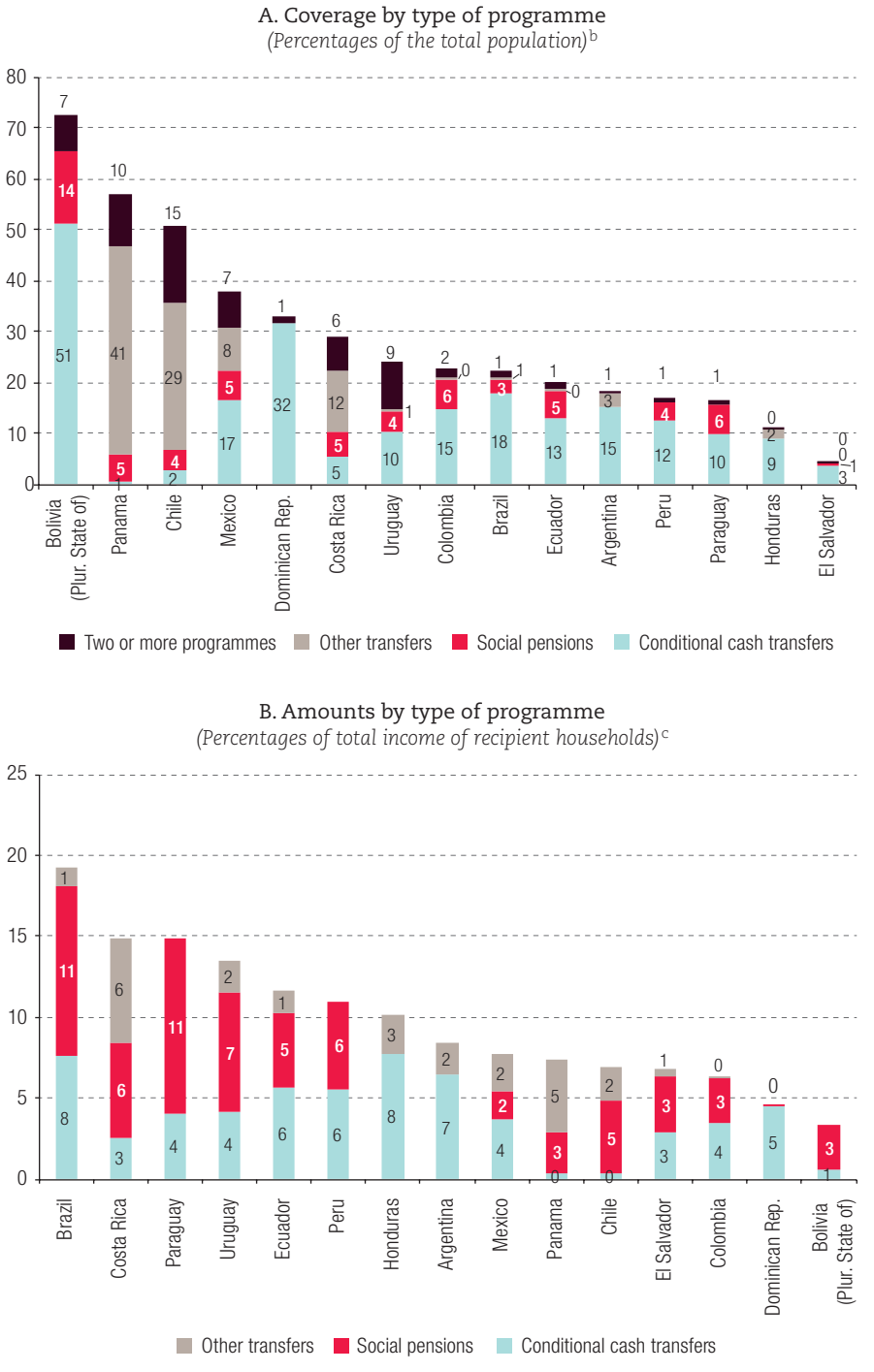


Source: Prepared by the authors on the basis of Household Survey Data Bank (BADEHOG).
[a] Percentage of population living in households receiving non-contributory transfers (conditional cash transfers, social pensions and other State transfers).
[b] 2013, 2014, 2016 and 2017.
[c] 2012, 2013, 2014 and 2015.
[d] 2011, 2013, 2015 and 2017.
[e] 2013, 2014, 2015 and 2016.
[f] 2010, 2012, 2014 and 2016.

To assess whether non-contributory transfers are sufficient to enable households to overcome poverty and extreme poverty, the average per capita amount received by households is compared with the average per capita income deficit affecting people living in poverty and extreme poverty, taking into account household income before non-contributory transfers.[6] Between 2014 and 2017, non-contributory transfers amounted to less than the average income deficit of the poor relative to the total poverty line in the 15 countries analysed; in other words, on average they were not sufficient to close the gap between the autonomous income of poor households and the poverty line. The lowest amounts in relation to the average income deficit were observed in the Plurinational State of Bolivia, El Salvador, Colombia and the Dominican Republic. The largest amounts were found in Uruguay, Brazil, Costa Rica and Paraguay (see figure 3).

[6] The income deficit refers to the distance between monthly per capita household income and the poverty or extreme poverty line. If monthly per capita non-contributory transfers equal or exceed this deficit, they enable households to overcome poverty or extreme poverty. In some countries, there are transfers whose amount is calculated in such a way as to supplement families' income enough for their monthly per capita income to rise above the extreme poverty line, as in the case of the Bolsa Família grant to reduce extreme poverty in Brazil or the Bono Base Familiar grant of the Chile Seguridades y Oportunidades programme in Chile.

Figure 2
Latin America (13 countries): coverage and amounts of non-contributory transfers by type of programme, on the basis of information from household surveys, around 2017[a]



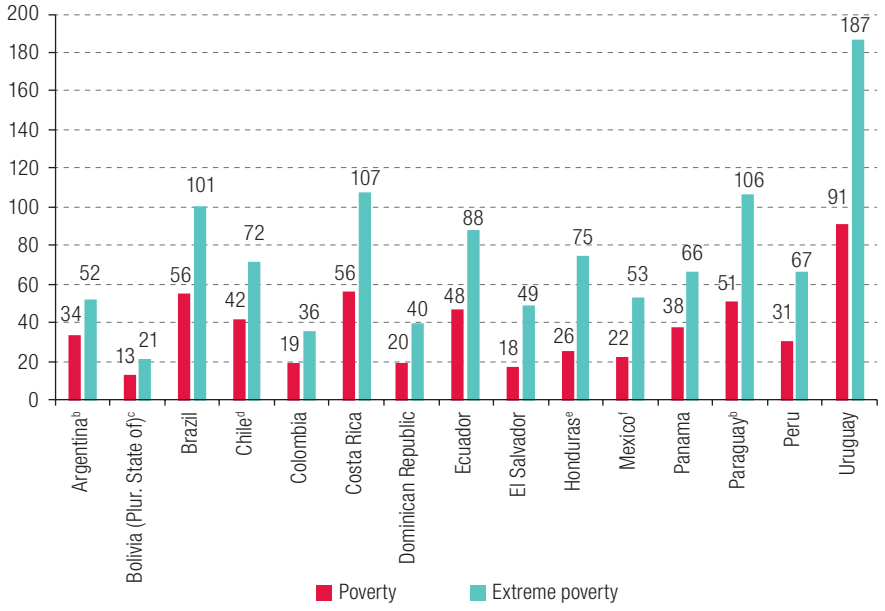
Source: Prepared by the authors on the basis of Household Survey Data Bank (BADEHOG).

[a] The data refer to 2017, except for Bolivia (Plurinational State of) and Honduras, where they refer to 2015, and Mexico, where they refer to 2016.

[b] Percentage of total population living in recipient households.

[c] This indicator expresses, for each of the programmes, the average per capita household transfer as a percentage of the total average per capita income of recipient households.

Figure 3
Latin America (15 countries): amounts of non-contributory transfers relative to the income deficits[a] of the poor and extremely poor populations, based on information from household surveys, around 2014 to around 2017[b]
(Percentages of the income deficit, average of the four survey rounds for each country)



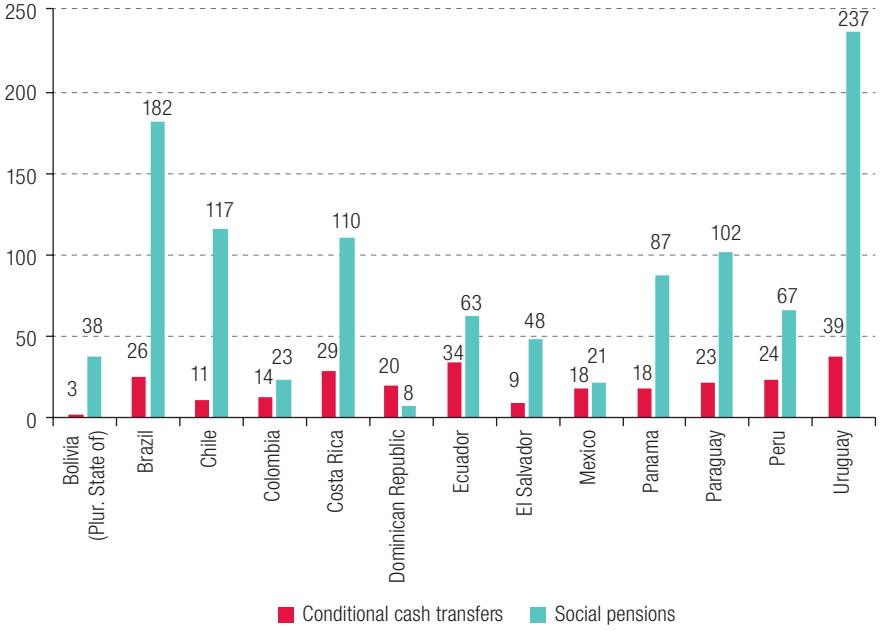
Source: Prepared by the authors on the basis of Household Survey Data Bank (BADEHOG).
[a] The income deficit is the distance between monthly per capita household income and the poverty or extreme poverty line.
[b] 2013, 2014, 2016 and 2017.
[c] 2012, 2013, 2014 and 2015.
[d] 2011, 2013, 2015 and 2017.
[e] 2013, 2014, 2015 and 2016.
[f] 2010, 2012, 2014 and 2016.

In Uruguay, Costa Rica, Paraguay and Brazil, the average amount of non-contributory transfers more than closed the income deficit with respect to the extreme poverty line. The lowest amounts were observed in the Plurinational State of Bolivia, Colombia and the Dominican Republic.

The amounts of social pensions are sufficient to cover, in the vast majority of countries, a much larger proportion of the poor population's income deficit than the amounts of conditional cash transfers. In around 2017, the largest social pensions were provided in Uruguay, Brazil, Chile, Costa Rica and Paraguay, with amounts equivalent to more than 100% of the income deficits of those living in poverty. The lowest social pensions were provided in the Dominican Republic, Mexico, Colombia and the Plurinational State of Bolivia (see figure 4).

Conditional cash transfers, in around 2017, were of the highest amounts with respect to the income deficits of the poor population in Uruguay, Ecuador, Costa Rica and Brazil. The proportionally lowest amounts were found in the Plurinational State of Bolivia and El Salvador.

Figure 4
Latin America (13 countries): amounts of conditional cash transfers and social pensions relative to the income deficit[a] of the population living in poverty, on the basis of information from household surveys, around 2017[b]
(Percentages of the income deficit)



Source: Prepared by the authors on the basis of Household Survey Data Bank (BADEHOG).
[a] The income deficit is the distance between monthly per capita household income and the poverty line.
[b] The data refer to 2017, except for the Plurinational State of Bolivia, where they refer to 2015, and Mexico, where they refer to 2016.

III. The direct impact of non-contributory transfers on poverty

This section assesses the direct impact of non-contributory transfers on poverty in 15 countries in the region between 2014 and 2017, comparing the incidence (or headcount ratio), depth (or gap) and severity (or squared gap) of poverty in the total population, with and without non-contributory transfers.[7] An analysis is also provided that disaggregates by type of programme.

The assessment of the direct impact of non-contributory transfers on poverty assumes that the programmes have no effect on households' decisions concerning reproduction and labour participation, an assumption that could lead to overestimation of the impact. However, this assumption is empirically supported in the literature. Results from impact assessments conducted in Argentina, Brazil, Chile, Colombia, Honduras, Mexico, Nicaragua and Paraguay (ECLAC, 2017) and from randomized controlled trials in Latin America (Honduras, Mexico and Nicaragua), Asia (Philippines and Indonesia) and Africa (Morocco) show that cash transfer programmes do not disincentivize labour participation (Banerjee and others, 2016). In addition, a meta-analysis of conditional cash transfer programmes shows that there is generally no impact on fertility (Bastagli and others, 2016).

[7] The monetary poverty indicators used in this article are from the class of parametric measures proposed by Foster, Greer and Thorbecke (1984): the headcount ratio (FGT_0), which corresponds to the percentage of people living in poverty; the poverty gap (FGT_1), which weights the percentage of people living in poverty according the average distance between their income and the poverty line, and the squared poverty gap (FGT_2), which accounts for the distribution of income among people living in poverty.

The results of the analysis of the direct impact on reducing the headcount ratios for poverty and extreme poverty are presented in table 2. The differences between the situations with and without transfers are presented in absolute values (percentage points) and relative values. In the latter case, the difference is expressed as a percentage with regard to poverty rates without transfers.

Table 2
Latin America (15 countries): headcount ratios for poverty and extreme poverty in the total population, with and without non-contributory transfers, around 2014 to around 2017
(Percentages and percentage points)

Country/years		Extreme poverty				Poverty			
		With transfers	Without transfers	Absolute decrease *(percentage points)*	Relative decrease	With transfers	Without transfers	Absolute decrease *(percentage points)*	Relative decrease
Argentina	2017	2.8	3.3	-0.5	-15.2	18.7	20.7	-2.0	-9.7
	2016	3.0	3.6	-0.6	-16.7	22.9	24.3	-1.4	-5.8
	2014	3.4	3.9	-0.5	-12.8	25.2	26.6	-1.4	-5.3
	2013	3.4	4.0	-0.6	-15.0	23.0	24.2	-1.2	-5.0
Bolivia (Plurinational State of)	2015	15.0	16.8	-1.8	-10.7	35.4	36.7	-1.3	-3.5
	2014	15.3	16.9	-1.6	-9.5	34.3	36.0	-1.7	-4.7
	2013	15.9	18.3	-2.4	-13.1	34.5	35.9	-1.4	-3.9
	2012	16.8	18.4	-1.6	-8.7	36.3	37.3	-1.0	-2.7
Brazil	2017	5.5	8.4	-2.9	-34.5	19.9	22.7	-2.8	-12.3
	2016	5.1	8.1	-3.0	-37.0	19.5	22.3	-2.8	-12.6
	2015	4.0	6.4	-2.4	-37.5	18.8	21.7	-2.9	-13.4
	2014	3.3	5.6	-2.3	-41.1	16.5	19.5	-3.0	-15.4
Chile	2017	1.4	2.6	-1.2	-46.2	10.7	14.0	-3.3	-23.6
	2015	1.7	3.1	-1.4	-45.2	13.6	17.0	-3.4	-20.0
	2013	2.0	3.7	-1.7	-45.9	16.1	19.3	-3.2	-16.6
	2011	3.1	4.8	-1.7	-35.4	25.0	27.9	-2.9	-10.4
Colombia	2017	10.9	12.2	-1.3	-10.7	29.8	30.9	-1.1	-3.6
	2016	12.0	13.4	-1.4	-10.4	30.8	31.8	-1.0	-3.1
	2015	11.3	13.0	-1.7	-13.1	30.6	31.9	-1.3	-4.1
	2014	11.9	13.6	-1.7	-12.5	30.9	32.3	-1.4	-4.3
Costa Rica	2017	3.3	6.0	-2.7	-45.0	15.1	19.1	-4.0	-20.9
	2016	4.2	6.8	-2.6	-38.2	16.7	20.3	-3.6	-17.7
	2015	4.5	6.7	-2.2	-32.8	17.2	20.2	-3.0	-14.9
	2014	4.1	6.7	-2.6	-38.8	18.0	20.9	-2.9	-13.9
Dominican Republic	2017	8.5	9.6	-1.1	-11.5	28.2	29.7	-1.5	-5.1
	2016	9.5	10.6	-1.1	-10.4	29.2	30.3	-1.1	-3.6
	2015	9.4	10.6	-1.2	-11.3	30.3	31.4	-1.1	-3.5
	2014	9.7	10.9	-1.2	-11.0	33.2	34.6	-1.4	-4.0
Ecuador	2017	6.2	8.0	-1.8	-22.5	22.8	24.8	-2.0	-8.1
	2016	7.3	9.2	-1.9	-20.7	25.8	27.5	-1.7	-6.2
	2015	7.2	9.3	-2.1	-22.6	25.6	27.6	-2.0	-7.2
	2014	6.5	8.4	-1.9	-22.6	25.8	27.8	-2.0	-7.2
El Salvador	2017	8.3	8.7	-0.4	-4.6	37.8	37.9	-0.1	-0.3
	2016	10.5	10.9	-0.4	-3.7	40.1	40.4	-0.3	-0.7
	2015	10.4	10.8	-0.4	-3.7	42.3	42.5	-0.2	-0.5
	2014	11.6	11.9	-0.3	-2.5	44.3	44.4	-0.1	-0.2
Honduras	2016	18.5	18.6	-0.1	-0.5	53.0	53.2	-0.2	-0.4
	2015	18.9	20.3	-1.4	-6.9	55.0	55.5	-0.5	-0.9
	2014	19.3	20.5	-1.2	-5.9	55.3	55.6	-0.3	-0.5
	2013	22.6	23.8	-1.2	-5.0	59.1	59.7	-0.6	-1.0

Table 2 (concluded)

Country/years		Extreme poverty				Poverty			
		With transfers	Without transfers	Absolute decrease *(percentage points)*	Relative decrease	With transfers	Without transfers	Absolute decrease *(percentage points)*	Relative decrease
Mexico	2016	11.9	14.6	-2.7	-18.5	44.3	46.1	-1.8	-3.9
	2014	13.4	16.8	-3.4	-20.2	45.7	47.6	-1.9	-4.0
	2012	13.5	16.1	-2.6	-16.1	45.0	46.4	-1.4	-3.0
	2010	12.8	15.3	-2.5	-16.3	44.8	45.9	-1.1	-2.4
Panama	2017	7.6	11.7	-4.1	-35.0	16.7	20.7	-4.0	-19.3
	2016	8.4	12.4	-4.0	-32.3	17.4	21.6	-4.2	-19.4
	2015	7.9	12.3	-4.4	-35.8	18.2	22.0	-3.8	-17.3
	2014	9.1	12.1	-3.0	-24.8	20.2	23.0	-2.8	-12.2
Paraguay	2017	6.0	8.1	-2.1	-25.9	21.6	23.6	-2.0	-8.5
	2016	8.1	9.8	-1.7	-17.3	24.4	25.9	-1.5	-5.8
	2014	7.8	8.8	-1.0	-11.4	22.8	23.9	-1.1	-4.6
	2013	7.3	8.3	-1.0	-12.0	23.3	24.0	-0.7	-2.9
Peru	2017	5.0	6.6	-1.6	-24.2	18.9	20.5	-1.6	-7.8
	2016	8.4	10.2	-1.8	-17.6	25.6	26.9	-1.3	-4.8
	2015	8.5	10.4	-1.9	-18.3	26.0	27.3	-1.3	-4.8
	2014	8.6	10.1	-1.5	-14.9	26.3	27.3	-1.0	-3.7
Uruguay	2017	0.1	0.6	-0.5	-83.3	2.7	5.4	-2.7	-50.0
	2016	0.2	0.7	-0.5	-71.4	3.7	6.4	-2.7	-42.2
	2015	0.2	0.8	-0.6	-75.0	4.3	7.1	-2.8	-39.4
	2014	0.2	0.9	-0.7	-77.8	4.7	7.4	-2.7	-36.5
Simple average	2017	7.4	9.1	-1.7	-25.9	25.0	27.1	-2.0	-11.8
	2016	8.4	10.2	-1.8	-23.8	27.0	28.9	-1.9	-10.1
	2015	8.4	10.1	-1.8	-23.7	27.5	29.3	-1.8	-9.3
	2014	8.7	10.3	-1.6	-22.6	28.8	30.4	-1.7	-8.1

Source: Prepared by the authors on the basis of Household Survey Data Bank (BADEHOG).

As a simple average for the 15 countries analysed, it was found that, in absolute terms, in 2017 transfers contributed to reducing extreme poverty by 1.7 percentage points and poverty by 2.0 percentage points. This equates to a relative reduction in the extreme poverty rate of 25.9% and in the poverty rate of 11.8%. In relative terms, the impact has increased slightly but steadily since 2014.

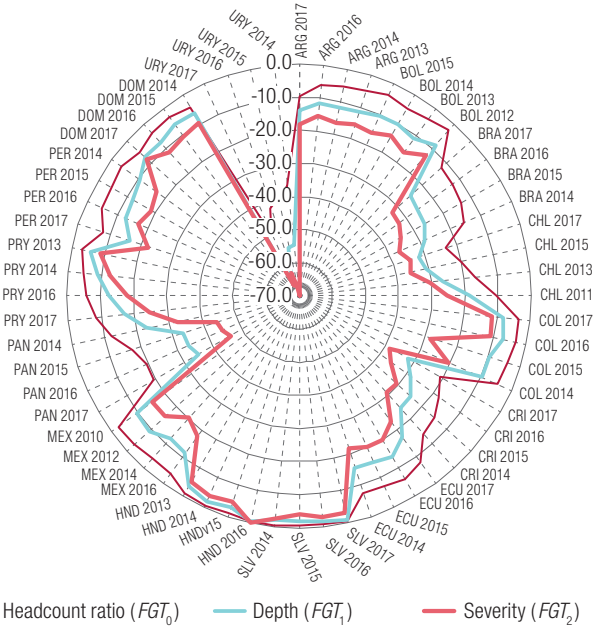
The direct impact of non-contributory transfers on total poverty, measured in absolute and relative values, is greater in countries where the poverty headcount ratio without transfers is lower. The countries where transfers reduced total poverty the most in absolute terms were Panama, Costa Rica and Chile, with effects of more than 3.0 percentage points, followed closely by Brazil and Uruguay. In the remaining countries, the average reduction in poverty ranged from 0.2 to 1.9 percentage points.

Analysing the relative impact of transfers on total poverty, the greatest simple average effect for the four survey rounds, by far, was found in Uruguay (-42%), followed by Chile, Panama, Costa Rica and Brazil, with reductions of between 18% and 13%. In the rest of the countries, which have higher poverty headcount ratios without transfers, the relative effect did not exceed 7%.

In the case of extreme poverty, the largest absolute reductions through transfers were found in Panama, Mexico, Brazil and Costa Rica (2.5 percentage points or more). In terms of relative impact, in countries with extreme poverty levels without transfers of below 10% (on average for the four survey rounds), the relative reduction was 36% on average. In countries with extreme poverty headcount ratios above 10%, the relative reduction was only 13%.

The information in table 2 also shows that the relative impact of non-contributory transfers was, in almost all the countries and years analysed, more significant in reducing extreme poverty than total poverty. This explains why the direct impact of transfers is systematically greater in reducing the severity and depth of poverty than in reducing the headcount ratio for total poverty (see figure 5). These results corroborate the findings of Cruces and Gasparini (2013) and Amarante and Brun (2018).

Figure 5
Latin America (15 countries): reduction in the headcount ratio, depth and severity[a] of poverty because of non-contributory transfers, around 2014 to around 2017
(Percentages, relative rates)[b]



Source: Prepared by the authors on the basis of Household Survey Data Bank (BADEHOG).

[a] The headcount ratio corresponds to the percentage of people living in poverty; depth is the weighting of the percentage of people living in poverty according to the average distance between their income and the poverty line; and severity refers to the way in which income is distributed among people living in poverty.

[b] The relative rate is obtained by dividing the absolute difference between the poverty indicators with and without transfers by the value of the poverty indicator with transfers (baseline). The result is multiplied by 100.

An analysis of the impact of conditional cash transfer programmes alone shows that, as a simple average for 14 countries in the region, there were reductions of 0.7 percentage points (absolute value) and 13% (relative value) in extreme poverty in 2017, and reductions of 0.8 percentage points and 5.1% in poverty (see table 3).

The largest absolute reductions in total poverty occurred in Argentina, Brazil and the Dominican Republic, while the largest reductions in extreme poverty occurred in Mexico and Brazil. The most significant relative impacts of conditional transfers on both extreme and total poverty were found in Uruguay, Argentina and Brazil.

In terms of the impact of social pensions on total poverty, the simple average for 14 countries in the region in 2017 shows reductions of 0.8 percentage points and 11.9% for extreme poverty and 0.9 percentage points and 4.8% for poverty (see table 4).[8]

[8] The 14 countries analysed are not the same as those examined in the case of conditional cash transfer programmes, so it is not advisable to compare the regional averages with those programmes.

Table 3
Latin America (15 countries): headcount ratio for poverty and extreme poverty in the total population, with and without conditional cash transfers, around 2016 to around 2017
(Percentages and percentage points)

Country	Year	Extreme poverty				Total poverty			
		With transfers	Without transfers	Absolute difference *(percentage points)*	Relative difference	With transfers	Without transfers	Absolute difference *(percentage points)*	Relative difference
Argentina	2017	2.8	3.3	-0.5	-15.2	18.7	20.6	-1.9	-9.2
	2016	3.0	3.6	-0.6	-16.7	22.9	24.1	-1.2	-5.0
Bolivia (Plurinational State of)	2015	15.0	15.3	-0.3	-2.0	35.4	35.5	-0.1	-0.3
	2014	15.3	15.5	-0.2	-1.3	34.3	34.8	-0.5	-1.4
Brazil	2017	5.5	7.2	-1.7	-23.6	19.9	21.3	-1.4	-6.6
	2016	5.1	6.9	-1.8	-26.1	19.5	20.9	-1.4	-6.7
Chile	2017	1.4	1.5	-0.1	-6.7	10.7	10.9	-0.2	-1.8
	2015	1.7	1.8	-0.1	-5.6	13.6	13.8	-0.2	-1.4
Colombia	2017	10.9	11.8	-0.9	-7.6	29.8	30.5	-0.7	-2.3
	2016	12.0	12.9	-0.9	-7.0	30.8	31.4	-0.6	-1.9
Costa Rica	2017	3.3	3.7	-0.4	-10.8	15.1	15.9	-0.8	-5.0
	2016	4.2	4.6	-0.4	-8.7	16.7	17.2	-0.5	-2.9
Dominican Republic	2017	8.5	9.6	-1.1	-11.5	28.2	29.7	-1.5	-5.1
	2016	9.5	10.5	-1.0	-9.5	29.2	30.3	-1.1	-3.6
Ecuador	2017	6.2	7.2	-1.0	-13.9	22.8	23.8	-1.0	-4.2
	2016	7.3	8.4	-1.1	-13.1	25.8	26.6	-0.8	-3.0
El Salvador	2017	8.3	8.5	-0.2	-2.4	37.8	37.8	0.0	0.0
	2016	10.5	10.7	-0.2	-1.9	40.1	40.3	-0.2	-0.5
Honduras	2016	18.5	18.6	-0.1	-0.5	53.0	53.1	-0.1	-0.2
	2015	18.9	20.3	-1.4	-6.9	55.0	55.4	-0.4	-0.7
Mexico	2016	11.9	13.6	-1.7	-12.5	44.3	45.2	-0.9	-2.0
	2014	13.4	15.6	-2.2	-14.1	45.7	46.6	-0.9	-1.9
Panama	2017	7.6	8.2	-0.6	-7.3	16.7	17.0	-0.3	-1.8
	2016	8.4	9.0	-0.6	-6.7	17.4	17.6	-0.2	-1.1
Paraguay	2017	6.0	6.9	-0.9	-13.0	21.6	22.4	-0.8	-3.6
	2016	8.1	8.9	-0.8	-9.0	24.4	24.9	-0.5	-2.0
Peru	2017	5.0	5.9	-0.9	-15.3	18.9	19.7	-0.8	-4.1
	2016	8.4	9.4	-1.0	-10.6	25.6	26.1	-0.5	-1.9
Uruguay	2017	0.1	0.2	-0.1	-50.0	2.7	3.9	-1.2	-30.8
	2016	0.2	0.3	-0.1	-33.3	3.7	4.8	-1.1	-22.9
Simple average	2017	7.7	8.4	-0.7	-13.0	25.8	26.5	-0.8	-5.1
	2016	8.7	9.6	-0.9	-11.6	27.7	28.4	-0.7	-3.9

Source: Prepared by the authors on the basis of Household Survey Data Bank (BADEHOG).

The largest absolute declines in total poverty occurred in Panama, Costa Rica and Brazil. In the case of extreme poverty, the largest declines were found in Panama, the Plurinational State of Bolivia and Brazil.

The effect of social pensions on total poverty and extreme poverty in relative terms was greatest in Uruguay, Chile, Panama and Costa Rica (see table 4).

A comparison of the relative impact on poverty of social pensions and conditional cash transfers shows varying results from country to country (see figure 6), depending the amounts of transfers, population coverage and the quality of programme targeting.[9] In Chile and Panama, the effect of social pensions exceeds that of conditional cash transfers by 12.6% and 7.9%, respectively. In contrast, in Uruguay and the Dominican Republic, the impact of conditional cash transfers exceeds that of social pensions by 6.5% and 4.3%, respectively. In half of the countries, the difference between the impact on total poverty of social pensions and conditional cash transfers is 1.0% or less (average of 2016 and 2017).

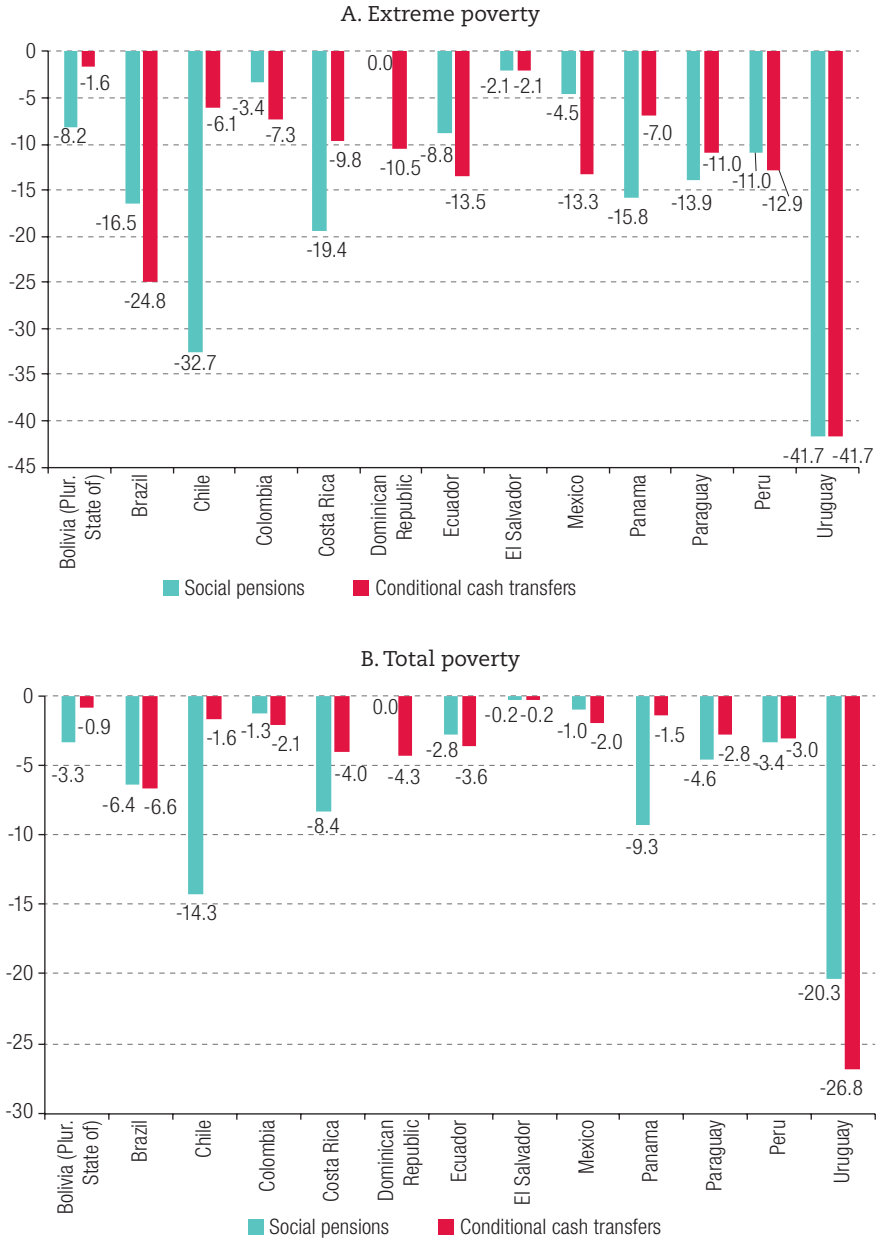
Table 4
Latin America (13 countries): headcount ratios for poverty and extreme poverty in the total population, with and without social pensions, around 2016 to around 2017
(Percentages and percentage points)

Country	Year	Extreme poverty				Total poverty			
		With transfers	Without transfers	Absolute difference *(percentage points)*	Relative difference	With transfers	Without transfers	Absolute difference *(percentage points)*	Relative difference
Bolivia (Plurinational State of)	2015	15.0	16.4	-1.4	-8.5	35.4	36.5	-1.1	-3.0
	2014	15.3	16.6	-1.3	-7.8	34.3	35.6	-1.3	-3.7
Brazil	2017	5.5	6.6	-1.1	-16.7	19.9	21.2	-1.3	-6.1
	2016	5.1	6.1	-1.0	-16.4	19.5	20.9	-1.4	-6.7
Chile	2017	1.4	2.1	-0.7	-33.3	10.7	12.7	-2.0	-15.7
	2015	1.7	2.5	-0.8	-32.0	13.6	15.6	-2.0	-12.8
Colombia	2017	10.9	11.3	-0.4	-3.5	29.8	30.2	-0.4	-1.3
	2016	12.0	12.4	-0.4	-3.2	30.8	31.2	-0.4	-1.3
Costa Rica	2017	3.3	4.1	-0.8	-19.5	15.1	16.6	-1.5	-9.0
	2016	4.2	5.2	-1.0	-19.2	16.7	18.1	-1.4	-7.7
Dominican Republic	2017	8.5	8.5	0.0	0.0	28.2	28.2	0.0	0.0
	2016	9.5	9.5	0.0	0.0	29.2	29.2	0.0	0.0
Ecuador	2017	6.2	6.8	-0.6	-8.8	22.8	23.5	-0.7	-3.0
	2016	7.3	8.0	-0.7	-8.8	25.8	26.5	-0.7	-2.6
El Salvador	2017	8.3	8.5	-0.2	-2.4	37.8	37.8	0.0	0.0
	2016	10.5	10.7	-0.2	-1.9	40.1	40.3	-0.2	-0.5
Mexico	2016	11.9	12.4	-0.5	-4.0	44.3	44.8	-0.5	-1.1
	2014	13.4	14.1	-0.7	-5.0	45.7	46.1	-0.4	-0.9
Panama	2017	7.6	9.1	-1.5	-16.5	16.7	18.4	-1.7	-9.2
	2016	8.4	9.9	-1.5	-15.2	17.4	19.2	-1.8	-9.4
Paraguay	2017	6.0	7.3	-1.3	-17.8	21.6	22.8	-1.2	-5.3
	2016	8.1	9.0	-0.9	-10.0	24.4	25.4	-1.0	-3.9
Peru	2017	5.0	5.7	-0.7	-12.3	18.9	19.7	-0.8	-4.1
	2016	8.4	9.3	-0.9	-9.7	25.6	26.3	-0.7	-2.7
Uruguay	2017	0.1	0.2	-0.1	-50.0	2.7	3.5	-0.8	-22.9
	2016	0.2	0.3	-0.1	-33.3	3.7	4.5	-0.8	-17.8
Simple average	2017	7.5	8.2	-0.8	-11.9	25.1	26.0	-0.9	-4.8
	2016	8.7	9.4	-0.8	-10.8	26.9	27.9	-0.9	-4.4

Source: Prepared by the authors on the basis of Household Survey Data Bank (BADEHOG).

[9] For example, in Panama the amount of the social pension transfer is US$ 120 per month, compared with US$ 50 in the case of the Opportunities Network (CCT programme), and in the Plurinational State of Bolivia the Renta Dignidad social pension provides 210 bolivianos per month, while the Juancito Pinto Grant (CCT programme) provides 200 bolivianos per year. In the Dominican Republic, while conditional cash transfers through the Progresando con Solidaridad programme cover 3.5 million people, the old-age, disability and survivors' solidarity pensions have very limited coverage. Inclusion and exclusion errors also vary from programme to programme; in this regard, see Robles, Rubio and Stampini (2015).

Figure 6
Latin America (13 countries): reduction in the headcount ratios for poverty and extreme poverty owing to the effect of conditional cash transfers and social pensions, around 2016 and 2017
(Relative values, averages of the last two survey rounds)[a]



Source: Prepared by the authors on the basis of Household Survey Data Bank (BADEHOG).
[a] The relative rate is obtained by dividing the absolute difference between the poverty indicators with and without transfers by the value of the poverty indicator with transfers (baseline). The result is multiplied by 100.

The heterogeneity among countries is greater when comparing the relative impact of the two types of programmes on extreme poverty. In Chile, the effect of pensions exceeds that of conditional cash transfers by 26.6%, and in the Dominican Republic, the impact of conditional cash transfers is 10.5% greater than that of social pensions. In Mexico and Panama, the difference between the effect of the two programmes is 8.8%; in the former, conditional cash transfers have a greater impact, and in the latter, the social pension has a greater impact. In Brazil, the impact of conditional cash transfers exceeds that of the social pension by 8.3%, and in the Plurinational State of Bolivia, the impact of the social pension exceeds that of conditional transfers by 6.6%.

IV. Discrepancies between capture of transfer recipients in surveys and in administrative records

In the region, the direct impact of non-contributory transfers on poverty has been assessed on the basis of surveys. However, recent information on developed countries shows that surveys capture fewer recipients of State transfers than administrative records (Meyer, Mok and Sullivan, 2015; Meyer and Mittag, 2016).

As discussed in Villatoro and Cecchini (2018), the errors that lead to undercapturing of transfers in surveys are: (i) coverage error, which occurs when the survey's sampling frame does not include the entire population; this error occurs when certain territories, households or persons are excluded from the sampling frame; (ii) unit or total non-response, which occurs when a selected household refuses to be interviewed; (iii) item or partial non-response, which occurs when a household participates in the survey but does not answer one or more income questions; and (iv) measurement error, which occurs when respondents give incorrect answers about their income. This last error is partly because of cognitive failures, as respondents may confuse or forget the names of programmes and may not remember when they received transfers. Another reason is intentional underreporting, which in the ethnographic literature from developed countries has been linked to the stigma associated with receiving social assistance. In Latin America, the precarious living conditions of the poorest, the selectivity of social programmes, the lack of understanding of the purposes of the surveys and the belief that the information will not be treated confidentially may encourage respondents not to declare income (Feres and Villatoro, 2012). Instrumentation and mode of survey implementation can also lead to response and measurement errors. The wording and order of questions and the length of interviews affect the interpretation of the questions and interviewees' motivation to respond (Biancotti, D'Alessio and Neri, 2008). Interviewer and interviewee characteristics may also play a role (Meyer, Mok and Sullivan, 2015).

However, administrative records are not completely reliable. Unlike surveys, the data collection process for records is usually not monitored in developing countries (World Bank, 2015). Furthermore, information from records that is not essential for management is of lower quality (Meyer, Mok and Sullivan, 2015; Mittag, 2012). In any case, as the delivery of transfers is the main task of non-contributory transfer programmes, information on such transfers and on recipients should be more reliable than other data that is less important for management.

In addition to the above limitation, the two sources are not fully comparable. Some of the discrepancies between records and surveys are to be expected, owing to their different purposes, procedures and reporting modes (Guimarães Ferreira de Souza, 2013; Groen, 2012). Records exist to support management, while surveys are designed for research and to represent a broader segment of the population (World Bank, 2015). In addition, the populations and reference periods of the two sources often do not match exactly (Groen, 2012).

In recent years, empirical information has been obtained indicating that the quality of surveys in developed countries has deteriorated and that discrepancies between surveys and records are explained by survey non-response. The number of households that do not respond to surveys, do not answer questions about transfers, or provide unreliable answers to questions about their income has grown. These problems appear more severe at the extremes of the income distribution and seemingly reduce the reliability of poverty rates (Meyer and Mittag, 2016; Meyer, Mok and Sullivan, 2015; Meyer, Mittag, and Goerge, 2018; Bruckmeier, Müller and Riphahn, 2014).

With respect to countries in the region, MDS/SAGI (2012) concludes that Brazil's National Population Census found 25.9% fewer families receiving Bolsa Família and transfers from the Child Labour Eradication Programme (PETI) than records did. Guimarães Ferreira de Souza (2013) notes that the National Household Survey (PNAD) has historically captured 20% to 25% fewer families receiving Bolsa Família than administrative records. In the case of the Continuous Benefit Programme, the number of recipients according to the survey has generally been around half the official number.

Villatoro and Cecchini (2018) examined discrepancies between surveys and records in the capture of transfers in 15 Latin American countries between 2011 and 2015. In line with the conclusions in developed countries, it was found that surveys capture fewer transfers overall than records and that these gaps are essentially because of undercapturing of recipients rather than recipients underreporting transfers in surveys with respect to records.

This section updates the exercise carried out by Villatoro and Cecchini (2018) with information available for the period between 2008 and 2017, limiting it to the detection of gaps in the capture of recipients between surveys and records. With regard to conditional cash transfers, in 9 of the 15 countries studied, the average undercapture of recipients in the surveys was over 20% between 2008 and 2017 (see table 5).

In Brazil, the undercapture of Bolsa Família recipients was greatest in the last three rounds of surveys, with the particularity that in 2016 and 2017 programme transfers were measured directly in the survey. In contrast, between 2008 and 2015, Bolsa Família transfers were recorded by the National Household Survey in a more general stream of "other income", meaning that indirect methods must be used to identify recipients. One similar case is Colombia, where undercapture reached its highest levels in 2016 and 2017, when transfers were measured by the surveys directly. Between 2011 and 2015, transfers from the Más Familias en Acción programme were included in a general stream of social assistance transfers (government and others).

In Argentina, the undercapture rate of recipients of the Universal Child Allowance (AUH) was close to 50% between 2011 and 2016. Universal Child Allowance transfers are also measured through a more general stream of "government aid", so recipients must be identified through proxies. In Honduras, the exceedingly high rate of verified undercapture is largely a result of the value for 2016, when undercapture was almost 100%. In addition, the indicator of undercapture varies significantly throughout the series, suggesting that the measurements may be unreliable.

One factor that may have a bearing on the gap between the extent to which surveys and administrative records capture conditional cash transfer recipients is the lack of equivalence between their statistical units. In surveys, the statistical unit is the household, while in many conditional cash transfer programmes the unit is the family. If the statistical units in records are nuclear families, table 5 may overestimate undercapture rates, since a household may include several nuclear families.

Table 5
Latin America (15 countries): observed gap[a] between surveys and administrative records in the capture of conditional cash transfer recipients,[b] 2008 to 2017
(Percentages)

Country	Programme	2008	2010	2011	2012	2013	2014	2015	2016	2017	Average
Argentina	Universal Child Allowance (AUH)			-47.4[c]	-52.5[c]	-48.2[c]	-47.8[c]		-50.7[c]	-50.1[c]	-49.5
Bolivia (Plurinational State of)	Juancito Pinto Grant	-9.0		3.8	-5.5	-5.1	4.0	0.0			-2.0
Brazil	Bolsa Família	-23.6[c]		-18.0[c]	-20.8[c]	-26.0[c]	-22.2[c]	-28.1[c]	-27.4	-29.9	-24.5
Chile[d]	Family protection grants					-18.1		-26.2			-22.2
Colombia	Más Familias en Acción (family grant)			-25.0[c]			-14.1[c]	-12.8[c]	-32.6	-34.1	-23.7
Costa Rica	Avancemos		-28.0	-25.1	-27.1	-21.2	-18.3	-20.8	-20.4	-17.5	-22.3
Dominican Republic	Progresando con Solidaridad	-50.5[f]			-10.6[f]	-26.2[f]	-21.9[f]	-20.9[f]	-7.0		-22.8
Ecuador	Human Development Grant (BDH)	-20.6[c]			-19.0[c]	-11.6[c]	-0.9[c]	-1.5[c]	-6.0[c]	16.9[c]	-6.1
El Salvador	Comunidades Solidarias	-39.2[e]				-23.3	-37.9	-36.9	-25.8		-32.6
Honduras	10,000 Grant (called the Better Life Grant since 2015) and the Family Allowance Programme (PRAF)					-23.6	-53.2	-48.6	-97.9		-55.8
Mexico	Prospera (formerly Progresa and Oportunidades)	-10.1	-14.1		-12.1		-7.0		-2.1		-9.1
Panama	Opportunities Network			-8.2		-6.1	-14.4	-18.9	-13.4	-6.7	-11.3
Peru	National Programme of Direct Support for the Poorest (Juntos)	-12.2	-3.2		-22.3	1.4	-1.9	19.1	33.8	31.2	5.7
Paraguay	Tekoporã	-55.0[e]	-39.0	-68.6	-14.3	-28.4	-22.7		-8.1	-7.8	-30.5
Uruguay	Family Allowances–Equity Plan	11.1[e]		-7.0	-1.9	-6.5	-8.4	-4.7	-9.9		-3.9

Source: Prepared by the authors, on the basis of information from the Non-contributory Social Protection Programmes in Latin America and the Caribbean Database [online] http://dds.cepal.org/bpsnc/ and Household Survey Data Bank (BADEHOG).

[a] The gap is calculated by means of the capture rate (*TC*), which corresponds to the following equation: $((\bar{Y}eh/\bar{Y}ra)-1)*100$. $\bar{Y}eh$ is the estimate on the basis of the survey and $\bar{Y}ra$ is the estimate on the basis of the administrative records. A negative (positive) value indicates that the survey-based estimate is lower (higher) than the record-based estimate.

[b] Corresponds to households, except in the cases of Argentina, Bolivia (Plurinational State of) and Uruguay, where it corresponds to individuals.

[c] Estimate. The income item that corresponds to the programme is captured and/or recorded within a more general item, meaning that indirect methods must be used to identify the recipients. This entails identifying the eligible population and determining the ranges of possible amounts, in the case of variable programme transfers.

[d] Nuclear families were used to identify recipients in the surveys, rather than households. In the case of records, it was assumed that a family can receive only one grant.

[e] Values for 2009.

[f] It is assumed that government aid income is from the Progresando con Solidaridad programme.

In the case of social pensions, in 7 of the 12 countries studied, the average undercapture of recipients in the surveys was over 20% between 2008 and 2017. The countries with average undercapture rates of over 20% were Brazil, Paraguay, Uruguay, Peru, El Salvador, Mexico and Colombia (see table 6).

In Brazil, there was only direct measurement of Continuous Benefit Programme recipients in the surveys in 2016 and 2017. Capture of recipients in 2016 and 2017 was better than between 2008 and 2013, but worse than in 2014 and 2015. In Paraguay, the 2017 measurement showed better capturing of Food Allowance recipients than in previous years. In El Salvador, undercapture increased in the last round, and in Mexico capture of recipients in 2014 and 2016 was lower than in previous rounds. In Peru, undercapture of contributory pension recipients declined sharply, while in Uruguay it remained relatively stable.

Table 6
Latin America (12 countries): observed gap[a] between surveys and administrative records in the capture of recipients of social pensions,[b] 2008 to 2017
(Percentages)

Country	Programme	2008	2011	2012	2013	2014	2015	2016	2017	Average
Bolivia (Plurinational State of)	Renta Dignidad (old-age pension)	-15.0	-9.0	-12.0	-10.0	-11.0	-10.0			-11.2
Brazil	Continuous Benefit Programme (BPC)	-60.1[c]	-62.8[c]	-55.9[c]	-57.4[c]	-46.0[c]	-49.6[c]	-53.4	-54.4	-54.9
Chile	Basic Solidarity Pension	0.0[d]	-16.0		5.0		29.0		35.7	10.7
Colombia	Colombia Mayor (old-age social protection programme)							-22.5	-20.7	-21.6
Costa Rica	Non-contributory Pension Scheme	-3.0		-5.0	2.0	-4.0	12.0	13.0	33.6	6.9
Ecuador	Old-age Pension (part of the Human Development Grant (BDH))	-29.0[c]		-25.0[c]	-19.0[c]	-13.1[c]	-16.9[c]	-16.2[c]		-19.9
El Salvador	Nuestros Mayores Derechos				-28.0	-17.7	-17.2	-28.9		-22.9
Mexico	Old-age Pension	-10.1	-20.5[e]	-16.6		-36.3		-25.6		-21.8
Panama	120 a los 65 Programme		0.9		-4.9	-1.5	-8.0	2.6	4.4	-1.1
Peru	Pension 65			-58.0	-28.0	-26.0	-16.0	-6.0	-6.0	-23.3
Paraguay	Food Allowance for Older Persons Living in Poverty		-64.8	-27.7	-33.0	-32.5		-19.5	-18.7	-32.7
Uruguay	Old-age Pension				-24.4	-26.6	-28.7	-23.4		-25.7

Source: Prepared by the authors, on the basis of information from the Non-contributory Social Protection Programmes in Latin America and the Caribbean Database [online] http://dds.cepal.org/bpsnc/ and Household Survey Data Bank (BADEHOG).

[a] The gap is calculated by means of the capture rate (*CT*), which corresponds to the following equation: $((\bar{Y}eh/\bar{Y}ra)-1)*100$. $\bar{Y}eh$ is the estimate on the basis of the survey and $\bar{Y}ra$ is the estimate on the basis of the administrative records. A negative value indicates that the survey-based estimate is lower than the record-based estimate (undercapture). a positive value indicates that the survey-based estimate is higher than the record-based estimate (overcapture).

[b] Population aged 65 and over, except in El Salvador (70 and over) and the Plurinational State of Bolivia (60 and over). In the cases of Bolivia (Plurinational State of), Chile, Costa Rica, Peru (all rounds) and Ecuador (2008, 2012 and 2013), a correction was made to the estimate of recipients obtained through the survey expansion factor, using census projections instead.

[c] Estimate. The income item that corresponds to the programme is captured and/or recorded within a more general item, meaning that indirect methods must be used to identify the recipients. This entails identifying the eligible population and determining the ranges of possible amounts, in the case of variable programme transfers.

[d] Value for 2009.

[e] Value for 2010.

Lastly, in Chile and Costa Rica, on average for the entire data series, capture of recipients of social pensions was higher in surveys than in administrative records. One of the factors that may affect these results is people systematically declaring income from other streams as social pensions.[10]

V. Imputation of unrecorded transfers and the effect on the calculated impact of transfers on poverty

One of the questions raised by the undercapture of recipients of social programmes is the extent to which this affects the calculated impact of transfers on poverty figures. We address this question through a simulation using data from Brazil's 2017 National Household Survey (PNAD), as this is one of the cases of considerable underreporting of recipients compared to administrative records.

The simulation, based on household survey data, consists of increasing the number of transfer programme recipients so that the total number is equal to the figure from administrative records. This is

[10] In Chile, part of the transfers from the Solidarity-based old-age welfare contribution, a stream that is quite undercaptured in the survey (see ECLAC, 2018b), could be being declared as a Basic Solidarity Pension.

done by identifying individuals or households that meet the criteria to be recipients of the programmes but did not report receiving income from them. If the total of actual and potential recipients in the household survey exceeds the total reported in administrative records, a selection criterion is applied to potential recipients.

The impact on poverty figures from this correction of coverage of recipients depends on several factors, including the extent of underrecording, the amount of the assistance provided and the accuracy of targeting.

Correcting the undercapture of the Bolsa Família programme has a smaller impact on the headcount ratios for extreme poverty and poverty (FGT_0) than on their depth (FGT_1) and severity (FGT_2). In the case of extreme poverty, the extent to which the FGT_1 and FGT_2 indicators are reduced depends largely on the assumption about exclusion error. If the transfer is allocated strictly to potential households with lower income, the percentage reduction in FGT_1 because of Bolsa Família increases from 34% to 52%. However, if transfers are randomly allocated (to households up to the sixth decile that have children), the coverage correction does not lead to a greater impact of Bolsa Família on the headcount ratio. The result is similar for poverty, since the coverage correction produces appreciable changes only in the FGT2 indicator, but not in the other indicators (see table 7).

Correcting the coverage of the Continuous Benefit Programme has a slight impact on the headcount ratios for extreme poverty and poverty. The differences in the FGT_1 or FGT_2 indicators are negligible (see table 8).

If both transfers are considered together (assuming a random selection of potential recipients), the coverage correction has a more appreciable impact on poverty indicators. For example, in the case of poverty, the headcount ratio would be 19.4% instead of 19.9% (see table 9).

Although Brazil has one of the highest levels of underreporting of recipients among the countries analysed, this does not significantly affect the conclusions on the role of transfers in poverty reduction.

Table 7
Brazil: extreme poverty and poverty rates in different coverage scenarios for the Bolsa Família programme, 2017
(Units of the corresponding indicators)

Indicator	Extreme poverty				Poverty			
		With transfers				With transfers		
	Without transfers	According to survey	According to administrative records *(no error)*	According to administrative records *(randomization)*	Without transfers	According to survey	According to administrative records *(no error)*	According to administrative records *(randomization)*
Headcount ratio *(FGT_0)*	7.2	5.5	5.3	5.5	21.3	19.9	19.8	19.7
Change compared to the situation without transfers *(percentages)*		-23	-26	-24		-6	-7	-8
Gap *(FGT_1)*	3.9	2.6	1.9	2.4	9.0	7.6	7.0	7.4
Change compared to the situation without transfers *(percentages)*		-34	-52	-37		-16	-22	-18
Gap squared *(FGT_2)*	2.9	1.8	0.9	1.7	5.7	4.4	3.7	4.2
Change compared to the situation without transfers *(percentages)*		-36	-69	-41		-23	-35	-26
Recipient households *(millions)*		9.5	13.6	13.6		9.5	13.6	13.6

Source: Prepared by the authors, on the basis of the National Household Survey (PNAD), 2017.

Table 8
Brazil: extreme poverty and poverty rates in different coverage scenarios for the Continuous Benefit Programme (BPC), 2017
(Units of the corresponding indices)

Indicator	Extreme poverty			Poverty		
	Without transfers	With transfers		Without transfers	With transfers	
		According to survey	According to administrative records		According to survey	According to administrative records
Headcount ratio *(FGT_0)*	6.5	5.5	5.4	21.2	19.9	19.7
Change compared to the situation without transfers *(percentages)*		-15	-17		-6	-7
Gap *(FGT_1)*	3.0	2.6	2.5	8.4	7.6	7.4
Change compared to the situation without transfers *(percentages)*		-16	-19		-10	-12
Gap squared *(FGT_2)*	2.1	1.8	1.8	5.0	4.4	4.3
Change compared to the situation without transfers *(percentages)*		-14	-18		-13	-15
Recipients *(millions)*		0.9	2.0		0.9	2.0

Source: Prepared by the authors, on the basis of the National Household Survey (PNAD), 2017.

Table 9
Brazil: extreme poverty and poverty rates in different coverage scenarios for Bolsa Família and the Continuous Benefit Programme (BPC), 2017
(Units of the corresponding indices)

Indicator	Extreme poverty			Poverty		
	Without transfers	With transfers		Without transfers	With transfers	
		According to survey	According to administrative records		According to survey	According to administrative records
Headcount ratio *(FGT_0)*	8.2	5.5	5.3	22.6	19.9	19.4
Change compared to the situation without transfers *(percentages)*		-33	-35		-12	-14
Gap *(FGT_1)*	4.4	2.6	2.3	9.9	7.6	7.3
Change compared to the situation without transfers *(percentages)*		-42	-47		-24	-27
Gap squared *(FGT_2)*	3.2	1.8	1.6	6.4	4.4	4.1
Change compared to the situation without transfers *(percentages)*		-43	-51		-32	-36

Source: Prepared by the authors, on the basis of the National Household Survey (PNAD), 2017.

VI. Conclusions

Over the past 20 years, non-contributory cash transfers have been a key instrument of social policies to help people overcome poverty in most Latin American countries. Analysis of 15 countries in the region shows that both conditional cash transfers and social pensions contribute to lower rates of poverty and extreme poverty. Specifically, data from around 2017 show that, in terms of a simple average for the region, the combination of these monetary transfers resulted in extreme poverty and poverty being 1.7 and 2.0 percentage points lower, respectively, than they would have been if households had not had this source of income (equivalent to relative decreases of 25.9% and 11.8%, respectively).

The data also show that household surveys underrecord the number of transfer recipients, which could lead to underestimation of the impact on poverty, especially when using indicators that take into

account the level and distribution of income of people living in poverty, such as the depth (FGT_1) and severity (FGT_2) indicators. However, as can be seen in the case of Brazil, low transfer amounts mean that the impact on the poverty headcount ratio is less underestimated, validating the aptness of household surveys as instruments for analysing the impact of non-contributory monetary transfers on poverty.

In a context of growing poverty and extreme poverty (ECLAC, 2021), it is essential to strengthen non-contributory cash transfers in the countries of the region. To achieve this, it is advisable to increase transfer amounts to close the poverty gap, expand coverage to reach those living in poverty and those who are at high risk of falling into poverty, and effectively coordinate with other social programmes, within a framework of universal and comprehensive social protection systems.

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Annex A1

Table A1.1
Latin America (15 countries): survey questions and variables for capturing non-contributory transfers, around 2017

Country/year	Programme[a]	Measurement of receipt of transfers	Variables with the income stream in the database	Estimation notes
Argentina, 2017	Universal Child Allowance (AUH)	Indirect. Question used: Do you receive a subsidy or social assistance from the government?	v5_m	- Approximate monthly amounts of the AUH are used. - Filter for eligible households: at least one person aged 0–18.
	Other subsidies	Indirect. Question used: Do you receive a subsidy or social assistance from the government?	v5_m	- Filter for eligible households: no persons aged 0–18.
	Education grants	Direct.	v11_m	
Bolivia (Plurinational State of), 2015	Juancito Pinto Grant	Direct, without asking for the amount.	bonojpi_i	- The income is allocated and converted into a monthly amount.
	Juana Azurduy Grant	Direct.	bonojaz_i	
	Renta Dignidad (old-age pension)	Direct.	digni_i	
Brazil, 2017	Bolsa Família	Direct.	v5002a2	
	Continuous Benefit Programme (BPC)	Direct.	v5001a2	
	Other subsidies	Direct.	v5003a2	
Chile, 2017	Chile Solidario Ethical Family Income (IEF)	Direct. Fixed amount grants. The amount is not asked.	y2201, y2202, y2203, y2204, y2205, y2301, y2302, y2303, y2502, y2506	- Fixed-rate grants: the amount is allocated. - Variable grants: self-reported and payment receipts.
	Basic Solidarity Old-Age Pension Basic Solidarity Disability Pension	Direct. Fixed amount grants. The amount is not asked.	y2601, y2604	- The amount is allocated.
	Other subsidies	Direct. Fixed amount grants. The amount is not asked.	y2001, y2002, y2003, y2004, y2005, y2302, y2401, y2501, y2503, y2504, y2505, y2507	- Fixed-rate grants: the amount is allocated. - Variable grants: self-reported and payment receipts.
Colombia, 2017	Más Familias en Acción (family grant)	Direct.	p1661s1a1	
	Jóvenes en Acción (youth grant)	Direct.	p1661s2a1	
	Colombia Mayor (old-age social protection programme)	Direct.	p1661s3a1	
Costa Rica, 2017	Non-contributory Pension Scheme	Direct.	trnc, taprnc	
	Avancemos	Direct.	timas	Type of grant (a9a) = 1.
	Other subsidies (transfer from the Joint Institute for Social Aid (IMAS), education grants, others)	Direct.	ts, timas, tbc	Type of grant (a9a) <> 1 (for timas variable).
Dominican Republic, 2017	Progresando con Solidaridad	Direct.	gob_comer_primero_monto gob_inc_asis_escolar_monto gob_bono_luz_monto gob_bonogas_hogares_monto gob_bono_estudiante_prog_monto gob_inc_educacion_sup_monto	

Table A1.1

Country/year	Programme[a]	Measurement of receipt of transfers	Variables with the income stream in the database	Estimation notes
Ecuador, 2017	Human Development Grant (BDH)	Direct, without separating by grant.	p76	Filter: the eligible population is people under 65 years of age.
	Human Development Grant — Older Persons	Direct, without separating by grant.	p76	Filter: the eligible population is people aged 65 and over.
	Joaquín Gallegos Grant	Direct.	p78	
El Salvador, 2017	Comunidades Solidarias	Direct.	r44506_i	Filter: the eligible population is people under 70 years of age.
	Basic Universal Pension	Direct.	r44506_i	Filter: the eligible population is people aged 70 and over.
	Other subsidies	Indirect.	r44506_i	Filter: non-recipients of Comunidades Solidarias and Universal Basic Pension.
Honduras, 2016	Better Life Grant	Direct.	oih14_i	
	Grant for people with disabilities, education grants, other government programmes	Direct.	oih9_i, oih12_i, oih16_i	
Mexico, 2016	Prospera	Direct.	yp042	
	Old-age Pension	Direct.	yp044	
	Programme of Direct Rural Support (PROCAMPO), Temporary Employment Programme (PET), government grants, No Hunger Card, other programmes for older persons, other social programmes	Direct.	yp038, yp043, yp045, yp046, yp047, yp048	
Panama, 2017	Opportunities Network, Grant for Food Purchase programme	Direct.	p56_g1, p56_g2	
	120 a los 65 Programme	Direct.	p56_g5	
	Universal Grant, Public Institution Grant, Guardian Angel programme	Direct.	p56_g6, p56_f2, p56_f1	
Peru, 2017	National Programme of Direct Support for the Poorest (Juntos)	Direct.	d5566c	
	Pensión 65	Direct.	d5567c	
Paraguay, 2017	Tekoporã	Direct.	e01ide	
	Old-age Food Allowance	Direct.	e01kde	
	Solidarity Programme for the Protection of Older Persons	Direct.	gob_proteccion_vejez_monto	
Uruguay, 2017	Family Allowances, Uruguay Social Card (MIDES)	Direct.	yotr3, yotr4	
	Old-age or disability pension	Direct.	pen_i	Filter: population that reported receiving old-age or disability pensions.

Source: Prepared by the authors on the basis of Household Survey Data Bank (BADEHOG).

[a] In some cases, the names do not identify programmes, but income streams.

Ethnicity and social exclusion in Colombia in 2012–2017

Edinson Ortiz Benavides and José Javier Núñez Velásquez

Abstract

This study aims to provide an approach to concepts and ways of measuring ethnicity and social exclusion that can be generalized to any context and time and, thus, make it possible to establish a statistically significant relation between these two categories. The methodology involves fuzzy sets and ordinary least squares regression, using data obtained from the Colombian National Quality of Life Survey for 2012–2017. At the 95% confidence level, it is concluded that when ethnicity increases by 1 percentage point, the degree of social exclusion in the country rises by 7 points. Other characteristics, such as having a darker skin tone, self-identifying with an ethnic group, being an immigrant and living in rural areas, produce similar effects.

Keywords

Ethnicity, indigenous peoples, people of African descent, ethnic and racial groups, economic, social and cultural rights, poverty, income, social isolation, measurement, social integration, social policy, Colombia

JEL classification

J10, J15, I32, F22

Authors

Edinson Ortiz Benavides is Associate Professor in the Economics Department of the University of Nariño (Colombia) and holds a PhD from the University of Alcalá (Spain). Emails: edinson.ortiz@uah.es, edinson@udenar.edu.co.

José Javier Núñez Velásquez is Associate Professor in the Economics Department of the University of Alcalá (Spain). Email: josej.nunez@uah.es.

I. Introduction

Ethnicity and social exclusion are two categories on which there is a lack of consensus in terms of conceptualization, measurement and interrelationships. Although recently coined expressions, their roots can be traced centuries back in sociology, biology or anthropology. This study does not seek to provide a compendium on the subject, but to offer an approach to concepts and ways of measuring these phenomena that can be generalized to any context and time period, and to establish a statistically significant relation between the two.

The concepts of race, ethnic origin and immigration, alongside those of gender, class, age and religion, underpin a range of cultural, economic and social systems and mechanisms of domination that prevent large human groups gaining equitable access to the enjoyment of symbolic and consumer goods (Bello and Rangel, 2000, p. 4). The analyses and research projects undertaken in the last two decades, on social exclusion, poverty and inequality in Latin America, have highlighted the situation of disadvantage and marginalization suffered by indigenous populations and Afrodescendent groups —which has its roots in colonialism and the slavery system of which they were victims (Valdivia, 2011, p. 20). This has led to a recognition of the existence of certain "ethnic gaps" which highlight the difference in the degree and manner in which ethnic-racial groups confront the problems of poverty and social exclusion (Valdivia, 2011, p. 20).

Using statistical data from Colombia's National Quality of Life Survey for 2012–2017, the study aims to align the concepts mor closely to the categories available in the data and to identify the evolution of these phenomena and the relations between them in that period. To that end, this article has been divided into five sections including this introduction: section II addresses ethnicity, its conceptual development and the establishment of an indicator (the ethnicity factor (*factor de etinicidad - fet*); section III deals with the dimensions and complexity of social exclusion, and proposes an alternative way of measuring it based on the degree of social exclusion (*grado de exclusión social - ges*); section IV reports the results obtained from the established indicators, along with their evolution and the relations between them; and section V presents the main conclusions of the study.

II. Ethnicity: social and economic category

1. The concept of ethnicity

Although the concept of ethnicity emerged half a century ago, it does not command consensus. Negligible progress has been made in defining it clearly; and, in fact, it is openly confused with the notions of race and ethnic origin, which the concept was intended to overcome. Ever since the American sociologist David Riesman first referred to the concept in 1953, ethnicity has been associated with the culture of belonging, inequality, discrimination and the domination of one social group over another, on the grounds of putative superiority, or on the basis of better and more legitimate rights than those of the people who are devalued and excluded (Oommen, 1994). Like other categories, such as gender and class, ethnicity underpins a wide range of institutional, cultural, economic and social systems and mechanisms of domination. Through these, large human groups suffer clear and repeated processes of social exclusion and are denied equal access to the enjoyment of symbolic and consumer goods (Bello and Rangel, 2000).

Ethnicity is thus a socially constructed category with strong economic implications. It also encompasses other categories that differentiate between population groups in a given context and time. These categories are race, ethnic origin and immigration, which are essential components of ethnicity, and together represent the key elements of discrimination and social exclusion in a country.

2. The components of ethnicity

(a) Race

Race is the first category or component of ethnicity and is constructed to justify phenotypic differentiation between human beings. The concept of race includes the taxonomic division of the human genus based on biological, morphological and physiological differentiations. However, according to Stavenhagen (2002), the term race has been used not as an empirically demonstrated taxonomic category in biology, but as a social construct that uses certain visible biological traits as classification criteria. This has occurred even though genetic biology has shown that no such racial division exists in the human species, and that all human beings share the same biological traits (Antón and Del Popolo, 2009).

Wade (2011) posits three theories of the meaning of race. The first has to do with human genetic variation. The biological constitution of human beings clearly varies in some very obvious ways. The question is whether such variation can be classified in a discrete number of defined categories, called "races", each of which has certain characteristics in common, such as skin colour, hair type, blood type, or aspects of genetic constitution. If so, the concept of race would be useful for talking about variations in human nature. In fact, that is precisely the meaning of race that predominated in Western popular and scientific circles throughout the nineteenth and for much of the twentieth centuries (Wade, 2011, p. 208).

The second, more controversial, theory holds that superficial variation in external appearance correlates with other human characteristics. An individual's skin colour is greatly influenced by inherited genes; the question is whether those same genes, or some correlated part of the genetic complement, also exert a significant influence on cognitive abilities, such as "intelligence", or perhaps on skills such as strength or speed. This second theory fit the first like a glove and also predominated in the nineteenth and much of the twentieth centuries. A "race" could thus be defined not only in terms of biological markers such as skin colour and facial features, but also in terms of moral and intellectual characteristics (Wade, 2011, p. 209).

The third theory of race holds that, whatever human genetic variation exists, it cannot be usefully described in terms of race; and that race is an idea, with no biological relevance to human potential. Its status as an idea, however, does not diminish its enormous social importance. Even if race has no biological basis in human nature, people are clearly primed to discriminate against others whom they define as racially different. […] This third theory is based on the currently accepted idea that "races" are social constructs, while recognizing that the concept of race remains a very important and often deeply rooted notion that affects people's behaviour and their opportunities in substantial ways (Wade, 2011, pp. 209–210).

Rangel (2004) also refers to this third theory and states that, from the early years of the twentieth century, theories that disdained morphological classifications of human beings became increasingly accepted, and the concept of race lost its scientific importance and was partially abandoned. Biology started to recognize the non-existence of subdivisions of the human species that could be justified on the basis of genetic factors, and which would correlate with certain distinct physical, psychological, moral or intellectual qualities. It was then realized that the differences between human groups could only be explained scientifically on the basis of their historical and cultural origin; and the concept of ethnicity gained analytical importance, replacing that of race (Rangel, 2004, pp. 31 and 32).

(b) Ethnic origin

The concept of ethnic origin as a second component of ethnicity is derived from the Greek word *ethnos*, which in turn comes from the term *ethnicus*. The word *ethnos* originally meant people or nation

and was used interchangeably with the discredited category of race, to characterize ethnic groups or the ethnic identities that comprised them. According to Valdivia (2011), the ethnic conceptualization has recently developed mainly through two major theoretical strands. The first is known as the primordial approach, according to which ethnic groups are defined by characteristics that are inherent to their culture, such as language, music, customs, ancestors, clothing, institutions and values, among others. The second theoretical strand embraces several positions that emerged in opposition to what has been called "primordialism". These form part of a contextual or circumstantial approach and share two basic ideas: firstly, there are no predefined and immutable ethnic identities, since identity is dynamic and subject to changes in the historical development of the groups in question; and, secondly, identities depend largely on the social, political and cultural environment in which peoples or population groups develop; so they reflect certain strategic positionings defined from the context (Valdivia, 2011, p. 30).

In general, the conventional definitions of ethnic identity tend to include elements of both perspectives —the "primordialist" and the "circumstantial" or "constructivist". Thus, the concept of "ethnic group" usually refers to a community that shares a past (tradition), a culture and a form of social organization. An ethnic group also perceives itself, and is perceived by others, as a collective with common social attributes and cultural elements (language, religion, nationality or "race"). Its existence implies shared values and beliefs, and involves a common sense of identity (Valdivia, 2011, p. 32).

Ethnic origin, therefore, implies an ethnic group understood as a community that not only shares a racial identity, but also recognizes itself as such and shares customs, territory, beliefs, worldview and linguistic or dialectal and symbolic notions. Nonetheless, an ethnic group thus understood does not imply the existence of class-based, political and economic homogeneity within the group or community. The term only makes it possible to redefine collective identity. In other words, an ethnic group has social, economic and political differentiations of its own, while maintaining a strength as a cultural group, both inwardly and outwardly (Hopenhayn and Bello, 2000).

(c) Immigration

In the context of this research, immigration —meaning the phenomenon whereby people move their habitual residence from one country to another— constitutes the third component of ethnicity. This is because, by crossing political borders, migrant populations assume the characteristics of ethnic groups and are perceived as such, both by themselves and by the host society. These population groups may originate from a particular region, country or group of countries, as exemplified by the Hispanic community in the United States.

Immigration, thus defined, is a phenomenon that has been present throughout the history of humanity; has conditioned the configuration of peoples and later of states; and has given rise to wide disparities between the most and least developed countries in the world in terms of socioeconomic circumstances, opportunities and human security. However, the migrations that have taken place since the start of the twenty-first century are unprecedented. They have recently attained their largest ever volume and display characteristics that distinguish them from those of earlier periods. This has led to a new conceptualization of the phenomenon, framed in what some analysts refer to as "the new era" of international migrations (Arango, 2003, cited in Godínez-Montoya, Figueroa-Hernández and Pérez-Soto, 2014, p. 13).

This new era is set in a scenario of economic, cultural and informational globalization, which stimulates broad segments of the population to respond ever more rapidly to information and opportunities that originate beyond national borders (CONAPO, 2009, cited in Godínez-Montoya, Figueroa-Hernández and Pérez-Soto, 2014, p. 13). These factors, in conjunction with unequal distributions of economic activity, income and poverty, as well as economic or political crises, or war, facilitate migratory movements. This

occurs because people are constantly striving for economic well-being, security and a better present and future social position; and, sometimes with great sadness, they come to realize that they will find it difficult to achieve these goals in their countries of origin (Peligero Escudero, 2006).

In the case of Latin America in particular, political and economic crises generate uncertainty about the future of countries and people. Although ECLAC data (2008) show that trends in economic growth, poverty reduction and job creation have been positive in recent years, the feeling of uncertainty generated in the region does not dissipate with a few economically bountiful years. The structural problems of the Latin American economy persist, including the dependency and vulnerability of domestic economies, disparities between different regions within countries, inequality between different social classes, unequal income distribution and a lack of efficient public services (Tedesco, 2010, p. 123).

3. Measuring ethnicity in practice

At the global level, but particularly in Latin America, there is growing consensus on the need to raise the profile of the different ethnic groups living within a country's borders, in order to identify their problems and needs, give them due recognition and accord them a leading role in decisions related to their own development. In this regard, initiatives have been implemented to include ethnic/racial identification in the official statistics generated in several countries, to have information available for designing and developing social inclusion policies that take into account the social, economic, political and cultural problems of these historically excluded groups (Schkolnik and Del Popolo 2006, p. 249, cited in Valdivia, 2011, pp. 19 and 20).

In Latin America, progress has clearly been made since 1990 and especially since the turn of the century. Recent years have seen initiatives to create systems of indicators to track the social and economic situation of ethnic groups, a concept that constitutes the second component of ethnicity and is often confused with race and immigration. An example of this is the use of black, mulatto, Afro-Hispanic, white-Hispanic, Chinese and other categories in some of the region's censuses.

Although there is interest in making the general characteristics of the countries' ethnic groups visible, there are several challenges that hinder the international comparability of the data, which are related to conceptual and methodological definitions. Estimates of the indigenous and Afrodescendent population, for example, have historically been controversial, both because of the scarcity of reliable data and owing to the diversity of criteria on which the estimations have been based. In many cases, the information obtained from censuses, especially in the 1980s and 1990s, also differs by very high percentages from other estimates obtained by ethnic authorities and scholars on the subject in the same periods or between censuses (Schkolnik, 2009).

In the vast majority of Latin American countries, ethnic self-identification categories tend to be conflated with those of race or immigration in censuses, not only among the reply alternatives, but also sometimes in the wording of the question itself (Schkolnik, 2009). The potential consequences of this on the quantification of ethnic groups depend on the sociocultural and geographic context of each country. Accordingly, there are multiple biases deriving from the operational decisions adopted in the census, which may or may not have involved participation by the indigenous, Afrodescendent or other groups, themselves, during the discussion process prior to implementation of the census (Schkolnik, 2009, p. 85).

Given the importance of including ethnic statistics as a way to formulate public policies aimed at improving the living conditions and social inclusion of these populations in the countries of the world generally, and of Latin America and Colombia in particular, data collection tools need to be refined to completely separate the ethnic origin category from those of race and immigration, and to consider the three categories as essential components of a broader concept of ethnicity.

4. The ethnicity factor: a methodological proposal

Aside from the consensuses achieved, there has been growing recognition of the complexity and importance of the ethnic issue in the last three decades. Some analysts have questioned the possibility of "measuring" ethnicity through discrete and even dichotomous categories (Valdivia, 2011, p. 52). Others claim that the eminently political and contextual nature of the definitions and ethnic categories used in the censuses of each country make it unfeasible, or at least relatively so, to establish a single approach for application worldwide (Morning, 2008, p. 28, cited in Valdivia, 2011). This is because the wordings of questionnaires and census questions on ethnic origin/race depend on the political interpretations, agendas and motivations that lead the governments of each country to undertake this task (Valdivia, 2011, p. 45).

Overcoming this problem requires redefining the census or household survey questionnaires, in order to disentangle the constituent elements of ethnicity and then combine them in a comprehensive measure, which this study refers to as the "ethnicity factor" (*fet*).

To construct the ethnicity factor, a variable needs to be defined for each of its categories or components. The variables in question must be adaptable to any country, categorical and assessed on a single scale to make them comparable. This task of definition is carried out below.

(a) Definition of the variable corresponding to race

Currently, in the vast majority of countries, ethnic origin and race are linked in the same questions in the surveys. This occurs, for example, with the categories black, white, mixed race (*mestizo*) and indigenous, among others, which refer indistinctly to the colour of a person's skin and her identification with a particular ethnic group.

In calculating the ethnicity factor, it is proposed to use skin colour (*color de piel - cp*) as a variable based on the tonality (*R*) imputed by the interviewer. Although it has been scientifically proven that neither the concept nor the conception of race can be used to classify the human species, skin colour is known to have instrumental utility in discerning how opportunities are distributed in societies. Moreover, in the case of several indicators of well-being, the interviewer's external classification or imputation based on a colour palette (from lightest to darkest) has proven a better predictor of ethnic-racial inequalities than self-classification, whether ethnic or racial (Telles, 2014).

For example, the Project on Ethnicity and Race in Latin America (PERLA), which was implemented in 2010 by Professor Edward Telles of Princeton University, made an effort to gather and analyse survey data, with a view to exploring a wide range of ethno-racial issues in the region. As part of the project, a survey conducted in four countries (Brazil, Colombia, Mexico and Peru) provided much needed data to identify conditions in the region. From the survey, Telles and Steele (2012) show that, in nearly all of the region's countries, skin tone is related to educational opportunities, measured by the number of years of schooling. In other words, as the authors claim, Latin American societies are "pigmentocracies", in which skin colour (along with social class, gender and other factors) affects life opportunities.

The chromatic scale used in the PERLA survey had 11 skin tones ranging from lightest to darkest. This scale is used again in the *fet*, with *R* being given the value 0 for the lightest skin colour and 10 for the darkest. It is thus proposed to follow the style of the PERLA survey by using a question that could be common to all countries, in which the interviewer assigns a number between 0 and 10 to the respondent's skin colour. A colourimeter could also be used, since the measurement of skin pigmentation has been shown to be scientifically possible. The colourimeter returns a skin colour rating ranging from 0 to 100, where 0 is the darkest colour and 100 is the lightest.

Thus, in order to normalize the variables to values of between 0 and 1, the following equation is used to obtain the component corresponding to skin colour (*cp*)

$$cp = R/10 \quad (1)$$

(b) Definition of the variable representing ethnic origin

In recent decades, census questionnaires have tended to use self-identification questions to identify ethnic groups. Nonetheless, the wording of the questions varies widely, as do the categories that are available in the replies and the adaptation of concepts and methodologies to each national reality. This affects the results. It can be argued that the complexities of using ethno-racial categories, compounded by the different ways of measuring and approaching this dimension, largely explain why the results of the magnitudes and proportions that appear in each ethno-racial classification diverge significantly in the same contexts and times (Schkolnik, 2009).

In practice, ethnic self-identification is complemented by mother tongue and language, culture and customs, physical traits and belonging to a people, among others. Given the international consensus in this regard, it is proposed to use self-identification with an ethnic group (*autoadscripción a un grupo étnico - age*) as a variable in the calculation of the ethnicity factor. The justification for this that it is the only criterion that respects the subjective dimension of the respondents and is, therefore, the least ethnocentric criterion. Moreover, this criterion is characterized by being the most encompassing, at least theoretically, since it includes all persons who declare themselves as members of an ethnic group, irrespective of what each person means by the term (Goldberg, 2007, p.7). Based on this self-recognition of identity as one of the basic dimensions for the treatment of ethnic groups, the other questions of common origin, culture and territoriality can be explored in greater depth.

A question that would make it possible to establish this variable in the case of Colombia would be the following:

According to your culture, people or physical features, are you, or do you consider yourself, a member of any of the following ethnic groups?

(a) Indigenous

(b) Roma (or gypsy)

(c) Afrodescendent

(d) None of the above

If the reply is (a), the respondent should also be asked to which village he/she belongs, and whether he/she speaks the native language. If the reply is (b), the respondent should be asked if he/she speaks the Romani language. If the reply is (c), the respondent should be asked to which people he/she belongs (Raizal of the San Andrés Archipelago, Palenquero or Afro-Colombian), and whether he/she speaks the mother tongue.

These questions could be extended to other Latin American countries, and could also be adapted without much effort to North American, European, Asian and African countries, because ethnic groups are recognized in all of them.

The variable *age* takes dichotomous values: 1, if the person self-identifies with any ethnic group (a, b, c); or 0, if the person does not self-identify with any group (d).

(c) Definition of the variable representing immigration

As mentioned above, when people cross their national borders in large collectives, the members of these collectives recognize themselves as such and show themselves to the outside world in accordance with the cultural traits and other material and immaterial (symbolic) elements they share. This engenders a feeling of group identity, or belonging, which is fundamental for the social reproduction of the collective in question (Fernández de Labastida, undated, p. 2).

In particular, ethnicity constitutes the social process that reactivates collective identities and feelings of identification with a set of common cultural traits. Individuals who have the same ethnic identity may or may not share physical traits; but what really defines the ethnic group is the sense of belonging that all of its members feel, as well as difference or contrast with respect to other groups. This type of collective feeling proliferates in certain contexts in which various cultures and communities coexist. In this sense, economic globalization is reactivating ethnicity, since one of its most direct consequences is an intensification of migration worldwide (Fernández de Labastida, undated, p. 2).

As a result of immigration, people from different cultures coexist in the same space and form distinct social groups. The relationship between these groups is usually asymmetric: the host society or receiving community is the dominant group, whereas the immigrant collective is subordinate. This generates relationships between minorities and majorities that indicate the social position or structural importance of each group. A minority group is one that, regardless of the number of people in it, lives in a situation of inferiority and subordination relative to the majority group, which holds the power. In any event, immigration generates and reactivates ethnicity because it implies the introduction of an other (the immigrant) into a territory and a culture that identifies with the "us" (Blanco, 2000, p. 108).

To calculate the ethnicity factor, the immigration variable (*im*) is incorporated by defining the nationality of the respondent and his/her parents. This entails finding out whether the respondent head of household was not born in the country in which the questionnaire is being applied (*jfb*), whether the respondent's mother was not born in that country (*mb*) and whether the respondent's father was not born in that country either (*pb*). Each of these dichotomous variables takes the value 1 in the affirmative case and 0 otherwise. With these values, the immigration variable (*im*) is calculated as follows:

$$im = 0.5 * jfb + 0.25 * mb + 0.25 * pb \quad (2)$$

(d) Calculation of the ethnicity factor

Once the three variables that comprise the ethnicity factor have been defined, the values that they can take are shown in table 1.

Table 1
Variables that comprise the ethnicity factor and values they can take

Variable	Values
Skin colour (*cp*)	[0]: very light skin tone [0–1]: intermediate skin tones [1]: very dark skin tone
Self-identification with an ethnic group (*age*)	[0]: the head of household does not self-identify with any ethnic group in the country [1]: the head of household self-identifies with an ethnic group in the country
Immigration (*im*)	[0]: the head of the household and both parents were born in the country where the survey is applied [0.25]: the head of household was born in the country where the survey is applied, and only one of his/her parents is a foreigner 0.5]: both parents or the head of household are foreigners [0.75]: the head of household and only one of his/her parents are foreigners [0.75]: the head of household and only one of his/her parents are foreigners [1]: the head of the household and both parents are foreigners

Source: Prepared by the authors.

The equation used to calculate the ethnicity factor is as follows:

$$fet_i = \frac{\sqrt{cp_i^2 + age_i^2 + im_i^2}}{\sqrt{cp^2 + age^2 + im^2}} \rightarrow fet_i = \frac{\sqrt{cp_i^2 + age_i^2 + im_i^2}}{\sqrt{3}} \quad (3)$$

where:

fet_i = ethnicity factor of household *i*; cp_i = skin colour of the head of household *i*; age_i = self-identification with an ethnic group by the head of household *i*; im_i = immigration status of the head of household *i*, and 1 is the maximum value that each of the ethnicity variables (*cp*, *age* and *im*) can take.

The values of the ethnicity factor range from 0 to 1. The higher the value of fet, the greater the ethnicity of the household. This indicator makes it possible to establish and compare ethnicity values in different contexts —for example, identifying which household, city or country is more ethnic than another and, therefore, whether it is more exposed to certain phenomena, such as social exclusion or poverty.

III. Social exclusion

1. The concept of social exclusion

Social exclusion is a very dynamic concept that appears as a phenomenon exclusive to post-industrial or advanced societies that result from greater global, technological and economic development. Following the crisis and subsequent restructuring of the welfare state, the social contract in these countries has changed. As a result, the welfare system of the new sociopolitical era does not ensure the integration of all social classes (Raya Díez, 2006, p. 30, quoted in Hernández Pedreño, 2008).

Although this concept is new to economic science, it is not new to sociology and has the advantages and challenges that any process approach entails. Its richness lies in its multidimensional nature; but, at the same time, it leaves much room for divergences between analysts to emerge, as noted by Trouillot (2000, p. 111). In this sense, social exclusion is a concept and a phenomenon that is still under construction and reconstruction by the social sciences —proof of which is the dispersion of meanings and discourses that denote different realities for the same process (Hernández Pedreño, 2008, p. 29).

Specifically, social exclusion can be defined as a set of structural [and institutional] mechanisms that [systematically] prevent certain social groups from participating fully in the economic, social, political and cultural spheres of society (Valdivia, Benavides and Torero, 2007, p. 604). These mechanisms cause lack of access to health services, residential marginalization, inadequate engagement with the labour market, tendencies towards occupational segregation, constraints on receiving good quality education and lack of effective political representation in the State, among other problems (Figueroa, Altamirano and Sulmont, 1996; Ñopo, Saavedra and Torero, 2004; Torero and others, 2004, cited in Valdivia, Benavides and Torero, 2007). The World Bank (2013) states that individuals and groups are excluded or included based on their identity. Among the most common group identities resulting in exclusion are gender, race, caste, ethnicity, religion and disability status. "Social exclusion based on such group attributes can lead to lower social standing, often accompanied by lower outcomes in terms of income, human capital endowments, access to employment and services, and voice in both national and local decision making" (World Bank, 2013, p. 5).

"Exclusion plays out through both tangible and intangible practices and processes. Although it is most evident in differences in "tangible" outcomes, it is rooted in intangible social norms and beliefs, which in turn lead to stereotypes, prejudices and stigmas. These intangible features are socially constructed and played out by both the excluder and the excluded" (World Bank, 2013, p. 8).

Based on the characteristics described above, social exclusion can be analysed and understood as a multidimensional process that often tends to accumulate, combine and separate, both individuals and groups, from a series of social rights such as work, education, health, culture, economy and politics, to which other groups do have access and the possibility of enjoying, and which, sooner or later, end up nullifying the concept of citizenship (Jiménez Ramírez, 2008, p. 178).

Without delving into an entire historical compendium, it could be said that "initially, the concept of social exclusion was used in Europe —first in France, Italy and the Nordic countries— to refer to the new social and economic problems associated with globalization, such as: precarious employment and underemployment; the social, economic, political and cultural insertion of immigrants; and social disintegration generated by ethnic differences" (Gacitúa and Davis, 2001, p. 13). It originates largely in theoretical contributions developed in earlier times by classic figures of sociology such as Marx, Engels, Durkheim, Tönnies, Bourdieu and Parkin, with special emphasis on the dual alienation of the "social class" and the "insider-outsider" dynamic. However, the most recent [contributions] to the concept of social exclusion are generally attributed to René Lenoir (1974), in his pioneering work *Les exclus: un Française sur dix* (Jiménez Ramírez, 2008), which estimated that 1 in 10 French people could be considered excluded, and even identified the social groups in question.

The influence of the European Union in generalizing the concept of social exclusion has been highlighted by many social researchers. The term first appeared in 1989 in the Second European Poverty Programme; and the European Union was the driving force behind the debate on poverty and new forms of inequality, marginalization and social vulnerability. In the late 1980s and early 1990s, the European Commission tasked itself with establishing a social dimension to European Union policy, by promoting debate, action and research on poverty (IGOP, 2003, p. 21).

In the First European Poverty Programme (1975–1980), citizens were considered poor if their resources were so meagre that they were excluded from the levels of coexistence considered acceptable in their countries of residence; that is, poverty was measured in strictly monetary terms (distribution of income or expenditure). It is in the Second European Poverty Programme (1985–1989) where explicit reference is made to social exclusion; and although the programme also emphasizes lack of resources, it extends its content to those of a social and cultural nature, that is, to all mechanisms through which families or groups of people may feel excluded (Estivill, 2004, pp. 29–38, quoted in Hernández Pedreño, 2008). However, the term social exclusion was only established in 1991 in the European Community programme concerning the economic and social integration of the economically and socially less privileged groups in society "Poverty 3", and in the guidelines of the Observatory of National Policies to Combat Social Exclusion (IGOP, 2003, p. 22).

This shows that social exclusion is a phenomenon of modern societies that goes beyond the concepts of poverty, marginalization and inequality: according to this conception, a group of people living in poverty is always considered excluded, but not every socially excluded group is poor.

2. Alternative measurement

The concept of social exclusion can be an effective research tool for comparing the different types of social policy efficacy as the main mechanism for preventing the emergence and spread of social exclusion. The concept's implementation in the political and scientific discourses provides an opportunity for international comparisons aimed at finding common and different manifestations of exclusion in countries with alternative approaches to social policy formation. However, a prerequisite for cross-cultural comparisons is the use of equivalent tools for data collection. Making such a comparison implies the structural similarity of the phenomenon that is studied in different societies (Loktieva, 2016, pp. 148–149).

There is a general consensus in the literature that social exclusion has the following characteristics: it is multidimensional; it is dynamic; it occurs in a given time and place; it is relative (or comparative); it is structural; it is relational; and it has to do with social processes. On the basis of these characteristics, and given the importance that the phenomenon has in the approach to public policy, over the past two decades, researchers have begun to quantitatively operationalize social exclusion. Early efforts relied heavily on familiar and well-used constructs, such as personal or household income and consumption below a poverty line (Good Gingrich and Lightman, 2015). Most recent studies operationalizing social exclusion in quantifiable terms use a combination of material and social indicators, thus emphasizing its multidimensional nature. These authors propose an index of social exclusion for Canada that includes multidimensional characteristics of material deprivation and social isolation; and they confirm that social exclusion falls most heavily on the migrant population and on ethnic minorities and darker-skinned groups.

In research on Ukraine and several European countries, Loktieva (2016) follows this multidimensional approach and concludes that the structures of distributional and relational components of social exclusion are similar in countries with different levels of socioeconomic development and welfare models.

Many of the elements that Alkire and Foster (2007) use in the calculation of multidimensional poverty also apply to social exclusion, since it has the aforementioned characteristics and is also defined by the accumulation of deficits (deprivations) that are interrelated and feed back on each other. In this sense, Domínguez and Núñez (2013) have also developed a synthetic index of social exclusion using a set of quantitative and qualitative indicators obtained from the Spanish Living Conditions Survey. In the index, the authors use the social exclusion indicator they proposed in 2009, based on fuzzy sets.

This study uses the degree of social exclusion variable (*ges*) as an alternative measure, and as a variation on the multidimensional poverty index (*MPI*) used by the National Administrative Department of Statistics (DANE) of Colombia. This is based on household deprivations in 15 variables and 5 dimensions, relative to a normative threshold (*zj*) established for each variable.

The deprivation is established as follows:

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1j} \\ \vdots & \ddots & \vdots \\ x_{N1} & \cdots & x_{Nj} \end{bmatrix}; \quad \bar{X} = \begin{bmatrix} \bar{x}_{11} & \cdots & \bar{x}_{1j} \\ \vdots & \ddots & \vdots \\ \bar{x}_{N1} & \cdots & \bar{x}_{Nj} \end{bmatrix}; \quad \bar{x}_{ij} \begin{cases} 1 \text{ if } x_{ij} < z_j \\ 0 \text{ yes No} \end{cases}$$

$$Z = \begin{bmatrix} z_1 & z_2 \ldots & z_j \end{bmatrix}; \quad W = \begin{bmatrix} w_1 & w_2 \ldots w_j \end{bmatrix} \tag{4}$$

$C = (c_1, c_2, \ldots c_N)$, where c_i $(i = 1, 2, 3, \ldots N)$, but $C = \bar{X}.W$ Weighted vector of deprivations

in which:

x_{ij} = Characteristics of household i in dimension j

$\bar{x}_{ij}$ = Deprivation of household i in dimension j

z_j = Threshold in dimension j

w_j = Weight assigned to dimension j

c_i = Weighted deprivation of household i

N = Total sample households

J = Total dimensions or variables

The weight w_j $\left(\sum_{j=1}^{J} w_j = 1\right)$ can be constructed at the discretion of the national statistical authorities, as is generally the case. In some countries equal weights are assigned to the dimensions and to the variables of each dimension; but, because the number of variables in each dimension varies, the weighting of each group of variables is different. Other ways of calculating the weights include the following:

Assign equal weighting to the variables:

$$w_j = \frac{1}{J} \tag{5}$$

Assign weighting according to the relative weight of the variables:

$$w_j = \frac{f_j}{F}, \text{ where } f_j = \frac{1}{N}\sum_{i=1}^{N} \bar{x}_{ij} \text{ and } F = \sum_{j=1}^{J} f_j \tag{6}$$

In this research, the weights (w_j) will be estimated by considering the inverse functional relation that exists between the system of weights and the frequencies corresponding to household non-deprivations ($g_j = 1 - f_j$) proposed by Dagum, Gambassi and Lemmi (1992) and adjusted by Domínguez and Núñez (2013). In this case:

$$w_j = \frac{v_j}{V};\ v_j = ln\left(1/g_j\right), \text{ where } g_j = \frac{1}{N}\sum_{i=1}^{N}\left(1-\bar{x}_{ij}\right) \text{ and } V = \sum_{j=1}^{J} v_j \tag{7}$$

which gives the following equality:

$$ges_i = c_i \tag{8}$$

IV. Results

1. The database

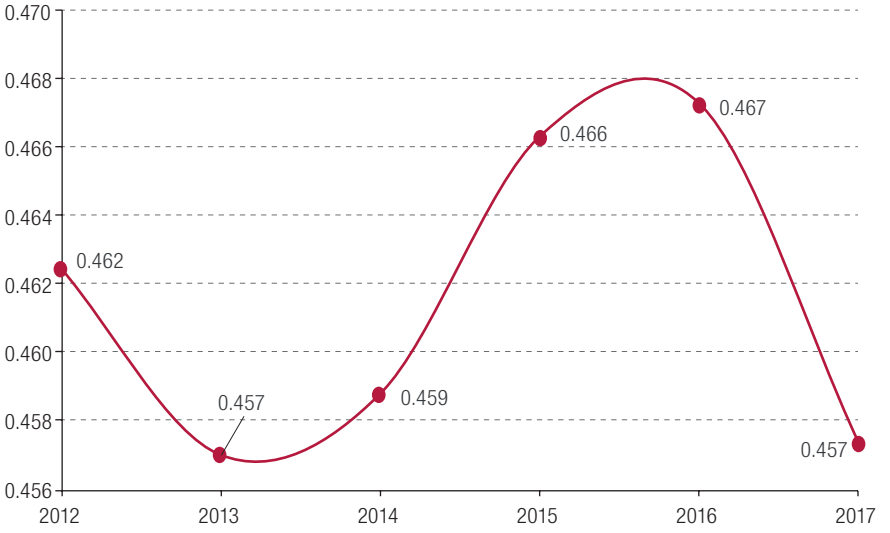
To apply the methodologies described above, data on 121,802 households were drawn from the National Quality of Life Survey (ECV) of Colombia spanning 2012–2017. The households were statistically representative, both nationally and in the urban and rural domains. The ECV is implemented by DANE for the purpose of collecting data on different aspects and dimensions of household welfare, such as access to public, private or communal goods and services, health, education and childcare for the under-fives, among others. Considering these issues then makes it possible to analyse the factors that explain the different standards of living in society.[1]

2. The ethnicity factor (*fet*) in Colombia

Applying the proposed methodology to the available data makes it possible to obtain the ethnicity factor for Colombia by combining the variables corresponding to skin colour, self-identification with an ethnic group and immigration. The results are shown in Figure 1.

[1] The information is obtained in the form of microdata from the DANE website (see [online] www.dane.gov.co).

Figure 1
Colombia: ethnicity factor, 2012–2017

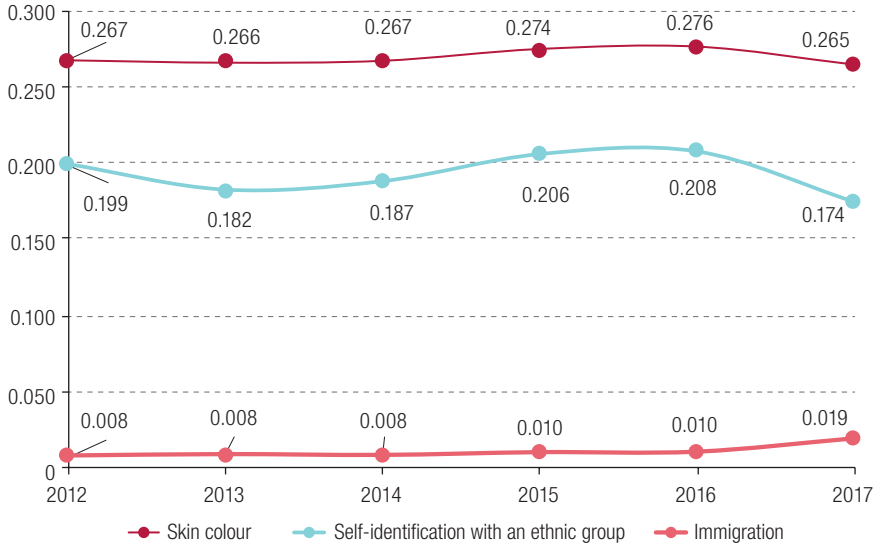


Source: Prepared by the authors.

The data show that Colombia is a highly ethnic country: in the period analysed its ethnicity factor is approximately 0.46 on a scale of 0 to 1. The values form a sine wave that exhibits a significant upturn in 2015 and 2016, owing partly to the slight economic improvement that occurred in the country in those years.

With respect to each of the variables that comprise the ethnicity factor, figure 2 shows that skin colour and self-identification with an ethnic group also exhibit a highly dissimulated sinusoidal behaviour pattern that corresponds to that of the factor as a whole. Moreover, a generalized rise can be discerned in immigration, with a pronounced spike in 2017 due mainly to the large-scale arrival of migrants from the Bolivarian Republic of Venezuela.

Figure 2
Colombia: components of ethnicity, 2012–2017



Source: Prepared by the authors.

Table 2 displays the components of ethnicity in Colombia in greater detail.

Table 2
Colombia: ethnicity factor, by group of interest, 2012–2017

Variable	Criteria	2012	2013	2014	2015	2016	2017	Total
Skin colour *(cp)*	<= 0.45	0.418	0.407	0.407	0.409	0.409	0.406	0.410
	> 0.45	0.773	0.772	0.772	0.772	0.772	0.773	0.772
Self-identification with an ethnic group *(age)*	No	0.389	0.389	0.389	0.389	0.389	0.392	0.389
	Yes	0.760	0.764	0.763	0.764	0.765	0.767	0.764
	Roma	0.577	0.612	0.577	0.625	0.577	0.577	0.589
	Afrodescendants	0.773	0.772	0.772	0.772	0.772	0.773	0.772
	Indigenous	0.739	0.739	0.738	0.739	0.739	0.740	0.739
Immigration *(im)*	No	0.460	0.455	0.457	0.464	0.464	0.452	0.459
	Yes	0.730	0.729	0.745	0.747	0.739	0.724	0.735
Gender	Male	0.462	0.456	0.459	0.463	0.464	0.455	0.460
	Female	0.464	0.459	0.459	0.473	0.474	0.461	0.465
Zone	Rural	0.468	0.462	0.464	0.458	0.462	0.459	0.462
	Urbana	0.459	0.454	0.455	0.471	0.471	0.457	0.462
Difference	Ethnic	0.371	0.375	0.375	0.375	0.375	0.374	0.374
	Gender	0.002	0.003	0.000	0.010	0.010	0.006	0.005
	By zone	0.009	0.008	0.009	-0.013	-0.009	0.002	0.0005

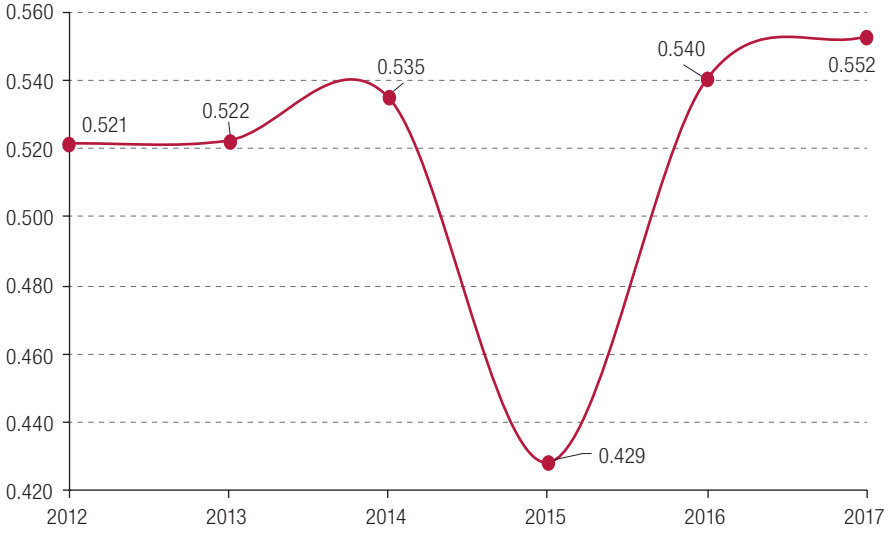
Source: Prepared by the authors.

As theory suggests, the data show that ethnicity is higher in the case of darker skin tones ($cp > 0.45$), those who self-identify with some ethnic group, immigrants and rural households. Among ethnic groups, Afrodescendants have the highest ethnicity factor, followed by indigenous and roma people, in that order. In contrast, mixed-race people (*mestizos*), or those who do not self-identify with any ethnic group, have the lowest ethnicity.

3. The degree of social exclusion (*ges*) in Colombia

According to the proposed methodology, Colombia's social exclusion indicator attains an average value of 55% in terms of household deprivation. The indicator dropped sharply in 2015, when there was a general improvement in the country's living conditions; but it rose again thereafter (see figure 3).

Figure 3
Colombia: degree of social exclusion, 2012–2017



Source: Prepared by the authors.

Table 3 displays the trend of the indicator during the period of analysis for selected groups of interest. It shows that social exclusion is higher in the population with darker skin ($cp > 0.45$), ethnic groups, men and the rural population.

Table 3
Colombia: social exclusion, by group of interest, 2012–2017

Variable	Criteria	2012	2013	2014	2015	2016	2017	Total
Skin colour *(cp)*	<= 0.45	0.519	0.521	0.533	0.428	0.539	0.549	0.512
	> 0.45	0.537	0.530	0.548	0.431	0.544	0.573	0.521
Self-identification with an ethnic group *(age)*	No	0.514	0.517	0.529	0.422	0.535	0.548	0.508
	Yes	0.551	0.545	0.559	0.453	0.558	0.576	0.536
	Roma	0.476	0.480	0.464	0.497	0.462	0.545	0.479
	Afrodescendants	0.537	0.530	0.548	0.431	0.544	0.573	0.521
	Indigenous	0.577	0.594	0.594	0.526	0.608	0.587	0.579
Immigration *(im)*	No	0.522	0.523	0.536	0.429	0.540	0.553	0.514
	Yes	0.419	0.467	0.475	0.371	0.510	0.535	0.466
Gender	Male	0.526	0.527	0.540	0.431	0.544	0.549	0.516
	Female	0.513	0.514	0.527	0.424	0.534	0.557	0.508
Zone	Rural	0.590	0.589	0.602	0.529	0.601	0.592	0.583
	Urbana	0.478	0.481	0.491	0.368	0.503	0.532	0.471
Difference	Ethnic	0.037	0.028	0.030	0.031	0.023	0.028	0.028
	Gender	0.013	0.013	0.013	0.008	0.010	-0.007	0.009
	By zone	0.112	0.108	0.111	0.161	0.098	0.060	0.112

Source: Prepared by the authors.

In general, the social exclusion indicator in Colombia displays a slightly rising trend. There is also a gradual deterioration of living conditions in Colombian households, which is more pronounced in rural areas and in households where ethnicity is greater, either owing to skin colour or through membership of ethnic groups.

4. The relationship between the ethnicity factor and the degree of social exclusion in Colombia in 2012–2017

In Colombia, the most intense social exclusion processes definitely occur among the groups or social sectors whose ethnicity factor is higher. This does not mean that there are no other drivers of exclusion in the countries, such as gender, age or religion. What it does seem to mean is that ethnic, racial and nationality differences are among the most prominent factors of social exclusion.

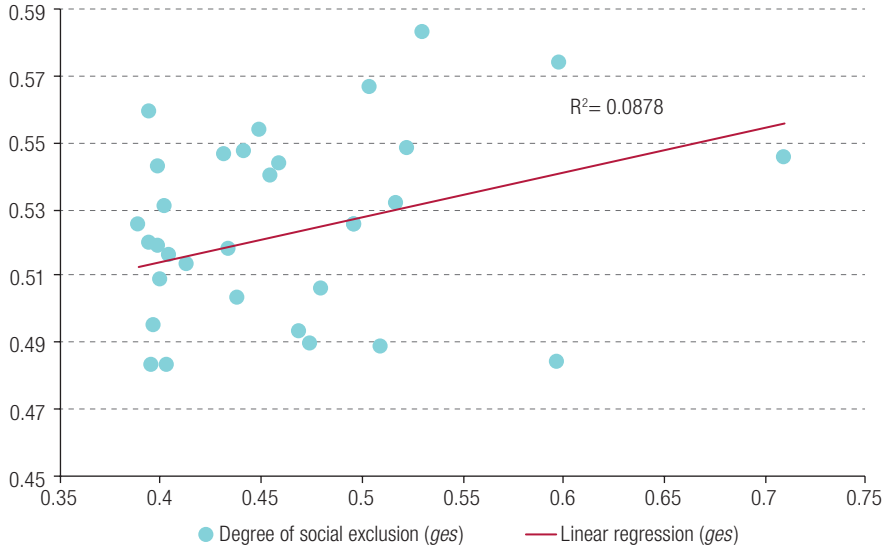
The results of this study reveal a direct and significant relation between the ethnicity factor (*fet*) and the degree of social exclusion (*ges*). This relation is obtained from the simple ordinary least squares (OLS) regression shown below:

$$ges_i = \beta_0 + \beta_1 fet_i + \mu_i \quad (9)$$

where β_0 represents the coefficient of the intercept, β_1 is the extent to which a variation in ethnicity affects the degree of social exclusion, and μ_i is the error term.

The results of the regression are shown in Figure 4.

Figure 4
Colombia: relation between the degree of social exclusion and the ethnicity factor, 2012–2017



Source: Prepared by the authors.
Note: The relation between the degree of social exclusion (vertical scale) and the ethnicity factor (horizontal scale) was estimated from a simple OLS regression.

This relation is analysed in greater detail through a multiple regression of social exclusion and the ethnicity factor, while controlling for the characteristics of heads of household. This makes it possible to determine whether an increase in ethnicity, either as a whole or in any of its components, increases the degree of social exclusion in the households under study. The information obtained from the ECV is organized into cohorts corresponding to the years 2012–2017, and the following model is established:

$$Y_i = \beta_0 + \beta_1 X_i + \beta_2 Z_i + \beta_3 T_j + V_i \quad (10)$$

where Y_i is the variable that measures social exclusion (*ges*), X_i is the variable that captures ethnicity (*fet*) or each of its components (*cp*, *age*, *im*), Z_i is a vector of control variables, T_j is a set of dichotomous variables for each of the years analysed and V_i represents the error in the model.

This equation is estimated by OLS to obtain the degree of social exclusion in relation to the ethnicity factor and to each of its component variables. The control variables refer to the personal and sociodemographic data of the heads of household (education, gender, income and area of residence). Dichotomous variables are used to represent the years, since they reflect changes in social exclusion conditional on ethnicity, while holding the passage of time and the other control variables constant.

The results show that the direct relation between ethnicity and social exclusion in Colombia remains significant at a 95% confidence level: when ethnicity increases by 1 percentage point, social exclusion rises by 7 points (see table 4).

Table 4
Colombia: linear regression model of the degree of social exclusion, 2012–2017

Variables	Degree of social exclusion			
	(1)	(2)	(3)	(4)
Ethnicity factor	0.0711***			
	(0.00212)			
Education	-0.0188***	-0.0188***	-0.0187***	-0.0187***
	(7.85e-05)	(7.85e-05)	(7.85e-05)	(7.89e-05)
Per capita income	-7.80e-09***	-7.80e-09***	-7.73e-09***	-8.07e-09***
	(2.51e-10)	(2.51e-10)	(2.51e-10)	(2.52e-10)
Male	0.000789	0.000882	0.000829	0.000358
	(0.000673)	(0.000674)	(0.000673)	(0.000676)
Rural	0.0477***	0.0481***	0.0475***	0.0479***
	(0.000712)	(0.000712)	(0.000712)	(0.000715)
2012	-0.0569***	-0.0567***	-0.0572***	-0.0564***
	(0.00124)	(0.00125)	(0.00124)	(0.00125)
2013	-0.0525***	-0.0526***	-0.0527***	-0.0523***
	(0.00124)	(0.00124)	(0.00124)	(0.00125)
2014	-0.0416***	-0.0417***	-0.0418***	-0.0413***
	(0.00126)	(0.00126)	(0.00126)	(0.00126)
2015	-0.142***	-0.142***	-0.142***	-0.141***
	(0.00122)	(0.00123)	(0.00122)	(0.00123)
2016	-0.0273***	-0.0273***	-0.0274***	-0.0264***
	(0.00122)	(0.00122)	(0.00122)	(0.00123)
Skin colour *(cp)*		0.0640***		
		(0.00215)		
Self-identification with an ethnic group *(age)*			0.0269***	
			(0.000809)	
Immigration *(im)*				0.0199***
				(0.00326)
Constant *(bo)*	0.676***	0.692***	0.704***	0.709***
	(0.00162)	(0.00142)	(0.00131)	(0.00131)
No. of observations	121 419	121 419	121 419	121 419
R^2	48.5%	48.4%	48.5%	48.0%

Source: Prepared by the authors.
Note: Estimated by ordinary least squares (OLS). Standard errors are indicated in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

This regression shows that the direct relationship between social exclusion and ethnicity is maintained when considering each of the components of ethnicity: having a darker skin tone, self-identifying with an ethnic group, or belonging to the immigrant category all increase the degree of social exclusion in Colombia. The model also confirms that having a higher level of education or income counteracts the possibility of being subject to social exclusion, or else makes it easier to escape from that situation. Other control variables, such as residing in rural areas of the country, increase the social exclusion of individuals. Gender, in contrast, does not have a significant impact on the level of social exclusion.

Analysis of the regression in each year of the period under study shows that the results are consistent and that there is a margin of variation of 6-9.4 percentage points for each point of variation in ethnicity. The ethnicity components also display smaller margins each year relative to the overall period; and the coefficient of determination (R^2) remains around 48% (see table 5).

Table 5
Colombia: regression of the degree of social exclusion by year, 2012–2017

Variables	Degree of social exclusion					
	2012	2013	2014	2015	2016	2017
Ethnicity factor	0.0776***	0.0685***	0.0668***	0.0942***	0.0596***	0.0595***
	(0.00443)	(0.00443)	(0.00446)	(0.00686)	(0.00387)	(0.00506)
R^2	48.7%	48.0%	50.22%	45.5%	47.2%	43.2%
Skin colour	0.0769***	0.0611***	0.0641***	0.0771***	0.0547***	0.0533***
	(0.00459)	(0.00445)	(0.00453)	(0.00697)	(0.00390)	(0.00509)
R^2	48.6%	47.9%	50.1%	45.4%	47.1%	43.1%
Ethnic group	0.0300***	0.0263***	0.0255***	0.0350***	0.0224***	0.0213***
	(0.00167)	(0.00169)	(0.00170)	(0.00262)	(0.00148)	(0.00197)
R^2	48.7%	48.0%	50.2%	45.5%	47.2%	43.1%
Immigration	-0.0107	0.0140*	0.0146*	0.0481***	0.0161***	0.0255***
	(0.00779)	(0.00717)	(0.00752)	(0.0108)	(0.00603)	(0.00553)
R^2	47.9%	47.4%	49.6%	45.1%	46.6%	42.7%
No. of observations	21 171	21 329	20 004	22 829	23 091	12 995

Source: Prepared by the authors.
Note: Estimated by ordinary least squares (OLS). Standard errors are indicated in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.

Furthermore, by establishing a Mincer equation that includes individual ethnicity, it can be shown that when ethnicity rises, the expected level of income falls, contrary to what happens with years of education (see table 6).

Table 6
Colombia: Mincer equation with respect to ethnicity, 2012–2016

Variables	Natural logarithm of per capita income			
	(1)	(2)	(3)	(4)
Fet	-0.355***			
	(0.0211)			
Education	0.122***	0.122***	0.122***	0.122***
	(0.000910)	(0.000910)	(0.000910)	(0.000912)
Exper Pot (potential experience)	0.0246***	0.0247***	0.0246***	0.0249***
	(0.000672)	(0.000672)	(0.000672)	(0.000673)
Exper Pot^2	-0.000155***	-0.000155***	-0.000155***	-0.000155***
	(8.44e-06)	(8.44e-06)	(8.44e-06)	(8.45e-06)
Male	0.251***	0.250***	0.250***	0.253***
	(0.00673)	(0.00673)	(0.00672)	(0.00673)
Urban	0.313***	0.315***	0.312***	0.313***
	(0.00711)	(0.00711)	(0.00710)	(0.00711)
2012	-0.398***	-0.399***	-0.396***	-0.399***
	(0.0124)	(0.0124)	(0.0124)	(0.0125)
2013	-0.330***	-0.329***	-0.329***	-0.329***
	(0.0124)	(0.0124)	(0.0124)	(0.0124)
2014	-0.279***	-0.278***	-0.277***	-0.278***
	(0.0125)	(0.0125)	(0.0125)	(0.0126)
2015	-0.0863***	-0.0867***	-0.0850***	-0.0888***
	(0.0122)	(0.0122)	(0.0122)	(0.0122)
2016	-0.0604***	-0.0608***	-0.0591***	-0.0633***
	(0.0122)	(0.0122)	(0.0122)	(0.0122)

Table 6 (concluded)

Variables	Natural logarithm of per capita income			
	(1)	(2)	(3)	(4)
Skin colour *(cp)*		-0.286***		
		(0.0214)		
Self-identification with an ethnic group *(age)*			-0.148***	
			(0.00806)	
Immigration *(im)*				0.0967***
				(0.0326)
Constant *(bo)*	11.12***	11.03***	10.99***	10.95***
	(0.0220)	(0.0204)	(0.0195)	(0.0194)
No. of observations	120 295	120 295	120 295	120 295
R^2	21.4%	21.3%	21.4%	21.2%

Source: Prepared by the authors.
Note: Estimated by ordinary least squares (OLS). Standard errors are indicated in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.

Here again, it can be seen that each of the components of ethnicity is related in the same direction to a person's income: an increase in any of these elements reduces expected income. However, some control variables, such as being male or residing in urban areas of the country, counteract this trend.

V. Conclusions

Ethnicity is a socially constructed category that has strong economic implications; it also encompasses other categories that can be used to differentiate between population groups in a given context and time. Race, ethnic origin and immigration are essential components of ethnicity; and they jointly represent the major elements of discrimination and social exclusion inspired by a supposed superiority and legitimacy of some over "others".

Nonetheless, aside from the consensus that may have been reached on this issue, the last three decades have seen increasing recognition of its complexity and importance. Hence interest has arisen in aligning ethnicity to official statistics. However, the definitions of ethnicity and race used in current surveys and census questions depend on the political interpretations, agendas and motivations that lead the governments of each country to undertake this task. Thus, there are multiple biases arising from the operational decisions that are made, with the result that official statistics on ethnic groups are highly unreliable; and, most importantly, it is virtually impossible to make comparisons between countries.

As a strategy to overcome this problem, census questionnaires or household surveys need to be redefined in order to separate the elements that make up ethnicity and then recombine in a comprehensive measure, which is here called the ethnicity factor (*fet*).

Social exclusion, meanwhile, is a concept and a phenomenon that the social sciences are still constructing and reconstructing, owing to the dispersion of meanings and discourses that denote different realities for the same process. Nonetheless, social exclusion could be defined as a set of structural [and institutional] mechanisms that [systematically] prevent certain social groups from participating fully in the economic, social, political and cultural spheres of society (Valdivia, Benavides and Torero, 2007, p. 604).

As social exclusion is a multidimensional, multicausal, structural and dynamic phenomenon that is also defined by the accumulation of deficits (deprivations) that are interrelated and feed back on each other, the concept encompasses many of the elements that Alkire and Foster (2007) use to calculate multidimensional poverty. This study therefore proposes the degree of social exclusion (*ges*) as an alternative measure and as a variation on the multidimensional poverty index (*MPI*) used by DANE in Colombia, based on household deprivations in 15 variables and five dimensions, according to a normative threshold (*zj*) established for each variable.

The data show that Colombia is a highly ethnic country, since the ethnicity factor is approximately 0.46 on a scale of 0 to 1 in the period analysed. The data also reveal that, as theory suggests, ethnicity is greater in the case of darker skin tones (*cp* > 0.45), those who self-identify with an ethnic group, and among immigrants and rural households. Moreover, the country's social exclusion indicator attains an average value of 55% in terms of household deprivation. The indicator dropped sharply in 2015, when there was a general improvement in the country's living conditions, but rose again in subsequent years. It also disproportionately affects rural areas and households where ethnicity is higher, either owing to skin colour or through belonging to ethnic groups.

In Colombia, the most intense social exclusion processes are clearly experienced in the groups or social sectors that have higher ethnicity factors. This does not mean that there are no other drivers of exclusion in the countries, such as gender, age or religion. What it does seem to mean is that ethnic, racial and nationality differences are among the most prominent factors of social exclusion. The results reveal a direct and significant relation between the ethnicity factor (*fet*) and the degree of social exclusion (*ges*) in the country: when the former increases by 1 percentage point, the latter rises by 7 points at a 95% confidence level. Similarly, having a darker skin tone, self-identifying with an ethnic group, being an immigrant and living in rural areas all increase the degree of exclusion. In contrast, having a higher level of education or higher per capita income counteracts this effect. Lastly, the gender of the head of household does not significantly affect the level of social exclusion.

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The incidence of poverty in Costa Rica between 1987 and 2017: stagnation or reduction?[1]

Andrés Fernández Aráuz and Ronulfo Jiménez Rodríguez

Abstract

According to official data (based on the income poverty line), 20% of households in Costa Rica were poor in 1994, a figure that has apparently not changed substantially since. The poverty level is currently considered to have stagnated at around 20% for more than two decades. However, the way poverty is measured has undergone methodological changes that preclude a strict comparison of the data over time. This study offers a method for dealing with the methodological difficulties and obtaining a set of comparable poverty data for the period from 1987 to 2017. It thereby demonstrates that the level of poverty in Costa Rica changed little between 1994 and 2006, but declined from the latter year onward.

Keywords

Poverty, income, households, household surveys, poverty mitigation, measurement, statistical methodology, Costa Rica

JEL classification

C13, C18, I3, P4

Authors

Andrés Fernández Aráuz holds a degree in Economics and a master's degree in Statistics from the University of Costa Rica. Email: affa17@gmail.com.

Ronulfo Jiménez Rodríguez holds a degree in Economics from the University of Costa Rica. Email: ronujimenez@gmail.com.

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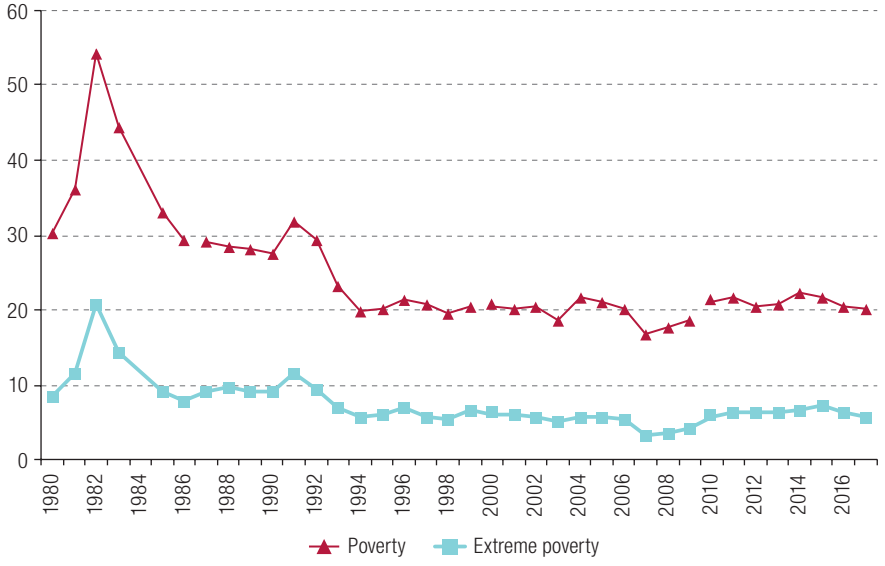
I. Introduction

Although various methods have been used to measure poverty in Costa Rica, the official measure, published annually by the National Institute of Statistics and Censuses (INEC), employs the income poverty line method.[2]

The income measurement carried out by INEC to estimate poverty levels was based on the Multipurpose Household Survey (EHPM) from 1976 to 2009 and has relied on the National Household Survey (ENAHO) since 2010.

According to official data, after the economic crisis that affected Costa Rica in the early 1980s, poverty fell to 20% of households in 1994, and apparently has not moved substantially away from that level since. The poverty level is currently considered to have stagnated at around 20% for more than two decades (see figure 1).

Figure 1
Costa Rica: official figures for poverty and extreme poverty, 1980–2017
(Percentages)



Source: P. Sauma and J. Trejos, "Evolución de la pobreza en Costa Rica: una revisión de las estimaciones 1980–1998", *La pobreza en Costa Rica*, Economic Science Research Institute (IICE), 2010, for the period from 1980 to 1986; National Institute of Statistics and Censuses (INEC), Multipurpose Household Survey (EHPM), for the period 1987–2009; and National Household Survey for the period 2010–2017.

However, the official method of measuring poverty in Costa Rica has four major limitations from the point of view of data comparability, three relating to the measurement of income and one to the measurement of the value of the poverty line, which hinder study of the long-term evolution of poverty.

Often these limitations are overlooked and the evolution of poverty over the last 30 years is discussed as though there were a comparable time series. In recent years, in fact, it has frequently been asserted that poverty reduction has stagnated, with claims such as the following:

> The estimates yielded by the income poverty line approach indicate that, on average, one fifth of Costa Rican households are poor. Since 1994 there has been a period of

[2] A version of the Multidimensional Poverty Index has recently been incorporated into the official measure. See INEC (2015a, 2015b and 2018) and Fernández and Del Valle (2017 and 2016).

> stagnation in which, with some variations in particular years (such as 2003 and 2007), the indicator has stood at 20%. In 2016, a rate of 20.5% was recorded (PEN, 2017, p. 42).
>
> In Costa Rica, the proportion of households living in poverty as calculated by the poverty line method has stood still at around 20% since the last decade [referring to the period 2005–2015] (INEC, 2015b, p. 9).
>
> The proportion of families living below the poverty line fell to 20% in the early 1990s, but since then has held fairly steady with some ups and downs. In 2013, the poverty rate was 20.7% (Hidalgo, 2014).

These claims are based on the official poverty measurements.

The aim of this paper is to overcome these limitations by reconstructing the per capita household income series so that the different years can be compared and by reconstructing the value of the basic food basket and poverty line. The results of this exercise are revealing. When measurement is carried out with a comparable methodology for the whole period, the claim that the poverty rate stagnated between 1994 and 2017 proves to be incorrect. According to the findings of this study, two subperiods can be distinguished. In the first, from 1994 to 2006, the poverty rate, defined as the percentage of poor households relative to the total number of households in the country, remained stagnant. In the second, from 2006 to 2017, not only did the incidence of poverty fall, but extreme poverty and the proportion of vulnerable households also declined.

The present article is divided into six sections, including this introduction. The second section explains all aspects of the measurement and processing of income data in the context of the household surveys conducted by INEC in Costa Rica. The third section describes the creation and composition of the basic food basket and the poverty line used in the country. The fourth section explains the methodology applied to create eight poverty series that are comparable over time. The fifth section presents the results and the sixth and last section the conclusions.

II. The measurement and processing of income data using household surveys

The poverty line method requires the measurement of household income and the establishment of a threshold or line to distinguish poor households from non-poor households. In Costa Rica, INEC is responsible for conducting a household survey and for processing and publishing the statistical data collected.

Since 1976, INEC has conducted a household survey each July to obtain a variety of statistics on the population and households. It is the main source of information on the incidence of poverty and on housing conditions and services, among other topics (INEC, 2010a and 2010b). Over time, INEC has made alterations to the sample, the definitions of concepts and the methods used to measure the different variables, with a view to improving the way in which economic and social phenomena and changes in these are measured and captured. While this is positive, methodological changes can make it difficult to compare data over long periods of time.

A new cycle of the household survey programme began in 2010. It is called the National Household Survey (ENAHO) to mark the change from the Multipurpose Household Survey (EHPM) conducted until 2009. The ENAHO continues to be a multipurpose survey in which basic research topics predominate, including sociodemographic and housing characteristics, activity status, the employment characteristics of those in work, income from earnings and other sources, and poverty. However, there are important differences between the two surveys in the way income information is collected and processed, and these are detailed below.

1. Definition of income

In general, income is very complex to measure. While some components are easy to quantify (monetary wages), others are more difficult (self-employment income). In addition, some income is received regularly and some sporadically, some in cash and some in kind.

Between 1976 and 1979, only wages were asked about in Costa Rica's EHPM. Subsequently, in the period 1980–1986, primary income, i.e., wages and income from business activities, was measured (Sauma and Trejos, 2010). Household surveys were modified again in 1987, when a larger sample than the one used until then was incorporated and the questionnaire (information-gathering instrument) was modified to adapt it to new definitions and changes in the information-gathering strategy. In the specific case of income, the definition and method of calculating primary income were modified in 1987, and transfers received by families began to be estimated. In 1991, capital income began to be measured as well.

Given the difficulty of establishing a common definition from 1976 onward, the poverty analysis in this study starts from 1987. The set of questions on income in the EHPM remained the same for 23 years (from 1987 to 2009). The ENAHO (2010–2017) differs from the EHPM in its broader coverage of wage income, its differentiation of self-employment income by sector of activity, and its closer specification of categories of income from property rents and regular transfers (INEC, 2010b).

Clearly, the way income data are collected differs greatly between the two surveys, so the analysis of total income (i.e., the sum total of all types of income) must be undertaken with extreme care, since many types of income captured in the new ENAHO did not appear in the old EHPM, and some data apparently collected in both surveys were not actually obtained via explicit questions in the EHPM, but were considered implicit in the answers provided by households.

The data for the 1987–2009 household income series are quite comparable in relative terms, because although there were several changes in the sampling frame, weights and stratification, these only affect the estimates of area or regional totals, while the estimates of relative figures (such as percentages) at the national level are perfectly comparable across years. Thus, the challenge is to bring the measurement of income in the new ENAHO into line with the old EHPM.

Currently, total household income as measured in the ENAHO comprises five major income sources, each of which is divided into different subcomponents. Of the 47 categories into which the income data currently collected can be broken down, only 19 were also included in the old EHPM, and even then not all of them were analysed in the same way. Thus, it is possible to calculate household income from 2010 to 2017, but excluding those categories that were not directly dealt with in the EHPM. Doing this will obviously result in a reduction of total household income owing to the exclusion of the new income categories included in the ENAHO.

In general terms, 88% of the total income captured by the new ENAHO is maintained at the national level, i.e., 12% of the income currently captured has to be left out in order for an income series that is comparable between periods to be obtained. However, the situation varies according to the initial income situation of each household. In the case of households in the tenth income decile, for example, only 85% of total income remains, while in that of households in the first income decile the figure rises to 95%, which means that the effect is smaller for households with lower incomes (because their income sources are less diversified). The incomes of the poorest deciles, then, change by less. Leaving these incomes out of consideration in the calculation of total household income will necessarily affect the poverty levels estimated for each year.

2. Imputation of missing income

The official poverty estimates derived from the EHPM (1987–2009) and the ENAHO (2010–2017) are not comparable because of the way missing or unreported income is treated.

Household surveys are administered to a representative sample of dwellings (and households) in the country. It may happen that the interviewer is unable to administer the questionnaire to a particular household because the respondent cannot be located or declines to take part. In this case, the household has to be replaced by another from which the information is forthcoming. It may also happen that the respondent agrees to the interview but is unable or unwilling to provide information on the incomes of some or all of those in receipt of them in the household. In cases where there are recipients with unknown incomes, the household is classified in the "income unknown" category.

When this happened in the EHPM framework between 1987 and 2009 and no actual measured income was available, INEC calculated poverty levels by excluding these households, i.e., the poverty line method was applied only to households with known incomes. The practice of excluding households with unknown incomes limits or precludes inferences regarding the total population, unless it can be assumed (implausibly) that the distribution of the missing data is completely random.

In the case of the new ENAHO (2010–2017), households with unknown incomes are incorporated by means of an imputation method whereby an income level is assigned to these households (conditional means). In the ENAHO, the proportion of households in which at least one income-receiving household member does not declare his or her income is around 6%. If the methodology used from 1987 to 2009 to estimate poverty were to be applied in this survey, but excluding households with unknown incomes, poverty levels would be higher than those officially estimated in all years. Moreover, the larger the percentage of households with missing income values, the greater the difference will be between the official poverty estimate and the unofficial estimate (which excludes these households).

This is because less than a tenth of all households to which at least one type of income is imputed are ultimately classified as poor, so that the greater the number of households that income has to be imputed to, the fewer poor and the more non-poor households will be proportionately obtained. This last idea must be interpreted with great care. The fact that most of the households to which income is imputed in the INEC databases are classified as non-poor implies that, in general, it is members of better-off households who do not report some of their income (since the imputation method estimates the level of income for persons with similar characteristics in respect of sex, education level and occupation). If this assumption were to hold for the period 1987–2009, it could be concluded that the official poverty estimates for those years were overestimates. In other words, if income were imputed to households where there are missing values (instead of these being excluded), the poverty level would be lower throughout the series. While a mean 20% of households were excluded from the poverty estimates in the 1987–1993 series, this proportion fell to 13% in the period 1994–2004 and to 7% in the period 2005–2009.

This means that the difference between the poverty rate estimated with the official methodology and that based on the imputation of unknown income is not constant over the period 1987–2017. The poverty rate estimates with imputation of unknown income would decrease the most relative to the official estimate in the period 1987–1993, while the 2005–2009 series would show the least change relative to the official series.

When these estimates were made, evidence was found to support the above contentions: the difference between the official poverty levels and the imputed figures is -15% for the period 1987–1993, -9.4% for the period 1994–2004 and -4.8% for the period 2005–2009. Accordingly, in order to methodologically standardize the estimation of household incomes with regard to unknown incomes for the whole period 1987–2010, the conditional mean imputation method used in the period 2010–2017 will be applied to the EHPM for the years 1987–2009, as explained in the methodology section.

3. Underdeclaration of income

While it is possible for households to provide income information for all recipients, in some cases respondents tend to underreport the amount of income received, i.e., for various reasons they declare incomes lower than those actually received by the household. For this reason, when income information from a survey is used, the dilemma arises as to whether to use the income amounts reported, even if they are suspected to be lower than the amounts actually received, or to adjust them to reduce or eliminate the underreporting effect.

In both the EPHM (1987–2009) and the ENAHO (2010–2017), INEC has favoured the second option, adjusting reported income by multiplying it by a coefficient. However, the adjustment criterion has been different in the two periods. In the EHPM (1987–2009), INEC adjusted the per capita income of urban and rural households differently, with reported income being multiplied by a coefficient of 1.174 for urban households and 1.358 for rural households (INEC, 2002). In other words, the per capita income of each household was increased by between 17% and 35% to arrive at the final calculation of the poverty level in the population (INEC, 2004). In the ENAHO (2010–2017), the coefficients are obtained by comparing the estimated incomes with the Central Bank's System of National Accounts by income source. In particular, the following types of income are adjusted (INEC, 2018): (i) agricultural wage income (coefficient of 1.59); (ii) non-agricultural wage income (1.30); (iii) agricultural self-employment income (1.60); (iv) non-agricultural self-employment income (1.30); (v) property rental income (2.08). All other forms of income (not mentioned) are unadjusted.

Not only are the values of the coefficients different, but so is their application by geographical area and income type: whereas before 2010 per capita income was adjusted by a single coefficient according to the type of household, so that the same coefficient was applied to all types of income, since that year the adjustment has no longer been applied to per capita income but to each type of income separately, and not to all types of income. A priori, it is not possible to know which of the two methodologies produces the largest income adjustment, since although the new coefficients applied in the ENAHO are higher than those used previously, they are only applied to some types of income (for example, transfers are not adjusted), while in the EHPM the coefficient was implicitly applied to all types of income (via per capita income).

In conclusion, adjustments for underreporting make it impossible to compare measurements of income and the incidence of poverty between the two periods. For this reason, two income series are used alternatively in the present study. One of them is adjusted for the entire period 1987–2017 using the income underreporting criterion applied in the period 1987–2009. Since it is not possible to adjust incomes for the whole period using the criterion applied between 2010 and 2017, as the way the information is disaggregated in the databases for the period 1987–2009 does not allow it, the other series is not adjusted in any way for underdeclaration, i.e., it includes incomes as declared by informants.

III. Poverty lines

As mentioned above, measuring poverty using the poverty line method requires household income to be compared with a minimum threshold or line so that households can be classified as poor or non-poor.

This section analyses the criteria applied by INEC in the official methodology to measure the basic food basket and the poverty line in the period 1987–2017 and proposes a way to achieve a uniform measurement of these concepts and allow comparison to be carried out in the period.

1. The poverty line and the basic food basket

The basic concept of the poverty line is one of the oldest in applied economics, having been known since at least the eighteenth century (Ravallion, 2016). Even before the establishment of poverty measures for descriptive purposes, attempts had already been made to establish a minimum level of income above which people were not to be considered poor for policy purposes.

The conception of poverty applied has ranged from concepts of welfare or utility to the measurement of gross domestic product (GDP) as a proxy. However, the availability of robust poverty measures using different criteria dates back only a few decades. While this has led to the development of several very different ways of measuring poverty in the literature, the present study focuses on the most widely used global measure, based on household income and known as the poverty line method.

The poverty line is defined in economics as the cost of obtaining a given level of economic well-being or standard of living in a given place and period (Ravallion, 2016). This definition depends on the cost-of-living index (or basic food basket) used to determine the level of well-being or standard of living taken as the benchmark.

The key idea of poverty lines is that the benchmark represents the minimum level of economic well-being necessary to not be considered poor. In Costa Rica, the official method involves the calculation of a poverty line that represents the minimum amount of income required for a household to have sufficient resources to meet the basic needs of its members (INEC, 2004).

For the period 1987–2017, two basic food baskets and, consequently, two poverty lines were used. The first, called the CBA-1995, was used for the period between 1987 and 2009, and the second, the CBA-2011, for the period between 2010 and 2017. Although the methodology of the two poverty lines is broadly similar, some details imply differences in their construction. For example, while the CBA-1995 was constructed in 1995 on the basis of the 1988 household expenditure structure, the CBA-2011 was constructed in 2011 on the basis of the 2004 household expenditure and consumption structure. Moreover, the CBA-2011 includes a larger quantity of food than the CBA-1995, although paradoxically it provides for a lower minimum calorie requirement (2,184 as against 2,230 in urban areas).

INEC began calculating the value of the CBA-2011 in 2004, as its construction was based on that year's National Household Income and Expenditure Survey (ENIGH). This made it possible to compare the basic food basket and the poverty line established with the two methodologies for the years 2004–2009. It is observed that the values of the basic food basket and the poverty line based on the 2011 methodology are higher than with the 1995 methodology. In other words, the methodological change entails more demanding thresholds for determining which households are poor and which are not. On average, in the period 2004–2009, the CBA-2011 cost 13% more than the CBA-1995 in urban areas and 7% more in rural areas. These changes are reflected to a greater degree in the value of the poverty line, because the 2011 methodology involved the application of higher coefficients to get from the basic food basket to the poverty line.[3] The poverty line was 37% higher in urban areas and 25% higher in rural areas with the 2011 methodology than with the 1995 methodology.

It is important to recall that INEC needed to make the methodological change to update the definition of poverty thresholds. As was to be expected, given the improvement in general living conditions in the country, monetary values for the basic food basket and the poverty line were higher under the new methodology than the previous one. While the official INEC estimate of the poverty rate for the period 2004–2009 was based at the time on the CBA-1995, it is clear that the poverty rate estimates would be higher if the CBA-2011 were used for the same years. In other words, the methodological

[3] In the CBA-1995, INEC applied the Engel coefficient to calculate the value of the poverty line, while in the CBA-2011 it used the Orshansky coefficient. The latter is the inverse of the Engel coefficient, which measures the share of food expenditure in total expenditure.

change has consequences for the estimated level of poverty and means that two periods in which the methodology for estimating the basic food basket and the poverty line are different cannot be compared.

In conclusion, two different baskets have been used to measure poverty in the period 1987–2017, each reflecting the consumption pattern prevailing in the year concerned. This differentiation has resulted in different levels of poverty being estimated for the country. A single series of comparable data on the value of the basic food basket and the poverty line for the whole period could be obtained by taking the CBA-1995, maintaining its composition and continuing to calculate its value with the prices observed in the period 2010–2017, or by taking the CBA-2011, maintaining its composition and estimating its value with the prices observed between 1987 and 2009. Unfortunately, both options are unfeasible, because the data for some goods in the old basket ceased to be collected after the methodological change and the prices of some goods in the new basket were not collected before it.

Given this impossibility, another way is to "splice" the value of the two baskets by measuring the growth in their current value. For this, it is important to find out whether they underwent similar changes in a period for which estimates of the value of both baskets are available simultaneously, i.e., between 2004 and 2009. There were no major differences in the trends in those years, but rather a great similarity in the values for some years. This means that, although the structure and composition of the basic food basket differ between the CBA-1995 series and the CBA-2011 series, the relative growth in the prices of goods and services within each basket has been similar. Assuming the same behaviour for the other years of the time series analysed in this paper, it is possible to simulate the value of the CBA-1995 in the period 2010–2017 and the value of the CBA-2011 in the period 1987–2003, thus obtaining two long-term poverty series that are comparable over time.

IV. Methodology

The objective of this section is to construct a series of comparable data on the evolution of poverty in Costa Rica over the period 1987–2017. This is done by starting from the official series and making the necessary adjustments to be able to compare the different measures of income and the poverty line and thus overcome the comparability limitations pointed out in the previous sections.

As mentioned above, the poverty estimates made by INEC from 1987 to 2017 are not strictly comparable in several subperiods, owing to changes in the measurement of income (definition of income, treatment of unknown incomes and adjustments for underreporting of income) and in the composition and valuation of the basic food basket and the poverty line. These changes are summarized in table 1.

Table 1
Costa Rica: main changes in the poverty measurement methodology of the National Institute of Statistics and Censuses (INEC)

Obstacles to comparison	Multipurpose Household Survey (EHPM), 1987–2009	National Household Survey (ENAHO), 2010–2017
For income		
Measurement of household incomes	Nineteen income types are monetized	Forty-seven income types are monetized
Treatment of households whose incomes are unknown	Not imputed (excluded)	Imputed (included)
Adjustment for underdeclaration of income	Applies to per capita income (all income types), with a distinction between urban and rural areas	Applies to some income types (not all), with no distinction between areas
For the basic food basket and poverty line		
Value of the basic food basket and poverty line	The 1995 basic food basket is used (National Household Income and Expenditure Survey (ENIGH) 1988)	The 2011 basic food basket is used (ENIGH 2004)

Source: Prepared by the authors.

The objective of this study is to estimate a long-term poverty data series for Costa Rica that is comparable at all points. To this end, the previous sections analysed the factors that hamper comparability and proposed different methods for dealing with these limitations and observing the evolution of poverty over time.

Because the objective is to analyse poverty trends rather than levels, eight poverty series will be estimated by combining factors that ensure standardization and comparability for the entire period analysed, as detailed in table 2.

Table 2
Details of the construction of eight poverty series that are comparable in the long term

Reconstructed poverty series	Income structure	Imputation	Value of the basic food basket and poverty line	Adjustment for underdeclaration of income
Poverty series 1	Multipurpose Household Survey (EHPM)	Not imputed (as per the EHPM)	CBA-1995 (National Household Income and Expenditure Survey (ENIGH) 1988)	No adjustment
Poverty series 2				Adjustment as per the EHPM
Poverty series 3			CBA-2011 (ENIGH 2004)	No adjustment
Poverty series 4				Adjustment as per the EHPM
Poverty series 5		Imputed (as per the National Household Survey (ENAHO))	CBA-1995 (ENIGH 1988)	No adjustment
Poverty series 6				Adjustment as per the EHPM
Poverty series 7			CBA-2011 (ENIGH 2004)	No adjustment
Poverty series 8				Adjustment as per the EHPM

Source: Prepared by the authors.

As can be seen, only the income series with the EHPM income structure can be used, which means adjusting the ENAHO income results downward (and making poverty look higher in the period 2010–2017). Both the methods for dealing with unknown incomes (not imputing and imputing) will be applied.

The conditional means method is used to impute income, consisting in the formation of categories from covariates correlated with the variable of interest and the imputation of missing data with observations from the subsample that shares common characteristics (Acock and Demo, 2005; Medina and Galván, 2007). In this method, missing data are assumed to follow a missing completely at random (MCAR) pattern and there will be as many averages as there are categories formed. This helps to mitigate biases in each cell. In this specific case, the conditioning variables used in the imputation process are "area of residence", "sex", "education" and "occupation". Imputation is performed on the main income, secondary income and other household income.

Poverty levels will be simulated under the conditions described using the two series of values for the basic food basket reconstructed with and without adjustment for underdeclaration of income. All this will yield eight poverty series that are different from each other, but methodologically comparable over the whole period.

The objective is to analyse the long-term trend of these eight poverty series to determine whether the incidence of poverty in Costa Rica has stagnated or changed over the last three decades. Since this is not a stationary time series (serial autocorrelation is significantly positive), the method used to understand whether the trends obtained from the poverty series estimates differ from the official series is to compare the slopes of the regression lines predicted by calculating a bivariate linear regression.

This regression estimates the slope of the model $P_t = \beta_0 + \beta_1 A_t + \varepsilon$, where P_t is the percentage of poverty in year t, β_0 is the intercept of the regression line, β_1 is the value of the slope of the line over year A_t, and ε is an error term. The model estimation is carried out on standardized variables so as to obtain standardized coefficients as a measure of effect size and comparison between the different models.

V. Results

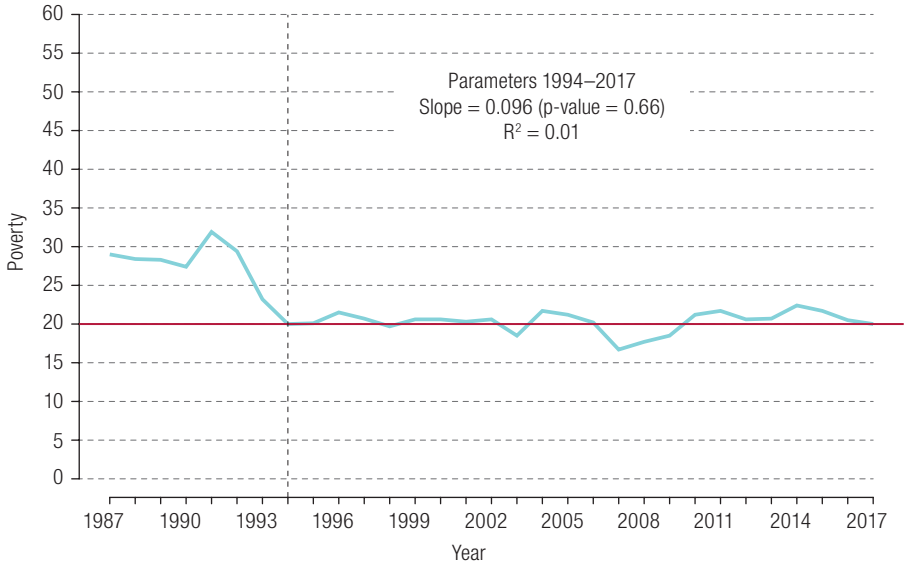
While the period analysed runs from 1987 to 2017 (31 years of observations), some specialists argue that the level of poverty (according to the official income poverty line measure) has remained relatively unchanged since 1994. This often results in statements such as "poverty has stagnated at around 20%" or "poverty has remained unchanged for the last two decades". Methodological changes implemented in the period under study can be expected to affect the recorded level of poverty and its long-term trend because, as demonstrated in the previous sections, methodological considerations have large effects on the measurement of income, the basic food basket and the poverty line.

The methodology described in the previous section was used to estimate eight different but methodologically comparable poverty series that enabled the evolution of poverty in the period 1987–2017 to be analysed.

While it is not possible to compare individual values, it is possible to compare the trends observed from these estimates with that derived from the official poverty figures estimated by INEC. Since this is not a stationary time series (serial autocorrelation is significantly positive), the method used to understand whether the trends obtained with the estimated poverty series are different from those yielded by the official series is to compare the slopes of the regression lines predicted by computing a linear regression, but showing the slope as the standardized coefficient obtained from the regression fit accompanied by its statistical significance (p-value) and the goodness-of-fit value (R-squared) of this bivariate model, taking into consideration only the period 1994–2017, as it is since 1994 that poverty is considered not to have shown substantial improvements.

For a better understanding of the procedure, the value of the slope and R-squared for the official poverty series estimated by INEC for the period 1994–2017 is shown below (see figure 2).

Figure 2
Costa Rica: poverty incidence estimated by INEC (official) and slope of the regression line, 1994–2017
(Percentages)



Source: Prepared by the authors, on the basis of figures from the National Institute of Statistics and Censuses (INEC) of Costa Rica.

As can be seen in figure 2, the incidence of poverty between 1994 and 2017 does not vary significantly from 20% (horizontal red line).

When a bivariate linear regression is estimated, it is observed that the slope of the poverty series from 1994 to 2017 is not statistically different from 0, as the Wald statistic is much higher than the values of 0.01, 0.05 and 0.10 that are usually used as parameters for comparison. This means that when the poverty time series officially estimated by INEC from 1994 to 2017 is analysed without taking into account the impossibility of comparing the data that make it up, it is indeed found not to have changed over time, i.e., to have been "stagnant" for the last 23 years. This type of analysis is the error that the present study attempts to rectify. Following the same logic, the poverty series estimated in this study are shown below (see figure 3 and the numerical data in annex A1).

Figure 3
Costa Rica: estimated poverty series that are comparable for the period 1987–2017
(Percentages)

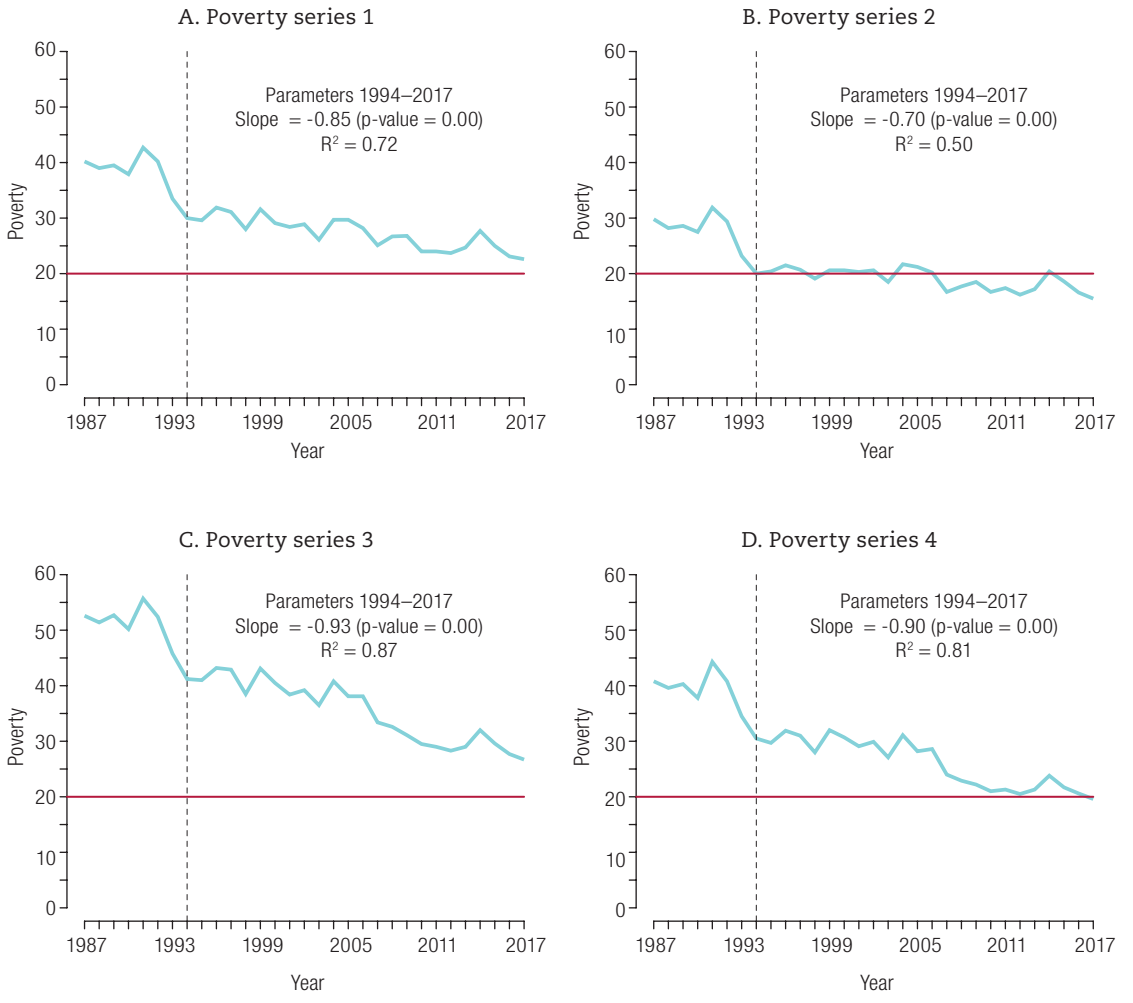
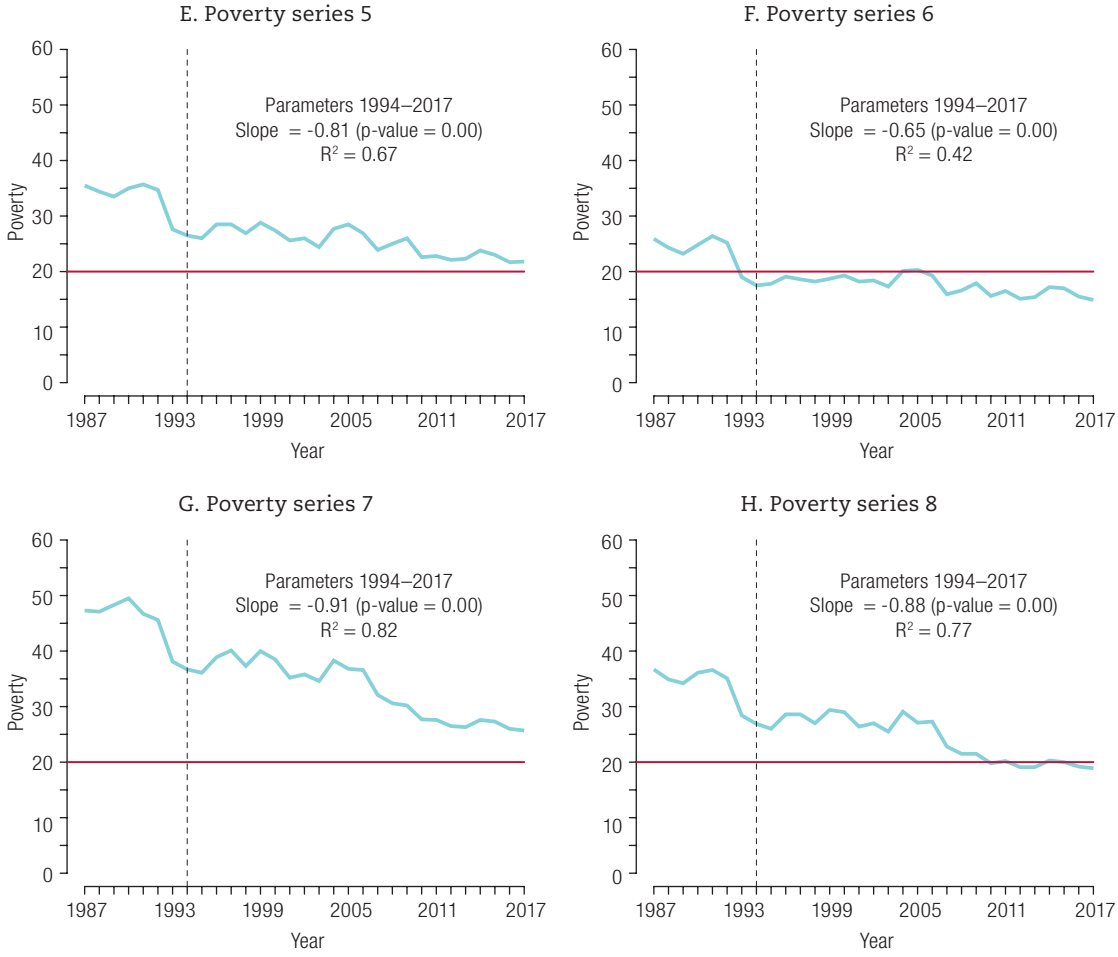


Figure 3 (concluded)



Source: Prepared by the authors, on the basis of figures from the National Institute of Statistics and Censuses (INEC) of Costa Rica.

Figure 3 shows the evolution of poverty in Costa Rica between 1994 and 2017 according to the eight series estimated. Visually, a decreasing trend can be seen in all eight panels, and this trend is statistically confirmed by observing that the slope of the estimated regression line for each of the eight series is negative, statistically different from 0 (p-value below 0.01) and of considerable effect, as the standardized coefficients can only vary between 0 and 1 (absolute value), and for four of the time series estimated the estimated slopes are higher than 0.75 (absolute value).

This result shows that, when poverty series based on data that are comparable over time are used, there has been a reduction in poverty over the last 30 years, including the period that has generated the most criticism (from 1994 onward).

Once again, it is important to bear in mind that each of these eight series is different from the others, as they are all produced by combining the parameters that originally rendered the data of the official series non-comparable. However, the underlying data are indeed comparable within each series, as the same methodology is applied throughout the period.

In conclusion, poverty in Costa Rica fell over the period 1994–2017, as evidenced by the analysis using comparable data series for income, the basic food basket, adjustment for underreporting and income imputation. However, an even closer study of the data reveals different patterns over the 31 years

of analysis. Given the changes in poverty in the eight series, it is possible to distinguish four subperiods, going by the record of significant changes in poverty rates. Thus, similar behaviours are observed in the years within four subperiods, namely 1987–1992, 1992–1994, 1994–2006 and 2006–2017.

To convey what happened in these subperiods, the above analysis is replicated exactly, with estimates of bivariate regressions and analysis of the value of the standardized coefficient of the regression (the magnitude of the effect) and the statistical significance of this coefficient. These results are shown in annex A2. The main conclusion is that before 1994 there was an initial period when poverty stagnated (1987–1992), followed by a sharp decline that lasted only two years (1992–1994). A new period of stagnation began in 1994 and lasted for 12 years, then a period of sustained poverty reduction began in 2006, lasting until 2017.

This means that the reduction in poverty in the period 1994–2017 was mainly due to the influence of what happened between 2006 and 2017, as there were no major variations in the trend between 1994 and 2006.

1. Brief characterization of households by poverty status

To study the evolution of poverty more thoroughly, the population was divided into four groups with a view to examining their main characteristics. These groups are households in extreme poverty, households in non-extreme poverty, vulnerable households and non-poor households. The analysis is based on one of the comparable poverty data series included in table 2 (series 8).

Households in extreme poverty are those whose adjusted per capita income is below the value of the reconstructed 2011 basic food basket. Households in non-extreme poverty have a per capita income higher than the value of the reconstructed 2011 basic food basket but lower than or equal to the value of the reconstructed 2011 poverty line. Lastly, vulnerable households are those which are not poor but whose income is at most 30% higher than the value of the corresponding poverty line, so that they are at risk of entering the group of poor households.

Figure 4 shows that in the years following the crisis of the 1980s, specifically in 1987, poverty affected 37% of the country's households, a proportion which rises to 48.5% when vulnerable households are included. In other words, almost half the country's households were poor or very close to it.

In the period 1987–1992, there were no significant changes in the household structure classification by poverty status.

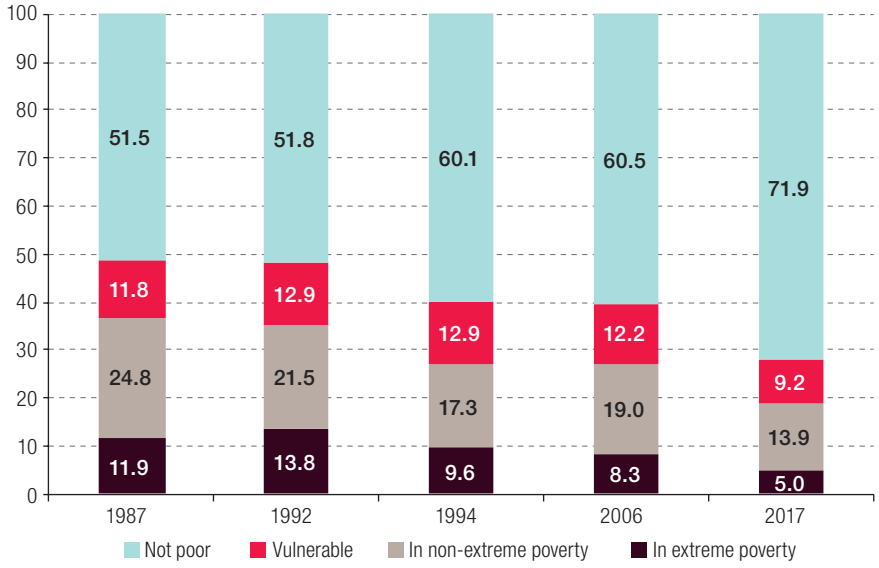
Between 1992 and 1994, a period of only two years, the proportion of households in extreme poverty and non-extreme poverty fell by 4.2 percentage points each. Although the causes of this dramatic reduction have been little studied, it is believed to be associated with strong national income growth, as this was over 6% per annum.

In the period 1994–2006, there were no substantial changes in the incidence of poverty, extreme poverty or vulnerability. In this period, national income growth was generally below 4%.

The period 2006–2017 shows a reduction in the incidence of poverty, as the proportion of households in situations of extreme poverty, non-extreme poverty and vulnerability decreases and the proportion of households not affected by poverty increases accordingly (see figure 4). Poverty declined particularly in 2007, when national income growth was above 6%.

Thus, the level of poverty in Costa Rica was 48% lower in 2017 than in 1987 or, if the comparison is made with the 1990s (when the so-called "stagnation of poverty" began), the country was 30% less poor than in 1994. This achievement is unquestionably even more significant when it is considered that the largest reduction was in households in extreme poverty, whose proportion of the total in 2017 was less than half what it had been in 1987.

Figure 4
Costa Rica: classification of households by poverty status (series 8), selected years
(Percentages)



Source: Prepared by the authors, on the basis of figures from the National Institute of Statistics and Censuses (INEC) of Costa Rica.

As regards the incidence of poverty among different subpopulations, one of the main focuses is on differences according to the sex of the household head. While the majority of poor households are headed by men (80% in 1987 and 54% in 2017), poverty affects female-headed households more, and particularly households headed by women who do not have a partner (lone female heads of household).

While the estimated poverty level in 2017 was around 18% nationally, this proportion increased to 24% for lone female heads of household. This trend is observed throughout the period under review (see table 3).

This is no minor issue, and it takes on particular importance when changes in the family structure of poor households are analysed. Between 1987 and 1994, about 70% of poor households were headed by men with partners, while only 2% were headed by women with partners. The second largest group was women without partners (lone female heads of household), who accounted for 19%.

This structure changed in 2017, with the proportion of poor male-headed households decreasing and the proportion of households headed by single women doubling. Considering that this is the very group with the highest historical incidence of poverty, it is clear that single female-headed households are much more vulnerable than any other type of household.

Education is another factor strongly associated with the probability of being poor. In fact, the educational environment of a household, defined as the average number of years of education of the adults living there, is a variable with high predictive power for poverty. In Costa Rica, an average of less than 6 years' education (incomplete primary) is considered low, an average of between 6 and 11 years is considered medium and an average of 11 years and over (complete secondary or better) is considered high.

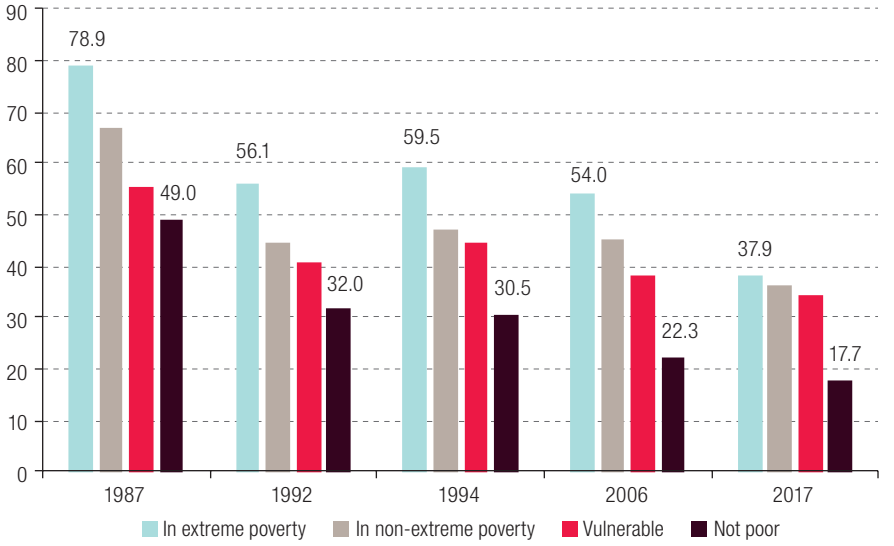
Figure 5 shows the percentage of households with low education by poverty status. Thus, in 1987, almost 80% of households in extreme poverty and about 70% of households in non-extreme poverty had a low level of education. Although non-poor households are less affected by educational problems, half of these households also had a low level of education in 1987.

Table 3
Costa Rica: incidence of poverty in different categories of households, 1987–2017
(Percentages)

Characteristic	1987	1992	1994	2006	2017
Sex and conjugal situation of household head					
Male (with partner)	68.1	69.1	70.8	61.6	46.2
Male (no partner)	12.2	10.2	8.5	5.9	8.4
Female (with partner)	1.1	2.4	1.9	3.2	8.2
Female (no partner)	18.7	18.4	18.8	29.3	37.3
Age group of household head					
Under 40 (young)	35.4	39.1	30.0	30.3	21.5
40 to 60 (intermediate)	31.3	32.2	23.7	24.0	16.8
60 or over (older)	40.6	40.6	34.5	33.8	19.6
Planning region					
Central	29.5	33.2	23.5	24.1	15.6
Chorotega	59.4	51.5	44.1	42.3	20.5
Pacífico Central	43.2	41.9	33.5	36.4	28.4
Brunca	48.0	51.6	44.3	39.7	26.3
Huetar Atlántica	33.2	29.2	29.0	29.3	24.2
Huetar Norte	42.1	40.3	32.9	31.0	23.4
Type of area					
Urban	30.9	29.7	24.4	26.6	19.0
Rural	40.8	39.4	33.0	30.5	18.7

Source: Prepared by the authors, on the basis of poverty series 8.

Figure 5
Costa Rica: distribution of households with low education by poverty status, selected years
(Percentages)



Source: Prepared by the authors, on the basis of figures from the National Institute of Statistics and Censuses (INEC) of Costa Rica.

As early as 1992, a marked decrease can be seen in the proportion of households with low education, but this was still the situation of half of all poor households. This situation continued until 2006. The positive effects of Costa Rica's increased educational coverage in recent years are more evident in 2017: on average, only 36% of poor households had low education (many had advanced to the medium education category) and less than one fifth of non-poor households were still in this position.

Figure 5 also shows that education has improved most rapidly at the top and bottom of the income distribution. In fact, the average years' education of the heads of extremely poor households rose from 3.7 in 1987 to 5.9 in 2017, an increase of 60%. Among households in non-extreme poverty, this average rose from 5.2 to just 5.9 years (the same as for the poorest), while among non-poor households the average years' education of household heads increased from 7.1 years in 1987 to 9.1 years in 2017, an increase of 29%.

In general, the incidence of poverty is higher in female-headed households, households with older heads and households in rural areas and, particularly, in coastal or border regions. Table 3 summarizes the incidence of monetary poverty for different population groups in the years studied.

VI. Conclusions

The official method of measuring monetary poverty in Costa Rica presents some obstacles to long-term study of the evolution of poverty, since for various reasons the official series are not comparable between the periods 1987–1999, 2000–2009 and 2010–2017.

One of these reasons concerns the measurement of income and the way this has changed over time, such that a much more accurate and detailed measure of the different incomes of household members is now available.

Furthermore, the construction of the basic food basket and the final calculation of its value in a given year depend on the accuracy with which expenditure data were collected in the income and expenditure survey of the period concerned (which improves with each new application) and, crucially, on the assumption that this representative basket of goods and services remains unchanged for several consecutive years.

Other reasons have to do with methodological and statistical aspects of the data, involving the application of different procedures when there are missing values in the composition of income or adjustment for possible underdeclaration of income by the respondents in each household.

To overcome these limitations, this study reconstructs the household per capita income series in order to make data from the different years comparable (or at least reduce the bias as much as possible), likewise reconstructs the value of the basic food basket (and thence of the poverty line) and evaluates income imputation scenarios and underdeclaration adjustments following INEC methodology, with the aim of studying the evolution of poverty in the period 1987–2017.

By combining the input series described above, it was possible to estimate eight different poverty series, and these are used to demonstrate the declining poverty trend over the period 1987–2017. This finding from the analysis of poverty using series of data that are comparable over time is consistent across the eight proposed poverty series.

Analysis of the poverty series that most closely resembles that obtained with the official INEC methodology shows that, contrary to what is believed, the incidence of poverty did not stagnate between 1994 and 2017, but declined considerably. According to the proposed measure, on average, poverty in Costa Rica decreased from 29% in 1997 to 23% in 2007, and then declined further to 19% in 2017.

However, this reduction was not sustained over the entire period: there actually was stagnation between 1994 and 2006, after which the downward trend resumed. For this reason, the level of poverty in Costa Rica not only has not stagnated over the last two decades, but has actually fallen by one third compared to 1994. This achievement is all the more important considering that the greatest decrease has been in extreme poverty.

Lastly, three observations can be made about the changes implemented by INEC in the official poverty measurement methodology. First, the objective of the changes is to improve the accuracy of poverty measurement in Costa Rica. Second, the changes were thoroughly explained by INEC. Third, INEC has been careful not to present the official data as if they were a comparable series for the entire period 1997–2017. It has been other entities and individuals that have collected and interpreted the non-comparable data as if they were comparable, despite INEC warnings.

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Annex A1

Table A1.1
Costa Rica: poverty series estimated using a comparable methodology, 1987–2017
(Percentages)

Details of the series:									
		Multipurpose Household Survey (EHPM)							
Income		EHPM	EHPM	EHPM	EHPM	EHPM	EHPM	EHPM	EHPM
Imputation of missing income		No	No	No	No	Yes	Yes	Yes	Yes
Value of the basic food basket and poverty line		1995	1995	2011	2011	1995	1995	2011	2011
Adjustment for underdeclaration of income		No	Yes	No	Yes	No	Yes	No	Yes
Year	Official	Series 1	Series 2	Series 3	Series 4	Series 5	Series 6	Series 7	Series 8
1987	29.00	40.22	29.83	52.62	40.78	35.48	25.90	47.28	36.70
1988	28.40	38.96	28.23	51.43	39.64	34.38	24.30	47.13	34.93
1989	28.30	39.47	28.60	52.72	40.34	33.49	23.24	48.31	34.18
1990	27.40	37.95	27.49	50.22	37.82	35.04	24.84	49.52	36.10
1991	31.90	42.65	31.91	55.75	44.29	36.09	26.59	47.46	37.19
1992	29.40	40.20	29.37	52.42	40.79	34.75	25.26	45.76	35.32
1993	23.20	33.50	23.16	45.79	34.51	27.93	19.18	38.62	28.74
1994	20.00	30.01	19.96	41.22	30.50	26.51	17.53	36.87	26.94
1995	20.10	29.59	20.38	41.05	29.69	26.24	17.92	36.53	26.29
1996	21.50	31.90	21.50	43.21	31.90	28.47	19.09	38.91	28.55
1997	20.70	31.12	20.71	42.89	30.98	28.54	18.58	40.07	28.56
1998	19.70	28.03	19.09	38.52	27.97	26.88	18.19	37.25	26.99
1999	20.60	31.55	20.64	43.09	31.98	28.79	18.75	39.96	29.38
2000	20.60	29.08	20.57	40.49	30.72	27.35	19.31	38.50	29.05
2001	20.30	28.39	20.32	38.45	29.09	25.62	18.16	35.17	26.36
2002	20.60	28.88	20.61	39.18	29.88	25.98	18.44	35.79	26.97
2003	18.50	26.06	18.54	36.53	27.12	24.42	17.31	34.62	25.48
2004	21.70	29.67	21.72	40.78	31.06	27.74	20.13	38.27	29.08
2005	21.20	29.65	21.22	38.07	28.22	28.52	20.28	36.75	27.10
2006	20.20	28.21	20.24	38.09	28.58	26.94	19.28	36.60	27.30
2007	16.70	25.14	16.73	33.43	24.00	23.90	15.86	32.05	22.77
2008	17.70	26.65	17.69	32.62	22.86	24.96	16.56	30.64	21.47
2009	18.50	26.76	18.49	31.07	22.16	25.96	17.86	30.21	21.46
2010	21.21	24.02	16.69	29.48	21.01	22.59	15.65	27.74	19.78
2011	21.65	24.03	17.44	28.99	21.31	22.83	16.49	27.59	20.21
2012	20.57	23.65	16.23	28.34	20.48	22.10	15.05	26.50	19.13
2013	20.70	24.73	17.25	28.95	21.27	22.34	15.43	26.32	19.15
2014	22.37	27.75	20.43	31.99	23.84	23.76	17.19	27.64	20.31
2015	21.73	24.97	18.60	29.56	21.74	22.97	16.99	27.33	19.96
2016	20.53	23.14	16.63	27.66	20.62	21.65	15.50	26.02	19.22
2017	20.03	22.59	15.46	26.66	19.56	21.82	14.85	25.70	18.91

Source: Prepared by the authors, on the basis of data estimated using different combinations of parameters.

Annex A2

Table A2.1
Costa Rica: estimation of bivariate regressions to analyse the poverty trend by subperiods, 1987–2017

A. Subperiod 1987–1992						
Series	Coefficient	p-value	R^2	Statistical significance	Magnitude of effect	Overall significance
Official	0.4010	0.4307	0.1608			No
Series 1	0.3151	0.5430	0.0993			No
Series 2	0.2768	0.5954	0.0766			No
Series 3	0.2741	0.5991	0.0751			No
Series 4	0.2910	0.5758	0.0847			No
Series 5	0.0935	0.8601	0.0088			No
Series 6	0.2051	0.6966	0.0421			No
Series 7	-0.3377	0.5126	0.1141			No
Series 8	-0.0526	0.9211	0.0028			No
B. Subperiod 1994–2006						
Series	Coefficient	p-value	R^2	Statistical significance	Magnitude of effect	Overall significance
Official	0.0624	0.8395	0.0039			No
Series 1	-0.4789	0.0978	0.2294			No
Series 2	0.0512	0.8682	0.0026			No
Series 3	-0.6439	0.0175	0.4146	***	***	Yes
Series 4	-0.4552	0.1181	0.2072			No
Series 5	-0.0893	0.7717	0.0080			No
Series 6	0.5407	0.0564	0.2924		***	No
Series 7	-0.2915	0.3338	0.0850			No
Series 8	-0.0404	0.8956	0.0016			No
C. Subperiod 1992–1994						
Series	Coefficient	p-value	R^2	Statistical significance	Magnitude of effect	Overall significance
Official	-0.9834	0.0464	0.9672	***	***	Yes
Series 1	-0.9840	0.0456	0.9682	***	***	Yes
Series 2	-0.9834	0.0464	0.9672	***	***	Yes
Series 3	-0.9947	0.0262	0.9895	***	***	Yes
Series 4	-0.9918	0.0326	0.9837	***	***	Yes
Series 5	-0.9212	0.0443	0.8486	***	***	Yes
Series 6	-0.9431	0.0431	0.8895	***	***	Yes
Series 7	-0.9298	0.0480	0.8646	***	***	Yes
Series 8	-0.9390	0.0447	0.8818	***	***	Yes
D. Subperiod 2006–2017						
Series	Coefficient	p-value	R^2	Statistical significance	Magnitude of effect	Overall significance
Official	0.5662	0.0550	0.3206		***	No
Series 1	-0.5888	0.0440	0.3467	***	***	Yes
Series 2	-0.3017	0.3406	0.0910			No
Series 3	-0.7915	0.0022	0.6265	***	***	Yes
Series 4	-0.6861	0.0138	0.4707	***	***	Yes
Series 5	-0.7650	0.0037	0.5852	***	***	Yes
Series 6	-0.5339	0.0438	0.2851	***	***	Yes
Series 7	-0.8538	0.0004	0.7290	***	***	Yes
Series 8	-0.7709	0.0033	0.5942	***	***	Yes

Source: Prepared by the authors.
Note: *** The coefficient has statistical significance (p-value of less than 0.05) or a considerable effect (an absolute standardized coefficient value of more than 0.5). Overall significance is obtained when the coefficient meets both conditions.

The social discount rate in the evaluation of investment projects: an application for Ecuador[1]

José Gabriel Castillo and Donald Zhangallimbay

Abstract

The standard social discount rate of 12% applied by planning institutions and multilateral agencies when evaluating public projects is a constant administrative parameter that is unsupported and unresponsive to changes in social preferences over time. This paper presents an alternative way of determining the social discount rate based on the gamma estimation model (Weitzman, 2001) in a developing-country context, which has three advantages: (i) it incorporates decreasing discounting, (ii) it is cost-efficient in that it sums up the various expert opinions and (iii) it adjusts for changes in short- and long-term preferences. Our estimates are lower than the standard nominal rate for different time periods, ranging from 2% for evaluation horizons longer than 51 years to 11% for the short term (0–5 years).

Keywords

Investments, development projects, project preparation, project evaluation, equality, welfare economics, mathematical models, developing countries, Ecuador

JEL classification

O22, D04, C93

Authors

José Gabriel Castillo is the Director of the Centre for Economic Research (CIEC) and the Laboratory for Experimental and Behavioural Economics (LEE) at the Faculty of Social Sciences and Humanities (FCSH) of the Escuela Superior Politécnica del Litoral (ESPOL), Ecuador. Email: jcastil@espol.edu.ec.

Donald Zhangallimbay is a Coordinator and Researcher with the Laboratory for Experimental and Behavioural Economics (LEE) at the Faculty of Social Sciences and Humanities (FCSH) of the Escuela Superior Politécnica del Litoral (ESPOL), Ecuador. Email: djzhanga@espol.edu.ec.

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I. Introduction

Cost-benefit assessment is the main tool used to determine the economic viability of public investment projects. The social discount rate (SDR) is a key parameter in this analysis, most particularly because it represents the opportunity cost of resource use over time and serves to compare projected revenues and costs (net cash flows) over different periods. Thus, setting the SDR too high may mean that socially desirable projects are rejected; conversely, setting it too low may result in resources being wasted on economically inefficient projects (Zhuang and others, 2007). The choice of an appropriate discount rate is not a trivial exercise; on the contrary, it is a subject of intense debate in the economic and financial literature, particularly with regard to the development of efficient methodologies and strategies that can ensure optimal use of resources and sustainable social development (see Correa, 2008a, for a summary).

There is as yet no consensus on how to measure and establish an appropriate SDR (Campos, Serebrisky and Suárez-Alemán, 2015). However, growing social demands for administrative transparency and the intense debate on project externalities reflected in pollution and environmental impacts have led a number of countries to review the economic evaluation parameters used. The economies of Latin America and the Caribbean (e.g. Chile, Colombia and Costa Rica) are no exception. The region's remarkable progress with economic development and access to external financing points to a need to re-evaluate the SDR as a tool for analysing the efficiency and intergenerational equity of public investment (Campos, Serebrisky and Suárez-Alemán, 2015).

Three approaches are commonly applied to determine the SDR: (i) the social rate of time preference approach, (ii) the social opportunity cost of capital approach and (iii) the combined, weighted average or Harberger approach (Harberger, 1972). However, traditional techniques framed within a constant discount rate model are inefficient when it comes to evaluating projects with a large externality component that is not absorbed by the market, or projects with intergenerational effects (or very long-term effects), such as transport infrastructure, hospitals, roads and waste disposal projects. The search for parameters compatible with social preferences prompts a reconsideration of the effects of public investment, especially when the effect extends socially and economically to future generations who have no say in the investment decision (Correa, 2008b). The rates currently applied in a number of developing countries, e.g. Ecuador, omit several technical evaluation criteria and suggest a relatively high discount level that characterizes a preference for resource use in the short term and quickly discounts the economic benefits to be obtained in the distant future (Frederick, Loewenstein and O'Donoghue, 2002).

While a constant SDR facilitates the modelling and interpretation of economic flows, a vast empirical and experimental literature from both psychology and economics (see, for example, Thaler, 1981; Harrison and others, 2005; Benhabib, Bisin and Schotter, 2010; Castillo and Zhangallimbay, 2018) has revealed numerous anomalies in preferences over time that argue for a pattern of decreasing discount rates; i.e. the longer the waiting period for cash flows is, the more patient individuals tend to be, which translates into lower discount rates. This behavioural anomaly has already been taken into account in investment project evaluation approaches. In the United Kingdom, for example, the standard method for discounting flows in the long term (more than 30 years) uses declining rates that range from 3.5% down to 1.0% (Lowe, 2008).

Delacámara (2008), meanwhile, recommends the use of an SDR that incorporates social preferences over time. In Ecuador, as in other Latin American countries, a fixed discount rate, usually of 12%, is used. This rate does not derive from any estimation of individual or social preferences over time, but is an administrative rate suggested both by international agencies such as the Inter-American Development Bank (IDB) and the World Bank and by national planning institutions. A number of countries have undertaken a review of their SDR, with interesting outcomes; the resulting estimates are generally lower than the discount level actually applied. In Ecuador alone, the National Secretariat for Planning

and Development (SENPLADES) uses the SDR to evaluate approximately 140 projects per year, and in none of these cases is any distinction made between short- and long-term implementation periods.

This study conducts a review of SDR estimation by distinguishing four evaluation periods, from the short to the long term: the immediate future (1–5 years), the medium future (6–20 years), the distant future (21–50 years) and the far distant future (51–100 years). Our estimates for a developing country, Ecuador, employ the gamma discounting mechanism, proposed by Weitzman (2001), to integrate the views of a diverse group of decision-makers, adapting a questionnaire so that it can be used to adjust the interval estimation and so refine the results (Edwards, 2016). Additionally, we present an adjustment in which we consider the present value bias generated by time preferences in a short-term context. The results show that the rates determined in this context differ from those estimated using the general long-term survey mechanism. Averaging the results obtained by both procedures, we observe a significant adjustment of the recommended rate for the immediate future (1–5 years), which represents an economically important argument against using the standard rate. Thus, the results suggest the use of a rate of 11% for the immediate future, 4% for the medium future, 3% for the distant future and 2% for the far distant future (for periods longer than 100 years, 1% is recommended). Lastly, we analyse factors related to respondents' SDR preferences and find that both age and levels of risk aversion are important conditions in shaping time preferences.

The rest of the article is organized into four sections. Section II presents a review of methodologies and results obtained by re-estimating SDRs in various countries. Section III details the methodology, the data and the adjustment applied to correct for the exposure biases in traditional questionnaires. Section IV presents the results of the study and a discussion of their implications. Lastly, section V presents the conclusions of the study.

II. Methodological alternatives and international experience

In the absence of consensus on the definition of the SDR and the mechanisms for estimating it, various ways of approximating this parameter can be found. Estimates made in a number of countries around the world (see table 1) show that the assumption of a constant rate derived from exponential discounting remains the most widely applied method (Campos, Serebrisky and Suárez-Alemán, 2015).

Table 1
Estimates of the social discount rate around the world

Institution or country	Rate	Conceptual or theoretical basis
	Multilateral agencies	
World Bank	10%–12%	Conventional administrative rate
Inter-American Development Bank	10%–12%	Conventional administrative rate/ opportunity cost of capital
Asian Development Bank	10%–12%	Conventional administrative rate
	Developed countries	
Germany	3%	Based on the federal refinancing rate
Canada	10%	Social opportunity cost of capital
Spain	6% for transport 4% for water	Social rate of time preference
United States, Office of Management and Budget	7%	Social opportunity cost of capital
United States, Congressional Budget Office and General Accounting Office	Treasury debt market rate	Social rate of time preference
United States, Environmental Protection Agency	Intergenerational discount rate: 2%–3%, subject to sensitivity analysis	Social rate of time preference

Table 1 (concluded)

Institution or country	Rate	Conceptual or theoretical basis
France	4%	Social rate of time preference
Norway	3.5%	Real government borrowing rate
United Kingdom	3.5% Lower differentiated rates for projects of over 30 years	Social rate of time preference
	Developing countries	
China	8% for short- and medium-term projects; less than 8% for long-term projects	Weighted average of the social rate of time preference and the rate based on the social opportunity cost of capital (Harberger method)
India	12%	Social opportunity cost of capital
Pakistan	12%	Social opportunity cost of capital
Latin American countries		
Chile	6%	Weighted average of the social rate of time preference and the rate based on the social opportunity cost of capital (Harberger method)
Colombia	12%	Equivalent to the minimum return expected by the investor
Mexico	10% before 2014: 12%	Weighted average of the social rate of time preference and the rate based on the social opportunity cost of capital (Harberger method)
Peru	9% before 2012: 10%	Weighted average of the social rate of time preference and the rate based on the social opportunity cost of capital (Harberger method)

Source: J. Campos, T. Serebrisky and A. Suárez-Alemán, *Tasa de descuento social y evaluación de proyectos: algunas reflexiones prácticas para América Latina y el Caribe*, Inter-American Development Bank (IDB), 2016; J. Zhuang and others, "Theory and practice in the choice of social discount rate for cost-benefit analysis: a survey", *ERD Working Paper*, No. 94, Asian Development Bank (ADB), 2007; E. Aldunate and R. Martner, "Fiscal policy and social protection", *CEPAL Review*, No. 90 (LC/G.2323P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2006; Chile: National Investment System of the Ministry of Social Development; Colombia: National Public Investment System of the National Planning Department; Mexico: Public Investment System of the Ministry of Finance and Public Credit; Peru: National Public Investment System of the Directorate General of Public Investment of the Ministry of Economy and Finance.

The economic and financial literature groups the various mechanisms for estimating the SDR into three broad approaches. The first sets out from the consumer's point of view, with the discount being derived from social preferences for present consumption (impatience), expectations of future consumption and pure time preferences (Dasgupta and Pearce, 1972). This method is known as the social rate of time preference. Using this approach, Zhuang and others (2007) set out to estimate the SDR in two ways: (i) by considering returns on government bonds or some other low-risk instrument (markets with periods longer than 20 years have yet to be developed) and (ii) by estimating the various components of the Ramsey (1928) equation:

$$r_t = \delta + \eta\left(C_t\right)\frac{dC_t}{C_t} \tag{1}$$

In most of the cases observed, estimates converge on this second alternative, setting out from macroeconomic aproximations of the parameters of equation (1). The SDR r_t is arrived at by aggregating two elements: (i) pure time preferences (δ) and (ii) the product of two factors: the intertemporal elasticity of consumption ($\eta(C_t)$) and the real annual rate of per capita consumption growth ($\frac{dC_t}{C_t}$). Using this method, Zhuang and others (2007), for example, estimated the SDR for several Asian countries, including Indonesia, Japan and Singapore, for which they obtained rates of 6.1%, 4.5% and 7.3%, respectively. The European Commission (2008) also calculates social discount levels for a number of its member countries. In the cases of Denmark, France, Germany and Italy, the results yield rates of 3.1%, 3.5%, 3.4% and 3.3%, respectively. A general observation from international experience is that the results are lower than the rate applied in a number of developing countries, such as Chile, Colombia, India and Peru (see table 1). In these countries, and even in Ecuador, there is still a need for a more

comprehensive assessment of the SDR that takes account of changes in welfare conditions resulting from historical public investment processes.

The second approach to SDR estimation takes the perspective of the producer (firm) as its starting point. The basic principle of this methodology is that the government directly invests funds that could otherwise be used by the private sector, and companies therefore lose the opportunity to employ these resources in economically profitable initiatives. In this context, the SDR must give the minimum project return sufficient to cover the profits lost to the private sector (Edwards, 2016). This approach is known as the social opportunity cost of capital.

In an undistorted economic environment, the SDR estimated from both approaches (the social rate of time preference and the social opportunity cost of capital) should converge on the real interest rate in the economy. However, assuming a market without failures is unrealistic; subsidies, taxes and externalities not absorbed by the price system, among other things, all distort economic relationships. In this context, the discount rates resulting from one and the other strategy will differ (Campos, Serebrisky and Suárez-Alemán, 2015). From the point of view of capital, if it is assumed that trade is open, that capital can move freely around the world and that exchange rates are flexible, the SDR will be given by the interest rate on external borrowing, duly adjusted for the expected price of the foreign currency when servicing the debt (Fontaine, 2000). One of the limitations of this method is that the international market has not carried out transactions covering very long periods (more than 30 years), which means that rates approximating to the prices of capital over distant evaluation horizons cannot be generated. In practice, planning institutions usually assume a constant discount rate, i.e. they take the rates generated in existing (short-term) markets and assume equivalence for rates over long and very long periods. This is a technical limitation in the evaluation of public projects that survive intergenerationally even though they are only evaluated at market rates for shorter terms, e.g. up to 20 years.

The United States Office of Management and Budget (OMB) and the Treasury Board of Canada Secretariat, applying the social opportunity cost of capital methodology, have estimated and use rates of 7% and 10%, respectively, in the cost-benefit assessment of their public investment projects. In some cases, applying this approach yields rates higher than those actually applied; Pakistan and the Philippines, for example, estimate SDRs of 12% and 15%, respectively. In most of the cases studied (see Zhuang and others, 2007, for examples), however, the estimated SDRs are lower than the administrative rate.

A third approach to estimating the SDR is that of Harberger (1972). This approach considers the discounting preferences of both consumers and firms; financing comes from these sources (displacement of consumption and sacrifice of private profits). In this context, the SDR is a weighted average of the marginal rate of time preference (δ) and the marginal rate of return on equity (R), including the respective adjustments for risk and taxes. In summary, the idea put forward describes a rate as follows: $SDR = \alpha R + (1- \alpha)\delta$, where α is the proportion of resources obtained by displacing private investment funds and $(1- \alpha)$ is the proportion of resources generated by displacing present consumption. Multilateral agencies such as the World Bank and the Inter-American Development Bank (IDB) recommend this method in their manuals. Countries such as China, Mexico and Peru have applied this methodology and obtained rates of 8%, 10% and 9%, respectively.

In recent years, the development of knowledge, the application of experimental and behavioural economics to identify individual preferences and the use of intergenerational equity analysis to gauge the effects of public investment have challenged traditional methods of estimating the SDR. The limitations of these methods matter because the allocation of social resources is subject to economic evaluation, in which the SDR is a crucial parameter. There are several alternative estimation methods that deal with these limitations, including the use of time-varying (usually declining) rate mechanisms (Weitzman, 2001) or alternative discounting models, e.g. the hyperbolic model (Mazur, 1987). In this paper, we implement these alternatives and recommend the use of a set of decreasing discount rates, with some adjustments.

III. Methodology

This section details the mathematical derivation of the SDR from the gamma estimation model. In addition, the data collection techniques are described and the present value bias adjustment process proposed for the estimates in a short-term context is outlined.

1. Gamma discounting

On the basis of the above arguments supporting the use of a decreasing discount rate, this paper adapts the gamma discounting methodology proposed by Weitzman (2001) and the extension proposed by Edwards (2016) to estimate a set of discount rates for Ecuador. One of the advantages of this methodology is that it recognizes the difficulty and uncertainty involved in determining an SDR, and it consequently proposes a simple mechanism which integrates the perceptions of a group of experts into a single discount factor. In addition, the model demonstrates that aggregating the views of a group of individuals leads to convergence on a structure of decreasing discount rates, even when at the individual level each subject identifies with an exponential discounting mechanism, the kind typically employed in practice.

The model proceeds from two basic arguments. The first is that there is no consensus, at least with regard to the short run, on the value of the SDR that should be applied to projects with benefits and costs in the long run (e.g. more than 20 years and 50 years). In practice, economists use various methods to determine an approximate level, looking at the marginal productivity of capital or the elasticity of consumption, for example, or estimating individual preferences over time. Each method prioritizes a specific aspect of public investment analysis; intergenerational equity, technological change, distortions in the economy, effects on the environment and the presence of externalities are all among the issues of interest (Correa, 2008a). The second argument asserts that to integrate the whole range of opinions and types of respondents captured in a probability distribution, discount functions rather than reported rates should be averaged. To understand this assumption, we take the example given by Edwards (2016). Suppose that two sensible and perfectly informed individuals consider that the SDR should be 10% and 7%, respectively. If equal weight is given to the two opinions, then the present value of one dollar in 15 years will be given by $0.5(1/1.10)^{15} + 0.5(1/1.07)^{15} = 0.3001$; however, this value will be lower if the reported discount rates are weighted directly instead $(1/1.085)^{15} = 0.2941$.

A further assumption of the model is that it represents the individual discount structure via the standard model.[2] In other words it is assumed that, as individuals, people assign weightings over time by way of an exponential arrangement $D = e^{-rt}$, where the discount rate reported is given by $\frac{D'}{D}$ and is equal to the r parameter for all time delays t.[3] In practical terms, although a great deal of experimental information suggests that individual discount rates decrease over time (see, for example, Mazur, 1987; Benhabib, Bisin and Schotter, 2010; Castillo and Zhangallimbay, 2018), the most common applications take an exponential function as a model of analysis; it is thus easy to assume that the opinions obtained proceed from this benchmark model. Lastly, the model incorporates what the author defines as "irreducible uncertainty", assuming that the suggested rates (opinions) follow a gamma probability distribution. In this case, the decreasing function of the discount rate is generated by individual uncertainty about the value that the rate may have in distant periods of time and not necessarily by a pattern of individual preferences differing from the traditional one, like the hyperbolic model.

To put it simply, imagine an executive in charge of analysing a socially important project for an international development institution. Uncertain about whether to accept the project, the executive

[2] Weitzman (2001) concludes that, even if all respondents state that the discount rate is constant, the effective discount rate declines sharply over time.

[3] represents the first derivative of the exponential discount function D.

decides that the best way to assess its economic viability is by seeking the opinion and collaboration of a group of experts, who are charged with proposing an ideal discounting mechanism to transform monetary units into equivalent terms. The general problem is represented as follows:

$$\int_0^\infty A(t)Z(t)dt \tag{2}$$

Where $Z(t)$ is the net benefit and $A(t)$ the discount factor integrated into each period t. If flows $Z(t)$ are given, then the factor $A(t)$ must be the result of considering the j opinions provided by the experts A_{jt}. The executive responsible for making the decision knows that he or she must consider the opinion of all the experts before determining an SDR; however, there is no one right way of doing so. This is where assumptions come in. The exponential structure $A_{jt} = e^{-x_t t}$ for every $j = 1, 2, ..., n$ makes it possible to model the process whereby the opinions and the respective discount rates x_j are generated. Furthermore, the gamma distribution assumption determines the probability that x_j (opinions) will take a particular value x by means of the following function:

$$f(x) = \frac{\beta^\alpha}{\Gamma(\alpha)} x^{\alpha-1} e^{-\beta x} \tag{3}$$

Where the integrated discount factor $A(t)$ is the weighted average of the discount factor or function of each member of the group:

$$A(t) = \frac{\beta^\alpha}{\Gamma(\alpha)} \int_0^\infty x^{\alpha-1} e^{-(\beta+t)x} dx \tag{4}$$

α and β are parameters of the gamma function that are estimated from the data. The implicit discount rate R_t is given by:

$$R(t) = -\frac{A'(t)}{A(t)} \tag{5}$$

Where $A'(t)$ is the first derivative of the integrated discount factor $A(t)$. Resolving (4) and (5) yields the SDR:

$$R(t) = -\left(\frac{\beta}{\beta+t}\right)^\alpha \tag{6}$$

From equation (6), it can easily be deduced that a decreasing discount rate structure is the result of aggregating or integrating the various opinions via the gamma probability distribution. This characterization of discounting is compatible with several behavioural theories that suggest the existence of inconsistent preferences at the aggregate level (decreasing rates), even when preferences at the individual level are consistent (constant rates). One of the advantages of applying the gamma probability distribution is that its parameters α and β can be expressed in terms of the sample mean (μ) and the standard deviation σ of the data:

$$\alpha = \frac{\mu^2}{\sigma^2} \tag{7}$$

$$\beta = \frac{\mu}{\sigma^2} \tag{8}$$

Substituting (7) and (8) into equation (6) gives the effective SDR in terms of the sample mean and variance:

$$R(t) \equiv \frac{\mu}{1 + \frac{\sigma^2}{\mu} t} \tag{9}$$

Lastly, equation (9) indicates an inverse relationship between the SDR and the uncertainty measure σ of the sample. Moreover, the function treats time as a continuous variable. To deal with the SDR from a discrete point of view, Weitzman (2001) determines the average for five defined time intervals: the immediate future (year 1–year 5), average 4%; the near future (year 6–year 25), average 3%; the medium future (year 26–year 75), average 2%; the distant future (year 76–year 300), average 1%; and the far distant future (year 300 onward), average 0%. In the present case of application to Ecuador, bearing in mind some operational criteria for the evaluation of public investment projects, the rates are evaluated for the time intervals indicated in table 2.

Table 2
Evaluation horizon

Interval (years)	Evaluation horizon
0–5	Immediate future
6–20	Medium future
21–50	Distant future
51–100	Far distant future

Source: Prepared by the authors.
Note: Time intervals established in the analysis.

Estimating the SDR by the gamma estimation method involves a discounting approach different to the earlier ones (Harberger, 1972); the result is a discount parameter that decreases depending on the evaluation horizon of the investment project. Again, its application emphasizes the analysis of the opportunity cost of resources over time, so that the resulting SDR is unaffected by changes in other economic prices (account or efficiency prices) and does not affect them in its turn.

Previous approaches to estimating the constant SDR have taken as a benchmark, among other alternatives, estimates of the average productivity of capital based on marginally accepted projects whose economic evaluation was carried out by adjusting market prices to efficiency prices in order to calculate the internal rate of economic return. This practice has several limitations. First, profit flows for projects that are approved tend to be overestimated, so that the average productivity of capital may only constitute a benchmark for the upper bound or maximum discount rate. Second, there are major information constraints; not only is it difficult to identify a representative sample of investment projects evaluated at efficiency prices, but it is also typical for there to be significant delays in updating efficiency prices, and State planning offices or development banks seldom instigate review processes. On top of this, regional integration dynamics have reduced the distortions that necessitate adjustments to market price conversion factors, examples being tariff reduction policies, the removal of subsidies, tax cuts, etc.

The gamma method applied in this study is insulated from these issues in that the benchmark information is derived from an independent decision instrument applied to decision-makers. The perception captured by this instrument is based on the project evaluation experience of those participating in the study, so that a priori it can be stated that their decision should encapsulate all the elements of analysis presented, without regard to the need to update factor efficiency prices for the economic evaluation of investment projects.

2. Data and adaptation

To apply the proposed method, a survey was conducted among a group of experts, analysts and decision-makers working on issues related to investment analysis and the evaluation of public and private investment projects. The group included four categories of people: teaching staff from the faculties of economics and administration of various universities (academics), postgraduate students in the areas of economics and business (master's students), financial sector managers and analysts connected to the country's association of private banks (financiers) and managers or business people connected to the chambers of industry, production and commerce (business people).[4] In the data collection process, 950 survey questionnaires were sent out via email. The surveys were designed and distributed using the SurveyMonkey digital tool. Arrangements were also made to confirm receipt of the emails and present the study to participants, both directly and through the associations of which they are members. The response rate was 28%. A total of 269 completed surveys were obtained, distributed among the four reference groups of the study.[5] Table 3 presents the composition of the sample.

Table 3
Composition of the sample of persons answering the survey designed for the study

Category	Frequency	Percentage
Academics	167	62.08
Master's students	82	30.48
Financiers	5	1.86
Businesspeople	11	4.08
Total	269	100

Source: Prepared by the authors.
Note: The survey was applied digitally using the SurveyMonkey tool.

Weitzman (2001) directly asked respondents about the SDR parameter for discounting the benefits and costs of climate change mitigation projects.[6] The question he put in his study was: Taking all relevant considerations into account, what real interest rate do you think should be used to discount over time the (expected) benefits and (expected) costs of projects being proposed to mitigate the possible effects of global climate change?

However, there are several drawbacks to this procedure. Some respondents state that they do not have sufficient knowledge in this area to give an opinion; others speak of the need to have differentiated rates for developed and developing countries; lastly, others clearly fail to understand the question. Problems of understanding can be encountered even in groups of experienced people, which can lead to biases in their answers and estimates. However, differences in opinions and value judgements regarding discounting mechanisms have more fundamental reasons related to intergenerational welfare and the allocation of public resources, among other issues (Weitzman, 2001). To minimize confusion, Edwards (2016) proposes a different survey methodology, using three hypothetical questions which are easy to understand and whose collection structure is adaptive, i.e. dependent on previous responses. In this way, instead of a single parameter, a range of discount rates is obtained from each respondent (see annex A1).[7]

[4] The authors would like to thank the Association of Private Banks of Ecuador (ASOBANCA) and the Chamber of Industries and Production (CIP) for their collaboration with this survey.

[5] We would like to highlight the quality of the responses received and the consistency between the answers and the control questions.

[6] The sample for this study totalled around 2,100 observations, including experts and economists from all over the world.

[7] Respondents choose between two possible investment projects, one generating profits valued at US$ 1.5 million over 15 years and one generating US$ 2.5 million over 30 years.

The survey used for the present study consists of three questions presenting a choice between investment projects with long-term benefits. To capture potential design bias in the magnitude of the parameter, three versions of the questionnaire (E1, E2 and E3) were designed (see, for example, Coller and Williams, 1999; Harrison and others, 2005). Each version differs in the amounts generated by the investment projects: low amounts, medium amounts and high amounts (see annex A2).[8] In addition, each version allows four discount ranges to be specified: as the amounts increase, the discount ranges also differ, so that a total of 12 discount ranges are available (see table 4). For reasons of simplicity and efficiency, the midpoint of each range is taken as an approximate indication of the SDR for each respondent.[9] The overall range of the 12 options is from 0.98% to 14.13%. The range includes the current administrative rate of 12% as a validation mechanism.

Table 4
Discount ranges
(Percentages)

Survey	Lower bound	Upper bound	Approximate social discount rate (SDR)
E1	0	1.96	0.98
E1	1.96	3.41	2.69
E1	3.41	6.54	4.98
E1	6.54	-	6.54
E2	0	4.62	2.31
E2	4.62	7.32	5.97
E2	7.32	10.73	9.03
E2	10.73	-	10.73
E3	0	3.41	1.70
E3	3.41	10.73	7.07
E3	10.73	14.13	12.43
E3	14.13	-	14.13

Source: Prepared by the authors.
Note: The surveys are distributed independently.

Lastly, some individual characteristics of participants are also collected to assess their possible relationship with discount levels, including age, gender, work experience, number of children, risk aversion and others (see table 5).

Table 5
Sample characteristics

	N	Mean/proportion	Standard deviation	Minimum	Maximum
Female	199	0.32	0.47	0	1
Education level	200	3.12	0.55	2	4
Age	199	38.28	8.90	23	63
Has children	200	0.61	0.49	0	1
Work experience (years)	200	14.94	8.59	2	43
Risk aversion	207	6.70	1.99	1	10
Risk (DOSPERT)	207	4.98	1.43	1.33	9

Source: Prepared by the authors.
Note: Some respondents did not answer the survey in full, so there are discrepancies in the observations. The education level categories are: 1 = secondary, 2 = university, 3 = postgraduate, 4 = doctorate. Risk aversion is determined by a self-reported measure of willingness to take risks, on a scale of 1 to 10. The DOSPERT score is the average of the self-reported measures of risk in six areas: driving a vehicle, finance, sports, health, work and trust in others.

[8] While this process does not completely correct the framing problem, it allows for greater variation in the discount rates approximated by the survey, capturing a wider range of discount preferences.

[9] Edwards (2016) considers it necessary to estimate the SDR when a discount range is obtained; however, this approach does not represent a significant change in the sample mean and variance that are needed in gamma estimation, as compared to the application of a rate approximated by the midpoint of the range.

3. Adjusting for short-term preferences

In the gamma discounting methodology, the data collection mechanism is generally expressed in a context of long-term preferences. While an individual with time-consistent preferences should theoretically maintain the same intertemporal discount structure in the short and long terms, present value bias, i.e. the temptation to obtain immediate returns when they are imminent, is an anomaly that produces distortions between the two approaches. Because the Edwards (2016) methodology does not properly capture preferences in short-term periods, we adjust our results by including the following question in the survey: What is the minimum amount you would be willing to receive today (in dollars) rather than 200 dollars in three months' time?

An effective discount rate[10] determined in a three-month lag period is derived from the reported value. A value for each respondent's annual effective rate is obtained by applying rate equivalence. Using the same opinion integration mechanism, a general decreasing discount rate function can be estimated on the basis of lag t (years). The question is whether this exercise reflects behaviour similar to that observed for the integrated discount function in the original long-term mechanism. Although the original mechanism proposes a context in which there is a choice of investment projects with returns in periods that are far off in time, the mechanism is not immune to individual preferences. Therefore, if there are substantial differences in the rates determined by each of the functions over the different time intervals set, a better approximation to the SDR must be an average of the resulting rates.

IV. Results

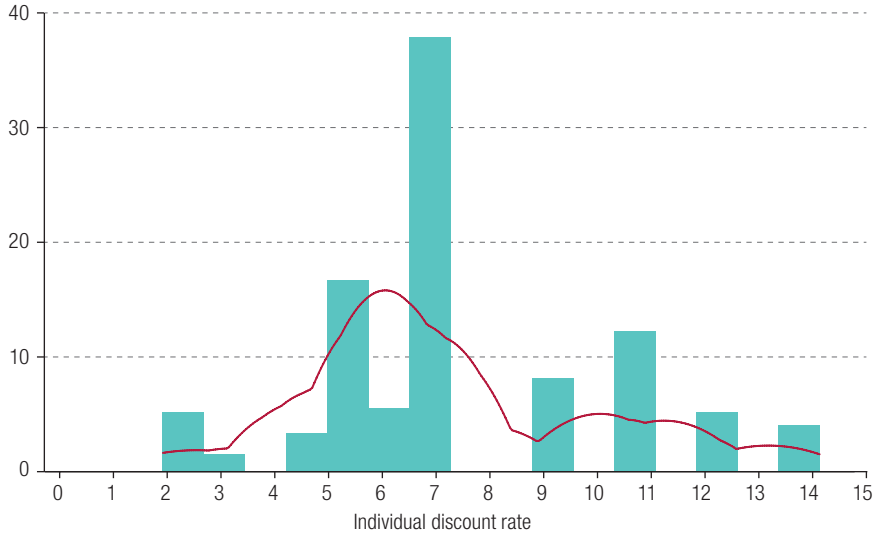
First, the results obtained using the original survey mechanism are analysed from a long-term perspective. Figure 1 presents the frequency histogram of the approximate discount rates collected and obtained using the three questions in the three versions of the survey applied to experts, academics, master's students, financiers and businesspeople. The gamma discounting methodology was used to integrate preferences, and a decreasing function of the SDR was estimated.

Equation (9) suggests that the SDR is equal to the weighted average of the μ data when $t = 0$; in the present case, this rate is 7.17%. In the estimation mechanism, $t = 0$ corresponds to periods shorter than the minimum period included in the survey, which is 15 years. The instantaneous rate in our results is higher than the value of 3.96% obtained by Weitzman (2001) and that of 4.92% obtained by Edwards (2016) in the case of Chile, but lower than the value of 10.76% found by Correa (2008b) for Colombia. The standard deviation σ of our data is 3.0024, which is lower than that found for Colombia (Correa, 2008b) and close to that of Weitzman (2001). Substituting the parameters μ and σ, the effective discount rate for each period t, according to the method used by Weitzman (2001), is given by:

$$R(t) = \frac{7.1722}{1 + \frac{(3.0024)^2}{7.1722}} \tag{10}$$

[10] When the exponential model is applied, the amount (present value) reported by participants is equal to , where r is the individual discount rate.

Figure 1
Histogram of the social discount rate (SDR)
(Percentages)



Source: Prepared by the authors, on the basis of the social discount rate obtained from a three-question survey.

An important point is that in short-term periods, e.g. periods of less than 15 years, the proposed methodology has difficulty in reflecting social preferences.[11] For practical reasons, however, the estimates in this study assume consistent behaviour from the earliest years. Thus, to evaluate public investment projects in Ecuador, the economic flow generated by the investment in year 5 should be discounted at a rate of 6.87%, while the flows generated in years 15 and 30 should be discounted at rates of 6.03% and 5.21%, respectively. Note that only one rate is estimated for each year's lag. However, equation (12) can be used to determine a rate that is constant and equivalent ($\bar{R}$) to the decreasing process of the discount rate.

$$\bar{R} = \frac{1}{\int_0^{\infty} A(t)dt} \tag{11}$$

Substituting equation (3) into (9) gives:

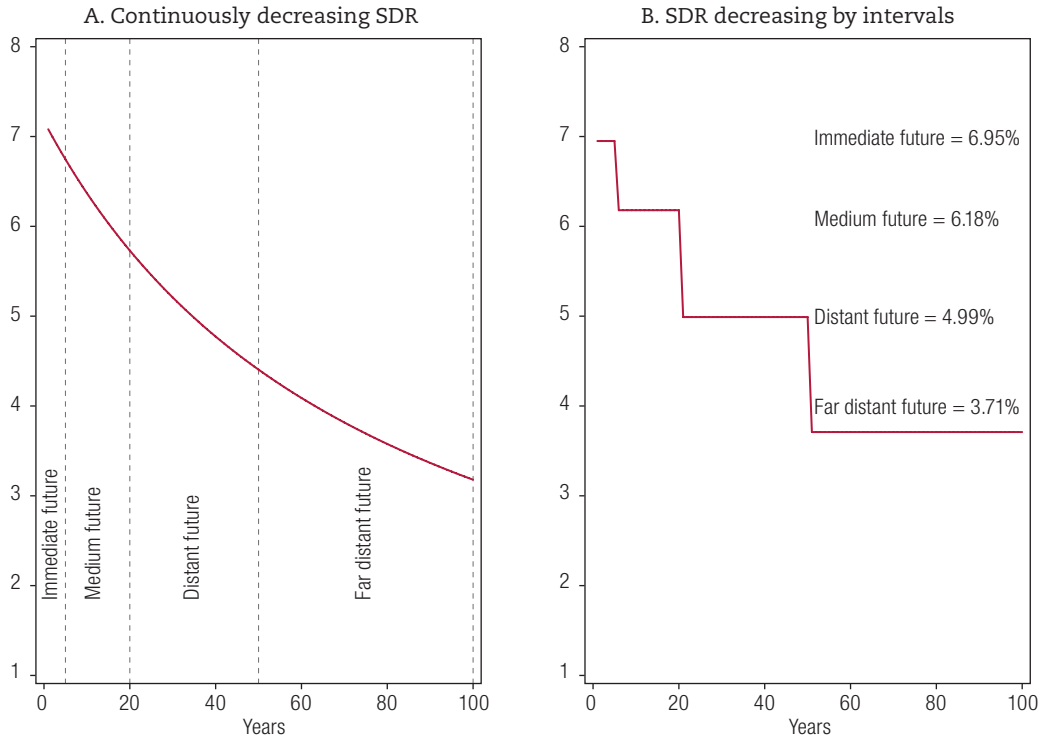
$$\bar{R} = \frac{(\mu-\sigma)(\mu+\sigma)}{\mu} \tag{12}$$

The constant equivalent rate for our estimates is 5.91% per annum, which is considerably lower than the administrative rate applied by several countries and some multilateral organizations. In relation to other similar estimates in the region, the equivalent rate ($\bar{R}$) is lower than that obtained in Colombia (8.0%) and higher than that estimated by Weitzman (2001) (1.43%).

Figure 2A shows the dynamics of the integrated SDR. A fairly moderate decrease can be observed, from a rate of about 7% for the first year to one of about 3% for the hundredth year.

[11] Edwards (2016) recognizes that the rates that can be inferred by his methodology are only consistent if is a year subsequent to the starting year established in the survey, which in our case is year 15.

Figure 2
Estimated long-term social discount rate (SDR)
(Percentages)



Source: Prepared by the authors, on the basis of the preference estimation mechanism (survey).

To implement a decreasing discount approach, thus capturing in the assessment criteria the large body of information that supports this discounting dynamic, the time intervals identified earlier can be used. In each segment, the SDR values are grouped by the average of the function in the time interval corresponding to the evaluation horizon. Figure 2 shows the dynamics of the SDR for Ecuador. Preliminary results suggest a discount of around 7.0% for the flows in the first 5 years, 6.0% for the next 15 years, 5.0% for the next 30 years and 3.7% for the next 50 years. A rate of 1.0% can be applied when assessing projects with longer-lasting effects (a horizon of more than 100 years) (see figure 2B). While in practice these assessment horizons are not commonly used, particularly in the region, in the United States, for example, the Environmental Protection Agency (EPA) uses horizons of more than 100 years to analyse its many research programmes, including the Air, Climate, and Energy programme, the Chemical Safety for Sustainability programme and the Safe and Sustainable Water Resources programme.

The basic assumption of the estimates is that, by its structure, the survey compels subjects to consider options for benefits to future generations, so that benefit preferences for their own generation (short term) are underestimated. To correct for potential inconsistencies in the estimations of rates for the short term, i.e. the immediate future and the medium future, the question about individual preferences over time is analysed for a period of three months and with a future value of US$ 200. The information collected by this question does not have a predetermined range in the survey design and, unlike Edwards (2016), we avoid adding the hypothetical context of public investment projects, instead directly obtaining individual preferences over time.

The results yield significantly higher rates than those determined by the original mechanism in Weitzman (2001). The range is from 1% to in excess of 200%. This result potentially derives from two sources: (i) the magnitude of the hypothetical reward in the question, which artificially makes the present

more attractive, or (ii) pure present value bias, irrespective of the proposed amount. Even so, it is still possible to assume that individual preferences regarding the discount rate follow a gamma probability distribution (see figure 3). Consequently, the expert opinions are aggregated, the aggregate discount function is determined and the function for the SDR is estimated for the lags of t. The results show discount rates of 14%, 2%, 1% and 0% for the immediate future, the medium future, the distant future and the far distant future, respectively (see figure 4).

Figure 3
Annual discount rate (short term)
(Percentages)

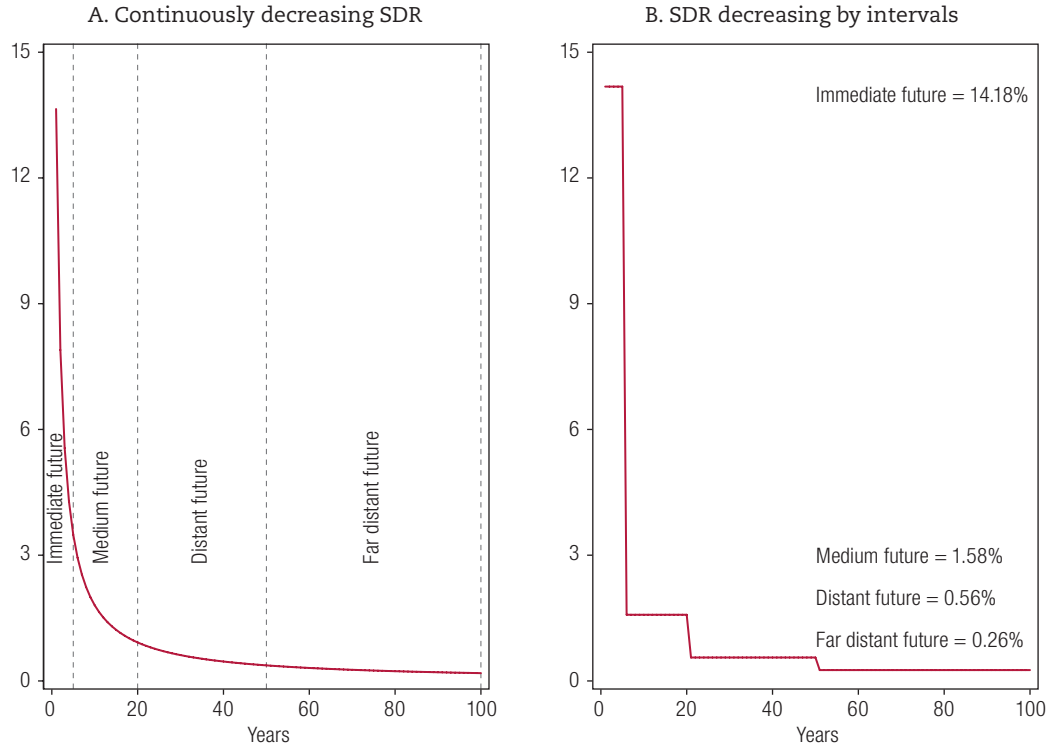
Source: Prepared by the authors, on the basis of the preference estimation mechanism (survey).

Figure 4A shows the dynamics of the annual rates estimated with the short-term estimation mechanism. In contrast to what is observed in figure 2, the process shows a more rapid decline than in the initial (long-run) context, possibly owing to the increase in the standard deviation (σ) of the data in this mechanism. Considering both the magnitude and variance effects of the response, what would be expected for the estimated rates in the short-run context is a steeper decline curve, but with higher rates than in the long-run context. However, our results show a considerable increase in the early years (for example, the estimated function suggests an SDR of over 120% for discounting the flow generated in the first year), while for year 100 the suggested SDR is lower than that of the long-term context, at about 0%.

Much as in other studies (see Herrnstein, 1961; Ainslie and Herrnstein, 1981; Loewenstein and Prelec, 1992; Coller and Williams, 1999; Manzini and Mariotti, 2007; Benhabib, Bisin and Schotter, 2010; Castillo and Zhangallimbay, 2018), the above results reveal the inconsistencies of individual preferences with respect to time and the context of analysis (see figure 5). The preference elicitation mechanisms, like the SDR estimation alternatives, are not universally consistent and are sensitive to the method of exposure or framing employed in the data collection questionnaire. In the face of this instrumental dilemma, and considering that the alternatives proposed are more cost-effective than larger-scale elicitation options, what is proposed is harmonization of the implicit biases in the two contexts, given that they reflect respondents' opinions and social preferences. It is also interesting to note that the estimated rates for the immediate future (1–5 years) in both the short- and long-term scenarios are in the range of 7%–14%, which the standard administrative rates usually employed fall into. In other words, our estimates suggest that these rates are good evaluation parameters for short-term projects

(less than 5 years); for longer evaluation horizons, however, these rates over-devalue the future net flows generated by a project, in a process where preferences for high returns in short periods of time predominate over the search for a balance of benefits taking account of the effect on future generations.

Figure 4
Estimated short-term social discount rate (SDR)
(Percentages)

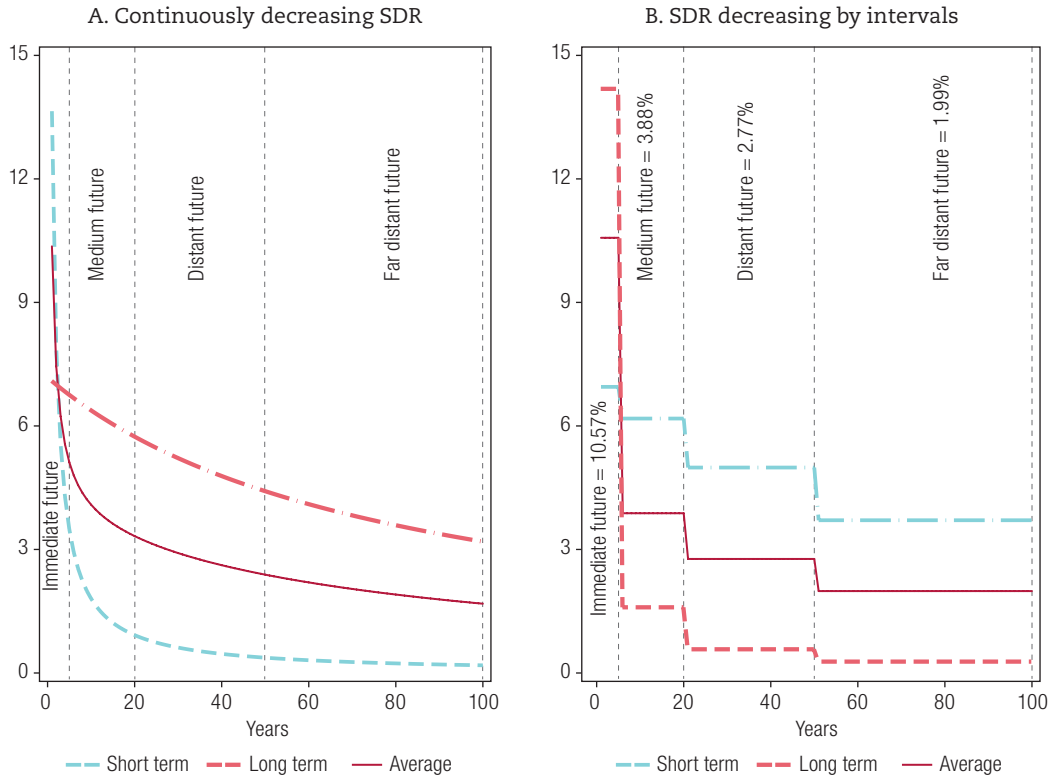


Source: Prepared by the authors, on the basis of the preference estimation mechanism (survey).

To harmonize the two approaches and adjust the estimates for the short- and long-term elicitation contexts, the average of the functions of the two estimates is evaluated. The solid line in figure 5 shows this dynamic. The high rates observed in the short-term context make it possible to adjust the component not considered by the Edwards methodology, which is precisely what prevents appropriate discount rates from being established for the early years of a project's life. In this case, correction is achieved by obtaining information from the agents themselves, emphasizing the need to determine more precisely the value of short-term returns, especially those that are potentially received in their own generation.

When these adjustment elements are considered in our estimates, the results suggest the application of a rate of about 11% for discounting economic flows generated in the immediate future (the first 5 years), about 4% for flows generated in the next 15 years, about 3% for the next 30 years and about 2% for the last 50 years, within a reference horizon of 100 years. Once again, if the assessment period extends beyond 100 years, a rate of 1% is recommended.

Figure 5
Social discount rate (SDR) adjusted for the short and long terms and for the average of these
(Percentages)



Source: Prepared by the authors, on the basis of the preference estimation mechanism (survey).

1. Determinants of long-term preferences

As an additional element of analysis providing important information about the type of answers given by the experts consulted, we analyse whether there is a relationship between individual characteristics and the time preferences reported, specifically with regard to the long term. The information collection questionnaire gathers a battery of data on participants' individual characteristics, including gender, age, work experience, level of education and level of risk aversion. In addition, the structure of the three-question survey used to obtain the SDR specifies four preference intervals arranged in ascending order and assigned on the basis of each subject's responses. The two supplementary versions of the survey present an increase in the magnitude of the benefits of public investment projects; however, they offer other discount intervals with different rates that are higher on average. Interval regression analysis was used to assess the relationship between the individual discount rate and the characteristics of the survey participants.

Table 6 presents the results. Two dichotomous variables capture the fixed effect of the additional versions of the survey (survey 2 and survey 3). Because the rates identified are higher on average in the two supplementary versions, a positive and significant relationship was found for one of these variables. That is, there is a framing effect in the way individual discount rates are obtained, something that should be taken into account in the design of questionnaires. In addition, a positive relationship between age and SDRs is observed, albeit a weak one (statistically significant only at 10%), which is apparent only when the estimation includes controls for individual preferences (risk aversion). In terms of behaviour, this result suggests that discounting behaviour changes with age, an observation documented in other

research; however, the observed relationship is the reverse of what has been found in other studies: the greater the age, the higher the discount rate. While this result may reflect respondents' levels of impatience or self-control, its low significance means that we have opted not to draw any further conclusions from it. Lastly, we find empirical evidence supporting the relationship between time and risk preferences (significant at 10%), insofar as more risk-averse individuals tend to report a preference for higher discount rates (i.e. a greater preference for the present).

Table 6
Determinants of time preferences

	Dependent variable Intervals of the social discount rate (SDR)	
	(1)	(2)
Age	0.4554	0.5091*
	(0.2910)	(0.2847)
Age2	-0.0048	-0.0055*
	(0.0034)	(0.0033)
Academic	-0.6856	-0.6813
	(0.8059)	(0.7888)
Has children	-0.1323	-0.0690
	(0.7607)	(0.7481)
Female	0.2975	0.4265
	(0.6508)	(0.7208)
Work experience (years)	-0.0323	-0.0251
	(0.0740)	(0.0738)
Education level	-0.5960	-0.5026
	(0.6027)	(0.6221)
Risk aversion		0.3335*
		(0.1896)
Risk (DOSPERT)		0.0050
		(0.3056)
Survey 2	1.9580***	1.9651***
	(0.7059)	(0.6917)
Survey 3	1.4412	1.4008
	(1.0633)	(1.0515)
Constant	0.6187	-3.1365
	(5.7615)	(6.2018)
Other controls	No	No
Observations	187	187

Source: Prepared by the authors.
Note: Participants for whom all information is available are considered (187). Risk aversion is determined by a self-reported measure of willingness to take risks, on a scale of 1 to 10. The DOSPERT score is the average of self-reported risk aversion in six areas (driving a car, finance, sports, health, work and trust in others).
Robust standard errors are shown in brackets.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

V. Conclusions

The SDR is a key parameter for economic and financial project evaluation. Cost-benefit analysis decisions, both in investment appraisal and in broader analyses such as those related to climate change, depend crucially on its level. However, despite its importance, there is considerable uncertainty as to the appropriate level for each country or context of analysis, and in most cases a simple approach has been chosen: to use a common administrative rate. In Ecuador, as in other countries of the region, an unvarying rate of 12% is used; however, this rate is very far from incorporating the changing dynamics of social preferences over time.

This paper identifies the need to continuously update the parameters required for the appraisal of public investments. It presents a cost-effective alternative for estimating the SDR that captures the wealth of empirical information on behaviour in respect of inconsistencies in time discounting and discount rates that decrease over time (hyperbolic discounting), while adjusting the estimates for the difference in context between short- and long-term decisions.

The results, adjusted for the time context by averaging the short- and long-term functions, yield a different level of discounting for four time horizons: the immediate future (approximately 11%), the medium future (approximately 4%), the distant future (approximately 3%) and the far distant future (approximately 2%). In this context, the administrative rates commonly applied are justified on the basis of the evaluation of profit flows obtained in the immediate future (5 years), which generates significant distortions in the economic valuation of investment projects.

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Annex A1

Three-question survey

(i) If you had to decide today between two projects, a government project generating returns that can be valued at US$ 1.5 million over 15 years and a government project generating returns that can be valued at US$ 2.5 million over 30 years, which would you choose?

- US$ 1.5 million over 15 years
- US$ 2.5 million over 30 years

(ii) You chose the project generating US$ 1.5 million over 15 years over the project generating returns of US$ 2.5 million over 30 years.

If now the returns of the second option rose to US$ 4.0 million with the same time horizon (30 years), which option would you choose?

- US$ 1.5 million over 15 years
- US$ 4.0 million over 30 years

(iii) You chose the project generating US$ 2.5 million over 30 years over the project generating returns of US$ 1.5 million over 15 years.

If now the returns of the 30-year project fell to US$ 2.0 million, which option would you choose?

- US$ 1.5 million over 15 years
- US$ 2.0 million over 30 years

Estimating the social discount rate (SDR) interval

For example, if someone answered that they chose the project generating returns valued at US$ 2.5 million over 30 years over the project generating US$ 1.5 million over 15 years, we get:

$$1.5e^{-15r} < 2.5e^{-30r}$$

$$ln(1.5e^{-15r}) < ln(2.5e^{-30r})$$

$$ln(1.5) - 15r < ln(2.5e) - 30r$$

$$r < 3{,}41\%$$

If this individual answered in the next question that they chose the project generating US$ 2.0 million over 30 years over the one generating US$ 1.5 million over 15 years, we get:

$$1.5e^{-15r} < 2e^{-30r}$$

$$r < 1.96\%$$

Consequently, this individual's answer, $r <$ 1.96%, is in the first proposed SDR range.

Annex A2

Survey versions

Table A2.1
Amounts in the surveys

Version	Time	Amount *(dollars)*
Survey 1 (low amounts)	15 years	1.5 million
	30 years	2.5 million
	30 years	2.0 million
	30 years	4.0 million
Survey 2 (medium amounts)	15 years	5.0 million
	30 years	15.0 million
	30 years	10.0 million
	30 years	25.0 million
Survey 3 (high amounts)	15 years	3.0 million
	30 years	15.0 million
	30 years	5.0 million
	30 years	25.0 million

Source: Prepared by the authors.
Note: The surveys were applied randomly.

The growth trajectories of Argentina, Brazil, Chile and Mexico: a comparative view through the framework space lens

Carmem Feijo, Lionello Franco Punzo
and Marcos Tostes Lamônica

Abstract

This paper discusses different growth trajectories in a selection of Latin American economies, namely Argentina, Brazil, Chile and Mexico, comparing the phase of import substitution growth strategies with the more recent period of financial integration into the world economy. Our working hypothesis is that different growth trajectories result from the linkages between macroeconomic conditions and changes in production structures. When policy space becomes narrower, long-term growth performance is impaired and structural change will not usually enhance growth potential. We carry out an analysis based on the framework space methodology, which serves to compare phases of growth described as an evolving coupling of the dynamic profile of productivity growth (a supply-side condition) with the behaviour of capital accumulation (a demand-side condition). In light of the framework space comparative analysis, our main conclusion is that economic opening in the 1990s did nothing to further the catching-up process in any of the four economies.

Keywords

Economic growth, import substitution, economic liberalization, economic integration, economic policy, economic history, comparative analysis, Argentina, Brazil, Chile, Mexico

JEL classification

E44, O11, O54

Authors

Carmem Feijo is a Professor at the Department of Economics of the Universidade Federal Fluminense. Email: cbfeijo@gmail.com.

Lionello Franco Punzo is a Professor at the Department of Economics and Statistics of the University of Siena. Email: punzo@unisi.it

Marcos Tostes Lamônica is Associate Professor at the Universidade Federal Fluminense. Email: marcostostes@hotmail.com

I. Introduction

Until the late 1970s, State-led import substitution industrialization was the dominant developmental strategy in most Latin American economies. This strategy was abandoned after the external debt crisis of the 1980s, which it took almost the whole decade to recover from. The ending of the long economic recession that followed the debt crisis (known as the "lost decade") is associated with economic opening and a deepening process of financialization in the region.[1]

As part of the financialization process, trade liberalization, privatization and financial deregulation became the main economic policy recommendations, and the management of monetary and fiscal policies came to be largely subordinated to the views of the international financial markets. As argued by Ocampo and Vos (2008), policy space in developing economies, and in Latin American economies in particular, has narrowed greatly since economic opening.[2] According to these authors, this narrowing has meant a loss of autonomy for economic authorities when it comes to implementing "effective countercyclical macroeconomic policies consistent with longer-term development objectives and developmental policies" (p. 29).[3] Their main argument is that, capital flows being procyclical, economic opening restricts the authorities' ability to manage countercyclical economic policy in response to booms and busts. Indeed, Ocampo (2007) argues that capital flows to developing countries "exacerbate rather than dampen both economic booms and recessions" (p. 9).

Interest in the growth strategies of Latin American economies has recently revived, with Bárcena and Prado (2016), for example, presenting a discussion of the different phases of Latin American growth since the 1980s. On the basis of the region's economic cycles, which have mostly been determined by external shocks, the study proposes a criterion for identifying different growth periods. In the structuralist tradition, structural change is assumed to depend on the strength and continuity of investment in capital accumulation, this being the main force driving and sustaining growth. Since investment is the most dynamic component of aggregate demand, short-term macroeconomic policy management, conducted in the interests of higher long-term growth, must succeed in curbing volatility in the main macroeconomic prices and in maintaining a countercyclical fiscal stance, a low and stable long-term inflation rate, low real interest rates and a real exchange rate that is competitive over time.

Our main focus in this paper is on the different growth trajectories of four Latin American economies, namely Argentina, Brazil, Chile and Mexico,[4] comparing the period of import substitution growth strategies with the more recent period of financial integration into the world economy. Our working hypothesis is that different growth trajectories result from the linkages between macroeconomic conditions and changes in the production structure. In this light, economic policy plays an important role in explaining the growth process, thus influencing the long-term trajectory. When policy space diminishes, long-term growth performance is impaired and structural change does not contribute to an increase in growth potential. In other words, we assume that structural change is important in explaining long-term growth performance, but that it does not occur smoothly and generally results in unbalanced growth with consequences for internal and external equilibria. For potential output to increase, then,

[1] Financialization can broadly be defined as taking place when financial markets, actors, practices and representations have a growing impact on social structures and dynamics (see Epstein, 2005).

[2] China and India are rare examples of cautious financial integration, and it is no coincidence that they have performed better than other developed and developing economies since the international financial crisis. See Nassif, Feijo and Araújo (2016) for a discussion of the economic performance of Brazil, Russia, India, China and South Africa (BRICS) since the financial crisis.

[3] Rey provides another way of looking at the loss of autonomy in financially integrated developing countries' economic policies. In a recent and influential paper, the author argues that independent monetary policies are possible in developing economies only if the capital account is managed (Rey, 2015).

[4] See, for instance, Moreno and Pérez (2009), who mention that these were the economies that followed a State-led industrialization strategy. They were also responsible for over 50% of total manufacturing value added in Latin America in the 2010s.

the policy space should be enlarged so that long-term policies (such as industrial and technological policies) can be closely coordinated with short-term macroeconomic policies.[5]

To argue this point, we shall conduct our analysis on the basis of the framework space methodology, which will allow us to compare phases of growth, described as an evolving coupling of the dynamic profile of productivity growth (a supply-side condition) with the behaviour of capital accumulation (a demand-side condition). Interaction between these two drivers naturally generates a non-linear growth trajectory, punctuated by discrete jumps or discontinuities, and of course this trajectory need not tend towards any predetermined equilibrium position (as predicted in conventional theory). As a bonus, the framework space methodology will allow us to interpret the phases of economic growth with reference to either the Kaldorian or the neo-Schumpeterian position, and classify accordingly the various structural changes Latin American economies have undergone. Thus, the main contribution of this paper is to provide an analytical interpretation, based on the framework space methodology, of the differences in the growth trajectories of these four Latin American economies.

After this Introduction, section II introduces the framework space methodology. Section III identifies three periods associated with different growth trajectories, and these are analysed in section IV for each individual economy, the contribution of this section being to interpret each country's historical growth record on the basis of the empirical framework space evidence, thereby providing an overview of each economy. Our main conclusion in the light of the framework space comparative analysis is that economic opening in the 1990s did nothing to further the catching-up process in any of the four economies. Section V summarizes our main conclusions.

II. The framework space methodology

The conventional approach to long-term growth implicitly assumes that real-world economies tend in the long run to a particular path forming part of a stable regime, and that this is so strong an attractor that any shorter-run dynamics are transient movements and practically irrelevant.[6] However, observed data fluctuate all the time, so growth patterns should be evaluated against the dynamics of related variables. To deal with this issue, the framework space methodology incorporates a menu of growth models, and it is from this menu that actual patterns of growth are constructed.[7]

The framework space is an analytical device used to focus on variables such as capital accumulation, employment and productivity. The primary justification for choosing these is, of course, that they are the variables employed by the growth theories familiar to us. The framework space takes only the rate of growth in investment per employee (on the vertical scale) and the rate of growth in labour productivity (on the horizontal scale) (see Böhm and Punzo, 2001, p. 48). The purpose of this selection is to explain the relationship between the dynamics of fluctuations in productivity and the dynamics of fluctuations in investment per employee. Construction of the framework space starts with the GDP or value added (va), real-term gross fixed capital formation (i) and employment (e) series. Thus, it is defined as:

$$\frac{d\left(\log va - \log e\right)}{dt} = gv \tag{1}$$

[5] Following the Kaleckian tradition, Titelman and Pérez (2016, p. 162) express this as follows: "A first important implication to arise from the analysis is that macroeconomics for development should not present cycle and trend or the short and long run as dichotomous elements. Short-term fluctuations do affect long-term outcomes."

[6] This prediction is crystal clear in neoclassical theory, which holds that the rate of economic growth in the steady state eventually arrived at will depend only on population growth and technical progress. It was this clarity that brought it to prominence as a theory and as a set of econometrically falsifiable propositions.

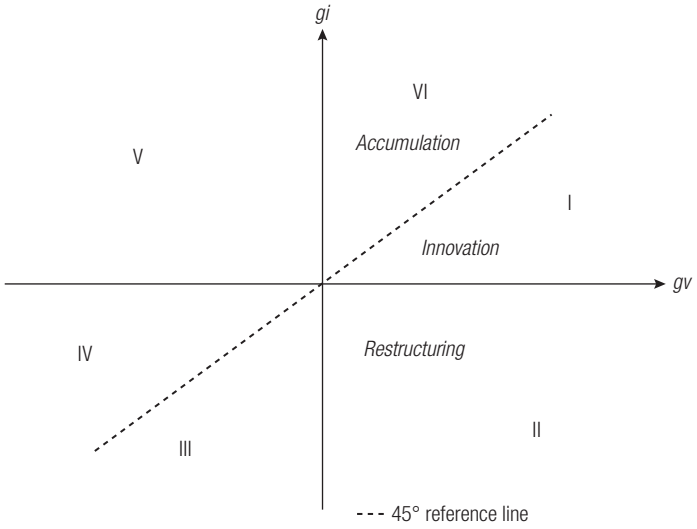
[7] A full presentation and discussion of the framework space approach can be found in Böhm and Punzo (1992, 1994 and 2001), Brida and Punzo (2003), Gaffard and Punzo (2005) and Feijo, Punzo and Lamonica (2012).

$$\frac{d(\log i - \log e)}{dt} = gi \tag{2}$$

where gv is the growth rate of output per employee (a measure of productivity growth) and gi is the growth rate of investment per employee. The variables gv and gi provide the coordinates for the dynamic trajectory of a given economy in the plane (figure 1). Changes in coordinate levels (gv, gi) represent changes in the dynamic relationship of the economy analysed and may signify a shift in the intensity of changes in the variables or the regime, i.e. structural change.[8]

Figure 1 shows how to interpret growth trajectories and their phases in the framework space apparatus. Six standard growth regimes and one special growth regime are dealt with in this framework. The latter is the line that intersects the plane of the coordinates (gv, gi) at 45 degrees; this is the so-called Harrodian corridor[9] separating regime IV above the line from regime I below the line. Both regime VI (accumulation) and regime I (innovation) are in the first quadrant where economic growth occurs, i.e. where rates of productivity growth (gv) and investment per employee (gi) are positive. Regime II (restructuring), in the second quadrant, combines a positive gv and a negative gi. The other regimes, III, IV and V, are treated in the analytical structure of the framework space as reflections of the regimes mentioned above.

Figure 1
Growth regimes in the framework space



Source: Prepared by the authors.

[8] Structural change is interpreted differently in other approaches. It can occur when there are changes in the composition of GDP or economic aggregates, or when there is a change in the organizational and institutional structure of an economy. In Kaldor's view, structural change is observed when there are changes in the composition of manufacturing industry in respect of technological intensity, captured by the elasticities of demand for exports and imports. Thus, according to the Kaldor-Thirlwall model, a structural change might be favourable or unfavourable to the growth of an economy in which the balance of payments is in equilibrium. See Dixon and Thirlwall (1975) and Thirlwall (1979). Also, structural change implies an interrelation between supply and demand forces accounting for growth trajectories. A large body of literature associated with endogenous growth theory supports this approach (De Long and Summers, 1991; León-Ledesma, 2002; Syverson, 2010). León-Ledesma (2002), for instance, estimated a structural model for a set of Organization for Economic Cooperation and Development (OECD) countries over the period 1965–1994. In addition to the impacts of investment and the traditional Kaldor-Verdoorn law, the paper also captures the direct and indirect effects of innovation and technical progress on the behaviour of labour productivity. In the author's words, "innovation not only leads to a higher degree of product differentiation and quality but also to process innovation leading to increased productivity" (León-Ledesma, 2002, p. 204).

[9] Harrodian behaviour is represented by the steady-state trajectories. The coordinates (0,0) are associated with the exogenous growth trajectory (Böhm and Punzo, 2001, p. 53) with a zero rate of technological progress (see below).

The relevant interpretation for our argument is that the framework space is endowed with three categories of growth regimes: (i) steady state; (ii) accumulation, where the focus is on changes in the intensity of investment, with productivity rising with capital accumulation (assuming technical progress is incorporated);[10] and (iii) innovation, which is functionally independent of capital accumulation, growth in this case being explained by innovations, be they new organizational forms or processes or the introduction of new products that increase the gap between unit costs and the final price. The growth trajectory is given by the sequence formed as a function of the pairs of gv and gi, distributed in the framework space plane. Each point in the framework space where these coordinates intersect is associated with a growth trajectory.

The framework space can be related straightforwardly to the predictions of the conventional theories. For example, neoclassical theory identifies a unique global attractor, a steady-state path in which the growth rate g_{NC} is defined as:[11]

$$g_{NC} = n + \lambda \tag{3}$$

where n is the rate of population growth and λ is technical progress. However, the observed rate of economic growth g will usually be different from this exogenous growth. The framework space thus attempts to explain the endogenous rate of growth g_{EN} as the deviation from the steady-state growth rate.[12]

$$g_{EN} = g - \left(n + \lambda\right) \tag{4}$$

The framework space takes the g_{NC} rate as the starting point for figure 1, i.e. the coordinates (0,0), in order to carry out the analysis of the endogenous growth rate. We thus assume that the behaviour of the effective rate g influences the long-term trajectory and thence that the endogenous growth rate can be explained by two regimes or growth models: capital accumulation and innovation.

In sum, all long-term theories are present in the two-dimensional framework space. The Solow (1957) model is the starting point, and the observed points lying elsewhere are associated with endogenous growth[13] that can be explained by both the theory, i.e. capital accumulation, and the innovation regime.

[10] See Kaldor (1957) and Kaldor and Mirrlees (1962), among others.

[11] It should be noted that in the neoclassical theory there is no clear distinction between a growth accumulation regime and a growth innovation regime when technical progress is assumed to be exogenous. To incorporate technical progress into modern growth theory, the production factors of capital (K) and labour (L) are modified, and the traditional aggregate production function $Y = Y(K,L)$ can be written with the addition of a time-dependent multiplier $A(t)$ that incorporates overall technical progress. Thus, according to Romer (2012, p. 10), the neoclassical aggregate production function incorporating technical progress can be written as: $Y(t) = F(K(t), A(t)L(t))$, where t denotes time. According to Aghion and Howitt (2009), however, this modification of the traditional production function to incorporate technical progress still leaves unexplained how this is incorporated. Thus, $A(t)$ can be seen as a useful modelling device, but one with little explanatory power.

[12] León-Ledesma and Thirlwall (2002) tested the hypothesis of the endogeneity of the natural rate of growth for a group of 15 OECD countries, as did Libânio (2009) for the group of the 12 largest economies in Latin America, in both cases successfully. The natural rate of growth rises in periods of expansion and declines during periods of contraction because the labour force and productivity growth are elastic to the growth of demand and output.

[13] Endogenous models with an emphasis on situations of imbalance are inspired by the contributions of Richard Goodwin. See Punzo (2006).

III. Growth trajectories in the period 1951–2014: an overview of the growth performance of the four selected economies

To shed some light on how to identify distinct phases which may be associated with distinct growth regimes in the selected economies, we shall first draw on some indicators related to the evolution of the manufacturing sector.

In the Kaldorian tradition, development is not sectorally neutral, and a special role is assigned to manufacturing industry in driving and sustaining long-term growth rates. Table 1 presents some indicators for the evolution of the share of manufacturing value added and international manufacturing trade over time.

Table 1
Argentina, Brazil, Chile and Mexico: selected manufacturing sector indicators, selected years
(Percentages)

	Share of total Latin American manufacturing[a]		Manufacturing as a share of GDP				Manufacturing exports as a share of GDP				Manufacturing imports as a share of GDP			
	1990	2015	1965	1980	2000	2015	1965	1980	2000	2015	1965	1980	2000	2015
Argentina	7.4	8.7	41.2	29.5	17.8	17.2	5.6	23.2	32.5	29.3	62.2	77.3	87.0	82.0
Brazil	39.0	32.1	26.2	33.5	15.3	11.4	7.7	37.2	58.4	38.1	50.3	40.8	73.3	75.9
Chile	2.5	3.5	24.0	21.5	16.9	11.9	3.9	9.1	16.2	14.4	63.7	59.6	71.4	74.7
Mexico	22.5	26.3	19.5	22.3	20.3	18.4	16.3	11.9	83.5	82.4	82.4	74.9	83.5	81.8
Total	71.4	70.5	24.9	27.1	17.5	14.0	9.3	18.5	51.3	50.8	70.9	64.4	77.2	78.1

Source: World Bank, World Development Indicators [online database] https://datacatalog.worldbank.org/dataset/world-development-indicators.
[a] Manufacturing value added in constant 2010 dollars.

The first two columns (estimates for Brazil are available from 1990 onward) show the relative contribution of each country to the manufacturing industry total in Latin America. Although Brazil's share declined during the 1990s and 2000s, it is still the most industrialized economy in the region.

The next four columns present the GDP share of manufacturing industry for each country and the whole region. The industrialization trend is illustrated in the last row, the manufacturing share of GDP. For the region as a whole, it increased from 1965 to 1980 and decreased afterwards. At the country level, it increased in Brazil and Mexico from 1965 to 1980, while it decreased in all the selected Latin American countries in the ensuing decades. The early 1980s can be identified as a period when deep changes occurred in the growth trajectory of Latin American economies, all of which were badly hit by the debt crisis.

The remaining eight columns present the evolution of the share of manufacturing goods in total exports and imports. This increased in all the selected economies from the 1960s to 2000. The share of manufactures in Mexican exports decreased from 1965 to 1980, but had sharply increased again by 2000, following the signing of the North American Free Trade Agreement (NAFTA) in 1994. The share of manufacturing exports decreased in all the economies from 2000 to 2015. If compared with 1965, however, it was still significantly higher in the latter year, mostly as a result of the industrialization process. If the beginning and end dates are taken, the share of manufacturing imports also generally increased. However, it decreased from 1965 to 1980 everywhere except Argentina.

Between 1980 and 2000, manufacturing imports generally increased, following the analogous movement in exports. From 2000 to 2015, while the shares of manufacturing exports decreased,

shares of manufacturing imports increased everywhere except Argentina. As far as flows of trade in manufacturing goods are concerned, therefore, the time period from 1980 to 2000 exhibits a significant change in the trade balance of the region's economies that might point to a significant change in the growth regime as well.

Table 2 presents GDP growth rates for the economies concerned in selected time periods. These have been chosen to capture different growth trajectories and transition periods for a single indicator, the average GDP growth rate over the time interval (the phase). Table 3 provides a summary of the main characteristics of each.

Table 2
Argentina, Brazil, Chile and Mexico: gross domestic product (GDP)[a] growth rates, selected periods
(Percentages)

	Phase 1 (1951–1981)	Phase 2 (1982–1999)	Phase 3 (2000–2014)
Argentina	2.9	2.1	3.3
Brazil	7.0	2.3	3.3
Chile	3.6	4.6	4.2
Mexico	6.6	2.1	2.5

Source: University of Groningen, Penn World Tables 9.0 [online database] https://www.rug.nl/ggdc/productivity/pwt/pwt-releases/pwt9.0?lang=en.
[a] Real GDP at constant prices in millions of 2011 dollars.

Table 3
Proposed phases of economic growth

	Period	Description
Phase 1	1951–1981	Growth regime based on State-led import substitution industrialization
Phase 2	1982–1999	Debt crisis and consolidation of economic opening
Phase 3	2000–2014	Growth regime based on economic integration in an asymmetrical world

Source: Prepared by the authors.

Phase 1, the period of State-led industrialization, captures the period that was most dynamic in Brazil and Mexico, the most industrialized countries in the region. Phase 2 covers the "lost decade", as it was in most Latin American economies, plus the period of greatest instability in foreign markets, associated with the Asian and Russian crises of the 1990s. The movement from phase 1 to phase 2 was a time when policy space narrowed in most economies, owing among other things to the shortage of international liquidity for heavily indebted economies. Phase 2 is thus treated as a transition to a new growth regime. Phase 3, on the other hand, is characterized by the consolidation of this new growth regime, marked by greater financial and trade integration.[14] The phases thus involve different growth models.

In sum, within the overall period, the two main phases are the first and the third, the second representing a transition. The phase of State-led import substitution industrialization was characterized by industrialization as the engine of development. State intervention in different domains of economic activity was the main driver of investment decisions, and development had a strong orientation towards the domestic market. However, this rapid industrialization led to external imbalances that culminated in the external debt crisis. Economic opening was the strategy for overcoming the shortage of external

[14] The third phase was characterized by deeper financial integration of the economies. Contrary to the assumptions of neoclassical theory, structural change towards more diversified and technologically advanced production sectors was not observed. Indeed, as Amsdem (2001, p. 85) has shown, "as a catching up strategy, free trade policies seem to have been limited to Switzerland and Hong Kong." Chang (2003, p. 2) also emphasized that most developed countries "adopted industrial and commercial policies" considered bad "in the assessment of the neoclassical current, such as protection of nascent industry and export subsidies."

liquidity. The transition period was characterized by structural and market reforms that occurred mostly during the 1980s and 1990s along the lines of the Washington Consensus. They were characterized by liberalization that unleashed market forces, seen as the most efficient way of allocating resources. This phase stood in sharp contrast to the orientation of the first phase, as the State and other non-market institutions were considered a "second-best" solution. Phase three was one of a new growth regime in which the economies were more integrated with one another and globally but also more susceptible to external shocks.

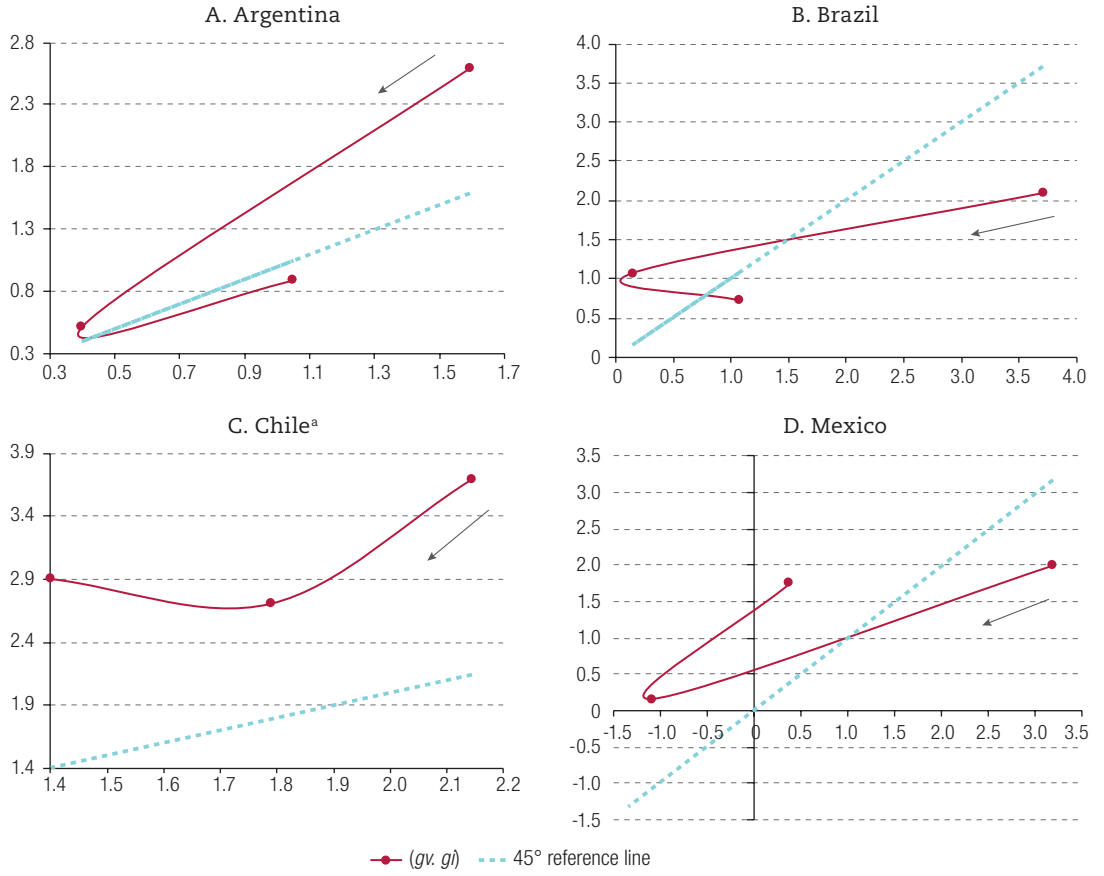
IV. Interpreting growth trajectories in the framework space

A growth regime qualitatively identifies a specific growth dynamic, generated by a given growth model. Hence, while a trajectory is any generic sequence of growth paths, a growth regime dynamic is the representation of a trajectory's qualitative features distilled via the properties of its regime representation (Böhm and Punzo, 1992 and 1994; Brida and Punzo, 2003). In the framework space, therefore, an economy's actual trajectory (its historical growth experience) is sequenced as a string of growth paths within or across regimes, or both. When growth paths span more than one regime, we talk of a change in regime as a qualitative change in the growth model, and this discontinuity is understood as a manifestation of an underlying structural change, rendered explicit or "emerging" through certain qualitative aspects of the economy's observed dynamics. Combining the notions implied in the framework space methodology with our predetermined segmentation into historical phases, we get a variety of possible ways of accounting for long-term growth trajectories.

It is the combination of qualitatively distinct growth trajectories, the regime dynamics, that we want to examine. Using the framework space, we can analyse the growth trajectories of the four selected economies under the assumption (introduced hereafter) that they were to a great extent operating under the same external economic conditions. Thus, different country trajectories might be interpreted as specific responses to domestic macroeconomic policy management measures impacting both productivity and investment performance. Figure 2 presents the trajectory of our four economies (Argentina, Brazil, Chile and Mexico) in the predefined growth phases. Table 4 summarizes their growth trajectories as seen through the framework space instrument.[15]

[15] See annex A1 for a description of the variables in figure 2.

Figure 2
Argentina, Brazil, Chile and Mexico: framework space diagrams, 1951–2014



Source: Prepared by the authors.
Note: See annex A1 for explanations of the terms.
[a] Starts in 1952.

Table 4
Argentina, Brazil, Chile and Mexico: Summary of growth trajectories

	Argentina	Brazil	Chile	Mexico
Phase 1 (1951–1981)	Accumulation	Innovation	Accumulation	Innovation
Phase 2 (1982–1999)	Accumulation	Accumulation	Accumulation	Retrenchment
Phase 3 (2000–2014)	Innovation	Innovation	Accumulation	Accumulation

Source: Prepared by the authors.

1. Phase 1: the State-led import substitution industrialization growth regime (1951–1981)

After the Second World War, the large countries of Latin America embarked on a process of industrialization based on import substitution in industry[16] and strict control of exchange rates. External borrowing was stimulated and was reflected in high investment rates. The 1960s and 1970s are often seen as a golden age in Latin American economic history.[17]

[16] Industrialization based on protectionist policies favouring infant heavy industries received a strong impetus in the 1950s, with Prebisch's centre-periphery model being a strong influence.

[17] See, for instance, Bértola and Ocampo (2012).

As a growth regime, State-led industrialization centred on a set of institutional arrangements aimed at promoting structural change with a view to catching up more quickly with mature economies. Brazil and Mexico are examples of successful import substitution industrialization strategies. Figure 2 shows that this phase was the one in which productivity growth rates were the highest on average for these economies. In both cases, the growth trajectory falls in the innovation quadrant, with average aggregate productivity growth exceeding average growth in investment per worker over the period. This result can be seen as a clear indication that the increase in aggregate productivity resulted from the intensification of the industrialization process. In both countries, industrialization was based on protectionist policies, i.e. at each step of the import substitution process, governments targeted certain industries as priorities for industrial policy and used both import licences and high tariffs to protect the manufacturing sector.[18]

The Argentine industrialization process took a different route. Argentina has comparative advantages in its agricultural sector because it is endowed with large areas of fertile land. Thus, industrialization entailed displacement of the dynamic centre of agricultural and livestock activities to manufacturing. Industrialization ended in 1976 (see Ferrer, 2004; Câmara and Vernengo, 2013), when a neoliberal economic policy agenda took over the economy, leaving the process unfinished. In the period from 1951 to 1981, Argentina's growth trajectory falls into the accumulation quadrant (figure 2), and the striking feature of the Argentine pattern of development since the War is not so much State-led industrialization as the political instability marking the country's development (see Câmara and Vernengo, 2013, pp. 115–116). Indeed, the 1976 military coup was an attempt to return Argentina to the economically liberal agricultural export growth model of the country's "glorious past" (Ferrari and Cunha, 2008, p. 27). Orthodox methods were used in an attempt to curb persistently rising inflation,[19] and the economy had stagnated by the end of the decade.[20]

The Chilean growth pattern in 1952–1981 also falls into the accumulation quadrant, indicating that the structural change promoted by the import substitution industrialization strategy did not alter the most important characteristics of the economy, with its heavy dependence on mineral extraction. In fact, the State–led orientation of the Chilean economy reached into all economic sectors. Between 1964 and 1973, Chile implemented a process of agrarian reform that affected 50% of agricultural land. In 1971, all mineral wealth was nationalized and the National Copper Corporation of Chile (CODELCO) was created and became the country's largest exporter, as it still is. Financial markets were regulated by the State. However, the military coup of 1973 moved the economy to a radical neoliberal agenda, very quickly reducing the presence of the State through an extensive privatization programme that encompassed public enterprises, banks and even social security, the promotion of private health insurance and the expansion of private education. Economic opening entailed internationalization of the financial sector. These economic reforms exposed the economy to movements in international financial markets, and consequently the Mexican default of 1981 badly hit Chilean GDP, which dropped by over 10% in 1982.[21]

The import substitution industrialization strategy was virtually abandoned by Brazil after Mexico's external default of 1982. Indeed, State-led strategies of this type were eventually to be abandoned in

[18] In Brazil, industrial policy actively fostered industrialization, and national development plans were launched to deal with major disequilibria in the trade balance, mainly during the 1970s. Brazilian industrialization was largely dependent on foreign savings; paradoxically, balance-of-payment crises reinforced government arguments in favour of renewing the use of protectionist instruments and import substitution. The import substitution strategy followed by Mexico, which was also based on protectionist policies, followed a different route from the 1960s, with the protectionist regime relying increasingly on import licences and less on tariff protection. According to Ros (1993), the essential criterion for granting import licences was the availability of domestic supplies.

[19] In 1978, the plan implemented by the neoliberal minister José Alfredo Martínez de Hoz failed completely and there was a banking crisis.

[20] Before the Mexican moratorium, Argentina had the highest ratio of external debt to GDP in Latin America.

[21] According to the World Development Indicators, in 2005 dollars at purchasing power parity (PPP).

most Latin American countries, their main flaw being that they relied on running external deficits and resorting to increasing amounts of external borrowing, a strategy that was unsustainable mainly because of the high volatility associated with external financing. Their abandonment was thus the result of the behaviour of both the trade and capital balances, as this meant that investment, the main variable when it comes to expanding aggregate income and output, was unsustainable. A common criticism of the import substitution strategy is that it left little room for export-led growth because excessive protectionism generated inefficiencies in industrial production. The lack of dynamism in export earnings became a major bottleneck for import substitution industrialization, since the industrial sector was import-intensive (Sapelli, 2003).

The golden age of the Latin American economies, during which structural change favoured industrialization, came to an end with Mexico's external moratorium.

2. Phase 2: the debt crisis, the consolidation of economic opening and the transition to a new growth regime (1982–1999)

The virtual abandonment of the developmentalist agenda guiding Latin American growth strategies after the Second World War was the result of the external debt crisis.[22] The increase in foreign debt after the sharp rise in international interest rates led to the implementation of recessionary policies in pursuit of external adjustments in all indebted countries. Sharp devaluations of domestic currencies following balance-of-payments crises led to rising domestic prices. In a word, policy space narrowed substantially in the Latin American economies once developmentalist policies were departed from.

According to the framework space (figure 2), all the economies entered a process of reduction in the growth rates of both productivity and investment per worker during phase 2.

Following the Mexican external moratorium of 1982, and as the financial fragility of the public sector worsened, Brazilian inflation became entrenched. High inflation dominated the macroeconomic situation in the mid-1980s and early 1990s, during which time several anti-inflationary plans were launched, though with little or no success. At the same time, development strategies lost ground in the economic debate as renegotiation of the external debt became the main economic policy priority. High inflation was eventually defeated with the Real Plan of 1994, while trade liberalization reforms were introduced in the early 1990s, relatively late in comparison with the other economies selected. However, they were implemented very quickly: between 1988 and 1994, most non-trade barriers were banished and the nominal import tariff was reduced from 39.6% to 11.2% (simple average), with the standard deviation dropping from 14.6% to 5.9% (Kume, Piani and De Souza, 2003, p. 11). Of all the economic reforms adopted in Brazil, though, the opening up of the short-term capital account was probably most responsible for exposing the domestic economy to the instability of the world economy and also for reducing the contribution of monetary, fiscal and exchange-rate policies to the maintenance of growth. If, on the one hand, opening up the economy helped to stabilize chronic inflation, on the other, it contributed to the emergence of a new cyclical trend of real-term currency appreciation that made the economy more vulnerable to external shocks. Lastly, financial integration and a fixed exchange-rate regime proved to be inconsistent with each other, and speculative attacks against Asian currencies and the Russian rouble forced Brazil to adopt a flexible exchange-rate regime in January 1999. New economic policy arrangements that included inflation targeting, a primary surplus and a flexible exchange rate were implemented in June the same year.

[22] Moreno and Pérez (2009, p. 37) state: "By the 1980's, the debt crisis which caused the largest drop in output growth in the region's history and affected most of Latin American countries, was used as the leitmotif to launch a devastating critique of earlier developmental policies and to recommend policies based on the mantra 'stabilize, privatize and liberalize'."

The Mexican reaction to the debt crisis was to begin reversing the State intervention policies implemented in the previous phase. Thus, the first "globalization phase" of the Mexican economy started in the mid-1980s, when trade liberalization policies began to be implemented. In 1986, Mexico acceded to the General Agreement on Tariffs and Trade (GATT). The government quickly began to dismantle the system of trade protection, liberalize the financial market and shrink the public sector by carrying out privatizations and reducing public spending. Consistently low inflation became the main macroeconomic goal, as this was seen as a necessary and largely sufficient condition for setting the economy on a path of strong and lasting export-led, labour-intensive growth. Liberal policies did not achieve the results hoped for, however, and integration into the world economy resulted in low growth and increase dependence on oil exports. Indeed, the growth path from 1982 to 1999 was the worst for the Mexican economy since the Second World War. In 1994, Mexico entered NAFTA, and an immediate consequence was the dismantling of the country's production chains, which made room for the maquilas. The specialization of Mexican industry in high-technology sectors actually led to deindustrialization in basic manufacturing, which in turn limited the growth of domestic demand (Levy-Orlik, 2012, p. 246). Besides the intensification of the deindustrialization process, a speculative attack on the domestic currency in 1994 exposed, according to Ibarra and Blecker (2014), the very limited ability of domestic policy to anchor monetary stabilization in a fixed exchange-rate regime. The recovery of the Mexican economy due to its integration into North American supply chains is observed in the following phase.[23]

Argentina was the economy with the worst growth trajectory of the four in phase 1, and a sequence of economic plans changed its economic landscape dramatically during phase 2. As we have seen, the movement towards liberal economic policies started earlier in Argentina, when the liberal economic platform centred on monetarist policies was established. In 1982, Argentina occupied the Falkland Islands (or Malvinas) and came into conflict with the United Kingdom. The result was a massive depreciation of the peso, severe inflation and the accumulation of sizeable external debts. During the 1980s, growth rates were low, and persistently high inflation became a chronic problem which was aggravated by serious episodes of capital flight towards the end of the decade. In 1991, a controversial plan to fight inflation was launched, whereby the peso was made fully convertible with the dollar at a fixed rate.[24] This reduced inflation sharply, but the fixed exchange rate lowered the cost of imports, leading to the flight of dollars from the country and a massive loss of industrial infrastructure and employment. The recovery of the Argentine economy in the early 1990s was associated with the stabilization of inflation and economic opening. Cunha and Ferrari (2009) claim that Argentina pushed neoliberal policies to an extreme with its adoption of the currency convertibility system in 1991. While the convertibility programme eliminated hyperinflation, it evinced little ability to absorb external shocks (Cunha and Ferrari, 2009, p. 7). The fixed exchange rate stimulated the expansion of private consumption, which was financed with increasing external borrowing. In a context of greater instability in international financial markets during the 1990s, Argentina became more and more dependent on official resources, financial packages led by the International Monetary Fund (IMF) and funding from the private debt market. The unsustainability of this macroeconomic arrangement came to a head with the 2001 moratorium: in December 1991, Argentina's total external debt was US$ 62 billion, equivalent to 32% of GDP, but by 2001 debt exceeded US$ 140 billion, more than 50% of GDP (Cunha and Ferrari, 2009, p. 14).

The Chilean economy was the most integrated in the 1980s, since Chile had abandoned the import substitution-based model in the early 1970s. Like all other Latin American economies, though,

[23] Since Mexico entered the international market via global supply chains, multinational corporations have taken on a central role in production. Thus, structural change in the country during the most acute phase of economic liberalism did not prevent it becoming financially and technologically dependent (mainly on the United States), although it did lead to diversification and to an increase in industry's share of the economy and the technology content of exports (Levy-Orlik, 2012, p. 237).

[24] It should be noted that the early years of convertibility were very buoyant in terms of domestic income growth and success in fighting chronic inflation (Ferrari and Cunha, 2008, p. 50). Between 1991 and 1998, the annual average growth rate of Argentina was around 6%.

Chile suffered a severe external crisis in the aftermath of the Mexican moratorium. Its currency was heavily devalued in 1982, sending the economy into a steep recession. GDP shrank by 13.2% in 1982 and 2.8% in 1983. The economic authorities adopted a number of measures to attract foreign capital, and much of the country's private external debt was turned into public external debt as a result of interventions in the financial system. To reduce this debt, the government opted for so-called debt for equity swaps, a mechanism whereby it offered to repurchase the bonds of foreign investors holding Chilean debt at par, but in Chilean pesos and provided that the capital was reinvested in the country. Years later, when the economy had stabilized, the merits of this Chilean solution to the crisis were recognized. Economic opening and early integration into the world economy led to resources being reallocated to industrial sectors targeting the external market (Carton and Slim, 2012). The relatively good economic performance of Chile in the 1990s, based on the expansion and diversification of natural resource exports, was the result of structural reforms in previous decades. According to Díaz (2013, p. 219), liberal macroeconomic policies were consolidated in the 1990s and underlay the recovery of the economy.

In summary, trade and financial liberalization policies became the main planks of most Latin American economies, and of the four leading economies in particular, decisively inaugurating a new pattern of growth led by market forces.

3. Phase 3: a new growth regime of economic integration in an asymmetrical world (2000–2014)

Phase 3 began in the 2000s and was a time of greater integration into the world economy for all four economies. Growth in productivity and investment per worker recovered.[25]

The new growth regime of economic integration was the result of the market-oriented economic policies implemented in the 1980s and 1990s. These contributed to structural change that led to greater specialization in commodity production and, in the case of Mexico, involvement in global supply chains. With the support of liberal economic policies, Argentina, Brazil, Chile and Mexico underwent an industrial reorganization that allowed exports to increase from the 1980s to 2000, although the income effects of exchange-rate appreciation and the heavy dependence of industry on imported inputs in all the countries meant that imports grew even faster (see table 1). Even in 2003–2007, the period of fastest growth in Latin America since the Second World War, none of the four economies was able to reverse the structural trend and reduce the technological gap with more developed economies.

In the case of Brazil, the recovery in the growth trajectory from 2000 onward can be judged weak. The growth trajectory is in the innovation part of the framework space, but productivity growth was lower than in phase 1 on average. This result can be interpreted as an inability on the part of policymakers to closely coordinate productivity-enhancing policies such as industrial, technological and trade policies with short-term macroeconomic policies (especially monetary and exchange-rate policies) (Bresser-Pereira, Nassif and Feijo, 2016; Nassif, Bresser-Pereira and Feijo, 2018). In other words, Brazil's macroeconomic policy regime, which combines an inflation and fiscal targeting regime with a floating exchange-rate regime, has not been successful in increasing policy space for growth policies. The very conservative modus operandi of this Brazilian macroeconomic policy "tripod" has not been able either to bring short-term domestic interest rates down to anywhere near international levels or avoid a cyclical tendency to overvaluation of the Brazilian currency in real terms.

[25] Carvalho (2008, p. 122) questions the resilience of liberal choices in view of the problems that most Latin American economies faced in the 1990s. According to the author, the deep crises of the 1990s did not alter the main characteristics of the financial regimes created in the liberalization process.

The macroeconomic policy orientation of the Mexican economy intensified the consolidation of the country's export industries in the 2000s. Indeed, manufacturing exports expanded continuously at annual rates of over 10% until the outbreak of the international financial crisis in 2008 and 2009. According to Moreno (2016), this achievement is far from having translated into high and sustained growth free of financial or balance-of-payments crises. This is because all the efforts of the Mexican economy to integrate into NAFTA resulted in denationalization of the economy, with multinationals transferring very little to Mexico by way of technology and research and development facilities. The growth of the maquila sector entailed deindustrialization and, according to Ocampo (2016), all this happened despite a competitive real exchange rate, arrived at through wage repression and contractionary economic policies. In figure 2, Mexico is positioned in the accumulation part of the framework space.

In the case of Argentina, the economy plunged into a severe depression lasting from 1999–2002 when the convertibility plan proved unsustainable. Recovery came from 2003 onward with the Kirchner administration and the implementation of policies to sustain aggregate demand. However, as pointed out by Porta (2016, p. 394), by late 2007 the growth trajectory was showing signs of considerable imbalances, most of which were rooted in the Argentine production structure. This diagnosis is based on the evidence that the Argentine production structure is centred on low-technology production (Porta, 2016, p. 402). Moreover, as pointed out by Cunha and Ferrari (2009), the process of economic recovery in the 2000s, involving a change of course in macroeconomic policy with respect to the neoliberal model in force until 2001–2002, should not be understood as a return to a developmental growth strategy. In a longer-term historical perspective, the authors suggest, the ending of the Kirchner era has shown that Argentine society remains much more willing to adhere to the liberal model, in its different versions, than to development strategies that seek to structurally change the production base (Cunha and Ferrari, 2009, p. 21).

The Chilean economy is the only one of the four economies that can be seen to have benefited from economic opening and specialization in natural resources. However, the country's growth trajectory did not signal a change in growth regime from the 1950s. The Chilean economy's growth capacity and export dynamism increased, then, although economic opening led to greater instability. Increased inflows of foreign capital and "Dutch disease" associated with copper exports have led to a prolonged cycle of real exchange-rate appreciation affecting the competitiveness of production and exports of goods and services with higher value added. Thus, productivity in the production structure is very heterogeneous and the Chilean economy is still very dependent on copper exports. Although macroeconomic indicators have been stable thanks to the implementation of consistent macroeconomic policies since the 1990s, the same progress has not been made with developmental or policy instruments to promote economic development (Díaz, 2013, pp. 246–252).

V. Concluding remarks

From the comparative analysis of the growth trajectories of Argentina, Brazil and Mexico we can conclude that the recent poor performance of these economies should not be seen as a cyclical phenomenon, but as the result of the way each was integrated into the world economy. In all cases, changes in the growth regime since the 1950s have entailed a narrowing of policy space and a scaling down of growth potential associated with increasing external vulnerability.

Structural changes from the first phase (phase 1) to the last (phase 3) involved the development of industries specializing in commodities and low-technology manufactured goods (Argentina and Brazil) and high-technology maquila (Mexico). Furthermore, the framework space shows that productivity growth in all four economies was lower than in phase 1. Argentina showed the most unstable growth pattern, as its growth trajectory was close to the Harrodian corridor.

The long-term growth performance of Chile is quite distinct to all the others', since it has maintained the same growth pattern for the last fifty years and has been able to diversify its production structure, although it is still essentially natural-resource-based.

Furthermore, the opening up of these economies before they could catch up with developed ones deepened their dependence on international capital flows. The long transition from phase 2 to phase 3, that of economic integration, substantially changed the role of the State, which became less interventionist. Private investors with access to international financial markets became the main actors guiding investment decisions and capital accumulation. Thus, it can be said that the commitment to a developmentalist approach prevailing during the State-led industrialization phase gave way to criteria of short-term profitability. Stabilization policies became the priority for economic policymakers, and these narrowed the space for long-term economic policies. Their implementation resulted most of the time in higher real interest rates and lower real exchange rates, disincentivizing real-term capital accumulation. Thus, specialization in the production of low value added goods and increased financialization are phenomena that occurred together after economic opening reduced the policy space.

Lastly, the boom in international trade in the 2000s "unleashed a wave of prosperity for developing economies, and Latin America in particular, that influenced their development and external trade and investment strategies" (De Souza and Ferraz, 2016, pp. 375–376). The 2008 international financial crisis brought about a sudden change in this situation. An open question is whether the semi-industrialized economies of this study are prepared for the period of lower international trade and greater financial uncertainties resulting from the hitherto slow recovery of developed economies. This question also raises a further issue, that of how much room for manoeuvre each economy has been left with in the effort to sustain growth. Now that market-oriented macroeconomic policies have been put in place and structural change has resulted in a shift towards low-technology industries, are these economies better placed to deal with an international slowdown in trade?

A menu of policy recommendations aimed at promoting a structural shift towards more technologically advanced sectors should provide for a consistent macroeconomic policy capable of widening the scope for industrial policy to achieve the best results in terms of dynamic economic change. Macroeconomic policies should be countercyclical, and accordingly management of capital flows should be an option to avoid capital volatility, which negatively affects nominal and real exchange rates. As for industrial policy, it should be designed to allow strategic decisions to be made about long-term economic development.

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Annex A1

The framework space variables (see table A1.1) are constructed with data from the Penn World Tables, version 9.0, as follows:

- *gv* is the rate of growth in the ratio of real GDP at constant local prices (in millions of 2011 dollars) to the number of persons employed (in millions).
- *gi* is the rate of growth in the ratio of capital stock at constant 2011 local prices (in millions of 2011 dollars) to the number of persons employed (in millions).

Table A1.1
Estimated *gv* and *gi* as geometric means

Phase	Argentina		Brazil		Chile		Mexico	
	gv	*gi*	*gv*	*gi*	*gv*	*gi*	*gv*	*gi*
1951–1981	1.5922	2.5927	3.70870	2.09340	2.1660	3.7082	3.18720	2.0081
1982–1999	0.3963	0.5124	0.14949	1.069462	1.8098	2.7287	–1.0925	0.1594
2000–2014	1.0488	0.8914	1.060694	0.721482	1.4214	2.9241	0.3756	1.7549

Source: Prepared by the authors, on the basis of University of Groningen, Penn World Tables 9.0 [online database] https://www.rug.nl/ggdc/productivity/pwt/pwt-releases/pwt9.0?lang=en.

Foreign direct investment flows: an analysis for Argentina, Brazil, Chile and Mexico based on the Grubel-Lloyd index

Álvaro Alves de Moura Junior, Pedro Raffy Vartanian and Joaquim Carlos Racy

Abstract

This article assesses the importance of using the Grubel-Lloyd (GL) index as a tool to reveal trends in foreign direct investment (FDI). The index was developed to further the study of a fundamental question in international political economy: how FDI affects economies, whether individual or regional, and becomes a general framework indicator of regional behaviour. The index is applied to the four largest economies in Latin America (Argentina, Brazil, Chile and Mexico) in the period 1995–2016, with a view to demonstrating the importance of FDI for the region. However, the "behaviour" of FDI may be different for each country. The article discusses characteristics in each of these countries that differ from those found in the same indicator for a bloc consisting of the developed countries plus China, for which the index as calculated is higher and varies little during the period analysed.

Keywords

International economic relations, globalization, foreign direct investment, transnational corporations, measurement, Argentina, Brazil, Chile, Mexico

JEL classification

F20, F21, F23

Authors

Álvaro Alves de Moura Junior is professor and research fellow on the Postgraduate programme in Economics and Markets of Universidad Presbiteriana Mackenzie, Brazil. Email: alvaro.moura@mackenzie.br.

Pedro Raffy Vartanian is professor, coordinator and research fellow on the Postgraduate programme in Economics and Markets of Universidad Presbiteriana Mackenzie, Brazil. Email: pedro.vartanian@mackenzie.br.

Joaquim Carlos Racy is professor and research fellow on the Postgraduate programme in Economics and Markets of Universidad Presbiteriana Mackenzie, Brazil. Email: joaquimcarlos.racy@mackenzie.br.

I. Introduction

Finance is considered the central link in the current stage of globalization, as well as the key determinant of many developments in other spheres of the international economic system. The expansion of international liquidity, especially since the 1990s, has fuelled a significant increase in flows of both portfolio capital and foreign direct investment (FDI).

According to Corazza (2005), these findings, which reflect financial globalization, result from three interrelated factors: (i) the high level of accumulation of monetary and financial wealth, held in the form of assets with different degrees of liquidity and traded in numerous currencies; (ii) the development of technological resources that make these assets extraordinarily mobile; and (iii) the current regime of floating exchange rates, which generates speculative gains.

In the case of FDI specifically, the corresponding increase in flows takes a very wide range of forms, including the following: the expansion of trade relations; flows of loans and financing between firms; the sale of technology; and the transfer of assets through mergers and acquisitions.

In reference to empirical evidence on the accuracy of FDI flows, there is an important caveat regarding the nature of this capital in relation to the classification of multinational firms, which Michalet (1985) defines as follows:

> A firm (or a group), generally of large size, which, starting from a domestic base, has set up several branches abroad in several countries, following a strategy and an organization conceived on a global scale. This definition remains useful in several respects; it points out that the multinational enterprise invariably began as a large firm at the national level, which also means that it is the result of a more or less lengthy and complex process of concentration and centralization of capital, and that it often diversified before it began to internationalize; that the multinational firm has a national origin, so that the strengths and weaknesses of its national base and the assistance it has received from its State will be components of its strategy and its competitiveness; whereas this firm is generally a group whose contemporary legal form is that of an international holding company; and, lastly, that this group acts on a global scale and has strategies and an organization set up for this purpose (cited in Chesnais, 1996, p. 73).

In general, this discussion shows that the functional integration of multinational firms has become a fundamental characteristic of the current international economic scenario, which is increasingly based on a production chain that interconnects a sequence of operational functions, each of which adds value to the process of producing goods and services.

The production chains created by multinational firms have the capacity to coordinate and control operations in more than one country. To this end they develop increasingly sophisticated mechanisms of intra- and inter-organizational relations, which shape the contours of today's economic system.

As the activity of multinational firms involves decisions on exporting or internalizing the production process, it should also be recognized that this current movement is supported by different forms of coordination. These represent genuine networks of relations within and between firms, since the hierarchy of the economic system is structured on the basis of different degrees of power and influence. Consequently, these networks are considered dynamic and in a continuous state of mutation.

However, investment decisions, as expressed in recent trends in FDI flows, show that national borders remain relevant in terms of global economic policy, as they are one of the main determinants of firms' location choices —with a direct influence on FDI flows.

Consequently, States have increasingly sought to act in the international system with the aim of influencing the multinational firms' geographical choices. Among the main expressions of this process

are the conditions offered to multinational firms in terms of access to the domestic market and to factors of production.

Another important point related to the performance of multinational firms is the actual process of setting up branches abroad, which, as has been noted before, usually occurs for the following reasons: (i) the chance to exploit raw materials located in the destination country; (ii) entry into the domestic market, which enables import substitution; and (iii) turning the destination country into a platform for exporting intermediate or finished products.

An analysis of the stock of FDI in 2016 shows that 63.3% of the capital in question was channelled to developed countries (UNCTAD, 2020). Nonetheless, there is no denying an effort to create a global market, in which the developing countries, as a bloc, absorbed 34% of the total stock of FDI in the same period.

When measured in terms of inflows, the United States is the main recipient of FDI, accounting for 23.9% of the total stock, while Latin America has a 7.3% share; hence the choice of countries analysed in this study.

In terms of outflows, developed countries accounted for 76.3% of the FDI stock in 2016, with developing countries representing 22.2%, and the Latin American countries 2.2%.

The networks of relationships that exist between domestic and multinational firms are usually denser and more extensive in developed economies than in developing ones. Moreover, in the latter, these linkages tend to occur in the larger, more industrialized economies. However, the majority of FDI flows are allocated to just a handful of developing countries, in particular the newly industrialized countries (NICs),[1] and especially China. In this group, just nine countries accounted for 53.1% of the total FDI stock held in developing countries in 2012. Some of those countries are analysed in this research, not only from the FDI standpoint. An assessment is also made of the export of investment capital to other countries, as well as the relationships between these flows revealed through an indicator that identifies the "import-export" pattern of production activity, the rationale for which will be described in the theoretical framework described below.

In this context, the present study assesses the relative importance of using the Grubel and Lloyd (GL) index to reveal behavioural trends in FDI for four Latin American countries (Argentina, Brazil, Chile and Mexico) between 1995 and 2016.

Calculation of the GL index to the four countries reveals their modest share of total "exports" of productive capital (FDI). Moreover, in the cases of Argentina and Brazil, inflows fluctuate widely, so the GL index suggests a degree of production internationalization that is erratic and much lower than that recorded by developed countries and China, which is the developing country bloc used for comparisons in this group. In contrast, Chile and Mexico both have a much higher GL index than Argentina and Brazil, thus displaying greater openness than these two countries but less than the developed countries and China.

Section II of this study discusses the relationship between FDI and international political economy; and it evaluates the flows and stocks of the capital in question, from the standpoint of both host countries (inward FDI) and origin countries (outward FDI). Section III describes the methodology applied in the research using the GL index. Section IV applies the index to the inward and outward FDI of four countries: Argentina, Brazil, Chile and Mexico. The choice of countries is justified by the prominence of their economies relative to other countries in terms of inward FDI, as the sample includes the four leading FDI recipients in Latin America. Lastly, section V presents concluding remarks.

[1] This group comprises the following countries: South Africa, Brazil, China, India, Malaysia, Philippines, Mexico, Thailand, and Turkey.

II. International political economy and global FDI flows

The conditions of the international system show that the end of bipolarity and the growth of trade and financial relations have ushered in a new phase of international relations. Despite claims to the contrary, these continue to be largely supported by the State, especially in the central or developed countries. However, the degree of complexity and interdependence of international political and economic relations, stemming from the global interconnection of the production activities of multinational firms, makes this reality different in each case.

In general, there are no major disagreements in the analyses of these transformations when assessing the growth of economic, cultural and social flows, because the fact that societies are increasingly interrelated is a matter of broad consensus. There is also a convergence of ideas regarding the importance of the use of new information technologies that enable interactions to occur at an increasing speed and scale, thereby contributing to a shrinking of real spaces between the different spheres and actors in the international scenario. A large segment of the social sciences assumes that a broad-based process of global interconnection based on material, normative and symbolic relations has prevailed.

What is invariably perceived in discussions of globalization are points of view that approve or disapprove of this process; and an extensive body of analysis has been produced that either criticizes or supports it, and, thus, refutes and/or maintains this reality. To some extent, positions on globalization are divided between sceptics and globalists.

However, beyond the traditional globalist and sceptic division of the theoretical debate on globalization, there is a third alternative, referred to as transformationalist, which seeks to merge elements present in the two extreme positions and offer an analytical proposal that is more reflective of the real complexity of the international system.

Martell (2007) argues that transformationalism seeks to criticize the hyperglobalists, based on the reality that globalization is an inexorable truth. Accordingly, its thoughts on this process find many points of connection with the sceptic perspective.

However, starting from the premise that the importance of liberal policies cannot be underestimated, the transformationists claim that analysis of the current international system should take account of the fact that, despite maintaining a relative centrality in the core country triad, the integration of the global economy has spread beyond this group to countries such as China and Brazil in particular.

On this point, Hay and Marsh (2000) provide a critical review of some of the sceptic positions, noting that their conceptions are often somewhat exaggerated. They therefore propose a multidimensional approach to the globalization process, which develops in a complex and uneven manner. Thus, globalization would not be seen as a process with an end state, but as a trend against which a series of countertrends emerge.

For example, the territorial aspects of the international reality are still considered central to the dynamics of the system, but the idea of this being the basis of modern life is disputed. Economic, social and political issues, while linked to a territory, are also part of a process of de-territorialization. As an example of this, the activities of multinational firms, while maintaining territorial ties, are increasingly seeking new trade and production bases beyond their national borders. According to Martell (2007), a related issue concerns the exclusively quantitative perspective of the analysis of reality as seen by sceptics. Yet, understanding the current stage of globalization also entails evaluating qualitative evidence, through an analysis that considers the individualized and interpretative nature of the whole process.

In practice, this means that it is not enough to quantify the value of goods and capital traded, or the number of people moving internationally; but, above all, it is essential to assess the qualitative impact of migration, trade and financial flows on the economy, politics and culture of each country through time.

From this perspective, globalization implies new patterns of stratification between and within societies, so that new configurations arise from patterns other than those of the traditional "centre-periphery" dichotomy, since islands of excellence —technological, financial and production sectors— are developing in a number of emerging countries, particularly in Asia and Latin America.

These relationships should be assessed by considering the different ways in which the flow of economic power can be transmitted, especially in terms of the creation of a space continuum, the expansion of trade relations, increased international liquidity, larger flows of factors of production and information, and the intertwining of cultural issues, among others.

These considerations also raise the need to rethink the role of territorial entities (States or regional power blocs), but from a logic that is convergent with purely capitalist interests.

This seems to be a central point for understanding the main analytical focus of this research, namely FDI flows in Brazil and other selected countries, since it highlights a relationship between capital and the domestic political decisions of a country at a time when the flow of capital has grown significantly in the last twenty years.

In this regard, the functional integration of multinational firms has been fundamental in characterizing the current context of globalization, which is increasingly based on a production chain that interconnects a sequence of operational functions, in which each stage adds value to the process of producing goods and services. In turn, this production chain raises the need to understand two important questions: how it is coordinated and regulated, and its geographical configuration.

With regard to the first point, the production chains established by multinational firms are characterized by their power to coordinate and control operations in more than one country and have developed increasingly sophisticated mechanisms of intra- and inter-organizational relations, shaping the contours of the current economic system.

On the other hand, all business organizations, including the most global multinationals, operate within some kind of regulatory system, since they are subject to national laws, even if they try to act with the clear objective of taking advantage of these regulations.

The result of this relationship, as Strange (1979) notes, is an expansion of the complexity of the relationships involved in business decisions, establishing a games logic between firms and States basically configured in a triangular interaction: firm-firm, State-State and firm-State. This configuration of reality, according to Dicken (1998), is responsible for a new "geo-economics", which is in a constant restructuring process and is produced by the actions of both firms and States, forming a tangle of dynamic relationships.

Accordingly, investment decisions, as expressed in recent trends in FDI flows, show that national borders continue to constitute the real differences in global economic policy, as they are one of the main determinants of firms' location choices, conditions that directly influence the flow of this capital.

Consequently, States have increasingly sought to act in the international system to influence the geographic choices of multinational firms. The main expressions of this process are the conditions offered to transnational corporations on access to the domestic market and factors of production.

Multinational firms can establish themselves by implementing new processes and production plants, but they can also do so through mergers and acquisitions. In this connection, it is worth assessing whether FDI flows have in fact enabled the economic restructuring of many developing countries, which may involve improving the productivity of some of their activities.

The price a country pays for participating in this game depends on the number of independent foreign firms competing for the investment opportunity, the importance for the country of the multinational firm to be established and the perceived level of national need for such a contribution.

Multinational firms, in turn, tend to base their decisions on the attractiveness of the specific investment opportunity offered by the host country in exchange for similar opportunities found in other countries; the economic conditions of the host country, especially its market position; and its degree of political stability.

Thus, it is concluded that the main components of the bargaining relationship between multinational firms and host countries are based on their power resources. Moreover, both operate under certain conditionalities that tend to restrict the scope of the exercise of these resources.

This expansion of capital flows in the international economic system largely speaks to the false notion that FDI has become preferable to portfolio investment and bank loans. In general, this view that FDI is not subject to the vagaries of other types of financial capital stems partly from examples drawn from the development models of Asian countries in the 1990s, which are known to have been closely linked to FDI.

One of the main arguments used to spread the idea that attracting FDI is the most appropriate form of financing is to associate it with fixed capital investments, which do not have immediate liquidity, unlike investments in public or private portfolios.

However, for Kregel (1996), such distinctions do not pertain to developing countries today; so, this capital should not necessarily be evaluated from a long-term perspective. This is because the intensity and importance of merger and acquisition processes dominated by developed countries is generally ignored. In this perspective, the author considers that innovation in financial markets turns the capital of many firms into a real commodity that is traded on a daily basis.

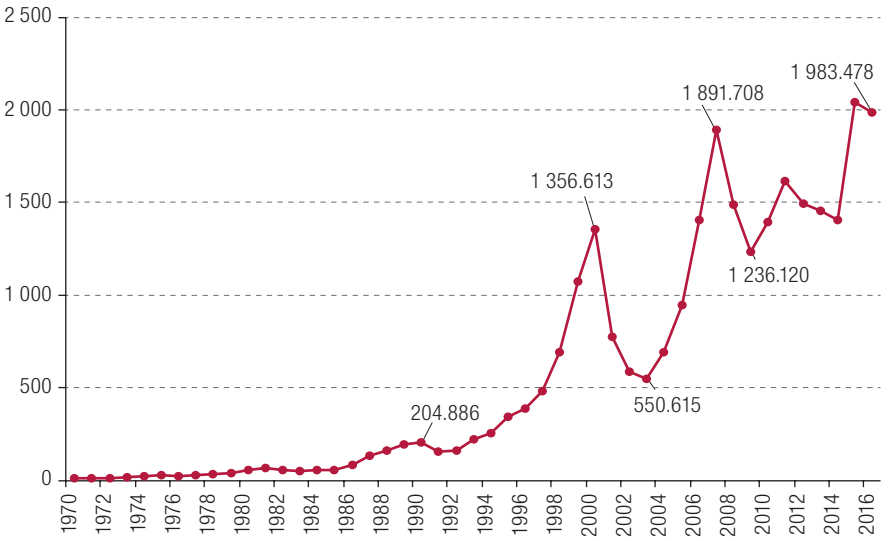
In addition to this, innovations in the international financial market have enabled the development of hedging methods, including FDI transactions in fixed assets, so that an operation may not directly involve the investor in actions affecting the exchange rate, nor even in transactions involving the capital market.

It is in this context that Brazil and, according to this research, the other selected countries, have consolidated themselves as actors with a degree of protagonism in the international system. The first objective of these actors is to express themselves as leaders among developing countries; and a second one is to open a prominent space for participation in the context of globalization.

Since the main objective of this research is to analyse the flow of capital to Argentina, Brazil, Chile and Mexico, through the Grubel-Lloyd (GL) index between 1995 and 2016, this study uses the concept of FDI defined by the United Nations Conference on Trade and Development (UNCTAD) (UNCTAD, 2020), which characterizes these investments as operations aimed at contracting a lasting business in the country of origin of the holder of such capital. Thus, FDI requires the existence of a headquarters and a subsidiary outside the headquarters, which leads to their joint operation, making it a multinational enterprise. It also requires a relationship of total control of the headquarters over the subsidiary outside the border to which the capital belongs; this control is expressed by the ownership of at least 10% of a corporation's common shares or voting rights, or its equivalent for private firms.

Having established this definition, FDI flows in terms of the amounts internalized by the countries receiving this capital, grew intensively in the 1990s. The trend has tended to grow uninterruptedly even through the international economic crises of the early 2000s and the 2008 crisis. One year before the 2008 crisis, the total flow of FDI absorbed by the various host countries was around US$2 trillion (in current prices). In this new crisis context, the flows behaved erratically, leading to a decrease in global flows, compared to 2007, as shown in figure 1.

Figure 1
Global foreign direct investment inflows, 1970–2016
(Billions of dollars at current prices)



Source: United Nations Conference on Trade and Development (UNCTAD).

An analysis of these flows from host countries during the period of this study (1995–2016) shows that developed countries received 59.7% of global FDI, with developing countries absorbing 36.6%, and the "transition countries" 3.6%. In addition to the evidence of the predominance of developed countries as the destination of this capital, the United States economy alone received 16.9% of the total flow in the period in question.

Table 1
Selected countries and groupings:
foreign direct investment inflows, total between 1995 and 2016
(Billions of dollars at current prices)

Ranking	Countries	Billions of dollars	Percentage of total
-	Total	24 785.947	100.00
	Developed economies	14 801.062	59.72
	Developing economies	9 069.407	36.59
	Transition economies	910.920	3.68
	Latin America and the Caribbean	2 328.583	9.39
1º	United States	4 188.608	16.9
2º	China	1 778.229	7.2
3º	United Kingdom	1 716.856	6.9
4º	China, Hong Kong SAR	1 156.861	4.7
5º	Belgium	887.680	3.6
6º	Germany	850.854	3.4
7º	Brazil	836.311	3.4
8º	Netherlands	810.011	3.3
9º	Canada	803.538	3.2
10º	Singapore	714.095	2.9
16º	Mexico	508.987	2.1
24º	Chile	237.432	1.0
31º	Argentina	174.413	0.7

Source: United Nations Conference on Trade and Development (UNCTAD).

Apart from China, Brazil is the developing country that received the most FDI —2.7% of the total between 1995 and 2016 for a total amount of US$836.3 billion. The other countries studied in this article —Mexico, Chile and Argentina— have shares and amounts received as shown in table 1. It should also be noted that the four countries in the sample (Argentina, Brazil, Chile and Mexico) account for 75.5% of the total flow absorbed by Latin American and Caribbean countries during the period analysed.

An analysis of FDI flows in terms of origin shows that 78.4% of the capital comes from developed countries, while 19.2% comes from developing ones and 2.4% from countries in transition.

The main FDI "exporter" is the United States, which provides nearly one fifth of the total amount. The United States is followed by the major economies of Europe, as well as Japan, Hong Kong and Canada.

Brazil, despite being among the largest economies in the world, sends a relatively small share of FDI to other countries, as also is true of Mexico, Chile and Argentina; these countries generated 1.5% of total outward FDI, and 76.6% of the total sent by the countries of Latin America and the Caribbean in the period analysed, as shown in table 2.

Table 2
Selected countries and groupings:
foreign direct investment outflows, total between 1995 and 2016
(Billions of dollars at current prices)

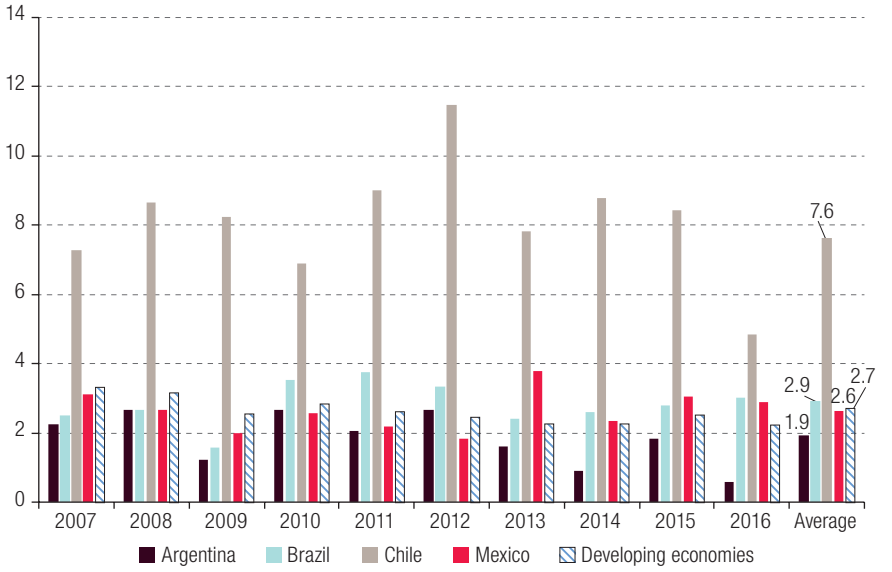
Ranking	Countries	Billions of dollars	Percentage of total
-	Total	24 017.089	100.00
	Developed economies	18 827.930	78.39
	Developing economies	4 605.962	19.18
	Transition economies	575.905	2.40
	Latin America	469.802	1.96
1°	United States	4 859.109	20.2
2º	United Kingdom	1 669.128	6.9
3º	Germany	1 506.727	6.3
4º	Japan	1 478.278	6.2
5º	Netherlands	1 323.072	5.5
6º	France	1 303.535	5.4
7º	Hong Kong	1 104.116	4.6
8º	China	971.487	4.0
9º	Canada	924.251	3.8
10º	Spain	885.227	3.7
31	Mexico	123.055	0.5
32	Chile	121.941	0.5
35º	Brazil	86.536	0.4
50º	Argentina	28.128	0.1

Source: United Nations Conference on Trade and Development (UNCTAD).

When comparing the FDI flows received by the four countries in the sample with the size of their economies, Chile's inward FDI/GDP ratio was much higher than that of the other economies analysed (Argentina, Brazil and Mexico), as well as being significantly higher than the same ratio recorded for the group of developing countries.

While this indicator for Argentina, Brazil and Mexico averaged 1.9%, 2.9% and 2.6%, respectively, and for developing countries 3.2%, the FDI inflow/GDP ratio for Chile was 7.6% on average in 2007–2016, as shown in figure 2.

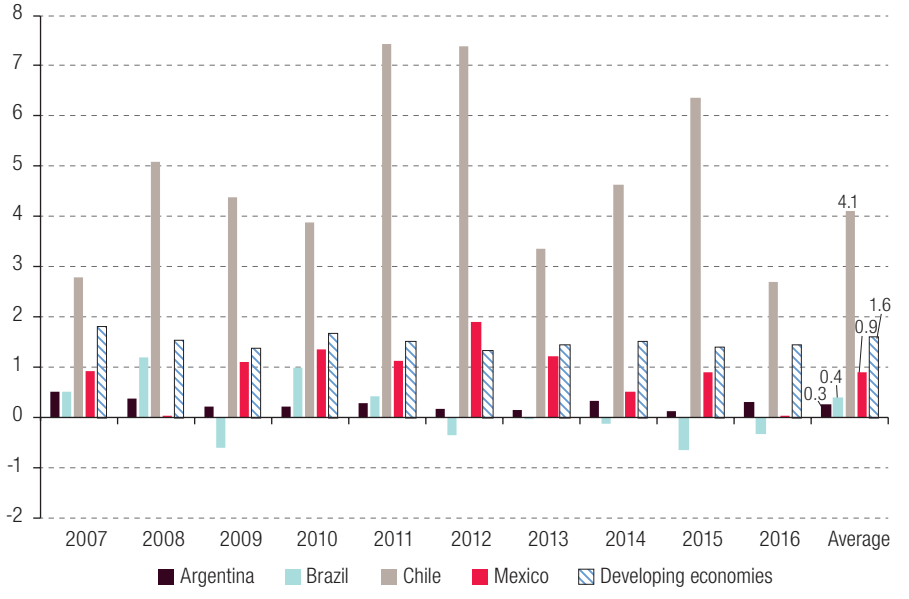
Figure 2
Selected countries: FDI inflows as a percentage of GDP, 2007–2016
(Percentages)



Source: United Nations Conference on Trade and Development (UNCTAD).

Similar behaviour can be seen in FDI outflows for the sample countries, with Chile also displaying a much higher outward FDI/GDP ratio than Argentina, Brazil, Mexico and the developing countries, as shown in figure 3.

Figure 3
Selected countries: FDI outflows as a percentage of GDP, 2007–2016
(Percentages)



Source: United Nations Conference on Trade and Development (UNCTAD).

The share of FDI varies from one country to another, both among the ten largest FDI recipient countries and for the four countries in the sample. The importance of foreign firms in Hong Kong's economy is clearly shown by its FDI stock/GDP ratio of above 4. The United States displays a ratio similar to that identified for the group of developed countries, which in turn is also close to the same measure for developing countries.

In the four countries of the sample, Chile's FDI stock represents almost 101.1% of GDP, showing the major importance of foreign capital for its economic activity, while the equivalent figures in the other countries are: Brazil 39.2%, Mexico 44.0% and Argentina 13%, as shown in table 3.

Table 3
Selected countries and groupings: stock of foreign direct investment relative to GDP, 2016
(Percentages)

Ranking	Countries	FDI/GDP
-	World	36.1
-	Developing economies	31.7
-	Developed economies	39.6
-	Transition economies	42.1
-	Latin America and the Caribbean	40.5
1º	United States	35.0
2º	China	12.1
3º	United Kingdom	55.7
4º	Hong Kong	506.68
5º	Belgium	106.9
6º	Germany	22.6
7º	Brazil	39.2
8º	Netherlands	107.1
9º	Canada	63.68
10º	Singapore	378.3
16º	Mexico	44.0
24º	Chile	101.1
31º	Argentina	13.0

Source: United Nations Conference on Trade and Development (UNCTAD).

In the rest of this article, the economic growth of the ten largest FDI recipients and the four sample countries (Argentina, Brazil, Chile and Mexico) will be briefly analysed using the GI index.

The intention is not to infer any relation between FDI flows and economic activity in these countries, but simply to make a concise descriptive analysis of the change in their real GDPs.

As is well known, China, the third largest recipient of FDI during the period analysed, has posted economic growth rates well above the world average. However, it is impossible to infer the importance of FDI to Chinese economic activity through this simple assessment; the mere fact that the country is a major recipient of this type of capital does not prove that the entry of foreign multinational firms into the country must be a major contributing component.

When the growth of the other main recipient countries is evaluated, the behaviour of their economic activity is similar to the world average.

In the four countries of the sample, Chile is again the standout case, with an economic growth rate well above that of the other countries, and also above the world average. In this regard, it is worth noting the importance of FDI in the Chilean economy, at nearly 60% of GDP.

Brazil and Argentina also posted real GDP growth rates above the world average, whereas growth in Mexico underperfomed. Table 4 presents additional details.

Table 4
Top ten FDI recipients and other selected countries: cumulative and average economic growth, 1995–2016
(Percentages)

Ranking of FDI inflows	Countries	Cumulative variation of real GDP (%)	Average real GDP growth, 1995–2016 (%)
-	World	88.94	2.93
1º	United States	70.29	2.45
2º	China	630.35	9.46
3º	United Kingdom	63.31	2.25
4º	China, Hong Kong SAR	113.14	3.50
5º	Belgium	55.21	2.02
6º	Germany	43.55	1.66
7º	Brazil	78.95	2.68
8º	Netherlands	66.82	2.35
9º	Canada	84.98	2.84
10º	Singapore	239.63	5.72
16º	Mexico	85.12	2.84
24º	Chile	180.13	4.79
31º	Argentina	82.96	2.78

Source: World Bank.

Having described recent FDI flows in the world and, in particular, in Argentina, Brazil, Chile and Mexico, the following sections will seek to broaden understanding of this topic based on the methodological discussion and calculation of the GL index for the four economies in question and for the group of developed countries.

The index in question represents a methodological alternative with potential to provide a new interpretation of these capital movements, noting that the results show a trend specific to the group of developing countries. In addition to the other characteristics already described throughout this section, this can contribute to the debate on FDI from the international political economy standpoint developed here.

III. The Grubel-Lloyd Index

The Grubel-Lloyd (GL) index became popular in the late 1970s, with research into the determinants of trade patterns between countries. This followed numerous attempts to explain these determinants both theoretically and empirically, ranging from the Ricardian model to modern theories of international trade that consider imperfectly competitive markets and the emergence of economies of scale as an important driver of trade. Ricardo's theory of comparative advantage showed that a country should specialize in the production of goods that involve a relatively lower opportunity cost than other countries. This important explanation was complemented by the Heckscher-Ohlin-Samuelson model, according to which a country has comparative advantages in goods whose production makes intensive use of a factor of production that is abundant in the country. The findings of the Ricardian and Heckscher-Ohlin-Samuelson models imply that countries trade in different products in international trade.

In more recent models, such as those of Krugman (1979 and 1980), an additional factor emerges as an important determinant of the pattern of trade between countries. Product differentiation, a characteristic of imperfectly competitive markets, explains why different countries trade similar products. Previous models did not allow for this possibility. The presence of economies of scale, combined with the product differentiation characteristic of imperfectly competitive markets was not present in traditional trade models and accounts for a substantial part of a country's trade with the rest of the world. In other

words, while the comparative advantage theory and the Heckscher-Ohlin-Samuelson model explain why a country exports agricultural products and imports manufactured products, the product differentiation thesis explains how two countries trade in the same type of product, such as automobiles.

International trade can be seen as consisting of two parts: inter-industry trade and intra-industry trade. The former refers to the pattern of trade explained by comparative advantages and the factor-proportion model. In contrast, intra-industry trade is due to the existence of imperfect markets, which is an important source of gains to trade, insofar as it allows for scale gains in differentiated products.

Inter-industry trade is thus determined by the abundance of one or more factors of production in a country. Capital-abundant countries tend to export capital-intensive products, such as technology and medicines. Conversely, land-abundant countries tend to export mainly agricultural products. Unlike inter-industry trade, intra-industry trade is unpredictable, although it is possible to identify a number of factors that contribute to its emergence. One relevant fact concerns the underlying characteristics of the countries in question. For example, if two countries have identical factor shares, there will be no inter-industry trade between them. Instead, there will likely be intra-industry trade, since economies of scale are an important source of trade benefits.

To calculate intra-industry trade, one of the most widely used indices is that of Grubel and Lloyd (1975), which has frequently been applied in international trade studies, mainly during the 1980s and is presented in the recent literature in the following format:

$$GLI_{IT} = \frac{\sum_{i=1}^{n}(x_i + m_i) - \sum_{i=1}^{n}|x_i - m_i|}{\sum_{i=1}^{n}(x_i + m_i)} \quad \text{in which} \quad 0 \leq GLI_{IT} \leq 1 \tag{1}$$

where:

GLI_{IT} = index of intra-industry trade in the sector

x_i = exports of the product or sector

m_i = imports of the product or sector

The original Grubel-Lloyd equation is expressed as the result of equation (1) multiplied by 100, which means the result will always be in the interval [1, 100]. However, in recent studies, the factor was removed and the result started to be given in the interval [0, 1]. Thus, when the value of exports of a given industry is similar to the value of imports, the index result will be close to 1. In contrast, the greater the difference in value between exports and imports, the closer the index result will be to 0. A result close to 0 indicates the existence of inter-industry trade, based, for example, on comparative advantages or abundance of factors of production.

In analysing the possible frontiers of intra-industry trade research, Herbert Grubel, one of the creators of the index, suggested that the GL index could perfectly well be applied to a country's balance of payments (Grubel, 2002). The author argued that international capital flows can be viewed as different "industries", such as portfolio investment, foreign direct investment and loans, and other categories. Using data from the International Monetary Fund, Grubel (2002) calculated GL indices for the financial accounts of Germany's balance of payments.

In addition, Grubel calculated the GL index of the FDI variable for several developed countries and also for regions. The author also conducted an analysis of other balance of payments "industries" such as portfolio investment and loans. The study concluded that there is significant intra-industry trade in assets among developed countries, with emphasis on portfolio investment.

For the present analysis, the GL index defined above was adapted to consider investment flows, according to the following expression:

$$GLI_{FDI} = \frac{\left(FDI_{out} + FDI_{in}\right) - \left|FDI_{out} - FDI_{in}\right|}{\left(FDI_{out} + FDI_{in}\right)} \text{ in which } 0 \leq GLI_{FDI} \leq 1 \quad (2)$$

where:

GLI_{FDI} = index of "intra-industry" direct investment

FDI_{out} = outward foreign direct investment

FDI_{in} = inward foreign direct investment

The adapted GL index makes it possible to calculate FDI inflows and outflows and to understand the dynamics of flows or stocks for a given economy. The result of equation (2) will always be in the interval [0, 1]. When the flow is only, or predominantly, in one direction, the result of the calculation will be close to 0. In contrast, the closer the inward and outward FDI values are to each other, the closer the result of the equation will be to 1.

The index has a number of limitations, however. If a country's FDI flows are predominantly inward or outward, the index will be the same, close to 0, regardless of direction. Moreover, if a country has both inflows and outflows of similar values in a given year, the index will remain close to 1. Since this is a relative index, it should be interpreted with caution. Nonetheless, the application of the GL index can be useful in comparisons and analysis of FDI flows, among other issues.

The suggestion for this calculation, with applications, appeared in Grubel (2002); and other studies subsequently applied the GL index to FDI flows and other variables. For example, Obstfeld (2004) applied the index to international asset flows, to assess potential imbalances in the indebtedness of some countries. However, that author qualified the index as a two-way asset trade index rather than an index of intra-industry trade in assets. Grubel (2002) noted that economists have suggested the work published as intra-industry trade in assets should be renamed as two-way asset trade. Although Obstfeld's (2004) view is more theoretically consistent, the present study maintains Grubel's taxonomy. Other studies applying the GL index to assets include Lane and Milesi-Ferretti (2007) and Obstfeld (2012).

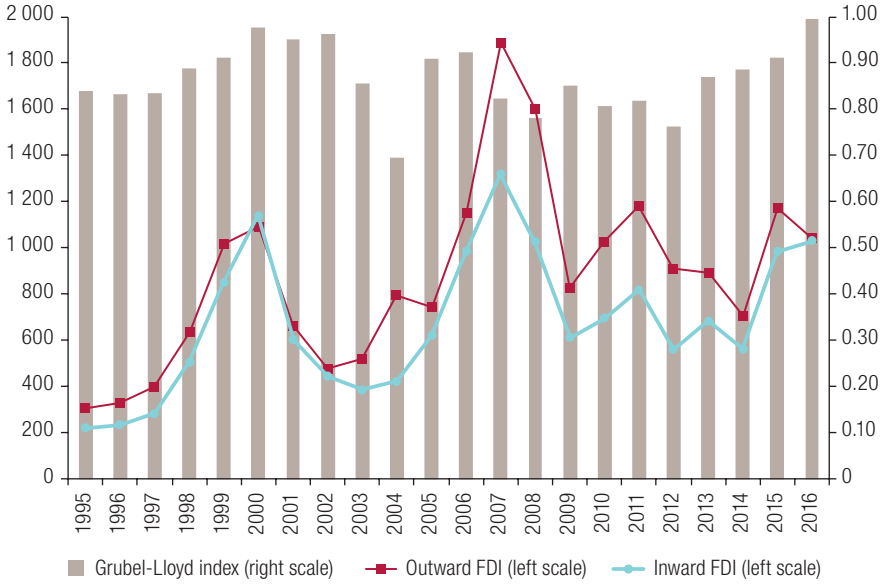
IV. The Grubel-Lloyd index applied to Argentina, Brazil, Chile and Mexico

With data on the stocks of inward foreign investment (FDI-in) and local investment abroad (FDI-out) obtained from UNCTAD, equation (2) made it possible to calculate the GL index for four selected Latin American countries (Argentina, Brazil, Chile and Mexico). These countries were the main FDI recipients in Latin America for the period analysed, which justifies their selection for the analysis. The analysis uses the same indicator for the group of developed countries as comparator,[2] in order to reinforce the debate on the movement of this form of capital.

As shown in figure 4, the index for developed countries is relatively stable compared to those of the countries in the sample analysed below; it's level is also fairly high —an average of 0.87 for the period 1995–2016— when the inflows and outflows are evaluated concurrently, characteristics that are not found for the four countries evaluated.

[2] According to the classification of the Department of Economic and Social Affairs (DESA) of the United Nations Secretariat. For further details see: http://www.un.org/en/development/desa/policy/wesp/wesp_current/2014wesp_country_classification.pdf.

Figure 4
Developed countries: inward and outward foreign direct investment and Grubel-Lloyd index, 1995–2016
(Billions of dollars)

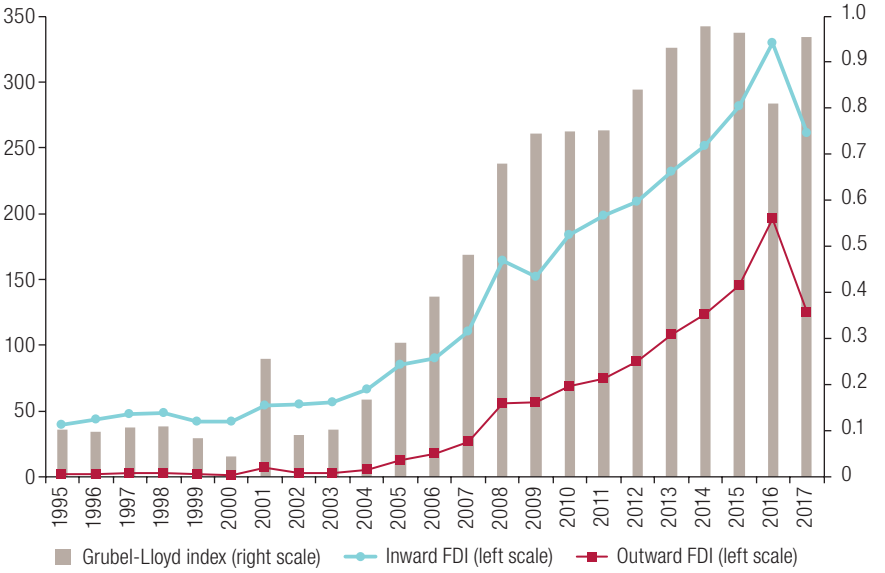


Source: Prepared by the authors on the basis of information from United Nations Conference on Trade and Development (UNCTAD).

The GL index for China was also calculated, not only because of the relative importance of this country in global flows, but also because it belongs to the developing country group, with which comparisons will be made of the results obtained for the four countries (Argentina, Brazil, Chile and Mexico).

China displays atypical behaviour compared to the rest of the developing countries, either because of the amount of investments, both inward and outward, which makes it the second and most important FDI exporter; or because of the behaviour of the calculated GL index, whose growth trend leads to results with the maximum scale of the indicator, in other words close to 1, since the inflows of such capital have been very close to the outflows, as shown in figure 5.

Figure 5
China: inward and outward foreign direct investment and Grubel Lloyd index, 1995–2016
(Billions of dollars)



Source: Prepared by the authors on the basis of information from United Nations Conference on Trade and Development (UNCTAD).

1. Argentina

The Argentine economy absorbed significant FDI inflows in the 1990s as a consequence of the relative economic stability provided by the currency board regime applied at the start of the decade. In this regard, figure 6 shows an upward trend in FDI inflows until 1999, after which there was an inflection following the currency crisis in Brazil, which affected the Argentine economy.

In the case of outflows, that is investment by Argentines abroad, a similar behaviour pattern is observed in the period analysed, with a net negative outflows in 2002, which means that the country's residents "disinvested" the resources that had been invested abroad previously. The cause of this behaviour can be attributed to the collapse of the currency board regime, which led a process of devaluation and greater instability in the Argentine economy.

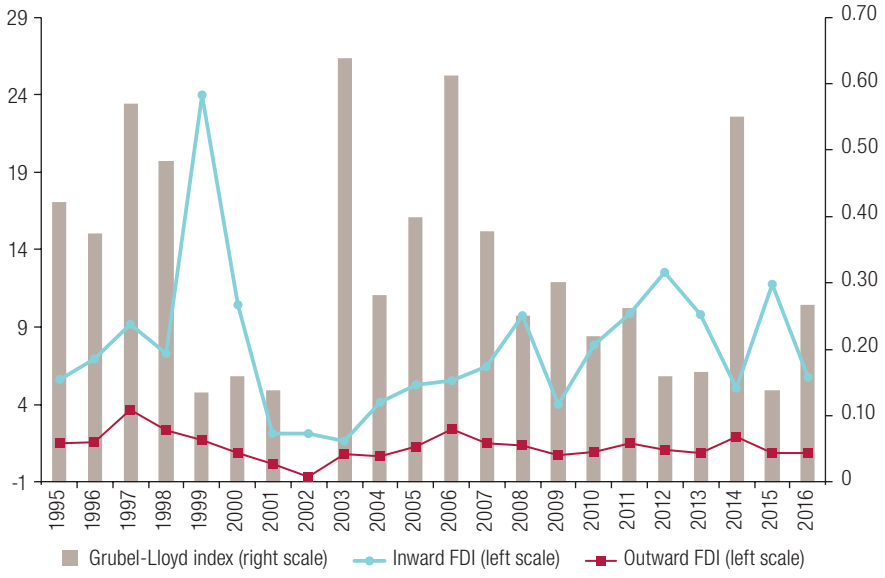
Thus, the GL index fluctuated in 1995–2016, while remaining below 0.3 in most of the period, reflecting the discrepancy between FDI inflows and outflows in the country.

These results are explained by the erratic movement of inflows and the small volume of outward FDI. In general, the values of the GL index are well below those calculated for the group of developed countries and for China. This indicates a relatively low degree of internationalization of production for the period analysed, despite the fact that Argentina had achieved a broad economic liberalization in the 1990s.

Confirmation of this is provided by the FDI/GDP ratio, which for Argentina was just 13% in 2016, well below the equivalent indicators for Latin America as a whole (40.5%) and the other sample countries, as shown in table 3.

As the share of FDI outflows is very small for the four countries in the sample, the same comparison will not be made for any of them in this study.

Figure 6
Argentina: inward and outward foreign direct investment and Grubel-Lloyd index, 1995–2016
(Billions of dollars)



Source: Prepared by the authors on the basis of information from United Nations Conference on Trade and Development (UNCTAD).

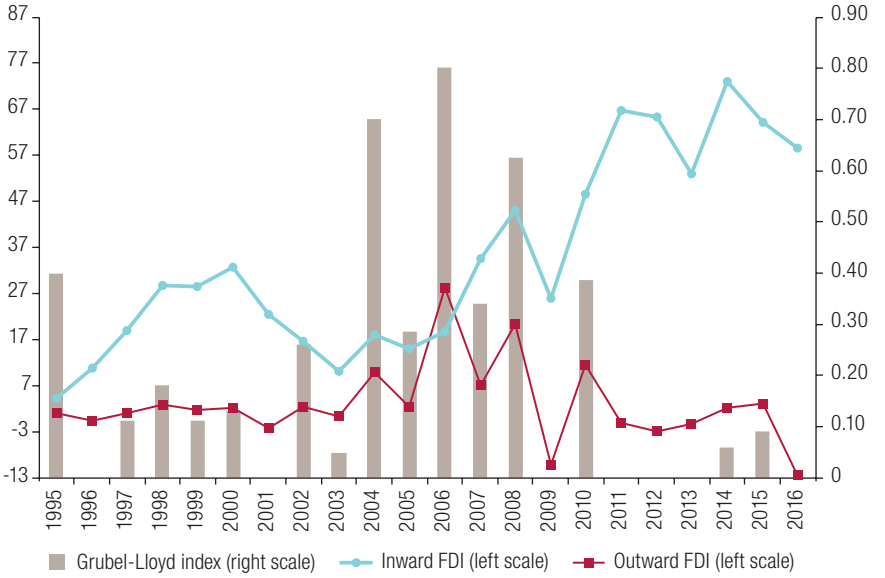
2. Brazil

The Brazilian economy received significant FDI inflows in different periods of time. The first period (1997–2001) was marked by the process of privatization of State-owned enterprises, while the second (2003–2008) was related to the commodity price boom on international markets and the economic growth with price stability that the Brazilian economy experienced. Following the reduction in inflows during the 2008 international crisis, the growth trajectory resumed in 2011–2016.

Investment by Brazilian residents abroad (FDI-out) has fluctuated but trended up since 2003, albeit interrupted by the 2008 crisis. As a result, FDI flows produced in a GL index above 0.30 in just three years (2004, 2006 and 2008), which reveals a divergent pattern of investment inflows and outflows for the period analysed.

The low level of the index, compared to those of the group of developed countries and China, stems from the large difference between inflows and outflows. Brazil was the world's seventh largest FDI recipient in the period but thirty-seventh among "FDI exporters". In addition, outflows have trended down strongly, as shown in figure 7.

Figure 7
Brazil: inward and outward foreign direct investment and Grubel-Lloyd index, 1995–2016
(Billions of dollars)



Source: Prepared by the authors on the basis of information from United Nations Conference on Trade and Development (UNCTAD).

3. Chile

Most of Chile's inward FDI is channelled into the mining sector, reflecting the importance of copper for the country's economy. Official statistics show that about 35% of the total stock of foreign investment is in this segment. Excluding data for the undeclared sectors, this represents more than 50% of the total stock of foreign capital channelled into Chile's production sectors.[3]

In the case of investments by Chilean residents in the rest of the world, mining activity again absorbs for most of the capital, since 45% of the total stock in 2016 was linked to this sector. The main destinations in that year were Brazil, Argentina, Luxembourg and Spain.

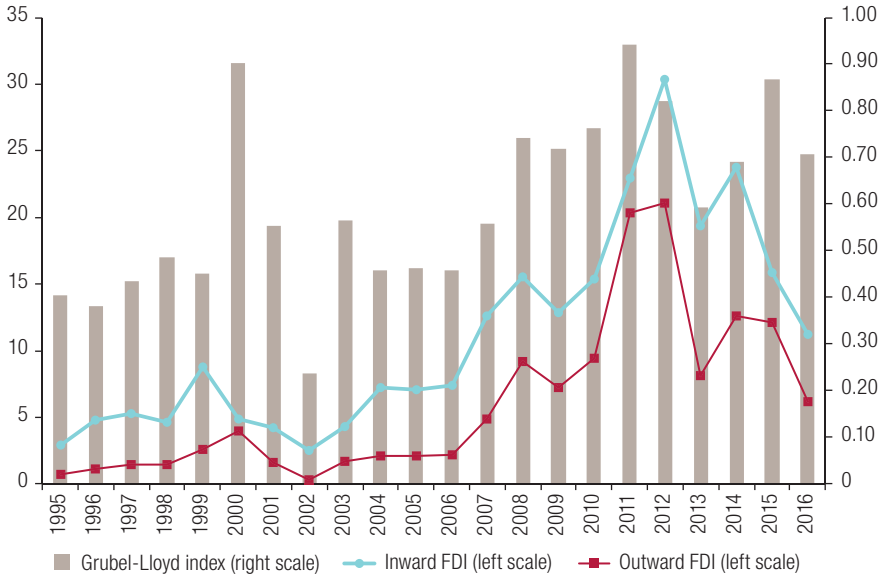
In this regard, figure 8 displays the greater symmetry between FDI inflows and outflows in the Chilean economy. This results in a calculated series in which the GL index is above 0.60 for more than half of the period. In other words. Chile displays a relatively more regular pattern than the other countries when comparing inflows and outflows.

Chile's FDI inflows and outflows also do not display the erratic behaviour of the other countries in the sample until 2012, when both flows drop. Outflows have also behaved similarly to inflows, which explains why its GL index is higher than that calculated for Argentina, Brazil and Mexico.

It is also possible to argue that Chile's openness in the 1970s led to a significant internationalization of its production activity, such that its FDI/GDP ratio is 101.1%, is above the levels reported in both the developed and Latin American blocs, as shown in table 3.

[3] According to statistics from the Central Bank of Chile. Available in: https://si3.bcentral.cl/estadisticas/Principal1/Estudios/SE/BDP/ied.html.

Figure 8
Chile: inward and outward foreign direct investment and Grubel-Lloyd index, 1995–2016
(Billions of dollars)



Source: Prepared by the authors on the basis of information from United Nations Conference on Trade and Development (UNCTAD).

4. Mexico

The analysis of foreign investment inflows and outflows in the Mexican economy reveals that 50% of the cumulative FDI flows received between 2000 and 2016 came from the United States, and 74.5% was channelled to the industrial sector. These data reflect Mexico's well-known strong economic relationship with the United States, in which it serves as a link in the manufacturing production chain, through Mexican maquiladora facilities.

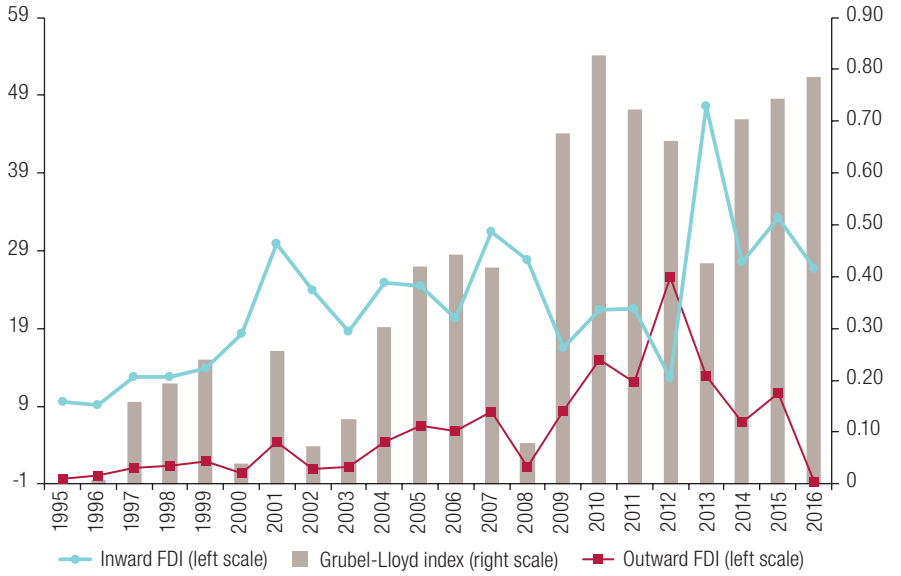
Foreign investment inflows into the Mexican economy faltered after the international financial crisis of 2007–2008. With this reduction and the increase in outflows that began in 2009, Mexico began to display GL indexes above 0.50 (see figure 9). In terms of the degree of internationalization, from the standpoint of inflows, Mexico also has a significant share of foreign capital in its economic activity. Its FDI/GDP ratio of 44% is higher than the Latin American average (see table 3).

The results concur with the finding of Grubel (2002), namely that emerging countries tend to have an index relatively close to 0 until a process of trade and financial openness begins that not only expands inflows but also stimulates a stronger outflows. In the 1990s particularly, Latin American countries, especially the four countries covered by the survey, expanded the process of trade and financial openness, which brought FDI inflows and outflows into closer alignment, as shown in the graphs.

As a result, the GL index moved closer to 1, as has been observed in developed economies and was also predicted by Grubel (2002). Obstfeld (2012) also drew attention to the same behaviour, although the index in this case was applied to the gross international asset and liability position of developed and emerging countries.

However, the rising trend of the GL index for Latin American countries' investment flows observed in this study may not be consolidated, since Argentina, Brazil and Mexico all experienced a fall in the index at the end of the period analysed, owing to a reduction in FDI inflows or outflows.

Figure 9
Mexico: inward and outward foreign direct investment and Grubel-Lloyd index, 1995–2016
(Billions of dollars)



Source: Prepared by the authors on the basis of information from United Nations Conference on Trade and Development (UNCTAD).

V. Concluding remarks

This article set out to analyse the behaviour of foreign investment inflows and outflows in four selected Latin American countries (Argentina, Brazil, Chile and Mexico) from 1995 to 2016, through the Grubel and Lloyd index adapted to the behaviour observed in developed countries. As noted throughout the study, the index for developed countries behaves differently from the pattern identified for the countries in the sample, since for the first group the indicator, in addition to being high, is relatively stable; this contrasts sharply with the erratic behaviour of the index for Argentina, Brazil, Chile and Mexico.

The analysis of FDI inflows and outflows for these countries demonstrates the importance of this variable for the region's economy. All of these economies display a rising trend in FDI flows, albeit with fluctuations owing to a series of events, including the global economic crisis of 2008.

However, the information extracted from the application of the GL index to these countries shows that FDI inflows have tended to display this trend but have also diverged sharply from outflows, especially in the case of Argentina.

In general, the GL index allows for a comparative evaluation between the four countries and the bloc of developed countries, showing that, in addition to being quantitatively lower, the indicator does not display the stable behaviour typical of this group. Similarly, in relation to China, whose GL index has risen significantly in the last ten years, the degree of production internationalization of Argentina, Brazil and Mexico is relatively lower, while Chile already has a more internationalized and effective pattern. Thus, as a group of developing countries, with different historical and political perspectives that are reflected in their economic policies and processes of engagement in the international economy, it is difficult to understand the movement of FDI as a regional trend without an analysis of each of the economies that comprise this group of countries and the relationships they establish among themselves.

Rather than invalidating the use of the GL index as an indicator of trends in the international economy, these results strengthen it, because it reveals aspects of this reality that would not otherwise be visible. So, by identifying the behaviour of FDI in different economies, either as a group or individually, divergences and idiosyncrasies are revealed. Other studies may lead to an additional explanation of the results observed.

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Okun's law in Mexico: an analysis of heterogeneity among States, 2004–2018

Eduardo Loría, Susana Rojas and Eduardo Martínez[1]

Abstract

The sensitivity of unemployment to economic activity in the Mexican States (from the beginning of 2004 to the first half of 2018) was evaluated on the basis of Okun's law (1983) as it relates to growth rates. To capture the heterogeneity of the 32 States, the results of individual regressions were compared with fixed effects panel data estimates. The Okun coefficient is significant and possesses the correct sign in 22 States, reflecting a variation between -7.21 and -1.25. The remaining 10 States (with the incorrect sign and an insignificant coefficient) are characterized by poor economic, social and institutional performances. The great recession brought about structural changes in 15 of the 22 States where Okun's law is valid throughout the period. Moreover, in these 22 States, the Rule of Law Index and the rate of critical employment conditions determine the sensitivity of unemployment growth to output growth.

Keywords

Economic growth, unemployment, ECLAC, regional development, local development, labour market, employment creation, structural adjustment, econometric models, Mexico

JEL classification

C21, C22, E24

Authors

Eduardo Loría is a tenured professor with the Faculty of Economics of the National Autonomous University of Mexico (UNAM), founder and coordinator of the Centre for Economic Modelling and Forecasting (CEMPE) of the same faculty, national researcher, level III, of the National System of Researchers and member of the Mexican Academy of Sciences. Email: eduardol@unam.mx.

Susana Rojas is an assistant with the Centre for Economic Modelling and Forecasting (CEMPE) of the Faculty of Economics of the National Autonomous University of Mexico (UNAM), and a specialist in applied econometrics with the same faculty. Email: surojasmanzo@gmail.com.

Eduardo Martínez is an assistant with the Centre for Economic Modelling and Forecasting (CEMPE) of the Faculty of Economics of the National Autonomous University of Mexico (UNAM) and a graduate student in Economics in the same faculty. Email: l.aleve@hotmail.com.

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I. Introduction

Since Okun published his foundational paper on the measurement of the bidirectional macroeconomic effects of the relationship between output and unemployment (1983, originally published in 1962), the literature has generally concentrated on estimations incorporating distinct particularities —including of individual countries and specific periods—, different econometric techniques and ad hoc functional forms. In some texts, such as that of Blanchard, Amighini and Giavazzi (2012), the Okun coefficient is estimated for individual developed countries and for different periods. The macroeconomic view of this important law has prevailed.

Applied studies that estimate the Okun coefficient for specific countries as it relates to macroeconomics are crucial for the assessment of the quality of economic growth in terms of its effect on the unemployment rate. However, they do not consider the differences in labour productivity between the regions to which these countries belong, according to the definition of structural heterogeneity of the Economic Commission for Latin America and the Caribbean (ECLAC) (Pinto, 1973; Cimoli and Porcile, 2011).

ECLAC (2016) argues that labour productivity is positively associated with economic growth and negatively associated with informality, so the level of structural heterogeneity reflects different trajectories of growth and job creation among regions within the same country. Our work focuses on the ECLAC definition of structural heterogeneity among regions in Mexico.

Thus, accepting the structural heterogeneity hypothesis, it is plausible that the Okun coefficient will vary based on the region of a country being examined; in other words, unemployment will respond differently to changes in output. The asymmetries in the Okun coefficients of the various regions reflect structural aspects of development and growth that characterize their labour markets, such as flexibility, segmentation (Dell'Anno and Solomon, 2008; Islas and Cortez, 2018), institutional frameworks (ECLAC, 2012) and productivity (Friedman and Wachter, 1974).

This has given rise —in several countries and in recent years— to works that estimate Okun's law at the international and subnational levels. For example, Huang and Yeh (2013) estimate a higher Okun coefficient in member countries of the Organisation for Economic Co-operation and Development (OECD). Ball and others (2016) find the same result —a higher Okun coefficient— in developed countries compared to developing countries.

At the subnational level, Melguizo (2015) finds that the level of economic activity in the provinces of Spain plays a key role in the estimation of the Okun coefficient. Guisinger and others (2018) estimate different Okun coefficients for the regions of the United States, which respond significantly to lower rates of union membership, higher levels of educational attainment, and higher female labour force participation rates. In Mexico, the only relevant research is that of Alarcón and Soto (2017), who estimate the Okun coefficient by State, without delving into determinants.

In line with ECLAC (2016), we accept the hypothesis of structural heterogeneity in Mexico based on the existence of structural economic, social and institutional gaps among the 32 States. These give rise to distinct trajectories of labour productivity, economic growth and job creation that, ultimately, yield different Okun coefficients.

One contribution of this work is the incorporation of economic, social and institutional variables that cause structural heterogeneity. The first group of variables explains the level of economic activity measured through GDP growth, per capita GDP, unemployment and total exports. In terms of social variables, we included the rate of critical employment conditions and the crime rate (measured through homicide and kidnapping rates). Finally, we incorporated the institutional factor, expressed through the 2018 Rule of Law Index. Thus, this study adheres to the ECLAC definition of structural gaps at the subnational level; in this case, among the 32 Mexican States.

Another contribution is the estimation of Okun's law for Mexico, as it relates to growth rates from the beginning of 2004 to the second quarter of 2018, which represents the longest and most integrated series derived from the same source of information (INEGI, 2018a and 2018b). The length of the period and the frequency of the data allowed for sufficient degrees of freedom to make robust and economically meaningful individual estimates, which were later compared with fixed effects panel data estimates and with the results of Rodriguez and Peredo (2007), who used the same specification at the national level, but for a much narrower period, from the third quarter of 1988 to the third quarter of 2003.

We also show that the great recession of 2008–2009 caused notable changes in the sensitivity of unemployment to economic activity in 15 of the 22 States in which Okun's law is valid, a group we call G1. Okun's law is no longer valid in a significant number of States, so other theoretical and empirical rationales are needed to explain the dynamics of unemployment from now on.

The last contribution is showing that the validity of Okun's law depends on the Rule of Law Index and the rate of critical employment conditions. This can only be demonstrated in the group of 22 States in which Okun's law is valid (G1). By contrast, and worryingly, the Okun coefficient is insignificant for all the variables analysed in the remaining 10 States (G2).

These results suggest that the implementation of State policies should not only consider economic factors —which are undoubtedly very important— but also, and even more so, social and institutional factors, so that labour markets can respond to variations in local and national economic activity.

The above-mentioned contributions were the outcome of the following strategy. First, the individual Okun coefficients were estimated for the 32 Mexican States and a very important result was highlighted: statistical significance and correct signs were found for only 22 States. This allowed the creation of two groups: 22 States (G1), on the one hand, and 10 States (G2), on the other. The individual analysis was complemented by fixed effects panel data estimates, which took into account the heterogeneity of the States thus grouped (Greene, 2003). The results derived from the individual estimates are supported by and consistent with those obtained from the panel regressions. The analysis of a large number of variables leads to the conclusion that G1 outperforms G2 in the sense that it functions better economically, socially and institutionally, and that the Rule of Law Index and the rate of critical employment conditions determine the Okun coefficient.

This suggests that the high level of precarious employment and institutional deficiencies in G2 perpetuate a vicious circle of high informality, low productivity and weak economic growth, all of which explains the non-significance of Okun's law, thus resulting in poverty that reproduces itself.

The article is divided into six sections in addition to this introduction. The second section presents a review of Okun's law in applied works that consider structural aspects. The third section defines the structural gaps behind the hypothesis of structural heterogeneity in Mexico, and the fourth section analyses the performances of the two groups formed. The fifth section links the econometric analysis of time series with that of panel data. The sixth section analyses and discusses the main results, and the seventh and last section presents our conclusions.

II. Literature review

Okun (1983) argued that there is a dynamic and self-reinforcing cycle of high unemployment, low wages and weak profits, which limits investment in equipment, housing, education and research. To the extent that the process replicates itself in the long run, the cost will be very high in economic terms (lag in potential output) and in social terms (higher unemployment).

Because of the significance of this relationship in economic theory and policy, modern macroeconomic analysis frequently uses Okun's approach to test one of the most important regularities

of macroeconomics: the bidirectional dynamic of unemployment and output. As a result, this relationship is now considered a macroeconomic law. According to Tobin (1980), Okun's law is one of the most reliable empirical regularities of macroeconomics.

However, almost 60 years after the publication of that foundational article, there is no global consensus on the optimal rate of sensitivity of unemployment to output for a developed or emerging economy (Islas and Cortez, 2013), especially considering the economic, social and institutional differences behind the structural heterogeneity among regions.

Ball and others (2016) find that unemployment is more sensitive to economic activity —or reflects a higher Okun coefficient— when per capita GDP and the share of the tertiary sector in the economy are higher. Therefore, it could be said that the degree of economic and technological development is a crucial determinant of the significance and magnitude of the Okun coefficient.

Dell'Anno and Solomon (2008) and Guisinger and others (2018) provide conclusive information on the determinants of the Okun coefficient in terms of labour market composition. They argue that a greater labour supply in the informal economy and a lower female participation rate are reflected in a lower Okun coefficient. In the extreme case, Agénor and Aizenman (1999) argue that the movement of skilled and unskilled workers from the formal sector to the informal sector cancels out the relationship between unemployment and output in the short run.

Dell'Anno and Solomon (2008) note that the relationship between informality and the magnitude of the Okun coefficient is associated with institutional weakness, which is a crucial determinant of structural heterogeneity (Cimoli and Porcile, 2011; ECLAC, 2012). However, they do not establish an econometric relationship between the Okun coefficient and the degree of institutionalization. Their research only points out that the lack of trust in deficient institutions prompts negative behaviour of workers because they opt for informality in the face of tax policy. To the extent that jobs increase in the informal sector, which is the most technologically unsophisticated, aggregate labour productivity will be lower, even if open unemployment is lower. Finally, there will be a negative impact on economic growth's effectiveness in reducing unemployment, i.e., a lower Okun coefficient.

As regards Mexico, Islas and Cortez (2018) suggest that higher informality could be reflected in a lower Okun coefficient. This means that in times of recession, unemployment reacts more strongly to economic activity than in the expansionary phase of the cycle. The same is true for the United States economy (Crespo, 2003).

Islas and Cortez (2018), drawing on the work of Jardin and Stephan (2012), posit that the non-linearity of the Okun coefficient in Mexico derives from the fact that in periods of recession, to the extent that the labour market is flexible, businesses fire employees quickly and aggressively, and do not hire in the same way in periods of expansion. This results in unemployment falling slowly in the recovery period, so that unemployed workers find a way out in informality (Loría, Aupart and Salas, 2016), especially women (Loría, Libreros and Salas, 2011).

Papers on Okun's law in Mexico are not limited to a rereading of the original article (Loría and Ramos, 2007), but have also focused on attributing the magnitude of the Okun coefficient to factors such as labour flexibility (Chavarín, 2001; Loría, Ramírez and Salas, 2015), gender (Loría, Libreros and Salas, 2011), informality (Islas and Cortez, 2018) and the phase of the economic cycle (Islas and Cortez, 2013 and 2018). However, although these studies are commendable in that they incorporate variables that enrich Okun's original analysis (1983), they do not explicitly consider the structural heterogeneity among the 32 States or the factors behind it.

Among the works available, only Alarcón and Soto (2017) have estimated Okun's law for the 32 Mexican States. The results of their research are supported by fixed effects panel data techniques for limited annual data (2003–2014), so when formulating individual estimates, the authors are confronted

with results that are not very robust. Moreover, they do not specifically develop or analyse the economic, social or institutional differences that give rise to structural heterogeneity. Herein lies the contribution of this paper. We recognize, then, that the limitations of the work on Okun's law as applied to Mexico are the motivation for this study.

III. Structural gaps in Mexico

ECLAC (2016) points out that there are economic, social and institutional differences between the 32 States of Mexico, which are called structural gaps. These gaps between regions (between productive sectors, between export-oriented firms and firms that concentrate on the local market, between firms of different sizes, between different skill levels and the sex of the workers, and between formality and informality) produce asymmetries in labour productivity and define structural heterogeneity. The results of the paper indicate that slow growth is associated with low productivity and, in turn, relate this low productivity to the existence of these structural gaps.

This document also recognizes that the heterogeneity among sectors and regions, as well as the significant weight of low-productivity activities in the Mexican economy, act as an obstacle to increasing overall labour productivity. The manufacturing sector, concentrated in the north of the country, reflects the strongest growth and is the most dynamic, recording the largest increase between 1990 and 2012 (2.1%), driven by scale-intensive industries (including the automotive industry). By contrast, the weakest performance was recorded by the primary sector and the States linked to oil activities.

This study identifies a considerable decrease in hours worked in the manufacturing sector in favour of increases in the service sector, particularly in commerce. This translates into labour shifts from sectors of high productivity growth to sectors where labour productivity is weaker, thereby accentuating structural heterogeneity.

ECLAC (2016) concludes that, in general, most States in the north and centre of the country reflect higher labour productivity than those in the south. The States with the highest levels of labour productivity, before and after the great recession, are Querétaro, Aguascalientes, Zacatecas and Nuevo León, while the States that recorded the lowest growth in labour productivity are Campeche and Baja California.

In addition, labour productivity in Mexico is negatively correlated with informality and positively correlated with GDP growth and exports. In this paper we also prove that the States with the strongest growth in labour productivity are those with the strongest economic growth, the lowest informality and the highest exports.

It is important to note that labour market conditions, such as composition (informal versus formal work and women's participation rate), increasing precariousness and institutional frameworks, reflect the structural heterogeneity of the country (ECLAC, 2012). The unemployed population tries to survive by offering their labour in precarious and low-productivity jobs, which are associated with micro-businesses and the informal sector. Amid the backdrop of poorly designed labour market institutions, the precariousness of these jobs will persist.

Progress towards more homogeneous labour productivity requires an active State that designs a long-term systemic strategy for industrial, labour, social and environmental policies, and above all, that supports the active participation of the private sector in the framework of development partnerships and agreements.

ECLAC (2012) emphasizes that institutions that foster innovation and learning have virtuous effects on growth and productivity. However, when they encourage unproductive activities, such as the misappropriation of resources, incentives to invest in the economy decline (Mauro, 1995), as does public

confidence in those institutions (Dell'Anno and Solomon, 2008). Consequently, job creation decreases and persons who are already employed in formal jobs have incentives to migrate to the informal sector. There is a very close relationship between productivity and economic growth, which are in turn linked to the increasing precariousness of labour and institutional variables.

Our work coincides with ECLAC (2012 and 2016) in the sense that we find that the significance and magnitude of the Okun coefficient depend on structural gaps, which lead to heterogeneous labour productivity performances. Note that there are no State data series that capture all the structural gaps over a long period of time and that are comparable with employment and output figures.

Even so, our analysis reveals that the Okun coefficient is not statistically significant in States where labour productivity growth is low, such as Morelos, Guerrero and Campeche. Meanwhile, States such as Querétaro, Mexico City and Nuevo León, with high rates of labour productivity growth since 2008, have statistically significant Okun coefficients with the correct sign.

IV. Structural heterogeneity

As we have already mentioned, works on Okun's law for Mexico, in general, neglect the issue of structural heterogeneity by formulating estimates at the macro level with different specifications, periods and frequencies of data. On the basis of the theoretical elements presented in the previous sections, individual regressions were carried out to detect the asymmetries of the Okun coefficient and thus establish a group of the States for which there is conclusive empirical information confirming Okun's law as it relates to growth rates.

Once the individual estimates were made,[2] it was possible to clearly identify two broad groups of States: G1 and G2. Hence, we grouped, respectively, the entities in which β_1 and β_2 are statistically significant with the correct signs and economically acceptable parameters, and the entities that do not present these characteristics. This initial exercise resulted in G1 being composed of 22 States and G2 of the remaining 10 States. The States that make up G1 are Aguascalientes, Baja California, Baja California Sur, Chihuahua, Mexico City, Coahuila, Colima, Mexico State, Guanajuato, Hidalgo, Jalisco, Michoacán, Nayarit, Nuevo León, Querétaro, Quintana Roo, San Luis Potosí, Sinaloa, Sonora, Tamaulipas, Tlaxcala and Veracruz. This grouping made it possible to identify the structural characteristics (differences) of both groups.

An initial examination of the hypothesis of structural heterogeneity is presented in table 1, which does not reflect marked differences in the breakdown of States' productive profiles by sector, except in the tertiary sector, where the figure for G1 is slightly higher than that of G2 excluding Campeche.[3] However, it is striking that the share of the secondary sector in GDP is exactly the same for G1, G2 excluding Campeche and the country as a whole.

The small difference in the share of the primary and tertiary sectors in G1 and G2 appears to determine structural heterogeneity. G1 includes more technological and less agricultural sectors, which is reflected in greater labour productivity and, therefore, in stronger economic growth (Padilla-Pérez and Villarreal, 2015).

Table 2 provides a clearer estimation of the factors behind structural heterogeneity and shows that our classification (G1 and G2) adequately accounts for the substantial differences in economic, social and institutional variables.

[2] See the econometric methodology in the following section.

[3] The States of Campeche and Tabasco should be highlighted, since their eminently oil-producing productive profiles significantly distort the variables of interest, particularly in the case of Campeche, so the subsequent G2 analyses are carried out with and without this State.

Table 1
Mexico: sectoral share of GDP by group of States, 2016
(Percentages)

Sector	National	G1	G2	G2 excluding Campeche
Primary	3	4	5	6
Secondary	32	32	38	32
Tertiary	65	64	57	62
Total	100	100	100	100

Source: Prepared by the authors, on the basis of Center for Public Finance Studies (CEFP), "Evolución de la actividad productiva nacional y de las entidades federativas 2003–2018", *Estudio*, No. 022/2018, Mexico City, 2018.

Table 2
Mexico: economic, social and institutional variables by group of States, first quarter of 2004–second quarter of 2018
(Rates, Mexican pesos, United States dollars and indices)

	National	G1	G2	G2 excluding Campeche
Real GDP growth[a]	0.66	0.74	0.34	0.51
Per capita GDP[b]	150 308	135 959	181 874	97 420
Per capita GDP growth[c]	0.26	0.36	0.05	0.23
Unemployment[d]	4.03	4.38	3.25	3.32
Unemployment growth[c]	0.43	0.36	0.58	0.48
Labour productivity growth[e]	0.20	0.53	-0.18	0.39
Total exports[f]	318 233	244 259	53 318	30 924
Employment in the informal sector[g]	26.6	25.40	29.22	29.59
Employment growth in the informal sector[c]	-0.12	-0.20	0.05	0.07
Critical employment conditions[h]	12.32	12.13	18.02	18.13
Rule of Law Index (2018)[i]	0.3922	0.3923	0.3920	0.3878
Homicide rate[j]	3.84	3.78	3.95	4.22
Kidnapping rate[j]	0.24	0.22	0.27	0.29

Source: Prepared by the authors, on the basis of National Institute of Statistics and Geography, *Estadísticas históricas de México 2014*, Aguascalientes, 2015; INEGI, "México: exportaciones por entidad federativa 2007–2015", 2015 [online] http://www3.inegi.org.mx/rnm/index.php/catalog/241/related_materials?idPro=; INEGI, "Encuesta Nacional de Ocupación y Empleo (ENOE), población de 15 años y más de edad", 2018 [online] https://www.inegi.org.mx/programas/enoe/15ymas/; INEGI, "Indicador trimestral de la actividad económica estatal", 2018 [online] https://www.inegi.org.mx/temas/itaee/; Economic Commission for Latin America and the Caribbean (ECLAC), *Productividad y brechas estructurales en México* (LC/MEX/L.1211), Mexico City, 2016; World Justice Project (WJP), *Índice de Estado de derecho en México 2018: perspectivas y experiencias en los 32 estados del país*, Washington, D.C., 2018; Executive Secretariat of the National Public Security System, "Incidencia delictiva", 2021 [online] https://www.gob.mx/sesnsp/acciones-y-programas/incidencia-delictiva-87005?idiom=es.

[a] The Quarterly Indicator of State Economic Activity (ITAEE), an index of physical volume with a base year of 2013 (INEGI, 2018b), was used for States' real GDP. Average growth for the entire period.

[b] Real GDP in Mexican pesos at 2013 prices per inhabitant of the corresponding State (INEGI, 2018b). Arithmetic average for the period.

[c] Average growth for the entire period.

[d] Percentage of the economically active population that did not work even one hour during the reference week of the National Occupation and Employment Survey (ENOE) but expressed their willingness to do so and carried out some activity to obtain employment (INEGI, 2018a). Arithmetic average for the period.

[e] Calculated with the index of total average labour productivity using the index of physical volume by State and the index of the employed population by State, both with 2008 as the base year (ECLAC, 2016). Average growth from 2005–2014.

[f] Mining and manufacturing industry exports (INEGI, 2015a and 2015b). Sum of the averages by State in millions of United States dollars at current prices from 2007–2017.

[g] Proportion of the population employed in non-agricultural economic units operated without accounting records and on the basis of household or personal funds, without being incorporated as a business (INEGI, 2018a). Average growth for the entire period.

[h] Percentage of the employed population in one of the following situations: (i) works less than 35 hours per week owing to labour market conditions; (ii) works more than 35 hours with an income below the minimum wage, or (iii) works more than 48 hours with an income of up to two minimum wages (INEGI, 2018a). Arithmetic average for the period.

[i] Measures society's perception of adherence to the rule of law. Based on a survey of 25,600 citizens (800 in each State), measurement of the rule of law as perceived by respondents. The index measurement includes eight factors: limits to government power, corruption, open government, fundamental rights, order and security, regulatory compliance, civil justice and criminal justice (WJP, 2018). Values close to 1 indicate greater adherence to the rule of law.

[j] Number of cases per 100,000 inhabitants in each State (Executive Secretariat of the National Public Security System, 2021).

G1 reflects better performances in all indicators except the unemployment rate, which may be because in these States there are institutions that promote productive activities, so there are fewer precarious jobs (ECLAC, 2012). As a result, although unemployment is higher, their labour markets benefit from a greater level of formal employment, so it is plausible that the records of open unemployment in G1 are more reliable because they more accurately reflect the functioning of labour markets.

With regard to economic variables, it should be noted that G1, in particular, reflects weaker growth in the unemployment rate and stronger linkages with international markets. The latter can be seen through the average value of exports,[4] which is considerably higher in G1 than in G2 excluding Campeche (US$ 244,259 versus US$ 30,924). Thus, although the productive contribution of the secondary sector is the same, the stronger linkage with international trade (five times greater) and what this implies in terms of competitiveness and productivity, and perhaps the slight difference in terms of the tertiary sector, together with its greater technical intensity, explain very different trajectories of growth and development.

All the variables in G2 have a negative impact on the Okun coefficient to the extent that the three groups of variables reflect poor performances, so it is plausible that this group faces a poverty trap[5] that can condemn the corresponding States to weak development and low steady-state economic growth. If this is the case, it is likely that they experience multiple externalities and social dysfunctionalities which, in turn, give rise to greater distortions, such as marginality and criminality.

V. Econometric aspects

The original version of Okun's law (1983) is expressed through three equations. However, in most of the applied literature, multiple variants have been used, all with the aim of best capturing the effects of economic activity on unemployment.

In this work, the econometric practice is correct insofar as the statistical results are robust for the largest number of States.[6] We find economically and statistically consistent and significant results only with the specification of the variables algebraically transformed into annualized growth rates (real GDP and unemployment). An additional advantage of this specification is that, since the variables are stationary, there are no cointegration problems and, therefore, no spurious relationships.

For time series:
$$\dot{u}_t = \beta_1 + \beta_2 \dot{Y}_t + \varepsilon_t \quad (1)$$

For panel data:
$$\dot{u}_{it} = \beta_{1i} + \beta_2 \dot{Y}_{it} + \varepsilon_{it} \quad (2)$$

Both models are based on quarterly series for the period from the first quarter of 2004 to the second quarter of 2018, where $\dot{u}_t$ and $\dot{u}_{it}$ represent annualized quarterly growth in the unemployment rate; $\dot{Y}_t$ and $\dot{Y}_{it}$ represent the annualized quarterly growth of the Quarterly Indicator of State Economic Activity; β_1 and β_{1i} are the constant terms representing the natural rate of growth in unemployment; β_2 represents the Okun coefficient, which measures the sensitivity of unemployment growth to economic growth; ε_t and ε_{it} are the error terms that capture the idiosyncratic errors of each State and, in equation (2), the

[4] From the manufacturing and mining sectors.

[5] See Basu (2003) and Azariadis and Stachurski (2005) for more details on the concept of the "poverty trap".

[6] A total of seven different specifications of Okun's law were tested: (i) first differences; (ii) difference and gap in GDP as a percentage of potential; (iii) difference and gap in GDP as the difference between real and potential GDP in monetary units; (iv) unemployment gap and GDP gap (as a percentage of potential); (v) unemployment gap and GDP growth; (vi) unemployment growth and GDP gap (as a percentage of potential) and (vii) specification with variables in annualized growth rates, the only one that produced robust results.

error composed of the specific individual effect and the remainder of the disturbance; t represents the period of each variable and i refers to the individual (State).

The main advantage of complementing the Okun's law analysis with the time series and panel data methods is that it allows us to consider differences among States. In particular, the fixed effects panel data model allows us to calculate β_1 for each State and to obtain an estimate of β_2 at the national and group level that considers the individual effects of each State, while the time series model allows us to estimate β_2 for each State.

Although in this paper we consider both econometric techniques complementary, and therefore that they enrich the analysis, an estimation using the panel method can be considered more efficient because it provides more information about the data, more variability, less collinearity between variables and more degrees of freedom (Klevmarken, 1989; Hsiao, 2014).

For estimation on the basis of equation (1), the selection criterion for G1 was that β_1 and β_2 had to be, individually and jointly, statistically significant at a confidence level of at least at 10% and that β_2 had to be less than 0 and β_1 greater than 0; in other words, that they also made economic sense. Thus, G1 = 22 States and G2 = 10 States.

VI. Analysis and discussion of results

Table 3 shows the results of G1 exclusively. The numbers in parentheses correspond to the t-statistics of β_1 and β_2 and, in the case of the F-statistic, to the joint significance (probability) of the regressors in each model.

Table 3
Mexico: estimation of Okun's law in growth rates in G1 States, first quarter of 2004–second quarter of 2018

State	β_1	β_2	R^2	F-statistic
Aguascalientes	10.42 (2.73)	-1.85 (-3.08)	0.145	9.49 (0.00)
Baja California	23.24 (5.19)	-7.21 (-8.23)	0.563	67.74 (0.00)
Baja California Sur	16.03 (2.93)	-1.32 (-2.14)	0.076	4.60 (0.03)
Chihuahua	19.44 (3.91)	-4.8 (-5.04)	0.313	25.46 (0.00)
Mexico City	7.88 (3.23)	-2.62 (-3.91)	0.214	15.28 (0.00)
Coahuila	5.07 (1.91)	-1.81 (-5.06)	0.314	25.66 (0.00)
Colima	16.23 (3.11)	-3.01 (-2.87)	0.128	8.23 (0.00)
Mexico State	10.49 (3.89)	-3.17 (-5.08)	0.316	25.82 (0.00)
Guanajuato	8.42 (2.17)	-2.19 (-2.83)	0.125	8.01 (0.00)
Hidalgo	21.32 (3.80)	-4.83 (-4.13)	0.234	17.10 (0.00)
Jalisco	11.37 (3.44)	-3.47 (-4.57)	0.272	20.90 (0.00)
Michoacán	10.71 (1.87)	-2.28 (-1.70)	0.049	2.90 (0.09)
Nayarit	12.66 (3.62)	-2.05 (-3.59)	0.188	12.94 (0.00)
Nuevo León	11.82 (3.78)	-3.66 (-5.86)	0.380	34.37 (0.00)

Table 3 (concluded)

State	β_1	β_2	R^2	F-statistic
Querétaro	26.9 (4.50)	-4.96 (-4.93)	0.303	24.31 (0.00)
Quintana Roo	18.64 (3.93)	-2.71 (-4.16)	0.236	17.34 (0.00)
San Luis Potosí	13.41 (2.33)	-2.6 (-2.16)	0.077	4.69 (0.03)
Sinaloa	8.78 (2.28)	-2.20 (-2.78)	0.121	7.72 (0.00)
Sonora	7.21 (1.77)	-2.12 (-2.75)	0.119	7.57 (0.00)
Tamaulipas	3.98* (1.29)	-1.71 (-2.43)	0.096	5.94 (0.01)
Tlaxcala	4.77 (2.13)	-1.25 (-4.09)	0.230	16.76 (0.00)
Veracruz	6.16 (2.01)	-1.48 (-1.77)	0.053	3.15 (0.08)

Source: Prepared by the authors, on the basis of National Institute of Statistics and Geography, "Encuesta Nacional de Ocupación y Empleo (ENOE), población de 15 años y más de edad", 2018 [online] https://www.inegi.org.mx/programas/enoe/15ymas/; INEGI, "Indicador trimestral de la actividad económica estatal", 2018 [online] https://www.inegi.org.mx/temas/itaee/.

Note: The t-statistics of β_1 and β_2 and the probability of the F-statistic are shown in parentheses. An asterisk (*) indicates that the coefficient is not significant at the confidence level of 10%.

The following results are derived from this table:

(i) The 22 States show economically and statistically sound results, although there are important differences in R^2.

(ii) The low values of Baja California Sur, Michoacán, San Luis Potosí and Veracruz stand out. However, the F-test does not allow us to accept that β_1 and β_2 are equal to zero. The case of Veracruz is the most delicate, because of the value of acceptance at 10%.

(iii) The considerable asymmetry of β_2, which varies between -7.21 (Baja California) and -1.25 (Tlaxcala) is immediately striking.

(iv) The reading of β_1 and β_2 allows us to answer the question about the rate of growth in output required for the unemployment rate not to increase. Thus, in Mexico City, Coahuila and Nuevo León, for example, economic growth of around 3% is required, and in Nayarit, Quintana Roo and Baja California Sur, just over 6%. This point is proved by evaluating the ratio β_1/β_2.

(v) It is plausible that, to the extent that $|\beta_2|$ is greater, there are more efficient institutions, less precarious jobs and, consequently, more efficient labour markets in terms of higher productivity (ECLAC, 2012).

Meanwhile, the time series regression for the entire country and the entire period yields a more sensitive coefficient than that of most of the G1 States. However, there are serious specification problems, as well as non-linearity, according to the Ramsey RESET test:

$$\dot{u}_t = 9.46 - 3.62 * \dot{Y}_t + \varepsilon_t \quad (3)$$
$$t \quad (4.88) \quad (-6.52)$$

R^2 = 0.43; F = 42.51(0,00); DW = 0.58; JB = 12.19(0.00); LM(4) = 10.41(0.00); ARCH(2) = 1.18(0.31); ARCH(4) = 2.54(0.51); White(n.c.) = 0.62(0.43); White(c) = 0.38(0.68); RESET(1) = 10.69(0.00); RESET(2) = 6.96(0.00).[7]

[7] These results contrast with those obtained with the same specification by Rodríguez and Peredo (2007) for the period between the third quarter of 1988 and the third quarter of 2003. These authors estimate an Okun coefficient of -2.47.

A second econometric exercise —which is an important contribution, since it is not carried out in the referenced works— consists of testing the hypothesis of structural change. This is done for G1 only, with the Bai and Perron (1998) test, which allows the detection of endogenous breaks (see table 4).

Table 4
Mexico: estimation of Okun's law in growth rates in the 15 G1 States that experienced structural changes, first quarter of 2004–second quarter of 2018

State	Period of significance	β_1	β_2	R^2	F-statistic
Aguascalientes	Q1 2004–Q1 2010	21.9 (5.34)	-2.23 (-3.30)	0.24	11.56 (0.00)
Baja California Sur	Q3 2007–Q4 2009	70.3 (9.74)	-2.96 (-4.01)	0.66	16.08 (0.00)
	Q1 2010–Q2 2018	2.3* (0.69)	-0.89 (-2.37)	0.14	5.63 (0.02)
Chihuahua	Q1 2004–Q3 2009	38.8 (4.65)	-5.74 (-4.03)	0.43	16.24 (0.00)
Mexico City	Q1 2004–Q4 2006	28.6 (3.80)	-5.59 (-3.17)	0.50	10.06 (0.00)
	Q1 2007–Q2 2018	5.3 (2.31)	-2.59 (-3.93)	0.26	15.50 (0.00)
Coahuila	Q1 2004–Q4 2009	10.8 (2.30)	-2.46 (-4.05)	0.42	16.44 (0.00)
Mexico State	Q1 2004–Q4 2009	16.0 (4.21)	-3.9 (-4.19)	0.42	17.62 (0.00)
Hidalgo	Q1 2004–Q3 2009	41.6 (4.36)	-6.34 (-3.28)	0.33	10.79 (0.00)
Jalisco	Q1 2004–Q1 2016	14.2 (4.65)	-3.40 (-4.88)	0.33	23.87 (0.00)
Nayarit	Q1 2004–Q4 2005	77.3 (3.87)	-7.64 (-4.06)	0.73	16.50 (0.00)
	Q1 2006–Q2 2015	13.4 (5.48)	-1.28 (-2.89)	0.18	8.39 (0.00)
	Q3 2015–Q2 2018	-2.1* (-0.44)	-3.61 (-2.56)	0.39	6.58 (0.02)
Nuevo León	Q1 2004–Q1 2010	23.5 (4.65)	-4.45 (-5.21)	0.54	27.24 (0.00)
Querétaro	Q1 2004–Q1 2009	28.1 (2.43)	-4.47 (-2.29)	0.21	5.25 (0.03)
	Q2 2009–Q1 2011	74.1 (12.45)	-12.61 (-12.11)	0.96	146 (0.00)
Quintana Roo	Q2 2009–Q2 2018	20.2 (6.72)	-5.01 (-10.15)	0.74	103.05 (0.00)
Sinaloa	Q1 2004–Q4 2005	43.9 (4.25)	-11.95 (-5.08)	0.81	25.87 (0.00)
	Q1 2006–Q2 2018	6.2 (1.67)	-1.43 (-1.90)	0.07	3.64 (0.06)
Tamaulipas	Q1 2004–Q2 2011	15.1 (3.12)	-2.43 (-2.80)	0.21	7.85 (0.00)
Tlaxcala	Q1 2004–Q1 2011	15.9 (5.59)	-1.45 (-4.62)	0.44	21.42 (0.00)

Source: Prepared by the authors, on the basis of National Institute of Statistics and Geography, "Encuesta Nacional de Ocupación y Empleo (ENOE), población de 15 años y más de edad", 2018 [online] https://www.inegi.org.mx/programas/enoe/15ymas/; INEGI, "Indicador trimestral de la actividad económica estatal", 2018 [online] https://www.inegi.org.mx/temas/itaee/.

Note: Only periods in which the Okun coefficient is significant at a confidence level of at least 10% are recorded. The β_1 and β_2 statistics and the probability of the F-statistic are shown in parentheses. An asterisk (*) indicates that the coefficient is not significant at the confidence level of 10%.

The table above produced the following results:

(i) In 15 States there is at least one structural change during the entire period examined, which implies that the parameters are stable in only 7.

(ii) In only 5 States of 15, Okun's law remains valid until the second quarter of 2018, which is the final observation of the analysis. These States are: Baja California Sur, Mexico City, Nayarit, Quintana Roo and Sinaloa. In the remaining 10 States, this law ceased to be valid at some point after the great recession.

(iii) In States that experienced multiple structural changes, such as Baja California Sur, Mexico City, Nayarit and Sinaloa, this law remains valid, but with notable changes in the magnitude of β_2. The Okun coefficient increased significantly in Nayarit in the final period, while in Baja California Sur, Mexico City and Sinaloa, it decreased.

(iv) In these four States, R^2 for the final period reflecting significance decreases notably.

(v) Querétaro[8] is a unique case, with two regimes (first quarter of 2004 to first quarter of 2009 and second quarter of 2009 to first quarter of 2011), the second of which reflects significant growth in R^2 (from 0.21 to 0.96),[9] but Okun's is no longer valid as of the second quarter of 2011.

The Bai and Perron test (1998) and the Quandt-Andrews test (derived from the Quandt test (1960) and presented in Andrews (1993)) for the entire country show that there is structural change in the fourth quarter of 2011,[10] so two period regressions were carried out.

The estimate for the period from the first quarter of 2004 to the fourth quarter of 2011 indicates that the Okun coefficient is significant, with the correct sign and of a magnitude similar to that of the entire period. It displays a better fit, although it presents problems of serial autocorrelation up to order 4. Given the type of model, it is plausible that this is pure autocorrelation; in other words, given its theoretical construction, it lacks systematic information:[11]

$$\dot{u}_t = 14.49 - 3.56 * \dot{Y}_t + \varepsilon_t \quad (4)$$
$$t \quad (6.05) \quad (-5.90)$$

R^2 = 0.53; F = 34.82(0.00); Wald = 48.05(0.00); JB = 2.10(0.34); ARCH(2) = 0.28(0.75); ARCH(4) = 0.83(0.51); White(n.c.) = 0.13(0.71); White(c) = 0.13(0.87); Reset(1) = 2.68(0.11); Reset(2) = 1.77(0.18).

The estimates for the period between the first quarter of 2012 and the second quarter of 2018 reflect no statistical significance, which again reveals that after the great recession, Okun's law ceased to be valid when considering the country as a whole, as was the case for several G1 States:

$$\dot{u}_t = -1.88 - 1.72 * \dot{Y}_t + \varepsilon_t \quad (5)$$
$$t \quad (-0.62) \quad (-1.59)$$

R^2 = 0.09; F = 2.54(0.12); Wald = 2.69(0.11); JB = 1.18(0.55); ARCH(2) = 0.54(0.58); ARCH(4) = 1.43(0.26); White(n.c.) = 0.17(0.67); White(c) = 0.49(0.61); Reset(1) = 0.48(0.82); Reset(2) = 0.28(0.75).

These structural changes appear to reflect profound transformation in labour markets, which entails significant changes in hiring and firing behaviour, particularly in terms of the reduction of incentives

[8] State that stands out nationally for showing the best indicators presented here.

[9] In fact, no state reflects such a high coefficient of determination.

[10] Maximum LR (maximum likelihood ratio), F-statistic (fourth quarter of 2011) = 12.66(0.00), maximum Wald F-statistic (fourth quarter of 2011) = 25.33(0.00), Ho = no structural change.

[11] In order to estimate a robust model in terms of homoscedasticity and no serial autocorrelation, we employ the Newey-West method (which uses the HAC weighting matrix) (IHS Global, 2019), which corrects for heteroscedasticity and autocorrelation standard errors.

to hire personnel. This comes amid uncertainty that the recovery phase following the great recession may not be permanent or strong. These changes could also derive from shifts in the capital-labour ratio, as well as changes in labour productivity in State economies, so the recovery phase has been accompanied by a smaller impact on employment. This hypothesis is in line with the non-linearity of Okun's law documented by Islas and Cortez (2013 and 2018).

In order to reinforce these results, table 5 presents the correct specification tests of the panel models for G1, G2 and all 32 States.

Table 5
Mexico: correct specification tests with panel data by group, first quarter of 2004–second quarter of 2018

Evidence	Hausman	Pesaran	Wald	Breusch-Pagan	Wooldridge
Ho:	Strict exogeneity	IID errors	Homoscedastic errors	Panel variations equal to zero	No first-order autocorrelation
National	$\chi^2(1) = 13.21$ prob = 0.00	prob = 0.00	$\chi^2(32) = 854.92$ prob = 0.00		F-stat = 57.31 prob = 0.00
Group 1	$\chi^2(1) = 21.36$ prob = 0.00	prob = 0.00	$\chi^2(22) = 476.22$ prob = 0.00		F-stat = 27.886 prob = 0.00
Group 2	$\chi^2(1) = 0.19$ prob = 0.65			chibar2(01) = 0.02 prob = 0.43	F-stat = 36.21 prob = 0.00

Source: Prepared by the authors, on the basis of National Institute of Statistics and Geography, "Encuesta Nacional de Ocupación y Empleo (ENOE), población de 15 años y más de edad", 2018 [online] https://www.inegi.org.mx/programas/enoe/15ymas/; INEGI, "Indicador trimestral de la actividad económica estatal", 2018 [online] https://www.inegi.org.mx/temas/itaee/.

The following results stand out for the 32 States as a whole and for G1:

(i) The Hausman test (1978) shows that there is correlation between individual effects and explanatory variables; i.e. strict exogeneity is not met, so estimation by the less efficient, but robust, fixed effects method is preferable. This test indicates that unemployment in each State depends not only on economic performance, but also on other variables, e.g. social and institutional variables such as the rate of critical employment conditions and the Rule of Law Index, which we test below.

(ii) The Pesaran test (2004) shows cross section dependence, so estimation is robust but not efficient and may reflect bias in standard errors. This test shows that the growth of economic activity in one State influences the unemployment rate in other States.

(iii) The Wald test (Greene, 2003) shows that there is heteroscedasticity of residuals and, therefore, that there are structural changes in the period under review, which is consistent with the results presented in table 4.

(iv) The Wooldridge serial correlation test (Drukker, 2003) shows that there is first-order serial autocorrelation, so the recorded standard deviations of the estimation coefficients are lower than the actual figures, and the recorded R^2 is higher than the actual figure. This test shows that the current level of unemployment depends on the past performance of economic activity.

For G2, the Hausman test (1978) and the Breusch and Pagan test (1979) indicate that a pooled estimation is preferable because there is no panel effect, since the individual effects of economic activity on unemployment do not show a particular behaviour. The panel estimation of G2 also reflects first-order autocorrelation.

Based on the above-mentioned tests, the most efficient estimates for the 32 States as a whole and for G1 are those obtained using the fixed effects method with robust standard errors and controlling for serial correlation and, for G2, those based on a pooled estimate controlling for serial correlation and among individuals (Cameron and Trivedi, 2010) (see table 6).

Table 6
Mexico: panel estimates of Okun's law in growth rates, first quarter of 2004–second quarter of 2018

Method	States	β_1	β_2	R^2	F-statistic
Fixed effects	National	8.01 (0.0000)	-1.34 (0.0000)	0.0808	60.92 (0.0000)
	G1	9.28 (0.0000)	-1.70 (0.0000)	0.1640	89.43 (0.0000)
Pooled estimate	G2	2.27* (0.479)	-0.09* (0.707)		

Source: Prepared by the authors, on the basis of National Institute of Statistics and Geography, "Encuesta Nacional de Ocupación y Empleo (ENOE), población de 15 años y más de edad", 2018 [online] https://www.inegi.org.mx/programas/enoe/15ymas/; INEGI, "Indicador trimestral de la actividad económica estatal", 2018 [online] https://www.inegi.org.mx/temas/itaee/.

Note: The probability of β_1, β_2 and the F-statistic are shown in parentheses. An asterisk (*) indicates that the coefficient is not significant at the confidence level of 10%. The nature of pooled estimation does not allow us to obtain R^2 or the F-statistic.

The estimates in table 6 indicate that for the 32 States as a whole and for G1, the unemployment rate falls by 1.34% and 1.70% for each percentage point of economic growth, respectively. However, unemployment grows at a natural rate (constant β_1) of 8.01% and 9.28%, respectively, in the absence of other factors, implying that economic growth must be 6.0% (8.01/1.34) and 5.4% (9.28/1.70), respectively, to keep the unemployment rate stable in these groups of States.

Meanwhile, as demonstrated in the first econometric exercise, the estimation of Okun's law for G2 based on pooled effects is not significant; i.e., it is confirmed that economic growth does not have an impact on the trend in unemployment.

Another method is fixed effects panel estimation incorporating dichotomous variables (dummies), which may be less efficient, as it does not control for serial correlation problems, but allows us to compare the States' unemployment rates through the estimated β_1.

In this case, the fixed effects panel estimation for G1 shows marked differences in the labour markets (see table 7), as the magnitude of β_1 varies (natural rates of unemployment growth), while the Okun coefficient common to G1 is -2.59.

Table 7
Mexico: fixed effects panel estimation (dichotomous variables) for G1 States, first quarter of 2004–second quarter of 2018

β_2 = -2.59 (0.0000)		
State	β_1	Standard error
Aguascalientes	13.83 (0.0000)	0.74
Baja California	13.72 (0.0000)	0.08
Baja California Sur	23.3 (0.0000)	1.17
Chihuahua	12.7 (0.0000)	1.87
Mexico City	7.84 (0.0000)	0.96
Coahuila	7.09 (0.0000)	0.00
Colima	14.91 (0.0000)	0.24
Mexico State	8.82 (0.0000)	0.13
Guanajuato	9.91 (0.0000)	0.40

Table 7 (concluded)

β_2 = -2.59 (0.0000)		
State	β_1	Standard error
Hidalgo	14.98 (0.0000)	0.10
Jalisco	8.69 (0.0000)	0.19
Michoacán	11.57 (0.0000)	0.04
Nayarit	14.56 (0.0000)	0.32
Nuevo León	8.29* (0.1080)	0.28
Querétaro	16.06 (0.0000)	0.76
Quintana Roo	18.1 (0.0000)	0.85
San Luis Potosí	13.42 (0.0000)	0.39
Sinaloa	9.86 (0.0000)	0.05
Sonora	8.77 (0.0004)	0.26
Tamaulipas	5.44 (0.0000)	0.34
Tlaxcala	6.49 (0.0052)	0.48
Veracruz	8.29 (0.0696)	0.24

Source: Prepared by the authors, on the basis of National Institute of Statistics and Geography, "Encuesta Nacional de Ocupación y Empleo (ENOE), población de 15 años y más de edad", 2018 [online] https://www.inegi.org.mx/programas/enoe/15ymas/; INEGI, "Indicador trimestral de la actividad económica estatal", 2018 [online] https://www.inegi.org.mx/temas/itaee/.

Note: The probability of β_1 and β_2 is indicated in parentheses. An asterisk (*) indicates that the coefficient is not significant at the confidence level of 10%.

The results shown in table 7 are consistent with the individual estimates presented in table 3, since the States of Hidalgo, Querétaro and Quintana Roo are among the five States with the highest β_1, while Coahuila, Tamaulipas, Tlaxcala and Veracruz are the States with the lowest β_1, according to both econometric techniques.

Finally, in order to incorporate the determinants of the Okun coefficient (β_2), multiple cross section regressions were run for G1 and G2 with the economic, social and institutional variables presented in table 2. On that basis, we tested the hypothesis that the Okun coefficient of G1 (dependent variable) responds to the Rule of Law Index and the rate of critical employment conditions in a significant and economically meaningful way for each State i. No significance was found for the country as a whole or for G2 with any of the variables presented in table 2.

To test the above hypothesis, the Newey-West homoscedasticity- and autocorrelation-consistent (HAC) covariance matrix was used to obtain efficient estimators free of heteroscedasticity and serial autocorrelation (IHS Global, 2019):

$$CO_i = 0.12 * TCCO_i - 10.64 * IED_i + \varepsilon_i \quad (6)$$

$$t \quad (2.01) \qquad (-6.15)$$

R^2 = 0.24; JB = 3.66(0.15); State i = 1, 2, 3, ..., 22.

It is shown that greater adherence to the rule of law makes economic growth more effective in reducing the unemployment rate; i.e., the result is a higher Okun coefficient in absolute terms. Meanwhile, to the extent that employment in precarious conditions is greater, as expressed by the rate of critical employment conditions, the magnitude of the Okun coefficient decreases.

VII. Conclusions and final comments

Okun's law has generally been estimated at the macro level on the basis of various specifications, functional forms and frequencies of temporal data, which implies that the heterogeneity among countries and among States or regions within a country is not taken into account.

Amid this backdrop, in this paper we estimate Okun's law for the 32 States of Mexico over the longest and most consistent period possible (first quarter of 2004 to second quarter of 2018). We incorporate into the analysis three groups of variables (economic, social and institutional) that give rise to the structural heterogeneity among these States (ECLAC, 2016). The incorporation of these variables allows us to confirm that they determine the significance and magnitude of the Okun coefficient.

On the basis of the specification of Okun's law in growth rates, we find the following:

(i) The labour market response to growth in economic activity is significant and possesses the correct sign in only 22 States (G1). These States have performed better economically (in terms of economic growth, labour productivity growth, lower unemployment growth, higher per capita GDP, higher exports and lower informality), socially (lower crime rates and less precarious employment) and institutionally (higher Rule of Law Index).

(ii) Estimating Okun's law with time series and fixed effects panel data, we find conclusive information on asymmetries in the Okun coefficient in G1, which reflect different degrees of labour market response to GDP growth, as the Okun coefficient ranges from -7.25 to -1.25.

(iii) In G2, where Okun's law is not valid, no conclusive panel effect data were found, meaning that the variance owing to the individual effect is not significant. Furthermore, this group reflects homogeneity in terms of very poor results in all the variables analysed, as the economic, social and institutional performances are weak.

(iv) The Okun coefficient not only differs among G1 States, but also varies over time. The Bai and Perron test (1998) for structural change shows that the effect of the great recession of 2008–2009 has conditioned the magnitude and significance of the Okun coefficient in most of the States in this group.

(v) These differentiated results in G1 denote different levels of economic growth required to keep the unemployment rate stable and, therefore, demonstrate the heterogeneity in this group.

(vi) Of all the attempts to identify the determinants of Okun's law on the basis of economic, social and institutional variables, only the Rule of Law Index and the rate of critical employment conditions explain the magnitude and significance of the Okun coefficient in G1 notably and in an economically meaningful way. Thus, it can be said that greater adherence to the rule of law and fewer precarious jobs make economic growth more effective in reducing unemployment; i.e., translate into a higher Okun coefficient (in absolute terms).

Beyond the different magnitudes of the Okun coefficient estimated by the econometric methods used here, a key finding is that the improvement of institutional frameworks and the reduction of precarious labour conditions, as measured by the Rule of Law Index and the rate of critical employment conditions, respectively, are crucial for strengthening the functioning of labour markets in G1 and, possibly, for unemployment growth to regain its sensitivity to output growth in G2. This would increase the efficiency

of economic growth in reducing unemployment at the national level and, through Okun's law, could generate virtuous effects on economic growth and on the other variables analysed in this work.

The results indicate, crucially, that the implementation of development policies at the State and municipal levels should not only be economic in nature, but —more importantly— should have a strong social and institutional orientation that addresses the serious issue of structural heterogeneity. Thus, a key finding is that the best institutional reform, which must be implemented urgently, is to strengthen the rule of law. This will have to improve employment conditions in labour markets and thus generate virtuous effects on labour productivity, economic growth and development.

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Rural employment trends in Brazil: an analysis using dynamic panel models

Evânio Mascarenhas Paulo, Francisco José Silva Tabosa, Ahmad Saeed Khan and Leonardo Andrade Rocha

Abstract

This article considers certain dimensions of the quality of employment in Brazil, particularly in rural zones. It starts from the perception of changes in rural production relations and the repercussions these have on employment practices. A panel data methodology is applied to capture the determinants of job quality, and a quality of employment index is proposed. Rural employment is more precarious than its urban counterpart, although the differences have been diminishing over time. In the agriculture sector, the economic growth of the 2000 decade merely resulted in the existing conditions of employment being extended to new contracts, without any change in average quality. Rising labour income and education levels are important not only for enhancing the quality of employment but also as a strategy for overcoming problems such as heterogeneity between groups.

Keywords

Rural employment, labour market, rural areas, labour relations, working conditions, measurement, evaluation, employment statistics, econometric models, Brazil

JEL classification

C23, J43, R11

Authors

Evânio Mascarenhas Paulo is a Professor in the Department of Economics at Universidade Regional do Cariri, Brazil. Email: evanio.paulo@urca.br.

Francisco José Silva Tabosa is a Professor on the Graduate Programme in Rural Economics in the Department of Agricultural Economics at the Federal University of Ceará, Brazil. Email: franzetabosa@ufc.br.

Ahmad Saeed Khan is a Professor on the Graduate Programme in Rural Economics in the Department of Agricultural Economics at the Federal University of Ceará, Brazil. Email: saeed@ufc.br.

Leonardo Andrade Rocha is a Professor in the Department of Human Sciences at Universidade Federal Rural do Semi-Árido (Brazil). Email: leonardoandrocha@yahoo.com.br.

I. Introduction

The processes that have unfolded in the rural and agricultural domain in recent years are of such complexity and scale that they have permeated a variety of structures specific to these spaces. In addition to specifically rural phenomena, such as the mechanization and modernization of agriculture, other changes associated with the urban sector, such as the semi-lethargic state of industrial activities, have had a major impact on the rural sector (Da Silva, 1997).

In this context, the structures that make up Brazil's agricultural and rural systems are likely to experience drastic and dramatic change. This article addresses one of these structures in particular: the labour market. This market can be expected to act as a mirror of the changes in production systems and techniques that have occurred in agriculture and the rural domain in recent years (Carneiro, 1998).

The new production processes that are starting to be applied in agriculture (which are more aligned with modern capitalist accumulation techniques) will naturally change hiring practices and the number of workers needed to operate the means of production in agriculture (Campolina, Silveira and De Magalhães, 2009). The specialist literature sees the additional labour force that is released as a result of changes in agricultural processes, but not absorbed by industrial and service activities in the urban area, as an immediate consequence of these new phenomena in the rural labour market. Thus, the spatial movement of workers from the countryside to the city is a likely consequence of these processes. However, in the most recent period, the rural exodus that characterized previous decades has not ended but been reformulated. This can be discerned in a significant reduction in direct migrations from the countryside to the city and an equally significant increase in "sectoral migrations" from agricultural to non-agricultural employment, with a set of elements stimulating these movements (Balsadi, 2007).

The factors that motivate rural dwellers to migrate to the cities are diminishing; and this represents an important turning point in the relationship between the rural and urban zones\. However, differences in income and general employment conditions between the traditional primary sector and other sectors of the economy are stimulating migration between sectors. Thus, the impact and influence of non-agricultural activities on the rural labour market have steadily increased. Nowadays, workers do not need to abandon the spatial environment of their homes in rural areas, but increasingly engage in off-farm activities that are not inherent to agriculture, but nonetheless associated with it (Balsadi and Da Silva, 2008).

Accordingly, this article makes a general analysis of the elements of employment quality that are prevalent among rural and urban wage earners in Brazil, considering the new determinants of the rural space and their consequences for employment practices in the countryside. In particular, it reviews recent changes in the rural labour market, focusing on the effects of the transformations that have taken place in rural spaces, and gauging the quality of rural and urban jobs in Brazil through the quality of employment index. Lastly, the article uses the panel data model to identify the factors that affect the quality of these jobs for wage-earners in Brazil.

As this study requires a detailed database that is continuous through time, it mainly draws on secondary information from databases held by national research institutes, in particular the Brazilian Institute of Geography and Statistics (IBGE).

This article is divided into five sections, including this introduction. Section II presents the methods and study strategies, and discusses conceptual and methodological issues. Section III discusses the descriptive results of the employment quality index, and section IV analyses the empirical results obtained from the econometric models proposed. The final section offers concluding remarks on the research.

II. Conceptual and methodological issues

1. Database and construction of the quality of employment index

The data used in the study were taken from the National Household Sample Survey (PNAD) spanning 2004–2014. This period saw the consolidation of several changes in the world of employment and is therefore important for analysing the recent Brazilian labour market, particularly rural employment. The decade of 2000 provides the scenario for phenomena such as the growth of the labour force and rising average labour income. These transformations are the result of a "metamorphosis" of hiring and recruitment practices, and of an increase in demand for a more highly skilled and trained work force that elicits a process of competition, both between employers and between employees, each with their respective effects on job quality.

This study aims to identify the factors that influence job quality for four specific population groups. The first represents urban agricultural wage-earning employees, that is individuals employed as wage-earners (both formal and informal) in agriculture sector enterprises but living in urban areas. The second group consists of urban non-agricultural workers, who are wage earners in non-agricultural enterprises living in urban regions. The third group is comprised of wage earners engaged in agricultural activities who live in rural areas; and, lastly, the fourth group corresponds to rural employees in non-agricultural enterprises.

This study only considers wage-earning employment, because the nature and characteristics of this type of employment (formality, working hours, security, among others) are more amenable to analysis than other types. While this allows for a better characterization of this segment of the labour market, the different segments have unique characteristics and, thus, different job quality dynamics. Moreover, the different segmentation patterns in job quality affect each other mutually, as the quality of wage-earning employment both influences and is influenced by the other segments of the labour market.

Job quality partly reflects the environment and employment opportunities that manifest themselves differently and produce very heterogeneous quality standards in the different segments of the labour market. Thus, a change in the composition of the labour market, such as a larger or smaller share of wage-earning employment, has effects on job quality generally. This can also induce processes that influence the quality of the different labour market segments, including wage labour itself. The terminology of job quality developed in this paper does not capture these interactions in labour market segmentation dynamics.

According to Do Nascimento and others (2008), the concept of employment quality may vary across different dimensions. However, the purpose of this research is to use labour market variables to measure the effects of specific elements that the authors consider relevant for determining the quality of employment. These include the absence of child labour, regular weekly working hours without being overworked, the employment contract, contribution to public or private social security institutes and the level of income, in addition to issues related to the workers' education level. However, job quality involves factors that are difficult to address, such as exposure to health and other risks, and supervision of working conditions by the labour inspectorate system, among others. This also needs to be taken into account when working with regionalized data.

The employment quality index proposed in this paper is an adaptation of the index initially formulated by Balsadi (2007), which is used as the initial matrix. The employment quality index is based on a scoring system, in which each subcategory band of the index is assigned a value ranging from 0 (worst condition) to 4 (best). Table 1 gives details on how the indices are constructed.

Table 1
Quality of employment index: construction methodology

Schooling [0.20]	[0] No education or primary education only, with subsistence wage	[1] Previous case without restriction	[2] Primary to secondary education	[3] Higher and postgraduate education	[4] Previous case with high wage
Working hours per week [0.15]	[0] More than 44 hours	[1] 40–44 hours	[2] 30–39 hours	[3] 1–29 hours	[4] Previous case with high wage
Worker's age [0.23]	[0] From 0–15 years of age (child labour)	[1] 16–18 years of age	[2] 19–24 years old, with low education level and informal schooling	[3] Previous case without restriction	[4] Over 25 years of age
Remuneration [0.30]	[0] Below minimum wage (subsistence)	[1] 1–2 times the minimum wage	[2] 2–3 times the minimum wage	[3] 3–5 times the minimum wage	[4] More than five times the minimum wage
Informal work [0.12]	[0] No social security contribution, no employment contract, low income	[1] Previous case without restriction	[2] No social security contribution but with employment contract	[3] With social security but no employment contract	[4] With social security and employment contract

Source: Prepared by the authors, on the basis of O. V. Balsadi, "Qualidade do emprego na agricultura brasileira no período 2001–2004 e suas diferenciações por culturas", *Revista de Economia e Sociologia Rural*, vol. 45, No. 2, April-June 2007.

The following sub-indices were selected: (i) the worker's level of education, blended with low income, in order to verify the relationship between poor job quality and low schooling; (ii) hours of work, which measures the different levels of hours worked and affords a perception of overwork; (iii) worker age, with a view to detecting the presence of child labour and the different levels of vulnerability to which young workers are exposed; (iv) average remuneration, since the average rate of pay affects the perception of the job quality to which workers are exposed; and (v) type of engagement, which reveals the presence of temporary and casual work, blended with low rates of pay. The quality of employment index is essentially a weighted average of these categories, which capture aspects that are relevant to the perception of job quality.

Following Do Nascimento and others (2008), the quality of employment index is obtained from the weighted average of the partial indicators. The weight of each category is specified in the first column of table 1. According to the aforementioned authors, the weight of each category in the composition of the quality of employment index reflects their relative contributions and was established through the conventional weighting system, in other words by the proposer of the index, based on a prioritization system. The weighting may generate controversy, because the importance attributed to each partial indicator always implies a degree of arbitrariness on the part of the authors. Nonetheless, the quality of employment index is constructed as the weighted averages of the partial indicators. Thus, with due allowance for arbitrariness, these indicators can contribute to an analysis of the quality of rural and urban employment, which makes it possible to assimilate the conditions of wage-earning employment in greater detail and to make comparisons between them.

2. Description of the variables

In order to determine job quality among the groups selected in this research, a set of variables was constructed to synthesize the factors affecting the quality pattern in employment relationships. These variables are summarized in table 2.

Table 2
Group of variables, description and sources

Variables	Code of the variable	Source
Natural logarithm of the quality of employment index	QE	Prepared by the authors
Natural logarithm of the lagged quality of employment index	QEt-1	Endogenous variable
Natural logarithm of agricultural value-added	VA01	Brazilian Institute of Geography and Statistics (IBGE)
Natural logarithm of non-agricultural value-added	VA02	IBGE
Natural logarithm of average labour income in each federative unit (urban agricultural workers)	RM01	IBGE
Natural logarithm of average labour income in each federative unit (urban non-agricultural workers).	RM02	IBGE
Natural logarithm of the average labour income in each federative unit (rural non-agricultural workers)	RM03	IBGE
Natural logarithm of the average labour income in each federative unit (rural agricultural workers)	RM04	IBGE
Natural logarithm of the Gini index of the concentration of labour income	IG	Prepared by the authors
Natural logarithm of the share of persons who have completed at least secondary education in each federative unit.	EDU	IBGE

Source: Prepared by the authors.

The first variable described (QE) refers to the quality of employment index, constructed as explained in the previous section. As noted above, the index gathers data on the degree of formalization of employment contracts and the pattern of workers' income. It thus indicates the sophistication of employment practices. This research seeks to verify potential differences between the employment conditions in the rural area and in agriculture, compared to the contractual relations prevailing in urban areas and in non-agricultural activities. The aim is therefore to identify their determinants and their contributions to the quality of employment.

The next variable described (QE_{t-1}) is the lagged employment quality index, which is a characteristic of the type of econometric modelling used in this research, to evaluate the properties of employment practices among the groups studied. This variable is expected to be statistically significant, since employment quality in the previous period proves to be a determinant of the quality of future employment. This expectation reflects the natural course of labour market dynamics, in which employment relations tend to become more sophisticated and advanced over time, so that —in an economic growth climate such as prevailed during the years in question— the chances of regressing to a lower standard are remote. Moreover, given the presence of labour legislation and its specific features (which set a standard for contractual relations that is starting to be applied in the market), rolling back these rights could result in the labour laws being flouted.

The variable VA01 represents agricultural value-added in each state. One possible behaviour pattern for this variable is that increased agricultural production in the states tends to enhance employment quality. The rationale for this is that the growth of crop and livestock output would increase the demand for labour, raise workers' incomes and improve employment conditions. Alternatively, the level of activity may not be associated with an increase in labour market quality. Thus, economic growth would merely entail the extension of existing contractual relationships to new hirings, without changes in their structure. The evaluation of the signs and the significance levels of the coefficients of this variable will indicate which of these hypotheses is supported more strongly.

The variable VA02, which expresses the value-added of non-agricultural activities, is expected to have a positive (negative) effect on job quality, insofar as new jobs —which in the case of non-agricultural activities are usually more complex and of higher quality than purely agricultural jobs— induce an improvement (deterioration) in the quality of employment. Moreover, as in the previous case, the variable

in question may not be related to an increase in the quality of employment contracts because it does not involve changes in hiring practices. This study also aims to evaluate the behaviour of cross-over effects: that is, how economic growth in non-agricultural activities affects the dynamics of agricultural and rural employment; and, conversely, how the expansion of agricultural activities affects the quality of non-agricultural and urban employment.

The "RM" variables group expresses the average income level of the main job for each group in each of Brazil's federative units (states). Thus, RM01 expresses the average income level of urban agricultural workers; RM02 the average income of urban non-agricultural workers; RM03 the average income of rural non-agricultural workers and, lastly, RM04 the average income of rural agricultural workers.

The "IG" variable corresponds to the Gini index, which measures the degree of income concentration in each federative unit, thereby evaluating how the income structure is distributed. The expected negative sign is justified by the perception that, as income concentration increases, job quality tends to deteriorate. It is further assumed that, if this coefficient is insignificant, job quality is independent of the structure of income concentration in the labour market. Thus, income growth alone guarantees improvements in job quality, even if this does not imply changes in the concentration structure.

Lastly, the variable "EDU" expresses the proportion of the population of each state who have completed at least secondary education. Higher levels of schooling would be expected to imply greater efficiency; and, as the overall level of education rises, job quality can also be expected to improve.

(a) Generalized method of moments (GMM)

When evaluating the behaviour of the quality of agricultural and non-agricultural employment —both urban and rural— and its determinants, in a dynamic panel data system, the lagged dependent variable must be included as one of the explanatory variables (Baltagi, 2009). Accordingly, the estimators of the generalized method of moments for systems (system-GMM) are used, as developed in Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998).

In brief, this research attempts to estimate models comprising the four equations specified in the following panel data regression models:

$$ln(QE_{AU})=\beta_1 ln(QE_{t-1})+\beta_2 ln(AV01)+\beta_3 ln(AV02)+\beta_4 ln(RM01)+\beta_5 ln(IG)+\beta_6 ln(EDU)+V_t+\mu_{it} \quad (1)$$

$$ln(QE_{NU})=\beta_1 ln(QE_{t-1})+\beta_2 ln(AV01)+\beta_3 ln(AV02)+\beta_4 ln(RM02)+\beta_5 ln(IG)+\beta_6 ln(EDU)+V_t+\mu_{it} \quad (2)$$

$$ln(QE_{NR})=\beta_1 ln(QE_{t-1})+\beta_2 ln(AV01)+\beta_3 ln(AV02)+\beta_4 ln(RM03)+\beta_5 ln(IG)+\beta_6 ln(EDU)+V_t+\mu_{it} \quad (3)$$

$$ln(QE_{AR})=\beta_1 ln(QE_{t-1})+\beta_2 ln(AV01)+\beta_3 ln(AV02)+\beta_4 ln(RM04)+\beta_5 ln(IG)+\beta_6 ln(EDU)+V_t+\mu_{it} \quad (4)$$

In these equations, the dependent variable is the quality of employment (QE) index for each federative unit; and its subscripts refer to urban agricultural employment (AU), urban non-agricultural employment (NU), rural non-agricultural employment (NR) and rural agricultural employment (AR), respectively; "QE_{t-1}" expresses the employment quality index lagged by one year, and in each case represents the lagged dependent variable for each group (the introduction of this variable is characteristic of this type of econometric modelling); "VA01" represents the agricultural value-added in each federative unit; "VA02" expresses non-agricultural value-added; "RM01" represents the average income in each state in urban agricultural activities in the first equation; "RM02" represents the average income in urban non-agricultural activities in the second equation; "RM03" represents the average income in rural non-agricultural activities

in the third equation; "RM04" represents the average income in rural agricultural activities in the fourth equation, "IG" expresses the degree of income concentration for each state, measured by the Gini index; "EDU" represents the proportion of people who have completed at least secondary education in each subnational unit; V_i represents individual-specific unobservable effects, and μ_{it} represents random disturbances. The subscripts i and t refer to the i-th state in year t, respectively.

These models make the following assumptions: $E[v_i]=E[\mu_{it}]=E[v_{it}\mu_{it}]=0$ for $i = 1, 2, ..., n$; $t = 1, 2, ..., t$. In addition, the error is assumed to be temporally uncorrelated; that is, $E/\mu_{i,t}, \mu_{i,s}/=0$ for $i = 1, 2, ..., n \ \forall t \neq s$. There is also the standard assumption regarding the initial conditions, $E|QE_{t-1}\mu_{it}|=0$ for $i = 1, 2, ..., n$ and $t = 1, 2, ..., t$. These assumptions are valid for all equations in the models presented above.

The studies published in the literature, especially Arellano and Bond (1991), draw attention to a number of problems when using traditional estimation techniques to estimate the models specified above, owing to the following:

(i) the presence of individual-specific unobservable effects, V_t, together with the dependent variable lagged by one period, QE_{t-1}, on the right side of the equation. In this case, the omission of individual fixed effects in the dynamic panel model makes the ordinary least squares (OLS) estimators biased and inconsistent. However, the within-groups estimator, which corrects for the presence of fixed effects, generates an estimate of β_1 that is biased downward in panels with a short time span; and

(ii) the likely endogeneity of the explanatory variables. In this case, it is necessary to deal with endogeneity on the right side of the equations to avoid a potential bias generated by the simultaneity problem.

Marinho and Araujo (2010) state that one way to overcome this problem would be to eliminate the presence of fixed effects from the model. Thus, a first attempt would be to estimate the models by OLS with dummy variables for each state, or else using the within-groups method, which generates the same estimations as the previous method, but the coefficients have slightly smaller standard deviations. The coefficient estimators in both methods will be smaller than those obtained by OLS. However, it could still be shown that the bias in the dynamic panel persisted.

The same authors suggest another way to eliminate these problems would be to take the first difference of the equations and estimate them using the generalized method of moments (GMM). This is usually called the generalized method of moments in differences (difference-GMM) and consists of eliminating the fixed effects by taking the first difference of the equations in question. Equation (1), for example, was transformed into equation (5):

$$\Delta ln(QE_{AU})=\beta_0+\beta_1\Delta(lnQE_{t-1})+\beta_2\Delta(lnVA01)+\beta_3\Delta(lnVA02)+\beta_4\Delta(RM01)+\beta_5\Delta(IG)+\beta_6\Delta(EDU)+V_t+\mu_{it} \quad (5)$$

Thus, for any variable, Y_{it}, $\Delta lnY_{it} = lnY_{it}–lnY_{it-1}$. Note that in the equations above, $\Delta lnQE_{t-1}$ is correlated with the error terms, $\Delta ln\mu_{it}$. Consequently, the OLS estimators for its coefficients will be biased and inconsistent. This makes it necessary to use instrumental variables for $\Delta lnQE_{t-1}$ and in each model.

The assumptions adopted in the equations presented at the start of this section mean that the momentconditions $E[\Delta lnQE_{t-1}\Delta ln\mu_{it}]=0$ for $t = 3, 4, ..., n$ and $s \geq 2$ are valid. On the basis of these moments, $lnQE_{t-1}$, for $t = 3, 4, ..., n$ and $s \geq 2$, must be used as instruments for the equation in first difference form.

In the second case, the values of the variable lagged by one or more periods are valid instruments for estimating the equation; and, in the last case, the values lagged by two or more periods are valid instruments.

According to Arellano and Bover (1995) and Blundell and Bond (1998), these instruments are weak when the dependent and explanatory variables display strong persistence and when the relative

variance of the fixed effects increases. This produces a biased and inconsistent difference-GMM estimator for panels covering short periods.

Consequently, Arellano and Bover (1995) and Blundell and Bond (1998) propose a system to reduce this bias problem that combines the set of difference equations —equations (1) to (4)— with the set of equations in which the variables expressed in level form —equation (5). This is referred to as system generalized method of moments (sys-MGM). For the difference equations, the set of instruments is as described above. For the regression of the level equation, the appropriate instruments are the lagged differences of the respective variables. For example, assuming that the differences of the explanatory variables are uncorrelated with the individual fixed effects (for $t = 3, 4, ..., n$) $E[\Delta lnQE_{t-1}\mu_{it}]=0$ for $i = 1, 2, ..., n$. Then, if the explanatory variables in differences and $\Delta lnQE_{t-1}$ are exogenous or weakly exogenous, they constitute valid instruments for the level equation. The same is true if they are endogenous; but the instruments are the explanatory variables in differences lagged by one period and $\Delta lnQE_{t-1}$ considered in this article, according to Marinho and Araujo (2010).

The system-GMM estimations are the result of using a corrected estimator to prevent the respective estimator of the variances from underestimating the true variances in a finite sample. The estimator used was proposed in two steps. In the first step, the error terms are assumed to be independent and homoscedastic across states and over time. In the second step, the residuals obtained in the first step are used to construct a consistent estimate of the variance-covariance matrix, thus relaxing the independence and homoscedasticity assumptions. The second-step estimator is asymptotically more efficient than the first-step estimator (Marinho and Araujo, 2010).

Lastly, there are two tests of the robustness and consistency of the models. The Sargan test is used to verify the validity of the instruments. If the null hypothesis is not rejected, the instruments are robust. In addition, since the $it\varepsilon$ error is initially assumed not to be autocorrelated, first-order and second-order serial correlation tests are performed on the first-difference residuals, $\Delta\varepsilon_{it}$. These errors are expected to be first-order correlated and second-order non-autocorrelated (Marinho and Araujo, 2010).

III. Some descriptive results

The data presented below illustrate the case of the Brazilian labour market in recent years, and reveal the expansion of non-agricultural jobs among the country's urban and rural population. This represents a major transformation of the pattern of organization of the rural domain in Brazil, driven by training processes and the growth of agribusinesses and their spread into rural areas. It also reflects the development of a new service sector dynamic; for while a large part of the population continues to live in rural areas, its main occupation is not directly related to agriculture. Another important fact that emerges from table 3 is that total rural employment increases as agricultural employment (both urban and rural) declines, thus demonstrating the sectoral migration of workers to non-agricultural activities.

Table 3
Brazil: employed population, by area of residence and type of activity, 2004 and 2014
(Number of people)

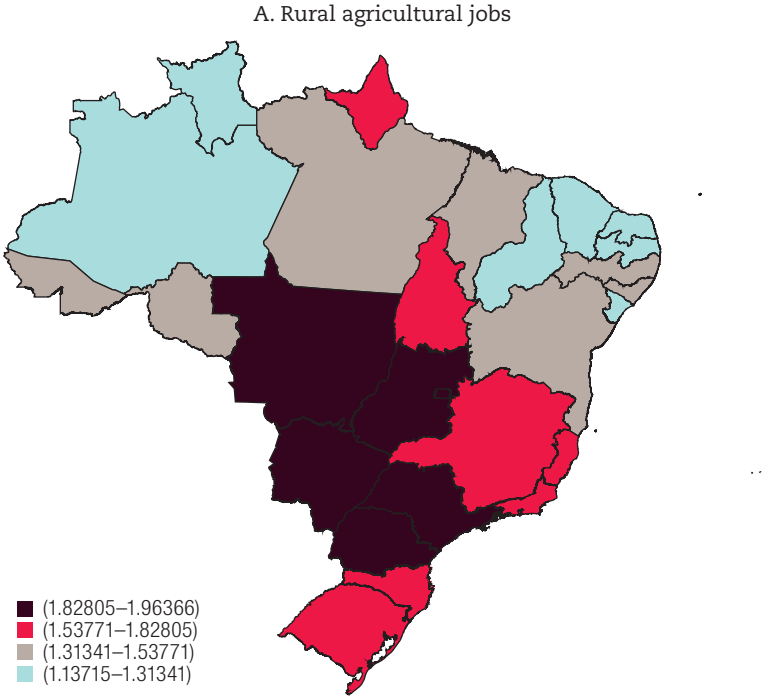
	Urban areas			Rural areas		
	Agricultural	Non-agricultural	Total	Agricultural	Non-agricultural	Total
2004	2 111 204	44 590 039	46 701 243	2 815 794	2 925 888	5 741 682
2014	1 702 514	57 755 438	59 457 952	2 237 135	3 865 981	6 103 116

Source: Prepared by the authors, on the basis of Brazilian Institute of Geography and Statistics (IBGE), "Pesquisa Nacional por Amostra de Domicilios - PNAD" [online] https://www.ibge.gov.br/estatisticas/sociais/educacao/9127-pesquisa-nacional-por-amostra-de-domicilios.html?=&t=o-que-e.

The indices of employment quality are presented below for Brazil's subnational units. Map 1, displaying the employment quality index for rural and urban agricultural employment, shows that the best quality levels are registered in the centre-south of the country, particularly in the Centre-West Region (especially the states of Mato Grosso, Mato Grosso do Sul and Goiás). Along with São Paulo and Paraná, this region displays the best quality standards in agricultural employment, whether urban or rural. Authors such as Priori and others (2012) add that, until recently, many regional economies in Brazil have tended to pursue the rationale of the external market, rather than coordinating mutually in a national production territory. The case of Brazilian agriculture, in which the modern agricultural complex of the centre-south part of the country bears little or no relation to subsistence farming in the interior of the North-East Region or in the rural communities of Amazônia (where quality standards are lower), does not seem to be far removed from this contemporary Brazilian reality. Obviously, this has repercussions on standards of job quality, as can be seen in map 1.

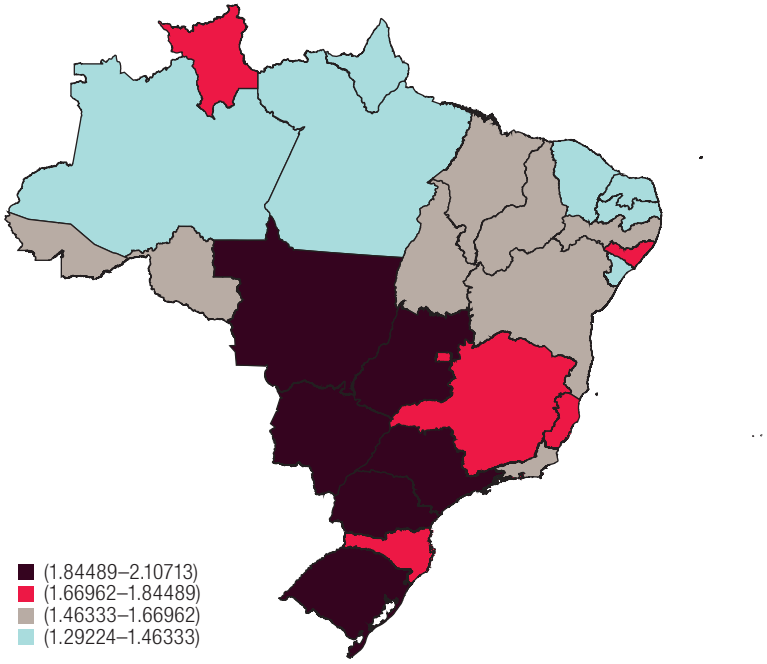
As noted by Dos Passos, Bariou and Dubreuil (2006), the investments made mainly in the 1970s enabled the Brazilian agricultural frontier to expand towards the South and Centre-West Regions, with significant agricultural productivity growth. As a result, these regions came to play an important role in the Brazilian economy, consolidating a successful agro-export model. The modernization of agricultural activities in these regions raised productivity levels considerably, which, in conjunction with the level of urbanization of these regions, enabled the development of a production complex aligned with agribusiness interests. In terms of job quality, this system offers much better conditions of agricultural employment than in other Brazilian regions, as can be seen in map 1.

Map 1
Brazil: quality of rural and urban agricultural occupations, by state, 2014



Map 1 (concluded)

B. Urban agricultural jobs



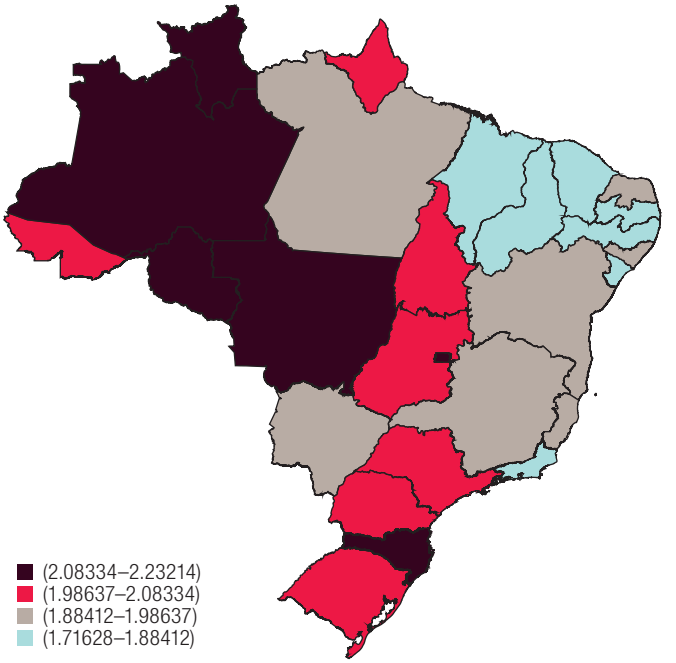
Source: Prepared by the authors.

However, although the Centre-West Region stands out in terms of agricultural employment, its non-agricultural employment is of lower quality than in other regions of Brazil. Nonetheless, the quality of non-agricultural employment is still superior to agricultural employment owing to its conditions and characteristics. The states of the South and South-East Regions that display greater urban-industrial development are the areas where conditions of urban non-agricultural employment are also the best, as can be seen in map 2.

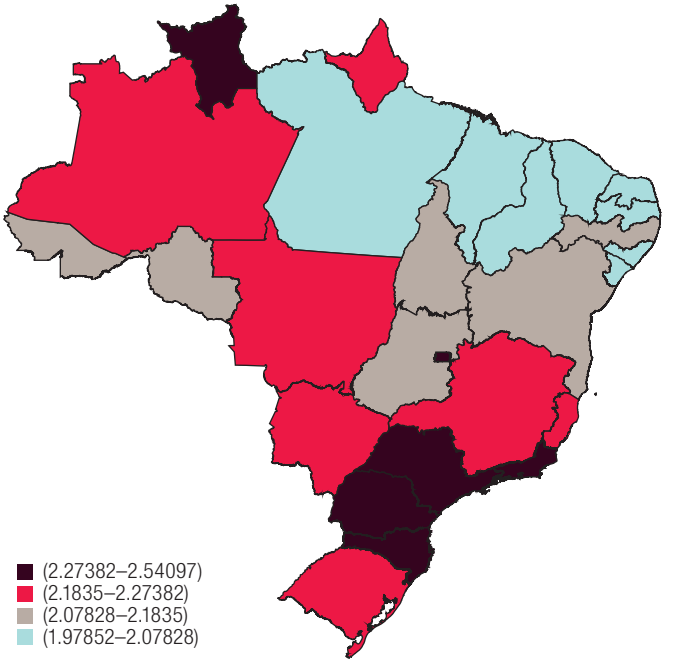
Although the North-East Region shows some progress since the start of the series (see table 4), its results are inferior to those of the other regions of the country and generally below the national average. The lesser modernization of economic activities, both agricultural and non-agricultural, produces a relatively precarious context for labour market development and sophistication, which is reflected in the lower job quality in this region, as illustrated in maps 1 and 2. Even in the states of the North-East where economic activity is more intense, for example in Bahia, the level of labour market development is not very high. As a result, the region lacks mechanisms to foster an improvement in employment practices, since even urban non-agricultural employment, where the best quality standards are generally concentrated, is not superior to that of the other regions.

Map 2
Brazil: quality of rural and urban non-agricultural occupations, by state, 2014

A. Rural non-agricultural jobs



B. Urban non-agricultural jobs



Source: Prepared by the authors.

Table 4
Brazil: quality of employment index by category and subnational units

	Rural				Urban			
	Agricultural		Non-agricultural		Agricultural		Non-agricultural	
	2004	2014	2004	2014	2004	2014	2004	2014
RO	1.33	1.54	1.88	2.23	1.63	1.67	2.09	2.18
AC	1.32	1.41	1.80	2.00	1.29	1.53	2.12	2.15
AM	1.51	1.31	1.98	2.16	1.25	1.29	2.13	2.21
RR	1.03	1.14	1.93	2.15	1.59	1.74	2.10	2.30
PA	1.29	1.48	1.83	1.92	1.33	1.45	1.90	2.04
AP	1.17	1.65	1.76	2.08	1.48	1.46	2.14	2.27
TO	1.26	1.61	1.85	2.03	1.31	1.67	1.92	2.15
N	1.30	2.01	1.86	2.49	1.35	2.06	2.01	2.63
MA	1.09	1.37	1.56	1.88	1.22	1.62	1.76	1.99
PI	1.00	1.22	1.66	1.84	1.09	1.48	1.83	1.98
CE	1.02	1.26	1.47	1.80	1.03	1.41	1.86	2.02
RN	1.14	1.28	1.75	1.92	1.14	1.44	1.96	2.08
PB	1.25	1.31	1.56	1.80	1.20	1.38	1.89	2.03
PE	1.22	1.35	1.57	1.72	1.36	1.57	1.94	2.11
AL	1.24	1.42	1.79	1.93	1.31	1.69	1.97	2.05
SE	0.98	1.31	1.42	1.78	1.28	1.40	2.06	2.08
BA	1.17	1.33	1.61	1.89	1.30	1.49	1.94	2.09
NE	1.15	1.76	1.60	2.27	1.25	1.95	1.91	2.51
MG	1.36	1.62	1.66	1.95	1.52	1.79	2.05	2.19
EN	1.32	1.55	1.72	1.99	1.43	1.68	2.10	2.22
RJ	1.66	1.66	1.80	1.87	1.64	1.67	2.24	2.32
SP	1.76	1.89	1.99	2.04	1.79	2.00	2.27	2.33
SE	1.46	2.21	1.85	2.48	1.66	2.38	2.21	2.80
PR	1.54	1.84	1.87	2.01	1.42	1.87	2.16	2.29
SC	1.54	1.83	1.98	2.19	1.58	1.76	2.23	2.32
RS	1.63	1.71	1.95	2.04	1.62	1.85	2.21	2.26
S	1.57	2.33	1.93	2.63	1.51	2.39	2.19	2.81
MS	1.77	1.96	1.72	1.92	1.73	2.11	2.00	2.19
MT	1.76	1.93	1.88	2.11	1.61	2.07	2.04	2.21
GO	1.62	1.89	1.65	2.05	1.52	1.94	1.98	2.15
DF	1.53	1.94	2.07	2.10	2.20	1.84	2.47	2.54
CO	1.71	2.47	1.79	2.52	1.58	2.55	2.10	2.74
BR	1.35	1.55	1.78	1.95	1.49	1.76	2.13	2.23

Source: Prepared by the authors.

The best quality standards in agricultural employment are mainly seen in regions where agriculture is more highly developed. Thus, traditional agricultural activities, which are more common in the North-East Region, define a scenario in which employment relations are more precarious than those of the modern agriculture practised in the centre-south of the country. The large grain-producing states register the best quality of employment. Consequently, the agro-export system of the centre-south stands out not only for its production capacity, but also because it offers better employment practices than those that characterize essentially agricultural and more traditional occupations.

The reduction in agricultural employment did not entail a significant decline in Brazil's rural population in the decade of 2000. This is because people previously employed in agricultural activities have sought jobs with better conditions in the non-agricultural labour market, but without leaving the rural area (see table 3). Thus, rural non-agricultural employment acts as a "buffer" between lower-quality agricultural employment in rural areas and higher-quality non-agricultural employment in urban areas, with quality levels between the two (see table 4).

The regional analysis shows that the states of the South Region, together with São Paulo, Rio de Janeiro and the Federal District, display the best quality levels, especially in the case of urban non-agricultural employment (see map 2B). In this category, some states in northern Brazil also display a high quality index, even though they are less economically dynamic and do not have a developed urban structure. In these cases, which are areas of lower population density, the need to attract workers from other parts of the country results in incentives being offered. This, in turn, is reflected in a better relative quality of employment, as suggested by the results reported by Freguglia, Gonçalves and Da Silva (2014). This also seems to be the case for rural non-agricultural employment (see map 2A), where the Centre-South Region stands out. Once again, the development level of non-agricultural activities in these states allow for a better "blending" of non-agricultural activities with the rural environment, since the dynamics and magnitude of the economic activities developed there produce more advanced employment relations than in the other areas of the country.

The results reported thus far reveal a labour market that is highly heterogeneous and asymmetric, in both sectoral and spatial terms. The centre-south economic complex has a much more sophisticated labour structure, in terms of quality, than the North-East and North Regions, where progress has been stronger but is still insufficient to catch up with the other Brazilian regions.

Brazil's rapid march towards industrial capitalism reinforced the characteristics of an extremely asymmetric and disconnected labour market. In the early 1960s, these paradigms induced heavy migration from the countryside to the city, culminating in the perception of rural areas that were emptying. The new configuration of the agricultural and non-agricultural labour market, characterized by heterogeneity, promotes a different migratory dynamic, intersectoral rather than spatial as in the past (Fajardo, 2008; Priori and others, 2012).

The results illustrated in maps 1 and 2 also show that the regions less closely connected to the Brazilian agribusiness system have a group of workers subject to more precarious job quality (both in spatial and in sectoral terms). This is the result of unemployment and chronic underemployment as specific phenomena of the economic-social composition of these regions and of Brazil itself. In the past, this fuelled intense migratory flows from the rural areas of these regions to the urban areas of the large agribusiness complex of the centre-south, and which now continues in the shift from the agricultural to the non-agricultural sector. This mixed migratory flow is inherent to the dual economic growth model that has characterized Brazil's development path. Many workers are immersed in a traditional and precarious low-productivity production system. In the poorer regions, this motivates them to move to the more modern region or sector, where labour productivity is higher and, therefore, the quality of employment is better. Other features of this scenario include a lack of opportunities for the rural population in the poorer regions to access land; the resistance of the large-estate (*latifundio*) sector to the formation of a campesino population; and the more backward forms of capitalist management, which have repercussions on the labour market.

Throughout the period under review, there were significant improvements in job quality, especially in the lowest-quality regions. However, as the data in table 4 show, significant regional and sectoral heterogeneities still persist. For example, the quality of employment in the North and North-East Regions is relatively worse than in the agribusiness complex in the centre-south of the country; and the quality of agricultural employment is inferior to that of non-agricultural employment.

IV. Quality of employment index: empirical results

This section reports and analyses the results produced by the econometric models presented in the section on methodological issues, which relate the job quality index for the four groups studied to a set of variables that synthesize some of the factors that determine the structure of the Brazilian labour

market. The section is organized as an interpretation of four tables (tables 5, 6, 7 and 8) that report the estimations of the four equations proposed. The interpretation starts with data on rural agricultural employment; then this is followed by urban agricultural, rural non-agricultural and, lastly, urban non-agricultural employment.

Table 5
Estimation results of the selected models for the rural agricultural labour market

Variables	Ordinary least squares [A]			Fixed-effects panel [B]			Instrumental variables regression [C]			Generalized method of moments [D]		
	Coeff	t	p>|t|	Coeff	t	p>|t|	Coeff	z	p>|z|	Coeff	z	p>|z|
Quality of employment index	0.721	12.39	0.000	0.140	1.98	0.049	0.494	4.28	0.000	0.494	4.28	0.000
Agricultural value-added	0.006	0.87	0.387	-0.046	-1.95	0.053	0.104	2.52	0.012	0.104	2.52	0.012
Non-agricultural value-added	-0.009	-1.50	0.135	0.139	3.43	0.001	-0.082	-2.34	0.019	-0.082	-2.34	0.019
Income	0.047	3.05	0.003	0.034	1.51	0.132	0.095	2.80	0.005	0.095	2.80	0.005
Inequality	0.090	0.93	0.353	-0.050	-0.42	0.676	0.208	0.55	0.583	0.208	0.55	0.583
Education	0.028	1.82	0.071	-0.127	-2.52	0.013	0.093	2.12	0.034	0.093	2.12	0.034
Statistical tests	F(6;210) = 1 860.37			F(6;183) = 16.06			F(6;7) = 2 071.99			Wald(6) = 14 546.24		
	Prob > F = 0.000			Prob > F = 0.000			Prob > F = 0.000			Prob > chi2 = 0.000		
	Number of observations = 216			Number of observations = 216			Number of observations = 216			Number of observations = 216		
	Adjusted R^2 = 0.970			R^2 (within) = 0.3449			R^2 (uncentred) = 0.93					
				Groups = 27			Groups = 8			Groups = 27		
							Kleibergen = 0.0158			Instruments = 7		
	HO: Absence of first-order autocorrelation									0.039		
	HO: Absence of second-order autocorrelation									0.260		
	Sargan test									0.608		
	Hansen test									0.621		

Source: Prepared by the authors.

Table 6
Estimation results of the selected models for the urban agricultural labour market

Variables	Ordinary least squares [A]			Fixed-effects panel [B]			Instrumental variables regression [C]			Generalized method of moments [D]		
	Coeff	t	p>|t|	Coeff	t	p>|t|	Coeff	z	p>|z|	Coeff	z	p>|z|
Quality of employment index	0.599	8.7	0.000	0.109	1.5	0.137	0.562	7.4	0.000	0.562	7.4	0.000
Agricultural value-added	0.018	2.5	0.013	0.016	0.6	0.551	0.027	3.1	0.002	0.027	3.1	0.002
Non-agricultural value-added	-0.005	-0.9	0.392	0.072	1.5	0.126	-0.003	-0.9	0.348	-0.003	-0.9	0.348
Income	0.032	2.6	0.010	0.042	2.2	0.031	0.066	4.9	0.000	0.066	4.9	0.000
Inequality	-0.028	-0.3	0.773	-0.279	-2.0	0.045	0.452	2.5	0.011	0.452	2.5	0.011
Education	0.079	4.0	0.000	-0.044	-0.8	0.454	0.048	2.4	0.016	0.048	2.4	0.016
Statistical tests	F(6;210) = 2 050.09			F(6;183) = 26.08			F(6;26) = 1 039.96			Wald(6) = 6 634.06		
	Prob > F = 0.000			Prob > F = 0.000			Prob > F = 0.000			Prob > chi2 = 0.000		
	Number of observations = 216			Number of observations = 216			Number of observations = 216			Number of observations = 216		
	Adjusted R^2 = 0.9696			R^2 (within) = 0.4609			R^2 (uncentred) = 0.97					
				Groups = 27			Groups = 27			Groups = 27		
							Kleibergen = 0.0071			Instruments = 7		
	HO: Absence of first-order autocorrelation									0.001		
	HO: Absence of second-order autocorrelation									0.523		
	Sargan test									0.394		
	Hansen test									0.386		

Source: Prepared by the authors.

Table 7
Estimation results of selected models for the rural non-agricultural labour market

Variables	Ordinary least squares [A]			Fixed-effects panel [B]			Instrumental variables regression [C]			Generalized method of moments [D]		
	Coeff	t	p>|t|	Coeff	t	p>|t|	Coeff	z	p>|z|	Coeff	z	p>|z|
Quality of employment index	0.465	8.0	0.000	0.071	1.2	0.253	0.405	5.0	0.000	0.405	5.0	0.000
Agricultural value-added	0.008	1.8	0.082	0.003	0.2	0.836	0.011	1.3	0.206	0.011	1.3	0.206
Non-agricultural value-added	-0.011	-3.3	0.001	-0.064	-2.5	0.014	-0.015	-2.1	0.040	-0.015	-2.1	0.040
Income	0.077	8.0	0.000	0.167	8.5	0.000	0.052	6.3	0.000	0.052	6.3	0.000
Inequality	0.081	1.3	0.195	0.133	1.9	0.065	-0.292	-2.2	0.029	-0.292	-2.2	0.029
Education	0.029	3.6	0.000	0.012	0.4	0.687	0.053	2.9	0.003	0.053	2.9	0.003
Statistical tests	F(6;210) = 12 234.51			F(6;183) = 46.10			F(6;7) = 3 268.60			Wald(6) = 22 946.87		
	Prob > F = 0.000			Prob > F = 0.000			Prob > F = 0.000			Prob > chi2 = 0.000		
	Number of observations = 216			Number of observations = 216			Number of observations = 216			Number of observations = 216		
	Adjusted R^2 = 0.9957			R^2 (within) = 0.6018			R^2 (uncentred) = 0.995					
				Groups = 27			Groups = 8			Groups = 27		
							Kleibergen = 0.0033			Instruments = 7		
	H0: Absence of first-order autocorrelation									0.004		
	H0: Absence of second-order autocorrelation									0.561		
	Sargan test									0.819		
	Hansen test									0.562		

Source: Prepared by the authors.

Table 8
Estimation results of selected models for the urban non-agricultural labour market

Variables	Ordinary least squares [A]			Fixed-effects panel [B]			Instrumental variables regression [C]			Generalized method of moments [D]		
	Coeff	T	p>|t|	Coeff	t	p>|t|	Coeff	z	p>|z|	Coeff	z	p>|z|
Quality of employment index	0.849	29.6	0.000	0.407	8.0	0.000	0.834	15.3	0.000	0.834	15.3	0.000
Agricultural value-added	-0.001	-0.8	0.415	0.004	0.8	0.406	-0.003	-1.3	0.196	-0.003	-1.3	0.196
Non-agricultural value-added	0.001	0.5	0.649	-0.079	-4.6	0.000	0.002	1.5	0.138	0.002	1.5	0.138
Income	0.020	5.5	0.000	0.105	5.3	0.000	0.018	3.0	0.002	0.018	3.0	0.002
Inequality	0.012	0.8	0.454	-0.080	-2.8	0.007	-0.028	-0.7	0.477	-0.028	-0.7	0.477
Education	0.0	2.3	0.023	0.051	5.2	0.000	0.007	1.6	0.100	0.007	1.6	0.100
Statistical tests	F(6;210) = 99 999			F(6;183) = 167.93			F(6;7) = 64 182.17			Wald(6) = 45 0585		
	Prob > F = 0.000			Prob > F = 0.000			Prob > F = 0.000			Prob > chi2 = 0.00		
	Number of observations = 216			Number of observations = 216			Number of observations = 216			Number of observations = 216		
	Adjusted R^2 = 0.9997			R^2 (within) = 0.8463			R^2 (uncentred) = 0.9997					
				Groups = 27			Groups = 8			Groups = 27		
							Kleibergen = 0.0000			Instruments = 9		
	H0: Absence of first-order autocorrelation									0.000		
	H0: Absence of second-order autocorrelation									0.979		
	Sargan test									0.189		
	Hansen test									0.998		

Source: Prepared by the authors.

Column [A] of each table reports the result of the OLS estimations; and column [B] shows the estimations obtained using the fixed-effects panel method, which is more efficient than the random-effects method, according to the Hausman test in all four of the models estimated. Column [C] presents the instrumental variables model, used to evaluate the possibility of underidentification. Lastly, column [D] presents the parameter estimates obtained through system-GMM. It should be noted that [C] and [D] are essentially the same model. As noted above, system-GMM is the result of an extension of the original Arellano and Bond (1991) estimator, proposed by Arellano and Bover (1995) and developed further by Blundell and Bond (1998).

As can be seen in column [A] of each table, the estimated coefficients of the variable "Quality of employment lagged by one period" obtained through OLS are, in fact, higher than those shown in column [B] for this same variable using the fixed-effects panel data method. If the instruments used are appropriate, the coefficient on this variable estimated by GMM should lie between the coefficients estimated by the two previous methods. This is precisely what column [D] confirms. With this characteristic satisfied, the bias caused by the presence of endogenous variables on the right side of the regression and the unobservable fixed effects was corrected by GMM.

Thus, among the models presented in tables 5, 6, 7 and 8, those indicated in column [D] of each table were always chosen. The tests performed in system-GMM show that the statistical properties of the models are acceptable. The Hansen test, which indicates whether the instruments used are valid, and the Sargan test, which verifies the validity of the additional instruments required by system-GMM, are satisfied for the four models estimated, as can be seen in tables 5, 6, 7 and 8. It should also be noted that the null hypothesis of the Kleibergen and Paap (2006) underidentification test is rejected, indicating that the model contained in column [C] is not underidentified.[1] Note also that while the estimations of [C] and [D] are different, they are basically the same model, which indicates that [D] is also not underidentified.

Lastly, the Arellano and Bond (1991) statistical tests are also included to evaluate the existence of both first- and second-order autocorrelation. The absence of the latter is essential for the consistency of the GMM estimator. The test confirms that the hypothesis of first-order autocorrelation is not rejected, but second-order autocorrelation is rejected in all four models presented. This is as expected and in keeping with the instructions in the panel data literature. Accordingly, the models are rated as acceptable.

An initial finding is that the coefficient of the variable "Agricultural value-added" is not statistically significant for non-agricultural employment, whether urban or rural. This represents a significant feature of non-agricultural labour market behaviour in the groups studied. In principle, the expansion of agricultural production does not cause structural changes in the non-agricultural labour market. What is captured here is the weak linkage between agricultural output and the overall labour market, since, on average, the sector accounted for just 5.7% of the total output of the Brazilian economy in the reference period. Although the growth of agricultural production may also stimulate non-agricultural production and, hence, boost employment, a simple increase in the number of workers does not imply an improvement in job quality. Moreover, the coefficient of the variable "Non-agricultural value-added" is not significant for urban non-agricultural employment either. Thus, the growth of the urban non-agricultural labour market induced by the expansion of agricultural or non-agricultural production does not, *per se*, cause a change in existing or new employment relationships. The quality of these new hirings is, on average, similar to the job quality experienced by workers already participating in the market, without altering the sophistication structure of employment in these groups.

[1] The underidentification test determines whether the equation is identified, in other words whether the excluded instruments are "relevant" in the sense of being correlated with the endogenous regressors. This is essentially the rank test of a matrix: under the null hypothesis that the equation is underidentified, the reduced-form matrix of coefficients on the excluded instruments of L1 has rank = K1-1 where K1 = number of endogenous regressors. Under the null hypothesis, the statistic approximates a chi-squared distribution, with (L1-K1 + 1) degrees of freedom. Rejection of the null hypothesis indicates that the matrix has full column rank; that is, the model is identified. For further information see Kleibergen and Paap (2006).

However, the variable "Agricultural value-added" is positive and statistically significant at a significance level of at least 5%, for the agricultural employment groups —both rural (see table 5) and urban (see table 6). This means that agricultural employment responds more to the growth of agricultural production than does non-agricultural employment. Accordingly, an increase in agricultural activity has significant effects on the quality of agricultural employment.

The negative sign on non-agricultural value-added indicates that the growth of industrial and service activities is inversely related to the quality of employment for the groups in which this variable has a negative sign (rural agricultural, urban agricultural[2] and rural non-agricultural employment).[3] According to Balsadi and Delgrossi (2018), the population employed in agriculture is ageing progressively, and the abandonment of agricultural activities —to a greater extent by women and young people— contributes to the precariousness of this type of employment and even to some farming enterprises going out of business, as seen in some regions of Brazil. Thus, the expansion of non-agricultural production, which offers new employment opportunities to these groups, contributes to the relatively lacklustre performance of agricultural employment, with repercussions on its quality, as evidenced by the econometric models.

It is also found that labour hiring practices in non-agricultural activities are much more formal, which translates into higher income, shorter working hours and a lower incidence of child labour. Thus, as activities develop, they tend to influence agricultural labour through the sectoral migration process, as agricultural workers seek to improve their situation by engaging in activities in other sectors that offer better job quality.

The coefficient of the "Income" variable, which represents average labour income in each of Brazil's federative units, is statistically significant at a level of at least 5% and, as expected, has a positive sign for the four equations analysed. Thus, an increase in average labour income has significant effects on employment quality. This indicates that a policy of raising real wages may be important for improving the quality of employment and, above all, the profile of the workers. From this perspective, the increase in income is associated with jobs that have better labour hiring practices. It is also possible that the increase in income induces a competitive process within the labour market. Employers are encouraged to improve their hiring methods in order to obtain the workers they want; and the workers, in turn, feel less inclined to stay in precarious jobs (of lower quality), with lower income levels —at least in an environment of economic growth and declining unemployment, such as prevailed throughout most of the period analysed.

With regard to elasticities, the elasticity of employment quality with respect to income is less than unity in all cases, and so more inelastic. Nonetheless, raising the average wage in each federative unit could help reduce the differences between labour markets, both urban and rural and non-agricultural and agricultural, since the effects of an increase in state-average income are smaller in the former, as shown in the coefficients reported in tables 5, 6, 7 and 8.

The "inequality" variable, represented by the Gini index, which measures the degree of income concentration, is statistically significant and negative for rural non-agricultural employment; and negative, but not significant, for urban non-agricultural employment. Thus, the income concentration structure influences job quality in this segment of the labour market. A drop in the Gini index implies that the income level of the poorest workers converges to a higher level, with the respective repercussions in terms of job quality, since the "inequality" variable is inversely proportional to the job quality index. However, in

[2] Following the line of reasoning developed in this paragraph, urban agricultural employment should be treated with caution. Although the sign of the coefficient of non-agricultural value-added is negative, like that of the other types of employment, it is weakly non-significant; so this result and the inferences based on it should be interpreted with caution.

[3] Although rural non-agricultural employment is a "product" of the sectoral migration of workers from agriculture to non-agricultural activities, agriculture still seems to exert a strong influence on the labour market for these workers, as they remain spatially linked to the rural domain and, hence, to agriculture. Thus, their behaviour, when induced by non-agricultural activities, still show similarities with that of purely agricultural activities.

the case of urban non-agricultural employment, the Gini index does not seem to significantly influence job quality. Thus, urban non-agricultural employment practices maintain their own dynamics, regardless of the level of income concentration.

Lastly, the "Education" variable, which represents the population that has completed at least secondary education in each state, is significant at a level of at least 10% and has a positive sign, in accordance with the expected behaviour in these models for the four equations. From this perspective, a worker's education level influences job quality positively by increasing the chances of obtaining better jobs as the level of education rises. This is consistent with the literature that considers education level as a driver of better job quality. A labour force with higher levels of schooling is associated with higher-paying jobs, greater chances of formalization and more sophisticated conditions of employment. Thus, investments in education and job skills are very effective in terms of achieving outcomes and improvements in the quality of employment, since the latter always responds robustly to the level of education.

In the case of the variable "Quality of employment lagged by one period", IQE_{t-1}, the coefficient is positive and significant at a significance level of at least 5% in all four models. This indicates that job quality tends to persist from one year to the next. Past job quality tends to persist more strongly in urban non-agricultural employment. This is because, in addition to being more sophisticated than the others, this labour market displays higher levels of formalization and greater adherence to labour legislation. The logic at play here is based on worker behaviour and the dynamics of the labour market itself. In general, workers only have incentives to change their job if the conditions offered in the future job are better than in the current one —particularly in a scenario of output growth and falling unemployment, such as characterized the period analysed (the average open unemployment rate dropped from 11.48% in 2004 to 4.8% in 2014, according to IBGE data). Thus, the prevailing macroeconomic context has a major influence on the results presented here.[4] It is also argued that the labour market is resistant to giving up acquired worker rights; once acquired, they are generally not lost over time. This also applies to the quality of employment, insofar as resistance is created in the case of better working conditions already acquired. This means that job quality and its influence on current employment persists.

V. Final remarks

This study has sought to evaluate parallel trends in the quality of employment for four groups of workers, to evaluate the asymmetries that exist between them. A specific methodology was applied to verify the factors affecting job quality for the selected groups, in order to broaden the basis for explaining the asymmetries observed.

It is well known that the recent spatial transformations, both urban and rural, have had significant effects on employment practices. Nonetheless, this study shows that the changes in question go far beyond the new rural production dynamics. Currently, the behaviour of rural employment reflects a plurality of conditioning factors that go far beyond those operating in the rural domain. Urban dynamics are also starting to be taken into account and becoming important for evaluating the trajectory of rural employment relations more accurately.

The quality of employment index proposed in this research has revealed a wide variety in employment relations in the areas studied. In general, agricultural workers endure more precarious conditions than their non-agricultural peers. Moreover, with respect to asymmetry in the labour market, it is worth noting the differences between urban and rural employment. The rural domain remains a more precarious environment than the urban one, although the differences have been diminishing over time.

[4] The research findings do not capture the effects of the recent economic, social and political crisis in Brazil, which have been more intense since 2015.

The subnational spaces also present a number of specific features. In general, the best working conditions and the most intense and sophisticated dynamics are found in the agro-export complex of the centre-south of Brazil. This contrasts especially with the situation in the northern part of the North-East Region, which remains disconnected from this system and displays profound differences with respect to the agribusiness complex of the centre-south. The precarious employment relations that characterize the region are evident.

Lastly, an analysis of the models presented shows that economic growth is generally reflected to a greater extent in agricultural employment. The expansion of agricultural activities has a positive influence on the quality of agricultural employment. However, the expansion of agriculture does not seem to affect the quality of non-agricultural employment significantly, even when agribusiness is intensifying in Brazil. On the other hand, the growth of non-agricultural production generally has a negative impact on the quality of agricultural employment, since it constitutes an expansion of the possibility frontier for rural workers. As shown in this article, this contributes to the ageing of the rural population employed in agricultural activities and even impairs the viability and continuity of farming enterprises.

A different dynamic prevails in the case of non-agricultural employment. Recent economic growth has either extended the pre-existing hiring modalities, without major structural changes in the non-agricultural labour markets; or else, in some cases, it has generated jobs at the base of the pyramid with worse quality indices. However, an important caveat is needed: the long-term behaviour of the labour market may respond differently than observed thus far. This is because, as economic growth moves the economy towards full employment, extending the same hiring modalities to unemployed workers becomes increasingly difficult. As economic growth proceeds, even in the long run, it is likely to bring about changes in the labour market structure. Nonetheless, the possibility of structural changes induced by full employment has been rendered more remote by the recent crisis in Brazil.

The study also showed that increasing labour income and raising the average education level of workers are important instruments, not only for improving employment quality, but also as a strategy to overcome some of the problems of the markets studied, such as heterogeneity between groups.

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Reduction of the wage share of income and increasingly precarious employment

Daniel Velázquez Orihuela[1]

"Keep workers insecure and keep them under control, and they're not going to ask for decent wages or decent working conditions, or the right of free association, meaning unionizing. Now for the masters of mankind that's fine. They make their profits. But for the population it's devastasting." (*Requiem for the American Dream,* 2015).

Abstract

The economic globalization that began in the late 1970s and early 1980s has generated job insecurity for workers. This coincides with two trends: a reduction in the wage share of income and increasingly precarious employment, both of which have been seen in most market economies since the early 1980s. This article proposes an efficiency-wage model in a demand-constrained equilibrium scenario, to explain how rising job insecurity has reduced the wage share of income and made employment more precarious. An additional virtue of this model is that it explains several features of the Mexican labour market observed in recent decades.

Keywords

Employment, labour market, wages, conditions of employment, labour relations, income, income distribution, econometric models, Mexico

JEL classification

D33, E24, E25

Author

Daniel Velázquez Orihuela is full-time Research Professor of Economics at the Autonomous University of the State of Hidalgo, Mexico. Email: daniel_velazquez7607@uaeh.edu.mx.

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I. Introduction

A salient feature of the globalization of production, which began in the late 1970s and early 1980s, has been the relocation of production by transnational corporations to reduce labour costs. This has allowed such firms to undertake their labour-intensive processes in countries that have low wages and permissive labour regulations. The threat that production could be offshored has generated a state of insecurity among workers and has diminished their unions' bargaining power (Kalleberg, 2009). In addition, the collapse of the socialist bloc released millions of people on to the global labour market. Faced with this excess labour force, many of the world's poor countries have opted to compete for foreign direct investment (FDI) by offering low wages and flexible, or non-existent, labour regulations that allow and facilitate costless dismissal, which has generated a sense of job insecurity (*Requiem for the American Dream*, 2015). The perception of job insecurity among workers is one of the main effects that the globalization of production has had on labour markets, and is currently one of their key features in most cases (Kalleberg, 2009).

Production globalization, and the job insecurity it has generated, coincide with two major trends: a reduction in the wage share of income and the increasing precariousness of employment. Both of these started at the same time as globalization.

The shrinking wage share of income and increasing precariousness of employment are two trends that have been observed in rich and poor countries alike (IMF, 2007; ILO/OECD, 2015; Kalleberg, 2009). However, emerging and developing countries have experienced a more pronounced and steeper reduction in the share of wages in national income (ILO, 2011; Stockhammer, 2009) and a faster growth of precarious employment (Vázquez, Macias and Lawson, 2018) than has been the case in the rich countries.

According to ILO (2018), 46% of workers in emerging economies and 76% of those in poor countries are in vulnerable forms of employment. As a counterpart of this phenomenon, in Asia, the wage share of national income has decreased by more than 20 percentage points since 1994, and in North African countries, it has shrunk by over 30 percentage points since 2000.

In Latin America, while the decline has been more moderate, barely exceeding 10% since 1993, it has also been gathering pace (ILO, 2011). Abeles, Amarante and Vega (2014) claim that the labour share of output is declining in most Latin American countries, even when the income of self-employed workers is considered. Alarco (2014, 2016 and 2017) posits a common history in most Latin American countries, in which the wage share in 1950–2012 completes two cycles: the first cycle peaks in the mid-1960s, before dropping to a floor in the mid-1980s. The second peaks in the mid-1990s and reaches the bottom of the cycle between 2004 and 2006.[2] Nonetheless, the long-term trend of the wage share has been down: it was higher between 1950 and 1979 than in 1980–2014. In other words, wages gained their largest share when the import substitution industrialization model was more intense or when sociopolitical circumstances favoured workers; in contrast, the minimum levels occur after the debt crisis of 1980, when pro-market policies were in force.

This article aims to show that job insecurity is one of the causes of both the increasing precariousness of employment and the shrinking share of wages in income. To this end, an efficiency-wage model is constructed in a demand-constrained equilibrium scenario. This analytical framework is used to study the mechanisms through which heightened insecurity of employment causes jobs to become more precarious and the wage share of income to decline. The model has the additional virtue of reproducing and explaining some of the characteristics of the Mexican labour market.

[2] During the first five years of this century, the personal distribution of income improved, even though the wage share of income declined. This may reflect an underestimation of the income of the wealthiest percentiles (Abeles, Amarante and Vega, 2014).

The article is divided into five sections, of which section II, following this introduction, identifies some of the characteristics of the Mexican labour market. Section III constructs an efficiency-wage model in a demand-constrained equilibrium scenario to provide a common explanation for the income concentration, increasingly precarious employment and characteristics of the Mexican labour market discussed in the second section. Section IV presents a numerical example of the theoretical model; and the fifth and final section sets forth the conclusions of the study.

II. Selected characteristics of the Mexican labour market

In recent decades, income concentration and increasingly precarious employment have been permanent features of the Mexican economy, and have been accompanied by the following trends:

(i) Although the labour share of national income has been shrinking ever since 1976, the decline has gathered pace in the last decade (Ros, 2015; Samaniego, 2014; Luyano and Herrera, 2018).

(ii) Since 2008, wages have converged downward, with the median of high wage segments falling faster than that of the lower segments. This has narrowed the wage gap between different worker categories, whether classified by their occupational position, by years of schooling, or by whether they work in the formal or the informal sector of the economy (Colmex, 2018).

The following developments have occurred in the last two decades:

(iii) The number of low-paying jobs has increased, while the number of high-paying jobs has declined.[3]

(iv) Precarious jobs (defined as those that lack access to social security, offer only a temporary contract or none at all, and where pay is equal to or less than a minimum wage) have increased (Colmex, 2018).

(v) While the average growth rate of labour productivity has slowed, the productivity of the tradable goods manufacturing sector has surged (Ros, 2013 and 2015).

To provide an explanation for these trends, the next section develops an efficiency-wage model in demand-constrained equilibrium scenarios, with special emphasis on the processes that drive income concentration and make employment more precarious. It is important to clarify that the model identifies precarious employment on the basis of three characteristics: lower wages, greater effort made by workers and heightened job insecurity.[4]

III. The model

1. Initial conditions

The starting point is an economy consisting of a large number of producers and consumers. The latter can be classified in two social classes. However, all members of each class have the same set of tastes and preferences; and, similarly, all firms have the same production function. This makes it possible to work with a single representative firm and one representative consumer for each social class.

[3] As an example of the above: (i) in 2008 there were 1.5 million more workers earning over three times the minimum wage than in 2014; and (ii) the percentage of employees (paid subordinate workers) being paid less than the minimum wage increased from 14.4% in 2000 to 24.0% in 2017 (Samaniego, 2014; Colmex, 2018).

[4] There is no consensus on all of the characteristics needed to identify the "precarious work" category. In most of the specialized literature, however, they include low wages, job insecurity and the intensity or length of the working day.

Social classes are distinguished by two characteristics: (i) their income source; and (ii) their tastes and preferences. Distinguishing social classes by their income source is typical of both classical and Marxist theory. Workers whose sole source of income is their labour, which is employed and paid for by firms, are called proletarians; and the owners of capital, whose main source of income is the profits of the enterprises they own, are called capitalists. Following this tradition, this article will also refer to the two social classes as "proletariat" and "capitalist". In addition to the difference based on income source, it is assumed that capitalists employ labour to increase their leisure or make it more enjoyable.

In this model, proletarians have two work alternatives: the first is in firms (referred to as conventional employment); and the second is self-employment. Self-employed workers do not have the capital or the organization to set up a formal enterprise, so they supply their labour services to capitalist consumers, to increase the latter's leisure or make it more enjoyable. The only income that self-employed workers receive is the wage paid to them by capitalist consumers. This means that there are two production sectors: a conventional sector, in which firms produce goods, and another sector in which the self-employed supply their services.

Information is asymmetric and imperfect, so neither firms nor capitalist consumers can identify which of their workers are exerting themselves and which are not. It will be assumed that worker effort increases as wages or the subjective probability of dismissal increases. As a result all employers pay an efficiency wage, i.e., they pay the wage that maximizes their rate of profit or utility, as applicable.

The positive relations that exist between wages and effort and between the probability of dismissal and effort are standard assumptions in efficiency-wage theory (Caraballo, 1996). The probability of dismissal is usually represented by the unemployment rate. However, this study assumes that the subjective probability of dismissal reflects the workers' perception of job insecurity, which, in addition to the unemployment rate, takes into account variables such as the existence and duration of the employment contract, the existence of social security, the flexibility of labour legislation and respect for labour rights, among other issues.[5] Consequently, this perceived likelihood of dismissal can increase even without a rise in the unemployment rate.

The self-employed have less job stability, in other words they can be dismissed more easily than workers employed in firms. This idea is supported by the fact that the self-employed usually lack unions, social security, written contracts and legal protection. In this regard, Mexico's National Institute of Statistics and Geography (INEGI) shows that less than 1% of self-employed workers in the Mexican economy have some form of social security (INEGI, 2017).

The subjective probability of dismissal among the self-employed (p_b) depends positively on the subjective probability of dismissal among conventional workers (p_a). This hypothesis is supported by the fact that when unemployment rises, the unemployed may turn to self-employment. This will increase the supply of services provided by the self-employed and make finding employment harder for all of them. In this regard, Ros (2013) recognizes that the low-productivity service sector has become the last stage through which Mexican workers move before falling into unemployment.

The ideas expressed in the previous two paragraphs are formalized in the following hypotheses:

$$0 < p_a < p_b < 1 \text{ and } 0 < \frac{dp_b}{dp_a} < 1.$$

[5] According to Corporación Latinobarómetro (2005), 75% of workers in Latin America were afraid of losing their jobs in the next 12 months, and this percentage rose to 82% in the case of Mexican workers.

2. Representative firm

The firm's optimizing behaviour is formalized through the following maximization exercise:

$$max(1+\pi) = \frac{y_0}{wl_a} \tag{1}$$

Subject to

$$y_0 = Af\left(e\left(w,p_a\right)l_a\right) \tag{2}$$

In expressions (1) and (2), $(1+\pi)$ is the rate of profit, y_0 is the supply of output, w is the real wage, l_a is the firm's demand for labour, $e(w, p_a)$ is the effort function and p_a is the subjective probability of being fired by the firm.

Where $A \in \Re^+$, $e'_w > 0$, $e''_w < 0$, $e'_{p_a} > 0$, $e''_{p_a} < 0$, $e''_{w,p_a} = 0$, $e\left(w,0\right) > 0$, $0 < p_a < 1$ and f is a homogeneous function of degree 1.

The formalization of the firm's rationality axiom has two key features:

(i) Firms aim to maximize their profit rate, which is defined as the quotient of sales revenue over costs. This differs from standard neoclassical theory, which postulates that firms maximize the absolute level of profit (the difference between sales and costs). However, it is consistent with the classical and Marxist idea that the main variable guiding firms' decisions is the profit *rate*. More recently, financial investment theory highlights different rates of return as the key variables used by investors in deciding where to invest.

(ii) Following Solow (1979), from the standpoint of the individual firm, the wage has two characteristics: firstly, it is part of labour costs; and, secondly, it stimulates worker effort. Consequently, firms pay the wage that elicits the greatest effort from the worker at the lowest possible cost, and enables them to maximize their profit rate.

Solving the maximization exercise (equations (1) and (2))[6] gives:

$$\frac{e'_w}{e\left(w,p_a\right)}w = 1 \tag{3}$$

$$Af'_{l_a} = \frac{Af\left(e\left(w,p_a\right)l_a\right)}{l_a} \tag{4}$$

Equation (3) is the Solow equation, which ways that producers maximize profit when the wage they pay ensures that the elasticity of effort with respect to the wage is unity. The wage that satisfies this condition for the firms is called the efficiency wage (w^a).

Equation (4) is a condition that is usually obtained in analytical frameworks that involve maximization of the profit rate. It shows that firms maximize when the average and marginal products of labour are equal (Noriega, 2001; Velázquez and Hernández, 2018; Velázquez, Vargas and Hernández, 2019).

Note that equation (3) implies that producers set the wage independently of labour supply and demand, so there is no guarantee that the efficiency wage elicits full employment. On the other hand, because the production function is homogeneous of degree 1, equation (4) holds for all positive labour demand; and the optimal rate of profit is independent of the level of employment, but does depend on the wage:

[6] See section 1 of annex A1.

$$max(1+\pi) = \frac{Ae\left(w^a, p_a\right)}{w^a} \tag{5}$$

Unlike the profit rate, the absolute level of profit does depend on the level of employment. As long as firms offer the efficiency wage, absolute profit will be:

$$\Pi = \left(Ae\left(w^a, p_a\right) - w^a\right) l_a \tag{6}$$

Note that the Solow condition implies that the efficiency wage is: $w^a = \frac{e\left(w^a, p_a\right)}{e'_w}$. So, as long as $A > \frac{1}{e'_w}$ the profit rate will be positive, and absolute profit will grow as employment increases, so that: $\frac{d\Pi}{dl_a} = Ae\left(w^a, p_a\right) - w^a > 0$, $\frac{d^2\Pi}{dl_a^2} = 0$ and $\lim_{l_a \to \infty} \Pi = \infty$. This does not mean that the level of employment is unknowable, or that full employment is maintained systematically. Firms will produce only what the market demands, because if they produce more they will accumulate unwanted inventories and, hence, make losses. Consequently, they adjust their production to the prevailing effective demand, and this determines the maximum amount of labour to be hired $\left(\hat{y}_d\right)$. However, as will be shown in part 5 of this section, there is no market mechanism that systematically guarantees a level of effective demand that is compatible with full employment.

From the above, it follows that:

$$\hat{y}_d = Ae\left(w^a, p_a\right) l_a \tag{7}$$

$$l_d = \frac{\hat{y}_d}{Ae\left(w^a, p_a\right)} \tag{8}$$

Equation (7) simply shows that production adjusts to the prevailing effective demand, as a condition for obtaining the maximum possible profit; equation (8) expresses firms' labour demand. This is analogous to the employment function proposed by Keynes (1936), since, like the latter, it shows that the level of employment depends positively on effective demand.

3. Proletarian consumer

The proletarian consumer's rational behaviour is formalized through the following maximization exercise:

$$max\, U^p = \alpha \ln c^p + (1-\alpha) ln\left(\tau^p - e\left(w, p_i\right) l_0\right) \tag{9}$$

Subject to

$$w l_0 = c^p \tag{10}$$

In expressions (9) and (10), p_i (for all $i = a, b$) is the subjective probability of being fired in the case of persons employed in firm ($i = a$) or in the case of the self-employed ($i = b$); $0 < \alpha < 1$; c is consumer demand, τ is the time that is biologically available for work; and l_0 is the labour supply of a conventional worker or a self-employed person, as the case may be. The superscript p refers to the representative consumer of the proletarian class. Key aspects of the formalization of the rational behaviour of the proletarian consumer include the following:

(i) Utility is modelled as a Cobb-Douglas function; it is therefore well-behaved.

(ii) Proletarian consumers supply efficient labour $\left(e\left(w,p_i\right)l_0\right)$. Thus, an increase in their effort, *ceteris paribus*, will reduce their utility.

The maximization exercise gives the demand for consumption and the supply of labour, as follows:

$$c^p = \frac{\alpha\tau^p w}{e\left(w,p_i\right)} \tag{11}$$

$$l_0 = \frac{\alpha\tau^p}{e\left(w,p_i\right)} \tag{12}$$

Equations (11) and (12) represent habitual purchase and sale plans. Note that labour supply is not constant, but varies as worker effort changes.

4. Capitalist consumer

The rational maximizing behaviour of the representative capitalist consumer is formalized as follows:

$$max\, U^c = \beta \ln c^c + \left(1-\beta\right) ln\left(e\left(w,p_b\right)l_b\right) \tag{13}$$

Subject to

$$\Pi = c^c + wl_b \tag{14}$$

In expressions (13) and (14), $0< \beta <1$; the superscript c refers to the representative consumer of the capitalist class; and l_b is the capitalist consumer's demand for labour.

Formalization of the capitalist consumer rationality axiom has four key features:

(i) Similarly to the proletarian consumer's utility function, the capitalist consumer's utility is also modelled as a Cobb-Douglas function.

(ii) The idea that capitalist consumers' only source of income is the profit received from the enterprises they own implies that capitalist consumers do not supply labour. This is why labour supply appears neither in their utility function nor in their budget constraint.

(iii) The hypothesis that capitalist consumers demand labour to increase their leisure or make it more enjoyable is formalized by introducing their demand for labour multiplied by effort in their utility function.

(iv) Both capitalist consumers and firms know that workers' effort depends on the wage paid to them; so they offer a wage that elicits maximum worker effort and minimizes labour cost.

The maximization exercise gives the demands of the capitalist consumers and the wage that maximizes their utility:

$$l_b = \left(1-\beta\right)\frac{\Pi}{w} \tag{15}$$

$$c^c = \beta\Pi \tag{16}$$

$$\frac{e'_w}{e\left(w,p_b\right)}w = 1 \tag{17}$$

Equation (15) represents the capitalist consumer's demand for labour, in other words the demand for labour supplied by the self-employed. It depends positively on profit and negatively on the wage. Equation (16) represents consumption demand and simply shows that capitalists consume a proportion of their profit. Equation (17) is the Solow equation, which states that capitalist consumers maximize their utility when they pay a wage that ensures that the elasticity of effort relative to the wage is equal to 1; in other words when they pay efficiency wages (w^b). However, the efficiency wage paid by firms (w^a) does not necessarily have to be equal to the wage offered by capitalist consumers (w^b). This is because the self-employed and workers employed by firms have different subjective probabilities of being fired.

Comparing the wages offered by the firms with those received by the self-employed, it follows that, as $p_a < p_b$ then $w^b < w^a$. In other words, self-employed earnings are lower than the wages offered by firms, because the self-employed have a higher subjective probability of being fired. The reason for this is that the greater perception of job insecurity among the self-employed forces them to exert more effort than conventional workers to avoid unemployment; consequently, capitalist consumers can pay lower wages than firms and still extract the same effort from their workers.

5. Demand-constrained general equilibrium

The demand-constrained equilibrium is represented by the price and allocation vectors observed when output systematically adjusts to effective demand. However, the latter is not large enough to guarantee full employment. In the literature, demand-constrained equilibrium is usually explained in terms of prices being slow to adjust, which causes agents to engage in out-of-equilibrium transactions (Argandoña, Gámez and Mochón, 1996). In contrast to that literature, but analogous to Velázquez and Hernández (2018), this paper posits that demand-constrained equilibrium arises because firms' labour hiring plans are not inversely related to the real wage (see equation 8), and because wages are independent of labour supply and demand (see equations (3) and (17)).

The goods and labour markets are represented by the following equations:

$$\hat{y}_d - y_0 = 0 \tag{18}$$

$$l_a - \phi l_0 = 0 \tag{19}$$

$$l_b - (1-\phi)\gamma l_0 = 0 \tag{20}$$

Equation (18) represents the market for goods; effective demand $(\hat{y}_d)$ is the sum of all demands that can be financed, that is, the consumption plans that agents can afford with the profits they receive from firms or with the remuneration they obtain by offering their labour services and being employed. Equation (19) represents the "conventional" labour market, which links firms' demand for labour with what workers' supply; ϕ is the proportion of labour supply that is employed in this market, where $\phi \in (0.1)$. Equation (20) represents the self-employed labour market, which links the demand for labour by capitalist consumers to the labour supplied by the self-employed; γ is the percentage of labour employed in this market; consequently, $(1-\gamma)(1-\phi)$ is the unemployment rate.[7] Hereinafter equation (19) will be referred to as the "conventional labour market" and equation (20) as the "self-employment labour market".

[7] The labour supply hired by firms is ϕl_0 and the labour supply contracted by capitalist consumers is $(1-\phi)\gamma l_0$. Consequently, the unemployed labour force is $(1-\phi)(1-\gamma)l_0$ and the unemployment rate is $(1-\phi)(1-\gamma)$.

Wages in the conventional and self-employment labour markets are determined by equations (3) and (17), respectively. Henceforth, it is assumed that the wages paid in these markets are efficiency wages.

Effective demand comprises the sum of the financiable demands of the capitalist consumer and those of the proletarian consumer. Considering equations (11) and (16), gives:

$$\hat{y}_d = \beta\Pi + \phi\frac{\alpha\tau^p w^a}{e\left(w^a,p_a\right)} + \left(1-\phi\right)\frac{\alpha\tau^p w^b}{e\left(w^b,p_b\right)}\gamma \tag{21}$$

The first term on the right side of equation (21) is the financeable demand of the capitalist consumer; the second and third terms are the demand that the proletarian consumer can afford with the supply of labour that is employed and remunerated in the conventional labour and self-employment markets, respectively. Solving for equilibrium in the goods market, gives:[8]

$$Ae\left(w^a,p_a\right)l_a - \phi\frac{\alpha\tau^p w^a}{e\left(w^a,p_a\right)} + \phi\frac{\alpha\tau^p w^a}{e\left(w^a,p_a\right)} - Ae\left(w^a,p_a\right)l_a = 0 \tag{22}$$

Equation (22) shows that demand-constrained equilibrium is guaranteed in the goods market irrespective of the values of ϕ and γ. That is, whatever the distribution of employment across markets and whatever the unemployment rate, output will adjust to effective demand.

Note that it is impossible to determine the value of ϕ without assuming that the effective demand (equation (8)) or the level of employment used by the firms is known. However, assuming the value of ϕ is known, then γ can be determined as:

$$\gamma = \frac{\phi\left(1-\beta\right)}{\left(1-\phi\right)}\frac{w^a}{e\left(w^b,p_b\right)}\left(1-\frac{w^a}{e\left(w^a,p_a\right)}\right) \tag{23}$$

Expression (23) makes it clear that there are no market mechanisms guaranteeing that γ is equal to 1, in other words that full employment is achieved. This is because nothing ensures that effective demand is sufficient to elicit full employment. This result differs from what is usually obtained in efficiency-wage models; for example, in Shapiro and Stiglitz (1984), equilibrium occurs with unemployment because the latter is needed to extract a positive effort from workers. In contrast, in this analytical approach effort is positive, even is the subjective dismissal rate is 0.

6. Initial conditions for the analysis of job insecurity and the income distribution

The increasingly precarious nature of employment is a dynamic process that entails a drop in wages, greater insecurity in terms of being employed and an increase in the effort made by workers. The analysis of how more precarious employment leads to a higher concentration of income, starts from a demand-constrained equilibrium and introduces Clower's (1965) dual decision hypothesis, whereby all agents are both buyers and sellers, in that to be able to buy they must first have sold. This means that effective demand depends on the labour that the proletarian consumer managed to sell and on the profits that firms obtained from their sales, in both cases in the past period. Incorporating this hypothesis, gives:[9]

[8] See section 2 of annex A1.

[9] See section 2 of annex A1.

$$\hat{y}_d = l_{a-1} w^a + \Pi_{-1} \tag{24}$$

In equation (24) the subscript -1 means the variable in question is of the previous period, so it can be considered fixed. The effective demand expressed in equation (24) has two characteristics: (i) the wage does not carry the subscript because it is a current variable. This is because workers work for a period (such as a week or a fortnight), at the end of which they receive their wages, which they then use to finance their consumption in the next period; (ii) the consumption of the self-employed does not appear as part of effective demand. This is because capitalists finance their demand for both goods and labour with the profits they receive from firms; consequently, profits incorporate the consumption demand of both self-employed workers and capitalists.

7. Increasingly precarious employment

The analysis of the increasingly precarious nature of employment assumes that conventional jobs become less secure, so the perceived probability of dismissal among workers employed in firms rises. Consequently, conventional workers exert more effort to avoid being caught slacking and being fired as a result. The increased effort motivates firms to reduce wages, because high wages are no longer required to elicit effort. Thus, equation (3) gives:

$$\frac{dw^a}{dp_a} = \frac{e'_{p_a}}{e''_w w^a} < 0 \tag{25}$$

Greater insecurity in conventional employment increases insecurity in self-employment, because, as noted above, workers who lose their jobs in firms will seek self-employment, which makes it harder for all self-employed workers to obtain work. Thus, $0 < \frac{dp_b}{dp_a} < 1$.

Analogously to what happens with conventional workers, the increase in the subjective probability of dismissal among self-employed workers causes them to exert more effort to avoid unemployment. The greater effort motivates capitalist consumers to pay lower wages, since their workers are already exerting themselves. Thus, equation (17) gives:

$$\frac{dw^b}{dp_a} = \frac{e'_{p_b}}{e''_w w^b} \frac{dp_b}{dp_a} < 0 \tag{26}$$

Expressions (25) and (26) show that wages among workers employed in firms and among those who are self-employed both decrease. This then causes a reduction in effective demand. Equation (24) gives:

$$\frac{d\hat{y}_d}{dp_a} = l_{1-1} w^{a,}_{p_a} < 0 \tag{27}$$

Equation (27) shows that effective demand decreases because the purchasing power of workers employed in firms declines. However, lower incomes among the self-employed do not affect effective demand. This is because a reduction in the consumption of self-employed workers will be compensated by an increase in consumption by capitalists, since the latter use their profits to pay the workers they employ. Thus, consumption by both categories of consumer is ultimately financed by profits.

The reduction in effective demand forces firms to adjust their production downwards; so, they need to hire fewer workers. Equation (8) gives:

$$\frac{dl_a}{dp_a} = \frac{1}{A}\left[\frac{\hat{y}'_{d,p_a} e\left(w^a, p_a\right) - \left(e'_{w^a} w^{a,}_{p_a} + e'_{p_a}\right)\hat{y}_d}{e\left(w^a, p_a\right)^2}\right] < 0 \tag{28}$$

Inequality (28) shows that there are two reasons why firms' demand for labour decreases: (i) the increase in effort made by each worker $\left(e'_{w^a} w^{a,}_{p_a} + p_a e'_{p_a}\right)$; and (ii) the decrease in effective demand $\left(\hat{y}'_{d,p_a}\right)$. These results imply two key features:

(i) The change in workers' effort stems from two opposing effects. First, heightened job insecurity motivates workers to make a greater effort to avoid unemployment; and second, the greater effort they make allows firms to pay lower wages, which then discourages workers, causing them to reduce their effort. It is impossible *a priori* to determine which force will dominate. This article postulates that when faced with an increase in the subjective probability of dismissal, workers increase their effort, despite the reduction in wages. This is true as long as $e'_{p_a} > \left|e'_{w^a} w^{a,}_{p_a}\right|$, which obtains provided that $\left|e''_w w^a\right| > \left|e'_w\right|$.

(ii) The reason why less effective demand reduces the level of employment is that firms adjust their production downward to match the lower effective demand, thus requiring less labour.

Since entrepreneurs adjust their production to the currently prevailing effective demand, equation (18) gives:

$$\frac{dy_0}{dp_a} = \frac{d\hat{y}_d}{dp_a} \tag{29}$$

Equation (29) shows that output decreases by the same amount as effective demand. The decrease in both output and labour costs and the increase in effort change profits. This can be analysed by obtaining their differential with respect to the subjective probability of dismissal:

$$\frac{d\Pi}{dp_a} = \left[A\left(e'_{w^a} w^{a,}_{p_a} + e'_{p_a}\right) - w^{a,}_{p_a}\right] l_a + \left[Ae\left(w^a, p_a\right) - w^a\right] l'_{a,p_a} > 0 \tag{30}$$

Equation (30) indicates that the reduction in labour costs and the increase in workers' effort both generate higher profit, even though the lower level of employment reduces output and, thus, puts downward pressure on profit.[10] In other words, profit grows because the gap between labour productivity and wages widens, despite the drop in sales. Thus, under this scenario, the increase in profit changes the factor distribution of income in favour of capitalists.

The additional profit allows capitalist consumers to demand more consumer goods and more services supplied by the self-employed. Equations (15) and (16) give:

$$\frac{dl_b}{dp_a} = \left(1-\beta\right)\frac{\Pi'}{w^b} - \left(1-\beta\right)\frac{\Pi}{w^{b^2}} w^{b,}_{p_a} > 0 \tag{31}$$

$$\frac{dc^c}{dp_a} = \beta\Pi' > 0 \tag{32}$$

Expression (31) shows that capitalist consumers demand more labour because the price of labour has fallen, and their income has risen. Consequently, the employment of self-employed workers expands.

[10] See section 3 of annex A1.

Moreover, inequality (32) shows that capitalists consume more goods when their income increases. Note that the fall in production and the growth of capitalist consumption imply that proletarian consumption declines, despite the increase in self-employment; in contrast, capitalists' consumption of both goods and services increases. This is a consequence of the growth of profits, the decrease in wages received by both conventional and self-employed workers, and the reduction in conventional employment.

8. Analysis of selected characteristics of the Mexican labour market

(a) Concentration of income

The first characteristic to analyse is the reduction in the workers' share of national income. In this model, national income is composed of the value of goods production (y_0) plus the value of the services ($w^b l_b$) services provided by workers to capitalist consumers. Consequently, the shares of profits and wages in national income (IN) are defined, respectively, by:

$$\frac{\Pi}{IN} = \frac{\Pi}{y_0 + w^b l_b} \tag{33}$$

and

$$\frac{w^a l_a + w^b l_b}{IN} = 1 - \frac{\Pi}{y_0 + w^b l_b} \tag{34}$$

Note that equation (15) implies that $w^b l_b = (1-\beta)\Pi$. Hence:

$$\frac{d\frac{\Pi}{IN}}{dp_a} = \frac{\Pi'_{p_a}\left(y_0 + (1-\beta)\Pi\right) - \Pi\left(y'_{0,p_a} + (1-\beta)\Pi'_{p_a}\right)}{\left(y_0 + w^b l_b\right)^2} > 0 \tag{35}$$

Equation (35) states that the profit share of national income rises, so the wage share falls. This happens because the profits outpace the growth of national income, since the fall in goods production is not sufficiently compensated by an increase in services to allow national income to grow by more than profits.

The concentration of income in favour of profits means that the wage share of income declines, owing to the reduction in wages, the growth of more precarious employment (self-employment) and the reduction of conventional employment.

(b) Downward wage convergence

The second characteristic to analyse is downward wage convergence. According to equations (25) and (26), the wages of both conventional and self-employed workers decreased. However, downward wage convergence requires the wages of conventional workers to decrease by more than those of the self-employed. This only happens if $\frac{w^b}{w^a} > \frac{dp_b}{dp_a}$, that is, if $\frac{dp_a}{dp_b} > \frac{w^a}{w^b}$. In other words, the difference between the increase in insecurity among conventional employees and the increase among the self-employed must exceed the wage gap.

(c) Growth of precarious work and decrease in well-paid employment

The third and fourth characteristics of the Mexican labour market to be analysed are the facts that precarious employment expanded, while non-precarious employment declined. In terms of the model presented here, this means that employment that is lower paid, more insecure and requires greater effort, in other words self-employment, grew; in contrast, conventional employment decreased, which is consistent with inequalities (28) and (31).

Conventional employment declines because the effective demand satisfied by firms is reduced owing to the lower wages received by conventional workers; in contrast, self-employment expands because higher profits and the lower wages of the self-employed allow capitalists to increase their demand for services.

(d) Manufacturing productivity grows faster than average

The final characteristic of Mexico's labour market to be analysed is the fact that the average productivity of tradable manufactured goods outpaces average total productivity. This means that there is a production sector in which productivity growth is above average. To analyse this phenomenon, note that the average productivity of the conventional sector is $\frac{y_0}{l_a} = \frac{e\left(w^a, p_a\right)Al_a}{l_a}$ by definition, whereas the average productivity of the services offered by the self-employed is defined as $\frac{w^b l_b}{l_b}$. Neither of the two productivities depends on the level of employment, since both are homogeneous of degree 0 in employment. However, they respond in opposite ways to the increase in job insecurity.

Productivity in the conventional sector increases in response to an increase in the subjective probability of dismissal. This is because if workers perceive a higher probability of dismissal, they work harder and are therefore more productive. This can be represented in the following equation:

$$\frac{d\frac{y_0}{l_a}}{dp_a} = A\left[e'_{p_a} + e'_w w^{a'}_{p_a}\right] > 0 \tag{36}$$

In contrast, the average productivity of the services offered by the self-employed is reduced in the face of greater job insecurity. The reason is that, similarly to what happens with conventional workers, if the subjective probability of dismissal increases, self-employed workers work harder; consequently, capitalist consumers can pay lower wages. Lower wages means the services supplied are valued less, so the average productivity of the sector decreases. Hence:

$$\frac{d\frac{w^b l_b}{l_b}}{dp_a} = w^{b'}_{p_b} p'_{b,p_a} < 0 \tag{37}$$

The reduction in the average productivity of services means that the average productivity of the economy as a whole grows more slowly than the average productivity of the conventional sector, which is consistent with the data available for Mexico.

The results presented thus far stands in contrast to post-Kaleckian theory,[11] which studies the factor distribution of income and its effects on employment and output. The main differences and similarities include the following:

[11] It is not intended to make an exhaustive review of this literature here. See Hein (2014) for further details.

(i) In these post-Kaleckian models, the wage share of output declined owing to an increase in mark-up and in the degree of monopoly, which could be caused by exchange rate depreciations (Bhaduri and Marglin, 1990), interest rate hikes (Hein, 2014) or exogenous cuts in real wages. Unlike these models, in the analytical approach presented here, the wage share of income declines without assuming monopolies in the goods market and, hence, overpricing. However, postulating efficiency wages assumes non-competitive labour markets, in which capitalist firms and consumers can set wages according to their interests. This is because proletarians have to work for a living. Consequently, an increase in job insecurity enhances employers' wage-setting power, which therefore causes the wage share of income to fall.

(ii) The models in question also have scenarios in which production is driven by wages or by profits. They recognize the dual nature of wages: as components of demand and as costs of production. Like these models, the analytical approach adopted in this article also recognizes the dual nature of wages; however, there are no mechanisms that translate higher enterprise profitability, sustained by a cut in wages, into effective demand growth, since neither investment nor net exports are studied —two issues that form part of the pending research agenda.

IV. Numerical exercise

To give greater clarity to the theoretical model presented here, a numerical example is presented below, based on a parametrically defined effort function, analogous to the one proposed by Velázquez and Hernández (2018): $e\left(w,p_i\right) = 1 - \frac{a}{w} + p_i^{\delta}$ where $a \in \Re^{+}$, $0 < \delta < 1$ and $0 < p_i < 1$ for all $i = a, b$.

The characteristics of this function are:[12]

(i) $e'_w > 0; e''_w < 0; e'_{p_i} > 0; e''_{p_i} < 0$ and $e''_{w,p_i} = 0$

(ii) $e\left(w,0\right) = 1 - \frac{a}{w}$

(iii) $e\left(w,1\right) = 2 - \frac{a}{w}$

(iv) $\lim_{w \to 0} e\left(w,p_i\right) = -\infty$

(v) $\lim_{w \to \infty} e\left(w,p_i\right) = 1 + p_i^{\delta}$

The characteristics of the effort function include the following: (i) effort will be positive whatever the subjective probability of dismissal. However, as agents expect this probability to rise, they will increase their effort; (ii) As the wage tends to 0, workers will cease making effort. On the other hand, as the wage tends to infinity, effort is bounded.

The relationship between the subjective dismissal rate of the self-employed and that of conventional workers is determined by:

$$p_b = \zeta + \varphi p_a \tag{38}$$

where $0 < \zeta < 1$; $0 < \varphi < 1$ and $0 < p_b < p_a$.

Equation (38) shows that the subjective dismissal rate among the self-employed has one part that does not depend on what happens in the conventional sector (ζ) and another that absorbs that sector's insecurity (φ).

The production function will be $y_0 = Ae\left(w,p_a\right)l_a$. The utility functions will be those proposed in equations (8) and (12). The numerical values of the parameters of the functions are specified in table 1.

[12] The main difference between the function proposed by Velázquez and Hernández (2018) and the one put forward in this paper is that, in the former, the authors assume that the subjective probability of dismissal can be represented by the expectation of unemployment.

Table 1
Parameters of the functions of production, effort, subjective probability of self-employed dismissal and utility

A	a	δ	p_a	ζ	φ	α	β	τ^p
10	1	0.9	0.01	0.05	0.9	0.4	0.9	99

Source: Prepared by the author.
Note: A, a and δ are parameters; the first pertains to the production function, the next two to the effort function. α and β are the elasticities of utility with respect to consumption, of the proletarian consumer and the capitalist consumer, respectively (see the production, effort, and utility functions).

The numerical exercise is presented in two scenarios. In the first, a demand-constrained equilibrium is calculated, in which the percentage of labour supply employed in the firms (ϕ) is assumed known and exogenous. This assumption is dispensed with in the second case. This first scenario will serve as a starting point for analysing the precariousness of employment and the concentration of income. In the second scenario, it is assumed that the subjective probability of dismissal among conventional workers increases; this makes employment more precarious, concentrates income in favour of business owners, reduces the wage gap downwards, increases precarious employment, decreases conventional employment, and increases productivity in the conventional sector by more than average productivity.

1. Scenario 1: demand-constrained equilibrium

The parameters used in this scenario are the same as will be used in scenario 2 (see table 1).

The chosen parameters have the following features: the subjective probability of dismissal among conventional workers (p_a) is 1%. In other words, workers feel relatively secure in their jobs. This value is chosen so that it can be increased in the next scenario. The proletarians represent 99% of the population (τ^p). As the subjective probability of dismissal among conventional workers increases by 1.0 unit, that of the self-employed rises by 0.9. In other words, job insecurity is highly transferable from one sector to the other (φ). This assumption is made because, in the absence of unemployment insurance, workers laid off in the conventional sector will seek self-employment as a last resort to avoid unemployment. In addition to these parameters, formal employment is assumed to account for 80% of the labour supply, so $\phi = 0.8$. This is consistent with the fact that the self-employed in Mexico represent about 20% of the total labour force (INEGI, 2017). These parameters are used to obtain the allocations shown in table 2.

Table 2
Wages, allocations, and distribution in demand-constrained equilibrium

p_a	p_b	w^a	w^b	$e(w^a,p_a)$	$e(w^b,p_b)$	l_a	l_b
0.01	0.059	1.968	1.854	0.507	0.539	62.371	10.459
l_b%	u	y_0	S_a	IN	c^c	c^p	$\%c^c_t$
14.361	5.489	316.8	19.4	336.2	174.602	142.197	57.704
$\%c^p_t$	$\Pi\sigma$	$M.S$	%	%M.S	$Pmes$	$Pmec$	$Pmet$
42.295	194.003	142.197	57.704	42.295	1.854	5.079	4.616

Source: Prepared by the author.
Note: p, w, $e(w,p)$ and l are the subjective probability of dismissal, real wage, effort and labour demand, respectively; subscript or superscript "a" refers to the conventional worker and "b" to the self-employed worker; l_b% is self-employment as a percentage of total employment; u is the unemployment rate; y_0 is manufacturing output; S_a is the value of services; IN is national income; c^c, $\%c^c$, c^p and $\%c^p$ are consumption by capitalists, their share of total consumption, consumption by proletarians and their share of total consumption, respectively; Π is the profit received by the capitalists from the enterprises they own; M.S. is the wage bill; $\%\Pi$ represents the profit share of national income; %M.S. is the share of wages in national income; $Pmes$, $Pmec$ and $Pmet$ represent average productivity in the service sector, the conventional sector and total, respectively.

Table 2 shows the wages and allocations of the demand-constrained equilibrium. Workers employed by firms earn wages above those received by the self-employed. However, the latter make more effort, because their jobs are less secure, and they work harder to avoid dismissal. This, in turn encourages their employers to pay lower wages. Self-employed workers represent 14.361% of total employment. Note that this is less than the share of self-employed workers in the total labour force (ϕ = 0.2) because not all labour is employed. The unemployment rate (u) is 5.48%. The sum of the consumption of goods by workers and by capitalists equals the value of goods production, since firms adjust their production to what the market demands. National income (NI) is the sum of the value of goods produced by firms and the value of services provided by the self-employed (S_a). Consumption by capitalists, of both goods and services (c_t^c), absorbs 57.704% of national income, while the remaining 42.295% corresponds to consumption by the proletariat. As would be expected, these percentages coincide with the functional distribution of income. Lastly, it can be seen that the average productivity of the conventional sector (*Pmec*) is higher than that of the self-employed services sector (*Pmes*). Average total productivity (*Pmet*) is therefore lower than that of the conventional sector.

2. Scenario 2: increasing precariousness and income concentration caused by heightened job insecurity

In this scenario it is assumed that the subjective probability of dismissal among conventional workers rises steadily; in other words the perception of insecurity in conventional employment increases. This hypothesis is based on the previous scenario, while exogenously varying just the value of the parameter p_a. The results of this exercise are shown in table 3.

Table 3
Changes in allocations, wages, and distribution in response to a sustained increase in the subjective probability of dismissal from conventional employment

p_a	p_b	w^a	w^b	$e(w^a,p_a)$	$e(w^b,p_b)$	$y_0 = \hat{y}_d$	l_a	l_b	S_a	IN	Π	M.S	Pmec	Pmes	Pmet
0.02	0.068	1.943	1.837	0.515	0.544	315.163	61.222	10.685	19.624	334.787	196.236	138.550	5.148	1.837	4.656
0.03	0.077	1.918	1.819	0.521	0.550	313.677	60.172	10.899	19.825	333.502	198.250	135.252	5.213	1.819	4.693
0.04	0.086	1.895	1.802	0.528	0.555	312.300	59.193	11.105	20.011	332.311	200.106	132.205	5.276	1.802	4.727
0.05	0.095	1.874	1.785	0.534	0.560	311.010	58.271	11.305	20.183	331.193	201.834	129.359	5.337	1.785	4.760
0.06	0.104	1.853	1.769	0.540	0.565	309.793	57.396	11.499	20.345	330.139	203.455	126.684	5.397	1.769	4.792
0.07	0.113	1.833	1.754	0.546	0.570	308.640	56.563	11.689	20.498	329.139	204.982	124.157	5.457	1.754	4.822
0.08	0.122	1.813	1.738	0.551	0.575	307.544	55.766	11.875	20.643	328.187	206.427	121.760	5.515	1.738	4.852
0.09	0.131	1.795	1.723	0.557	0.580	306.500	55.002	12.058	20.780	327.279	207.797	119.482	5.573	1.723	4.880
0.10	0.14	1.776	1.709	0.563	0.585	305.501	54.268	12.237	20.910	326.411	209.101	117.310	5.629	1.709	4.908
0.11	0.149	1.759	1.695	0.569	0.590	304.545	53.562	12.413	21.034	325.580	210.343	115.237	5.686	1.695	4.935
0.12	0.158	1.742	1.681	0.574	0.595	303.629	52.881	12.586	21.153	324.782	211.528	113.253	5.742	1.681	4.961
0.13	0.167	1.725	1.667	0.580	0.600	302.748	52.224	12.757	21.266	324.015	212.662	111.352	5.797	1.667	4.986
0.14	0.176	1.709	1.654	0.585	0.605	301.902	51.589	12.925	21.375	323.277	213.748	109.529	5.852	1.654	5.011
0.15	0.185	1.693	1.641	0.591	0.610	301.087	50.974	13.091	21.479	322.566	214.788	107.778	5.907	1.641	5.035
0.20	0.23	1.620	1.579	0.617	0.633	297.343	48.156	13.890	21.935	319.278	219.353	99.925	6.175	1.579	5.146

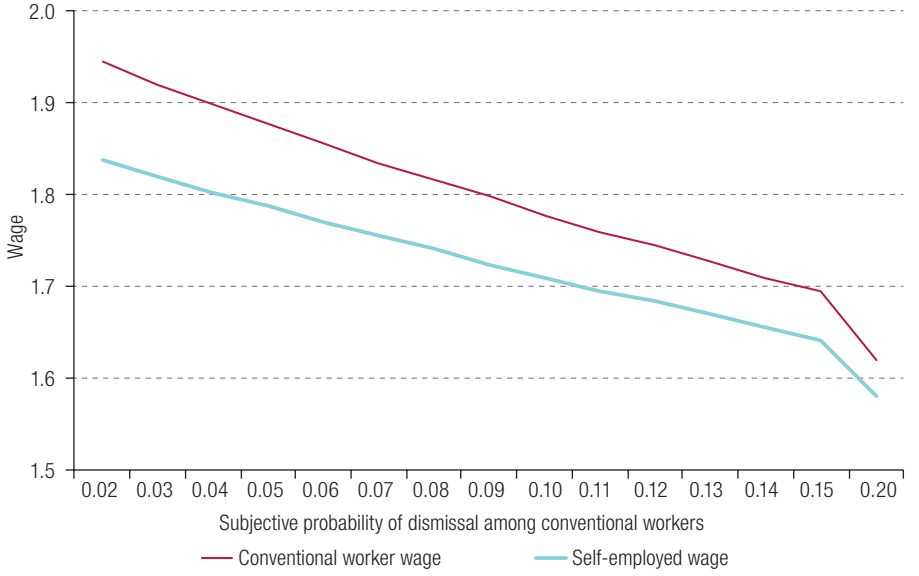
Source: Prepared by the author.
Note: *p*, *w*, *e(w,p)* and *l* are the subjective probability of dismissal, the real wage, effort and labour demand, respectively; subscript or superscript "a" refers to the conventional worker and "b" to the self-employed worker; y_0 is the value of manufacturing output; S_a is the value of services; *IN* is national income; is the profit received by the capitalists for owning the enterprises; M.S. is the wage bill; *Pmes*, *Pmec* and *Pmet* represent average productivity in the service sector, the conventional sector and total, respectively.

As table 3 shows, a sustained increase in the subjective probability of dismissal from conventional employment increases the subjective probability of dismissal among the self-employed. So, when p_a is

0.02, p_b is 0.068, but when p_a increases to 0.2, then p_b rises to 0.23. As the perception of insecurity in conventional employment grows, workers employed by firms see self-employment as a way to avoid unemployment. This would tend to increase the supply of services offered by the self-employed and thus make it harder for all of them to obtain work. Heightened job insecurity for both types of workers forces them to make a greater effort to avoid unemployment. Table 3 shows that as the subjective probability of dismissal increases, the effort made by workers also increases. However, the self-employed always make a greater effort than conventional workers, because their employment is inherently more insecure; that is, $p_a < p_b$ in all cases.

The additional effort made by both types of worker allows their employers to cut wages, since they no longer need to motivate effort with high pay (see the w^a and w^b columns of table 3). However, as job insecurity increases by more among conventional workers than among the self-employed, the effort made by the former increases faster than that made by the latter, so, conventional worker wages falls faster than those of the self-employed, resulting downward wage convergence, as shown in figure 1.

Figure 1
Downward wage convergence



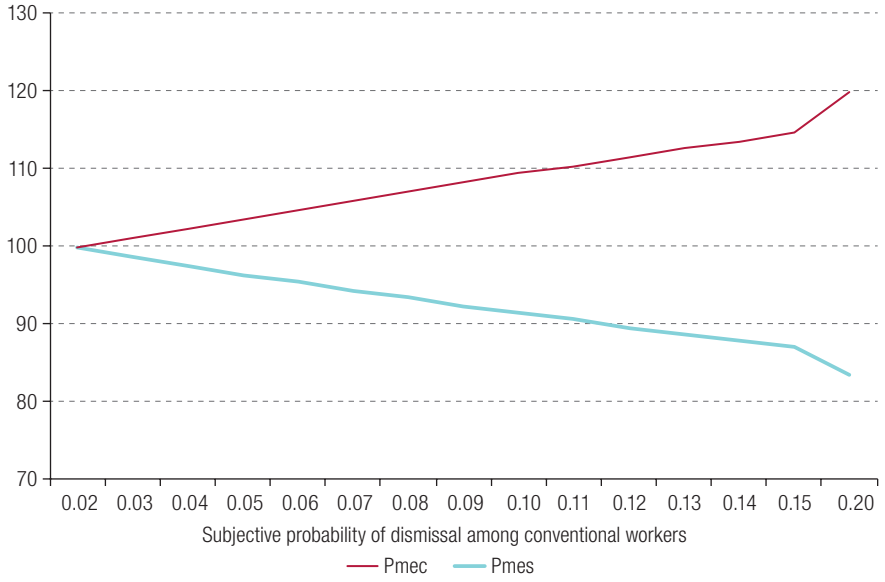
Source: Prepared by the author, based on the wage of the conventional worker and the wage of the self-employed, for different values of the subjective probability of dismissal among conventional workers (data presented in table 3).
Note: In both cases, real wages expressed in terms of units of output.

The fall in the wages of conventional workers results in a reduction in effective demand, so firms cut back on their production and hire less labour. The $y_0 = \hat{y}_d$ column of table 3 shows the fall in effective demand; and, as production is equal to this, the next column (l_a) shows the employment downsizing that firms undertake to match their output to the smaller effective demand.

In table 3, the column labelled shows that firms' profits grow, owing to a widening of the gap between their average productivity and the wage they pay.

Figure 2 shows how the gap between the average productivity and wage indices widens as job insecurity increases. The average productivity of firms grows because workers increase their effort.

Figure 2
Average productivity and wage in conventional employment
(Index)



Source: Prepared by the author, based on average productivity data for conventional employment and conventional workers' wages as shown in table 3.

Rising profits and falling wages for self-employed workers cause capitalist consumers to demand more labour. As can be seen in the l_b column of table 3, self-employment increases.

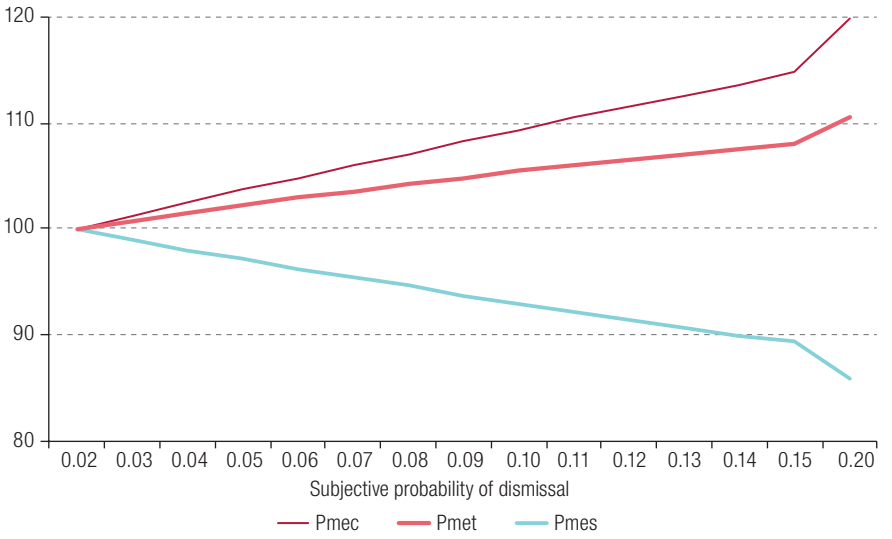
The increased self-employment and reduced conventional employment are consistent with trends in the Mexican economy, where non-precarious jobs have been shrinking and precarious jobs have been expanding.

The generalized reduction in wages, together with the expansion of more precarious employment and the retreat of conventional employment cause the share of the wages in national income to shrink. The Π and *M.S.* columns of table 3 show that the wage share declined, and the profit share grew, as job insecurity increased.

Lastly, it can be seen that the average productivity of the services provided by the self-employed decreased, owing to a reduction in their wages, which devalues the services they supply. In contrast, the productivity of firms increased, owing to the greater effort deployed by their workers. Both types of worker increased their effort, but with opposing effects on their average productivity.

Figure 3 shows how the average productivity of the conventional sector outpaces the average total productivity index, because average productivity among self-employed services falls.

Figure 3
Average productivity
(Index)



Source: Prepared by the author, based on the data of the average productivities of the service sector, conventional sector and total, as presented in table 3.

One of the main shortcomings of this analytical approach is that it does not incorporate the external sector, so it is effectively a world-economy model.[13] However, the fact that the decline in the wage share and the increased precariousness of employment are two phenomena that have been observed worldwide, gives the model validity. Nonetheless, as the Mexican economy is one of the most open in the world, it is necessary to sketch conceptually how the results would change in an open-economy model. The increase in the subjective dismissal rate would cause workers to work harder and their wages to fall. Lower wages would make the export sector more competitive and foster its growth. This would allow for profit-driven growth scenarios, provided that the increase in exports outweighed the drop in proletarian consumption. In this scenario, employment could increase.

V. Conclusions

The production globalization process that began in the late 1970s and early 1980s fuelled increasing job insecurity. This article has developed an efficiency-wage model in a demand-constrained equilibrium scenario, to show how the increase in job insecurity causes employment to become more precarious and the wage share of income to fall. In addition to arguing that job insecurity and income concentration may have a common, although not unique, cause, the study showed that the process that triggers heightened job insecurity can explain several characteristics of the Mexican economy.

The results of the theoretical model presented here suggest that improving workers' conditions and reversing the process of income concentration require employment policies aimed at reducing job insecurity.

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Annex A1

1. Producer maximization

The first-order maxima and minima conditions give:

$$\frac{d(1+\pi)}{dl_a} = \frac{Af'_{e(w,p_a)l_a} e(w,p_a) wl_a - wAf(e(w,p_a)l_a)}{(wl_a)^2} = 0 \quad \text{(A1)}$$

$$\frac{d(1+\pi)}{dw} = \frac{Af'_{e(w,p_a)l_a} e'_w wl_a - l_a Af(e(w,p_a)l_a)}{(wl_a)^2} = 0 \quad \text{(A2)}$$

Rewriting (A1) gives:

$$Af'_{e(w,p_a)l_a} e(w,p_a) = \frac{Af(e(w,p_a)l_a)}{l_a} \quad \text{(A3)}$$

As $f'_{e(w,p_a)l_a} e(w,p_a) = f'_{l_a}$, (A3) can be written as equation (4).

Equation (A2) implies that:

$$Af'_{e(w,p_a)l_a} e'_w w = \frac{Af(e(w,p_a)l_a)}{l_a} \quad \text{(A4)}$$

Substituting (A3) into (A4) gives equation (3).

2. Demand-constrained equilibrium

To solve for equilibrium in the goods market, equation (21) and the respective buying and selling plans are substituted into equations (18), (19) and (20). Hence:

$$\beta\Pi + \phi\frac{\alpha\tau^p w^a}{e(w^a,p_a)} + (1-\phi)\frac{\alpha\tau^p w^b}{e(w^b,p_b)}\gamma - Ae(w^a,p_a)l_a = 0 \quad \text{(A5)}$$

$$l_a - \phi\frac{\alpha\tau^p}{e(w^a,p_a)} = 0 \quad \text{(A6)}$$

$$(1-\beta)\frac{\Pi}{w^b} - (1-\phi)\frac{\alpha\tau^p}{e(w^b,p_b)}\gamma = 0 \quad \text{(A7)}$$

Note that wages were determined by equations (3) and (17). On the basis of (A7), $(1-\beta)\Pi = (1-\phi)\frac{\alpha\tau^p w^b}{e(w^b,p_b)}\gamma$. Substituting this expression, the definition of profit and equation (A6) into the goods market equation (A5), gives equation (22); and equation (23) is obtained from (A7) and (A6) and the definition of . Lastly, incorporating the dual decision hypothesis and substituting equations (A6) and (A7) into (21), gives equation (24).

3. Increase in profit caused an increase in the subjective probability of unemployment

To analyse the sign of expression (30), (29) and (27) are substituted into it, to obtain:

$$\frac{d\Pi}{dp_a} = l_{a-1} w^{a,}_{p_a} - w^{a,}_{p_a} l_a - l'_{a,p_a} w^a \tag{A8}$$

Assuming that $l_{a-1} + l'_{p_a} dp_a \approx l_a$ and substituting this idea in (A8), gives:

$$\frac{d\Pi}{dp_a} = -w^{a,}_{p_a} l'_{a,p_a} dp_a - w^a l'_{a,p_a} \tag{A9}$$

From equation (A9), $\frac{d\Pi}{dp_a} > 0$ if and only if $|w^a| > \left|w^{a,}_{p_a} dp_a\right|$, in other words whenever the wage is greater than the absolute amount by which it is reduced. This is true for all $w > 0$.

The economy of the North-East region of Brazil based on the 2011 regional input-output matrix

Marcos Falcão Gonçalves, Mateus de Carvalho Reis Neves and Marcelo José Braga

Abstract

This paper seeks to determine the leading sectors of the economy of the North-East region of Brazil based on input-output matrix methodology and the economic structure of 2011. For that purpose, the regional input-output matrix was updated from 2004 to 2011 and, subsequently, the Rasmussen-Hirschman linkage indices, field of influence and pure linkage indices were calculated, along with the type I and II multipliers of production, employment and income. The results confirm the importance of the textile and chemical sectors, along with those related to the oil industry, and show that the production of intermediate goods is one of the characteristics of the North-East region's economy.

Keywords

Economic conditions, economic development, regional development, industrial production, employment, income, input-output analysis, Brazil

JEL classification

R10, R11, R13

Authors

Marcos Falcão Gonçalves is General Coordinator of Studies and Research, Evaluation, Technology and Innovation of the Superintendency for the Development of the North-East (SUDENE), Brazil. Email: marcos.falcao@sudene.gov.br.

Mateus de Carvalho Reis Neves is a professor in the Department of Rural Economics (DER) of the Federal University of Viçosa (UFV), Minas Gerais, Brazil. Email: mateus.neves@ufv.br.

Marcelo José Braga is a professor in the Department of Rural Economics (DER) of the Federal University of Viçosa (UFV), Minas Gerais, Brazil. Email: mjbraga@ufv.br.

I. Introduction

In the 1970s, efforts to decentralize the Brazilian economy through public investment in infrastructure (roads, ports, energy, etc.) and in strategic industrial sectors picked up pace, including under the Second National Development Plan (1975–1979) (Government of Brazil, 1970).[1] As a result of these initiatives, large production complexes were established in the North-East[2] from 1970–1984 (Galindo, 1997).

The decentralization process appears to be ongoing, as the South-East region's share in the value of industrial transformation fell from 69.3% in 1996 to 61.6% in 2004, while that of the North-East region increased from 4.3% to 10.1% (BCB, 2006). This underscores the economic growth of the North-East in spite of the heterogeneous characteristics of this process, in which some dynamic areas of regional development coexist with entire areas that are stagnant and lacking in production modernization.

The input-output matrix has often been employed in the design or analysis of public policies. Its widespread use is justified by its capacity to predict the potential effects of a shock in the final demand of a certain sector, both on the sector itself and on the rest of the economy.

Thus, it allows policymakers to stimulate sectors considered key —i.e., those in which a final demand shock spreads most strongly to the rest of the economy, both upstream (backward) and downstream (forward) in the production chain— and to identify and clear production bottlenecks.

Against this backdrop, as noted by Tosta, Lirio and Silveira (2004), input-output models have contributed to a wide range of economic works and analyses, as they facilitate the evaluation of the impact of production changes in a specific sector on different sectors.

However, works on the economy of the North-East based on this methodology remain scarce. In one of these studies, Guilhoto and others (2012) present a more theoretical and methodological approach and build a regional input-output table (base year 2004), calculating the main indicators and also presenting data by State. Drawing on the work of Guilhoto and others (2012), Ribeiro and others (2013) analysed Suape (an industrial port complex located in the State of Pernambuco) and the potential economic effects of the construction of the Abreu e Lima refinery, which they considered the core of the industry driving development.

The input-output matrix was also used by Morrone (2017) to examine the basic economic structure of Rio Grande do Sul in 2008 and to estimate the impact of the increase in the tax on the circulation of goods and services (ICMS) on final demand and economic activity in the State. The study showed the negative effect of the measure, which limited the possibilities for regional development.

Montoya, Finamore and Pasqual (2012) also used the input-output matrix to analyse the sources of growth and structural change in the economy of Rio Grande do Sul from 1998–2003. The matrix reflects the reduction and resumption of economic growth.

Similarly, Ribeiro and Leite (2012) conducted an analysis focused on States and built an input-output matrix for the State of Sergipe, using the RAS method for the construction of regional matrices.[3] According to the authors, the Sergipe economy faced problems relating to the supply of inputs in sectors crucial to the State's development because, in addition to sectoral concentration and limited international integration, there were few key sectors to stimulate local growth.

[1] See Lessa (1977), Delgado (1985) and Fishlow (1986) for more details on the Second National Development Plan (1975–1979) and the Brazilian economic context of that period.

[2] Notably, the petrochemical complex in Camaçari, Bahia; the integrated petrochemical complex in Sergipe; the chlorochemical and rock salt complex in Alagoas; the sugar and alcohol complex on the eastern coast of Pernambuco and Alagoas; agroindustry within the irrigated perimeter of the São Francisco River where it runs through Pernambuco and Bahia; the port industry of Suape, in Pernambuco; the chemical and metallurgical industry of Rio Grande do Norte; the textile and garment industry in Ceará; the mineral and metallurgical industry in Maranhão; and oil production along the North-East coast (Galindo, 1997).

[3] See Miller (1998, p. 89) for more details on the RAS method.

Considering regional vicissitudes, the aim of this work is to determine the sectors that currently play a leading role in the economy of the North-East region of Brazil based on input-output matrix methodology and the economic structure of 2011, and to raise important points to guide public policies targeting the region's development. For that purpose, the regional input-output matrix was updated from 2004 to 2011 and, subsequently, the Rasmussen-Hirschman linkage indices,[4] field of influence[5] and pure linkage indices[6] were calculated, along with the type I and II multipliers of production, employment and income.[7]

In order to better understand the instruments used, the second section presents a brief theoretical foundation for the input-output model. The third section examines the methodology used in this work, while section four identifies the main economic sectors of the North-East region, and is followed by final considerations.

II. Theoretical foundation

According to Miller and Blair (2009), an input-output model consists of a system of linear equations, each of which describes the distribution of a sector's products throughout the economy. Its basic objective is to analyse the interdependence of economic sectors. Guilhoto and others (2012) compare the input-output model proposed by Leontief (1966) with an "economic snapshot" of the economy itself, which can show how sectors are linked or, in other words, identify the sectors that demand products and services and those that supply them.

Input-output tables are often used to represent this interdependence, which is systematized in table 1.

Table 1
Leontief input-output matrix for two sectors

Sectors		Purchases *(j)*								Gross production value
		Intermediate demand			Final demand					
		Sector 1	Sector 2	Subtotal	C	I	G	E	Subtotal	
Sales *(i)*	Sector 1	Z_{11}	Z_{12}	$\sum_{j=1}^{2} z_{ij}$	C_1	I_1	G_1	E_1	Y_1	X_1
	Sector 2	Z_{21}	Z_{22}	$\sum_{j=1}^{2} z_{2j}$	C_2	I_2	G_2	E_2	Y_2	X_2
Subtotal		$\sum_{i=1}^{2} z_{i1}$	$\sum_{i=1}^{2} z_{i2}$	$\sum_{i,j=1}^{2} z_{ij}$	$\sum_{i=1}^{2} C_i$	$\sum_{i=1}^{2} I_i$	$\sum_{i=1}^{2} G_i$	$\sum_{i=1}^{2} E_i$	$\sum_{i=1}^{2} Y_i$	$\sum_{i=1}^{2} X_i$
Imports		M_1	M_2	$\sum_{i=1}^{2} M_j$						
Net indirect taxes		T_1	T_2	$\sum_{i=1}^{2} T_j$						
Value added		VA_1	VA_2	$\sum_{i=1}^{2} VA_j$						
Gross production value		X_1	X_2	$\sum_{i=1}^{2} X_j$						

Source: Prepared by the authors on the basis of J. J. M. Guilhoto, *Análise de insumo-produto: teoria, fundamentos e aplicações*, São Paulo, School of Economics, Management and Accounting, University of São Paulo (FEA/USP), 2007.

[4] See Rasmussen (1956) and Hirschman (1958).

[5] See Mendes, Pereira and Teixeira (2011).

[6] See Guilhoto and others (1994).

[7] See Miller and Blair (2009).

Where z_{ij} is the supply of inputs from sector i to sector j; C_i is the supply of sector i earmarked for private final consumption; I_i is the supply of sector i allocated to private investment; G_i is the supply of sector i set aside for the government (consumption and investment); E_i is the supply of sector i earmarked for exports to the rest of the world; Y_i represents the total final demand met by sector i ($C_i + I_i + G_i + E_i$); X_i represents the gross production value of sector i (or total supply of i); M_j represents the imports of sector j; T_j represents the total net indirect taxes collected by sector j; VA_j is the total gross value added of sector j; and C_j is the total production cost of sector j.

Table 1 is used to obtain the production equation through equation (1):

$$X_i = \sum_{j=1}^{2} z_{ij} + Y_i \tag{1}$$

Considering the assumptions of the Leontief model contained in Miller and Blair (2009), namely: (i) fixed relationships between a sector's inputs and its output and (ii) constant returns to scale, and the technical coefficient of production, also called the input-output coefficient or direct input coefficient, we obtain through equation (2):

$$a_{ij} = \frac{z_{ij}}{x_j} \tag{2}$$

where a_{ij} is the technical coefficient that indicates the quantity of inputs of sector i necessary for the production of one unit of final output in sector j.

Applying (2) to (1) and generalizing to n sectors, we obtain equation (3):

$$X_i = \sum_{j=1}^{n} a_{ij} x_j + Y_i \tag{3}$$

In matrix form, equation (3) can be written as (4):

$$X = AX + Y \tag{4}$$

Since final demand is exogenous, it follows that:

$$X - AX = Y \tag{5.A}$$

or, too:

$$\left(I - A\right)^{-1} Y = X \tag{5.B}$$

where the term $(I - A)^{-1}$, also called matrix B, corresponds to the matrix of direct and indirect coefficients, or the Leontief matrix. The dimension of this matrix is $n \times n$, where n indicates the number of sectors considered, whose elements can be represented by b_{ij}.

On the basis of the national model, Miller and Blair (2009) proposed a regional model, as shown in table 2.

Table 2
Intersectoral and interregional flow of goods

			Purchasing sectors			
			Region L		Region M	
			1	2	1	2
Selling sectors	Region L	1	z_{11}^{LL}	z_{12}^{LL}	z_{11}^{LM}	z_{12}^{LM}
		2	z_{21}^{LL}	z_{22}^{LL}	z_{21}^{LM}	z_{22}^{LM}
	Region M	1	z_{11}^{ML}	z_{12}^{ML}	z_{11}^{MM}	z_{12}^{MM}
		2	z_{21}^{ML}	z_{22}^{ML}	z_{21}^{MM}	z_{22}^{MM}

Source: Prepared by the authors on the basis of E. R. Miller and P. D. Blair, *Input-Output Analysis: Foundations and Extensions*, Cambridge, Cambridge University Press, 2009.

Bear in mind the hypothetical intersectoral and interregional flow of goods to regions L and M, both with two sectors, in which z_{ij}^{LL} is the monetary flow from sector i to sector j in region L; z_{ij}^{MM} is the monetary flow from sector i to sector j in region M; z_{ij}^{LM} is the monetary flow from sector i in region L to sector j in region M; and z_{ij}^{ML} is the monetary flow from sector i in region M to sector j in region L.

III. Methodology

The methodology used in this article is based on the input-output matrix, with productive linkages between activities and the determination of key economic sectors, specifically evaluated through Rasmussen-Hirschman indices, fields of influence and pure linkage indices, in addition to production, employment and income multipliers, which are described below.

1. Rasmussen-Hirschman linkage index

The linkage index developed by Rasmussen (1956) and Hirschman (1958) makes it possible to determine the economic sectors which reflect the strongest linkages and which, therefore, can be considered key sectors.[8]

Estimation starts with matrix B, i.e., the Leontief inverse matrix, described in equation (5.B). According to Guilhoto and others (2012), the Rasmussen-Hirschman linkage index can be found using equations (6) and (7):

$$U_j = \frac{B_{*j}/n}{B^*} \tag{6}$$

$$U_i = \frac{B_{i*}/n}{B^*} \tag{7}$$

where U_j is the backward linkage index and U_i corresponds to the forward linkage index; B is the Leontief inverse matrix; B^* is the average of all the elements of B; B_{*j} and B_{i*}, correspond, respectively, to the sum of each column and each row of B; and n is the number of economic sectors. The backward linkage index indicates the extent to which one sector demands inputs from the other sectors, while the forward linkage index indicates the extent to which the outputs of one sector are demanded by other sectors.

[8] See Hewings and others (1989) for a discussion of key economic sectors.

According to Haddad (1989), index values above unity may denote key sectors, which are strongly linked with upstream and downstream sectors in the production chain. However, Guilhoto and others (2012) note that the application of the Rasmussen-Hirschman linkage index methodology makes it difficult to determine the coefficients that, when modified, produce a greater impact on the system as a whole. The analysis of the field of influence was developed to fill this gap.

2. Field of influence

According to Mendes, Pereira and Teixeira (2011), the field of influence approach describes the way in which changes in direct coefficients are distributed throughout the economic system as a whole and makes it possible to determine the relationships between the most important sectors in the production process. Thus, the field of influence shows the extent to which each sector links backward and forward to all the other economic sectors.

To arrive at that result, we use a matrix of direct coefficients $A = |\alpha_{ij}|$, defining the matrix of incremental variations in direct coefficients of input $E = |\varepsilon_{ij}|$. The corresponding Leontief matrices are given by equation (8):

$$B = \left[I - A\right]^{-1} = \left| b_{ij} \right| \tag{8}$$

and by equation (9):

$$B(\varepsilon) = \left[I - A - \varepsilon\right]^{-1} = \left| b_{ij}(\varepsilon) \right| \tag{9}$$

If the variation is small and only occurs in a direct coefficient, we obtain:

$$\varepsilon_{ij} = \begin{cases} \varepsilon, & i = i_1,\ j = j_1 \\ 0, & i \neq i_1,\ j \neq j_1 \end{cases} \tag{10}$$

The field of influence of this variation can be approximated using the expression (11):

$$F(\varepsilon_{ij}) = \frac{\left[B(\varepsilon_{ij}) - B\right]}{\varepsilon_{ij}} \tag{11}$$

where $F(\varepsilon_{ij})$ is a matrix (n x n) of the field of influence of coefficient α_{ij}.

To determine the coefficients with the greatest field of influence, it is necessary to associate a value with each matrix $F(\varepsilon_{ij})$. Thus,

$$S_{ij} = \sum_{k=1}^{n} \sum_{l=1}^{n} \left[f_{kl}(\varepsilon_{ij}) \right]^2 \tag{12}$$

where S_{ij} is the value associated with matrix $F(\varepsilon_{ij})$. Therefore, the direct coefficients with the highest values of S_{ij} will be those with the greatest field of influence within the economy as a whole.

3. Pure linkage indices

According to Mendes, Pereira and Teixeira (2011), pure linkage indices —which complement the analysis of the input-output matrix— determine the behaviour of the production structure, considering the level of production of each sector and allowing the measurement of interactions between sectors in terms of production value. Also known as the GHS index,[9] it was proposed by Guilhoto and others (1994) with the objective of isolating the effects of each sector on the economic system as a whole.

Therefore, considering the matrix of direct input coefficients, A (based on 5.B), which represents an input-output system for a given sector j, and the rest of the economy, we obtain:

$$A = \begin{bmatrix} A_{jj} & A_{jr} \\ A_{rj} & A_{rr} \end{bmatrix} \tag{13}$$

where A_{jj} and A_{rr} are square matrices of direct inputs of sector j and the rest of the economy, respectively; and A_{jr} and A_{rj} are rectangular matrices showing, respectively, the direct inputs purchased by sector j from the rest of the economy and the direct inputs purchased by the rest of the economy from sector j. Based on the following Leontief inverse matrix:

$$B = \left(I - A\right)^{-1} = \begin{bmatrix} B_{jj} & B_{jr} \\ B_{rj} & B_{rr} \end{bmatrix} = \begin{bmatrix} \Delta_{jj} & 0 \\ 0 & \Delta_{rr} \end{bmatrix} \begin{bmatrix} \Delta_j & 0 \\ 0 & \Delta_r \end{bmatrix} \begin{bmatrix} I & A_{jr}\Delta_r \\ A_{rj}\Delta_j & I \end{bmatrix} \tag{14}$$

the elements are defined as:

$$\Delta_j = \left(I - A_{jj}\right)^{-1} \tag{15}$$

$$\Delta_r = \left(I - A_{rr}\right)^{-1} \tag{16}$$

$$\Delta_{jj} = \left(I - \Delta_j A_{jr} \Delta_r A_{rj}\right)^{-1} \tag{17}$$

$$\Delta_{rr} = \left(I - \Delta r A r j \Delta_j A_{jr}\right)^{-1} \tag{18}$$

Thus, from (14), it is possible to determine the production process within the economy and derive a set of multipliers or linkages represented by the matrices. By combining (15) and (5.B), it is possible to derive a set of indices that can be used both to rank sectors according to their importance in the production value generated, and to determine the production process within the economy.

From (14) and (5.B), it follows that:

$$\begin{bmatrix} X_j \\ X_r \end{bmatrix} = \begin{bmatrix} \Delta_{jj} & 0 \\ 0 & \Delta_{rr} \end{bmatrix} \begin{bmatrix} \Delta_j & 0 \\ 0 & \Delta_r \end{bmatrix} \begin{bmatrix} I & A_{jr}\Delta_r \\ A_{rj}\Delta_j & I \end{bmatrix} \begin{bmatrix} Y_j \\ Y_r \end{bmatrix} \tag{19}$$

from which it is possible to derive the definitions of the pure backward linkage index (PBL) and the pure forward linkage index (PFL), given respectively by (20) and (21):

[9] In honour of its creators, Guilhoto, Hewings and Sonis.

$$PBL = \Delta_r A_{rj} \Delta_j Y_j \tag{20}$$

$$PFL = \Delta_j A_{jr} \Delta_r Y_r \tag{21}$$

The PBL provides the pure impact of the value of total output of sector j on the rest of the economy, while the PFL provides the pure impact of the value of total output of the rest of the economy on sector j. As both are in current values, we can proceed as in equation (22):

$$PTL = PBL + PFL \tag{22}$$

The values of the indices are normalised by the average value of the economic sectors, which allows a comparison, over time, in economies experiencing inflation or changes in the monetary standard. According to Nunes and others (2012), a sector is considered key —from the perspective of normalized pure linkage indices— when the values of the normalized pure total linkage indices (PTL) exceed unity ($PTL > 1$).

4. Multipliers

As noted by Tosta, Lirio and Silveira (2012), production, employment and income multipliers are often used to quantify the effects of exogenous changes on selected economic activities and can be classified into type I and type II multipliers. The fundamental difference between these two types is that the second model considers households' consumption, as well as their respective remuneration, endogenously.

Basically, Miller and Blair (2009) define employment and income multipliers as the increase in employment or wages, respectively, given a shock to final demand, which can be represented mathematically by the expression (23):

$$m(h)_j = \sum_{i=1}^{n} \alpha_{n+1} \cdot b_{ij} \tag{23}$$

where $m(h)_j$ is the employment (or income) multiplier for sector j; α_{n+1} is the ratio of the number of persons employed in the sector (or value added to the economy) to the sector's output; and b_{ij} is the element in row i and column j of the Leontief inverse matrix.

As defined by Miller and Blair (2009), the output multiplier for a specific sector is the total value of production in all economic sectors required to satisfy one additional monetary unit of final demand for the output of that sector. Mathematically, it can be expressed as:

$$m(o)_j = \sum_{i=1}^{n} b_{ij} \tag{24}$$

where $m(o)_j$ is the output multiplier for sector j; and b_{ij} is the element in row i and column j of the Leontief inverse matrix.

Type II multipliers can be found algebraically by means of the equations presented in (23) and (24). However, the Leontief inverse matrix is based on a matrix of technical coefficients in which households are endogenous to the model. Schematically, considering an economy with only two sectors, the matrix A is given by:

$$A = \begin{bmatrix} X_{11}/X_1 & X_{12}/X_2 & C_1/U \\ X_{21}/X_1 & X_{22}/X_2 & C_2/U \\ VA_1/X_1 & VA_2/X_2 & 0 \end{bmatrix} \quad (25)$$

where X_{ij} is the output of sector i to serve sector j; X_j is the total output of sector j; C_i is the private consumption of sector i; U is the sum of private consumption; and VA_j is the total gross value added of sector j.

As type II multipliers consider households endogenously, they tend to minimize the problem of underestimation posed by type I multipliers.

5. Updating of the input-output matrix

The starting point for building the input-output matrix for the North-East region and the rest of Brazil in 2011 was similar to that proposed by Guilhoto and others (2012) for 2004. This matrix includes 12 areas, namely: the States within the jurisdiction of the Superintendency for the Development of the North-East (SUDENE) (Alagoas, Bahia, Ceará, Maranhão, Paraíba, Pernambuco, Piauí, Rio Grande do Norte, Sergipe, and parts of Espírito Santo and Minas Gerais) and the rest of Brazil. First, the matrix of technical coefficients (Matrix A) was determined for 2004, by dividing intermediate consumption by the respective gross production value. This was used to obtain the Leontief inverse matrix (Matrix $B = (I\text{-}A)^{-1}$), of dimension 1,332 x 1,332.

The system of national accounts of the Brazilian Institute of Geography and Statistics (IBGE, 2014) was used to measure the variation of regional value added for the North-East States from 2004–2011. The ratio between the volume of gross value added in 2004 and that of 2011 was considered, taking into account the 111 sectors and activities listed in table 3.

Table 3
Brazil: selected activities and sectors of the input-output matrix of the North-East region, 2011

Sector or activity		Sector or activity	
1	Maize	57	Metallurgy of non-ferrous metals
2	Sugar cane	58	Metal products, except machinery and equipment
3	Soybean	59	Agricultural machinery and tools
4	Fruit growing	60	Machinery and equipment for oil exploration and extraction
5	Other crops	61	Other machinery and equipment
6	Forestry	62	Household appliances
7	Vegetable production	63	Office machinery and computer equipment
8	Cattle	64	Electrical machinery, equipment and materials
9	Other animals	65	Electronic and communications equipment
10	Pigs	66	Medical and hospital measuring and optical equipment and instruments
11	Poultry	67	Cars, vans and utility vehicles
12	Fish	68	Trucks and buses
13	Oil and other	69	Motor vehicle parts and accessories
14	Natural gas	70	Other transport equipment
15	Services related to oil and gas extraction	71	Furniture industry
16	Iron ore	72	Miscellaneous industries
17	Other products of the extractive industry	73	Electricity production
18	Slaughter of cattle	74	Electricity distribution
19	Slaughter of pigs and other animals	75	Piped gas
20	Slaughter of poultry	76	Water and sewerage
21	Vegetable oil production	77	Urban cleaning services

Table 3 (concluded)

Sector or activity		Sector or activity	
22	Dairy industry	78	Construction
23	Processing of other vegetable products	79	Wholesale trade
24	Poultry feed	80	Fuel retail trade
25	Sugar production	81	Vehicles, parts and accessories retail trade
26	Coffee industry	82	Supermarkets
27	Other food products	83	Other retail trade
28	Beverages	84	Cargo transport by road
29	Tobacco products	85	Cargo transport by air
30	Textiles	86	Cargo transport by rail
31	Clothing and accessories	87	Cargo transport by water
32	Leather goods and footwear	88	Cargo transport by pipeline
33	Wood products, except furniture	89	Ancillary cargo transport activities
34	Production of cellulose and mechanical pulp	90	Passenger transport by road
35	Production of paper, cardboard and paper products	91	Passenger transport by air
36	Newspapers, magazines, records	92	Passenger transport by rail
37	Oil and coke refining	93	Passenger transport by water
38	Alcohol	94	Ancillary passenger transport activities
39	Other chemical elements	95	Postal services
40	Fertilizers	96	Mobile telephone services
41	Manufacturing of basic petrochemical products	97	Fixed-line telephone services
42	Manufacturing of intermediate products for resins and fibres	98	Other information services
43	Manufacturing of other organic chemical products	99	Financial intermediation and insurance
44	Manufacturing of resins and elastomers	100	Real estate and rental services
45	Manufacturing of artificial and synthetic fibres, wires and cables	101	Maintenance and repair services
46	Pharmacy and veterinary services	102	Accommodation services
47	Pesticides	103	Food services
48	Perfume, hygiene and cleaning products	104	Business services
49	Paints, varnishes, enamels and lacquers	105	Private education
50	Miscellaneous chemical products and preparations	106	Private health care
51	Rubber industry	107	Other services
52	Plastic items	108	Public education
53	Cement	109	Public health care
54	Manufacturing of glass and glass products	110	Public security
55	Other non-metallic mineral products	111	Other public administration and social security services
56	Manufacturing of steel and steel products		

Source: Prepared by the authors on the basis of official information.

The final demand items for 2011were estimated by calculating the product of 2004 final demand and the respective value added growth ratios. The sum of these items generated a column vector (1,332x1), which represented final demand for 2011. Multiplying the Leontief inverse matrix (matrix B) by that vector gives the gross production value for 2011, which is also a column vector (1,332x1).

The intermediate consumption matrix for 2011 (dimension 1,332x1,332) was obtained by taking the matrix of technical coefficients (matrix A) and multiplying it by the gross production value. Next, the column vector of gross production value was transposed, giving rise to the row vector of dimension 1x1,332 from which the sum of each column of intermediate consumption was subtracted, which determined the value added to production for 2011. The same proportion recorded in 2004 was used to update the values relating to taxes and to disaggregate the value added items.

To determine the item "employed personnel", the annual variation of employed personnel was measured for each sector or activity from 2003–2008 (most recent year for which data were available), and used to estimate figures for the year 2011.

After updating the input-output matrix, the 12 areas were aggregated into only 2 areas, the first one including the 9 States of the North-East region and the second one integrating Minas Gerais and Espírito Santo into the rest of Brazil.[10]

IV. Results and analysis

1. Rasmussen-Hirschman linkage indices

Table 4 shows eight sectors with strong linkages, both upstream (backward) and downstream (forward) in the production chain, namely: oil and other (13), textiles (30), oil and coke refining (37), fertilizers (40), manufacturing of basic petrochemical products (41), manufacturing of resins and elastomers (44), manufacturing of steel and steel products (56), and metal products (except machinery and equipment) (58). With the exception of the second sector, all the sectors and activities listed belong to the intermediate goods industry, which means they reflect strong linkages. Thus, according to Prado (1981) and Guilhoto and others (1994), these sectors and activities can be considered key to the North-East region's economy in 2011 and strategic to the formulation of sectoral policies.

Table 4
North-East region of Brazil: Rasmussen-Hirschman linkage indices for 111 selected sectors, 2011

Sector	Forward	Backward	Sector	Forward	Backward	Sector	Forward	Backward	Sector	Forward	Backward
1	0.72354	0.82314	29	0.53872	1.13799	57	0.76379	1.05482	85	0.66087	1.13846
2	1.01153	0.70596	30	1.08843	1.08328	58	1.01705	1.03178	86	0.61709	0.97824
3	0.77160	0.70299	31	0.55268	1.04472	59	0.55290	1.13785	87	0.76187	0.99129
4	0.67836	0.71155	32	0.61421	1.21382	60	0.54061	1.11377	88	0.70264	1.10395
5	1.21008	0.77743	33	0.71347	1.03333	61	0.63537	1.11008	89	1.02975	0.91238
6	0.70688	0.83189	34	0.58320	1.11122	62	0.53675	1.13188	90	0.65240	0.90732
7	0.63879	0.69577	35	0.81300	1.05756	63	0.55504	1.13211	91	0.63151	1.10386
8	1.05394	0.85847	36	0.68633	0.96709	64	0.79273	1.08242	92	0.53382	0.89684
9	0.57570	0.88255	37	2.34460	1.23225	65	0.66517	1.20464	93	0.52896	0.87796
10	0.74281	1.00538	38	0.60660	0.94458	66	0.56500	0.90767	94	0.62746	0.78737
11	0.97111	0.91979	39	0.96093	1.16268	67	0.55683	1.32781	95	0.70868	0.78479
12	0.53958	0.93099	40	1.23459	1.18894	68	0.53936	1.30662	96	0.97496	0.87398
13	1.02749	1.01047	41	1.10412	1.14821	69	0.88599	1.18658	97	1.05959	0.87310
14	0.90663	1.01397	42	0.98196	1.28876	70	0.67221	1.19708	98	1.10018	0.82491
15	0.57316	0.77573	43	0.82138	1.21740	71	0.55676	1.03816	99	2.27300	0.83964
16	0.53174	0.93498	44	1.41930	1.22334	72	0.57476	1.05912	100	1.02986	0.56296
17	0.83825	0.95853	45	0.59717	1.11244	73	1.13878	0.64641	101	0.82337	0.71133
18	0.61142	1.21165	46	0.56599	0.97388	74	1.61589	0.84980	102	0.54363	0.85866
19	0.56294	1.28510	47	0.87593	1.18945	75	0.91970	1.05248	103	0.68086	0.98353
20	0.56295	1.23139	48	0.62772	1.08760	76	0.66747	0.69770	104	2.63910	0.77858
21	0.67299	1.30239	49	0.60998	1.21366	77	0.60692	0.82046	105	0.58584	0.83967
22	0.58696	1.28826	50	0.68712	1.17829	78	0.77135	0.90079	106	0.57086	0.91791
23	0.54419	1.17096	51	0.63465	1.12974	79	3.15717	0.69120	107	0.78992	0.80256
24	0.66304	1.23598	52	0.61817	1.20879	80	0.69760	0.67856	108	0.53063	0.67256
25	0.70647	1.02986	53	0.62865	0.94440	81	0.66004	0.73072	109	0.52677	0.82817
26	0.59904	1.29563	54	0.56697	1.00374	82	0.55883	0.71953	110	0.53168	0.82946
27	0.77187	1.27484	55	0.65966	1.04157	83	0.57337	0.69741	111	0.68703	0.78170
28	0.72714	1.11985	56	1.03698	1.07267	84	1.86853	0.93173			

Source: Prepared by the authors on the basis of official information.
Notes: The sectors are listed in table 3. The highlighted sectors reflect a backward or forward Rasmussen-Hirschman index greater than unity.

[10] Microsoft® Excel® 2013 and MATLAB® R2010a software were used to estimate the matrices, coefficients and multipliers.

Despite the importance of the petrochemical industry in the value of industrial transformation in the North-East region (highlighted by the linkage indices), Wanderley (2008) states that its growth did not translate into proportional development in some industries that would naturally benefit from the strong forward linkages in the chemical industry. In some industries —such as pharmaceuticals, perfumery and plastics, among others— there was no significant increase. This performance indicates that the raw materials of the chemical industry were not used in the North-East, probably owing to the lack of an incentive programme for the development of the sectors that use these raw materials, which would favour the linkages of the chemical industry in the region. The results of the observation of the field of influence, presented below, reflect this.

2. Field of influence

As a complement to the examination of the Rasmussen-Hirschman linkage indices, the analysis of the field of influence shows the notable performance of key sectors with respect to the other sectors analysed, as shown in annex table A1.1.

The observation of the field of influence of the North-East region's economy in 2011 validates the condition confirmed by the Rasmussen-Hirschman backward and forward linkage indices.

Thus, the evaluation of the field of influence reveals that the oil and other sector (13) demands products and services from sectors such as other transport equipment (70) and cargo transport by pipeline (88), indicating the importance of transport providers for the oil industry.

There are many linkages relating to the textile sector (30), characterised by the demand for inputs from sectors linked to agricultural activities (20, 21, 22, 25 and 26) and the purchase of their output, among others, by the wholesale trade sector (79). According to Garcia (2010), the configuration of local production systems is a fairly common feature of the textile, clothing and footwear industries in the North-East region. Given the simplicity of the technical base of these sectors and the ample opportunities for product segmentation, there is a strong incentive for the emergence and existence of a vast array of small specialized businesses. Moreover, the geographic concentration of businesses allows producers to enjoy the benefits deriving from business agglomerates and the interactions between them.

Another important sector, oil and coke refining (37), demands inputs and services from sectors such as cargo transport by pipeline (88) and financial intermediation and insurance (99), while it has backward linkages with sectors such as textiles (30), electronic and communications equipment (65) and fertilizers (40).

The manufacturing of resins and elastomers (44) has backward linkages with sectors such as oil and coke refining (37), cargo transport by pipeline (88) and financial intermediation and insurance (99), and provides outputs to the following sectors: textiles (30), electronic and communications equipment (65) and wood products, except furniture (33).

The aforementioned linkages reinforce the importance of the sectors considered key according to the Rasmussen-Hirschman linkage index. They also indicate basically the same dominant industries upstream and downstream in the production chain of the North-East region's economy, and underscore the importance of financial services, transport and logistics and the manufacturing of electronic and communications equipment.

3. Pure linkage indices

When evaluating the economy of the North-East region from the perspective of normalized pure linkage indices, or GHS indices, five sectors and activities reflect a total coefficient (*PTL*) greater than unity, namely: oil and coke refining (37); construction (78); financial intermediation and insurance (99); business services (104) and other public administration and social security services (111) (see table 5).

Table 5
North-East region of Brazil: normalized forward (*PFL*), backward (*PBL*) and total (*PTL*) GHS indices for 111 selected sectors, 2011

Sector	*PFL*	*PBL*	*PTL*	Sector	*PFL*	*PBL*	*PTL*	Sector	*PFL*	*PBL*	*PTL*
1	0.1216	0.0710	0.0963	38	0.0886	0.0880	0.0883	75	0.2025	0.2763	0.2395
2	0.3527	0.0282	0.1901	39	0.3190	0.0597	0.1891	76	0.1784	0.1254	0.1518
3	0.2023	0.0609	0.1315	40	0.4681	0.1198	0.2936	77	0.0920	0.0561	0.0740
4	0.1224	0.0932	0.1078	41	0.4975	0.1015	0.2991	78	0.5148	3.2660	1.8932
5	0.4748	0.1844	0.3293	42	0.3734	0.1500	0.2615	79	1.3992	0.3721	0.8846
6	0.0857	0.0371	0.0613	43	0.2231	0.1011	0.1619	80	0.3940	0.0887	0.2411
7	0.0526	0.0120	0.0322	44	0.7285	0.3449	0.5363	81	0.1266	0.2286	0.1777
8	0.3478	0.1511	0.2493	45	0.0241	0.0195	0.0218	82	0.0172	0.3828	0.2004
9	0.0171	0.0034	0.0102	46	0.0288	0.0344	0.0316	83	0.0281	0.4883	0.2587
10	0.0663	0.0470	0.0566	47	0.2327	0.0539	0.1431	84	0.7078	0.0406	0.3735
11	0.1845	0.1249	0.1546	48	0.0866	0.1250	0.1058	85	0.0382	0.0383	0.0383
12	0.0152	0.0265	0.0209	49	0.1123	0.0240	0.0680	86	0.0288	-0.0155	0.0066
13	0.6904	0.0417	0.3654	50	0.0800	0.0330	0.0564	87	0.1173	0.2710	0.1943
14	0.3607	-0.0750	0.1424	51	0.0514	0.0163	0.0338	88	0.0275	0.0079	0.0177
15	0.0384	0.0026	0.0204	52	0.0262	0.0031	0.0146	89	0.2630	0.0321	0.1473
16	0.0007	0.0010	0.0009	53	0.2433	-0.0009	0.1210	90	0.1304	0.8949	0.5134
17	0.2787	0.0596	0.1689	54	0.0400	0.0072	0.0236	91	0.1132	0.0202	0.0666
18	0.0982	0.3946	0.2467	55	0.3140	0.0346	0.1740	92	0.0064	0.0206	0.0135
19	0.0112	0.0403	0.0258	56	0.2843	0.2005	0.2423	93	0.0022	0.0012	0.0017
20	0.0099	0.0817	0.0459	57	0.1678	0.2089	0.1884	94	0.0640	0.0238	0.0438
21	0.1066	0.3323	0.2197	58	0.2985	0.1618	0.2301	95	0.1362	0.0081	0.0720
22	0.0233	0.0747	0.0490	59	0.0047	0.0129	0.0088	96	0.4568	0.0641	0.2601
23	0.0141	0.0503	0.0322	60	0.0008	0.0010	0.0009	97	0.4932	0.1960	0.3443
24	0.1411	0.2858	0.2136	61	0.0380	0.0960	0.0671	98	0.5755	-0.0036	0.2854
25	0.0958	0.2941	0.1951	62	0.0022	0.0306	0.0164	99	1.7043	0.3481	1.0248
26	0.0323	0.0856	0.0590	63	0.0140	0.1125	0.0633	100	0.4912	0.1938	0.3422
27	0.2345	0.6963	0.4659	64	0.1186	0.0644	0.0914	101	0.1964	0.0613	0.1287
28	0.2815	0.4787	0.3803	65	0.0101	0.0241	0.0171	102	0.0303	0.1361	0.0833
29	0.0001	0.0243	0.0122	66	0.0071	0.0204	0.0137	103	0.2442	0.9961	0.6209
30	0.4939	0.3259	0.4097	67	0.0039	0.8466	0.4261	104	2.1540	0.0491	1.0995
31	0.0372	0.3856	0.2117	68	0.0014	0.0362	0.0188	105	0.0747	0.4932	0.2844
32	0.0251	0.6542	0.3403	69	0.0931	0.0268	0.0598	106	0.0393	1.0400	0.5406
33	0.0458	0.0104	0.0281	70	0.0035	0.0316	0.0176	107	0.2527	1.0419	0.6481
34	0.0454	0.1020	0.0738	71	0.0254	0.1832	0.1044	108	0.0039	0.7653	0.3854
35	0.1041	0.0337	0.0688	72	0.0546	0.0479	0.0513	109	0.0001	1.2929	0.6478
36	0.1430	0.0507	0.0968	73	0.6315	-0.0273	0.3014	110	0.0052	0.3788	0.1923
37	1.3422	0.7978	1.0694	74	0.7904	0.5608	0.6754	111	0.1209	3.9736	2.0512

Source: Prepared by the authors on the basis of official information.
Notes: The sectors are listed in table 3. The highlighted sectors reflect a GHS index greater than unity.

Among the key sectors determined according to the Rasmussen-Hirschman criterion, only oil and coke refining (37) is also noteworthy according to the GHS methodology. In addition, the financial intermediation and insurance sector, which already stood out as an important service provider, now emerges as a key sector when examining the field of influence. This indicates that these sectors were important to the North-East economy in 2011.

Some sectors not highlighted by the Rasmussen-Hirschman methodology appear as key sectors according to the methodology of pure linkage indices, for example other public administration and social security services (111), as also shown by Mendes and others (2011) when analysing the economy of Minas Gerais.

4. Multipliers

The results obtained with the multiplier method, shown below, demonstrate the effects on employment, wages and production of a change in final demand in each selected sector or activity. Since the effects are propagated along the entire chain, backwards and forwards with respect to the target sector, industries with stronger linkages tend to present the highest multipliers. See annex tables A1.1 and A2.1, which contain type I and II multipliers, respectively.

With respect to type I multipliers, oil and coke refining reflects the highest employment multiplier (98.19) and the second highest wage multiplier (10.84), indicating the dynamism of this sector. Thus, for every increase of 1 million reais in final demand in this sector, there is an expectation of an increase or maintenance of 98.19 direct and indirect jobs and there is a tendency for wages in the economy to respond positively by 10.84 times in relation to the value of the initial shock. This result is consistent with that obtained by Nunes, Capucho and Parré (2012) when analysing the Brazilian economy, taking 2008 as the base year. Other sectors, linked to the energy industry as well, also generated significant results in terms of employment growth, as in the case of the piped gas sector (80.04) and the oil and other sector (38.79).

When considering the output multiplier, each increase of 1 million reais in final demand in the cars, vans and utility vehicles sector should result in an increase of 2.52 times that value in the total economic output, similar to that found by Guilhoto and others (2012) when analysing the economy of the North-East region in 2004. Other sectors, such as vegetable oil production (2.47), the coffee industry (2.46), the dairy industry (2.45) and the slaughter of pigs and other animals (2.44), are all part of agribusinesses which, in general, respond well to sectoral demand stimuli in terms of increased production.

In the case of type II multipliers, which differ from type I multipliers by making the "household spending" sector endogenous, changes are observed in the magnitude of the multiplier values, as well as in the ranking of the selected sectors or activities, which may lead to suggestions for formulating more targeted and effective public policies.

According to the results obtained with the type II multiplier, the oil and coke refining sector continues to present the highest employment multiplier (118.60) and is the third largest wage multiplier (12.06). In other words, for every increase of 1 million reais in the final demand of this sector, there is an expectation of an increase or maintenance of 118.60 direct, indirect and induced jobs and a tendency for wages in the economy to increase 12.06 times in relation to the value of the initial shock.

In the oil and other sector, there is an increase of 48.09 jobs, and the value of production in relation to the shock doubles. Another sector linked to the oil industry, natural gas, also responds significantly to the increase in demand, generating 35.84 additional direct, indirect and induced jobs and more than tripling the value of the shock in relation to wages.

Bearing in mind that the non-metallic mineral extraction and refining sites and chemical complexes are generally located in limited areas of the North-East region, these results appear to reflect, according to Lima and Simões (2010), the strengthening of heterogeneity within the region itself, where stagnant areas of selective and limited modernization (when it exists), coexist with dynamic areas where the production structure is quite modern and contributes significantly to the performance of the region as a whole.[11]

[11] As a mitigating counterpoint to this situation, it can be deduced that a significant movement of "employment insourcing" is under way in the North-East region. According to BCB data (2006), while 45.9% of the industry's jobs were carried out in the region in 1996, this figure had already risen to 51.6% in 2004.

In general, sectors with significant inputs downstream in the production chain are rising as a result of the changes in the economy of the North-East region since the implementation of the Second National Development Plan (1975–1979). According to Lima and Simões (2010), this reflects a trend towards greater complementarity between the industrial segments of the North-East and the rest of the country, especially the South-East region, despite the relocation of industries producing durable consumer goods to the North-East, especially to Bahia. In addition, the search for extra-regional consumer markets has reaffirmed the position of the North-East as a supplier of inputs for the other regions of the country, reflecting its special role in the interregional division of industrial labour in Brazil.

V. Final considerations

The analysis of the results obtained from the application of different methodologies to examine the input-output matrix has shown the importance of traditional sectors in the economy of the North-East region. Worthy of note are the textile industry and the sectors promoted within the framework of the Second National Development Plan (1975–1979), such as the chemical, resin and elastomer, and oil sectors.

It has also underscored the importance, albeit incipient, of sectors such as electronic and communications equipment, and pointed out that most of these sectors rely heavily on logistics systems and financial services.

Given the linkages in several sectors, it was confirmed that the economy of the North-East is still based, in part, on the organization established by the development policies of the 1970s and 1980s. The region remains a hub supplying intermediate goods to industries in other regions of the country, despite the recent relocation of some durable consumer goods industries to some States in the North-East. Consequently, the region's development is not an autonomous process and depends on the rest of the country.

However, for the integration of production to be effective, it must be based on planning that includes physical transport and logistics infrastructure that interconnects the different regions, as well as national projects that include energy generation and distribution, data transmission capacity and, above all, quality education.

Thus, the action of State and municipal governments is very important to close still wide gaps between regions, through tax incentives and structural improvements that also allow the decentralization of production and direct it to the North-East region, which is sometimes forgotten and lacks more thriving production sectors.

Those responsible for formulating public policy should pay more attention to incentives for the rural sector, given that activities relating to the growing of sugar cane and other crops and raising livestock reflect strong forward linkages.

Agro-industrial activities also reflect strong backward linkages that enhance value added, helping to support the inhabitants of rural areas and to improve their well-being thanks to the combination of the multiplier effects of employment and wages.

The textile sector, which in the past played a dominant role in the economy of some States in the North-East region, also represents a potential source of regional dynamism, given its strong influence upstream and downstream in the production chain. This justifies the need for stimulation through targeted public policies.

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Annex A1

Type I production, employment and income multipliers in the North-East region, 2011

Table A1.1

North-East region of Brazil: type I production, employment and income multipliers, 2011

Sector	Type I multipliers			Sector	Type I multipliers			Sector	Type I multipliers		
	Employment	Income	Production		Employment	Income	Production		Employment	Income	Production
1	1.0610	1.2306	1.5629	38	20.1414	3.8610	1.7934	75	80.0401	10.7379	1.9983
2	1.0152	1.0814	1.3404	39	10.4201	3.6488	2.2075	76	1.9771	1.2401	1.3247
3	1.3704	1.6294	1.3347	40	9.2598	3.3028	2.2574	77	1.3147	1.2304	1.5578
4	1.0153	1.1703	1.3510	41	7.4355	2.7333	2.1801	78	1.3303	1.8623	1.7103
5	1.1324	1.5127	1.4761	42	6.9810	15.4360	2.4469	79	1.3066	1.1933	1.3123
6	1.1931	1.4597	1.5795	43	6.3801	5.8975	2.3114	80	1.2635	1.1641	1.2884
7	1.0890	1.1988	1.3210	44	18.9709	3.9483	2.3227	81	1.1721	1.2354	1.3874
8	1.1212	1.3583	1.6299	45	2.7822	2.3543	2.1121	82	1.1487	1.2193	1.3661
9	1.0599	1.4378	1.6757	46	3.4064	1.8521	1.8491	83	1.0673	1.1894	1.3241
10	1.8175	1.8438	1.9089	47	19.7539	4.5913	2.2584	84	1.4524	1.8784	1.7690
11	1.1983	1.5198	1.7464	48	4.0184	2.0827	2.0650	85	10.7877	3.8855	2.1615
12	1.0662	1.3687	1.7676	49	7.9493	2.3100	2.3043	86	1.8228	1.4757	1.8573
13	38.7929	2.6379	1.9185	50	2.9262	2.3720	2.2372	87	3.6958	2.1877	1.8821
14	29.3068	3.0267	1.9252	51	5.0258	2.1699	2.1450	88	2.5914	2.5286	2.0960
15	2.4112	1.2021	1.4728	52	1.9191	1.8454	2.2951	89	1.4143	1.3997	1.7323
16	8.9887	3.6018	1.7752	53	8.8002	2.2286	1.7931	90	1.2403	1.3733	1.7227
17	1.5695	1.7090	1.8199	54	2.5234	2.0642	1.9058	91	6.6024	2.1911	2.0959
18	29.7316	5.0114	2.3005	55	1.4927	1.7492	1.9776	92	1.7023	1.2517	1.7028
19	13.4425	3.8766	2.4400	56	7.2917	2.9059	2.0366	93	1.9280	1.3035	1.6669
20	14.5036	4.1864	2.3380	57	2.8568	2.7634	2.0027	94	1.3505	1.2514	1.4950
21	20.3202	7.3520	2.4728	58	1.7774	1.9088	1.9590	95	1.3098	1.1664	1.4900
22	7.3290	3.8428	2.4460	59	2.7529	2.1207	2.1604	96	1.4637	2.0419	1.6594
23	8.0674	3.3269	2.2232	60	1.5288	1.7546	2.1147	97	2.3643	2.4961	1.6577
24	7.4981	2.9379	2.3467	61	2.0609	2.0218	2.1077	98	1.6343	1.4870	1.5662
25	12.3703	3.1589	1.9554	62	2.3880	2.2009	2.1491	99	3.2768	1.5778	1.5942
26	10.5345	3.6901	2.4600	63	6.1804	2.5824	2.1495	100	3.9215	1.5765	1.0689
27	3.9344	3.0116	2.4205	64	2.9882	1.7897	2.0551	101	1.2768	1.1945	1.3506
28	6.6452	2.5066	2.1262	65	4.6439	3.8798	2.2872	102	2.4056	1.2308	1.6303
29	13.3877	2.9401	2.1607	66	1.4977	1.6080	1.7233	103	1.3821	1.7169	1.8674
30	1.8717	2.3792	2.0568	67	12.1553	3.4727	2.5211	104	1.2100	1.3152	1.4783
31	1.2523	1.7580	1.9836	68	7.2150	4.2123	2.4808	105	1.3341	1.2027	1.5942
32	2.2513	2.1879	2.3046	69	3.0403	2.1045	2.2529	106	1.4245	1.4321	1.7428
33	1.8550	1.8151	1.9619	70	3.4722	2.3190	2.2728	107	1.0770	1.1660	1.5238
34	28.9656	4.5228	2.1098	71	1.8252	2.1092	1.9711	108	1.1564	1.0619	1.2770
35	2.9515	1.8823	2.0079	72	1.6153	2.1821	2.0109	109	1.7604	1.2256	1.5724
36	1.7622	1.5742	1.8362	73	7.3128	1.8755	1.2273	110	1.8203	1.2825	1.5749
37	98.1900	10.8380	2.3396	74	4.8449	1.9481	1.6135	111	1.4923	1.1939	1.4842

Source: Prepared by the authors on the basis of official information.
Note: The sectors are listed in table 3.

Annex A2

Type II production, employment and income multipliers in the North-East region, 2011

Table A2.1
North-East region of Brazil: type II production, employment and income multipliers, 2011

Sector	Type II multipliers			Sector	Type II multipliers			Sector	Type II multipliers		
	Employment	Income	Production		Employment	Income	Production		Employment	Income	Production
1	1.1031	1.4281	1.8964	38	20.7981	4.2940	2.0138	75	96.0721	12.0887	2.1168
2	1.0380	1.2069	1.7198	39	12.9557	4.0598	2.3331	76	2.6151	1.3628	1.4687
3	2.0700	2.6087	1.6598	40	11.6067	3.6677	2.3968	77	1.5437	1.3517	1.8023
4	1.0372	1.4159	1.6968	41	9.2919	3.0377	2.3013	78	1.4981	2.1696	1.9193
5	1.2197	2.0039	1.7925	42	8.3087	17.2399	2.5509	79	1.6144	1.3684	1.5929
6	1.2858	1.8181	1.8985	43	7.6214	6.5786	2.4228	80	1.5483	1.3281	1.5782
7	1.1493	1.4810	1.6802	44	23.7181	4.3913	2.4276	81	1.3091	1.4066	1.6692
8	1.1884	1.6499	2.0388	45	3.3501	2.6098	2.2356	82	1.2652	1.3857	1.6540
9	1.0829	1.7474	2.0666	46	4.1063	2.0511	2.0332	83	1.1190	1.3558	1.6105
10	2.0871	2.3044	2.2885	47	23.1338	5.1088	2.3870	84	1.6580	2.2064	1.9986
11	1.2572	1.8485	2.1454	48	4.7394	2.3201	2.2419	85	14.3167	4.5096	2.3513
12	1.0877	1.5989	2.1533	49	9.9259	2.5665	2.4716	86	2.2710	1.6352	2.1122
13	48.0909	2.9363	2.0709	50	3.4319	2.6365	2.3951	87	4.9078	2.5741	2.0924
14	35.8448	3.3757	2.0681	51	5.9869	2.4216	2.3004	88	3.1631	2.9275	2.3414
15	3.4865	1.3211	1.7277	52	2.2801	2.0379	2.4691	89	1.6870	1.5853	1.9922
16	10.7869	4.0221	1.8721	53	11.1774	2.4754	1.9165	90	1.3962	1.5533	1.9823
17	1.7934	1.9048	1.9892	54	3.0424	2.3055	2.0688	91	8.9529	2.4878	2.3055
18	32.0626	5.8864	2.5955	55	1.6735	1.9417	2.1633	92	2.3063	1.3778	2.0225
19	14.8433	4.5699	2.7225	56	9.1601	3.2282	2.1518	93	2.6736	1.4745	1.9247
20	15.4027	4.9165	2.6401	57	3.4338	3.0664	2.1190	94	1.6547	1.4224	1.7842
21	25.1616	9.2273	2.7217	58	2.1457	2.1389	2.1160	95	1.5923	1.2845	1.7606
22	7.9000	4.4391	2.7384	59	3.4318	2.3473	2.3305	96	1.5941	2.3183	1.8260
23	8.5199	3.8530	2.4861	60	1.7645	1.9375	2.3115	97	2.7690	2.8616	1.8098
24	8.3630	3.4324	2.5930	61	2.4770	2.2389	2.2771	98	1.9188	1.6591	1.7876
25	12.8413	3.5054	2.1962	62	2.8603	2.4351	2.3177	99	4.2172	1.7431	1.7812
26	11.6323	4.3496	2.7230	63	7.8418	2.8664	2.3170	100	5.0929	1.8217	1.0949
27	4.3260	3.4869	2.6616	64	3.8362	1.9764	2.2404	101	1.8652	1.4305	1.7033
28	7.3866	2.8288	2.3561	65	5.5107	4.3179	2.4430	102	3.1556	1.3716	1.9602
29	14.8288	3.4461	2.3885	66	1.7524	1.7939	1.9051	103	1.4869	1.9871	2.1509
30	2.0364	2.7289	2.2506	67	15.3430	3.8560	2.7148	104	1.3612	1.4971	1.7556
31	1.3295	2.0627	2.2846	68	8.8601	4.6785	2.6583	105	1.5472	1.3285	1.9444
32	2.5449	2.4451	2.5416	69	3.7748	2.3253	2.4425	106	1.6282	1.6146	2.0546
33	2.0143	2.0349	2.1885	70	4.2979	2.5663	2.4561	107	1.1352	1.2927	1.8951
34	32.1407	5.2212	2.2836	71	2.0814	2.4000	2.1692	108	1.4260	1.1630	1.6985
35	3.5056	2.0891	2.1832	72	1.8450	2.4882	2.1976	109	2.1977	1.3474	1.9118
36	2.1069	1.7476	2.0505	73	8.9747	2.0736	1.2748	110	2.3155	1.4096	1.8322
37	118.5966	12.0601	2.4499	74	6.2108	2.1490	1.6845	111	1.8822	1.3104	1.7816

Source: Prepared by the authors on the basis of official information.
Note: The sectors are listed in table 3.

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The submission of an article implies an undertaking by the author not to submit it simultaneously to other publications. The copyright to all articles published in the *Review* shall be owned by the United Nations.

Each article will be reviewed by the editorial board, which may decide to submit it to external referees.

Papers should be submitted in the original language (English, French, Portuguese or Spanish). They will be translated into the appropriate language by the relevant ECLAC services.

Each article must be accompanied by a summary, no more than 150 words in length, giving a brief description of its subject matter and main conclusions.

Each article must also carry three jel (Journal of Economic Literature) classification codes. The JEL Classification Codes Guide is available online at www.aeaweb.org/jel/jel_class_system.php.

Papers should be no longer than 10,000 words, including the summary, notes and bibliography. Shorter papers will also be considered.

Articles should be sent by e-mail to *revista@cepal.org* in Word format. Papers in pdf format will not be accepted.

Style guide:

Titles should not be excessively long.

Footnotes

- It is recommended that footnotes be kept to a minimum.
- It is recommended that footnotes not be used to cite bibliographical references; such references should preferably be incorporated into the text.
- Footnotes should be numbered consecutively using superscript Arabic numerals.

Tables, figures and equations

- It is recommended that tables and figures be kept to a minimum, avoiding any redundancy with the text.
- Equations should be written using the Office equation editor "MathType"; they should not be inserted as "pictures".
- Tables, figures and other elements should be inserted at the end of the text in the format in which they were designed; they should not be inserted as "pictures". Figures in Excel should include the corresponding worksheets.
- The location of tables and figures in the body of the article should be indicated in the appropriate place as follows:

  Insert figure 1

  Insert table 1
- Tables and figures should include an explicit and complete reference to their sources.
- Tables should indicate the period covered at the end of the title, and should indicate the units in which the data are expressed in a subtitle (in italics and between brackets).
- The symbols referred to in the "Explanatory notes" which appear on the page preceding the table of contents should be taken into account in the preparation of tables and figures.
- Footnotes to tables and figures should be ordered consecutively using superscript lower-case letters.
- Figures should be prepared bearing in mind that they will be printed in black and white.

Acronyms and abbreviations

- Acronyms and abbreviations should not be used unless absolutely necessary, in which case the full name should be written out the first time it occurs in the article.

Bibliography

- Bibliographical references should be directly related to the content of the article and should not be excessively long.
- At the end of the article, under the title "Bibliography", all the necessary information should be included accurately and in alphabetical order by author: name of author(s), year of publication, full name of article (if any) and publication (including any subtitle), city of publication, publisher and, in the case of a periodical, month of publication.

The editorial board of the *Review* reserves the right to make any necessary editorial changes in the articles, including their titles.

Authors will receive a one-year courtesy subscription to the *Review*, plus 30 offprints of their article in Spanish and 30 in English, at the time of publication in each language.

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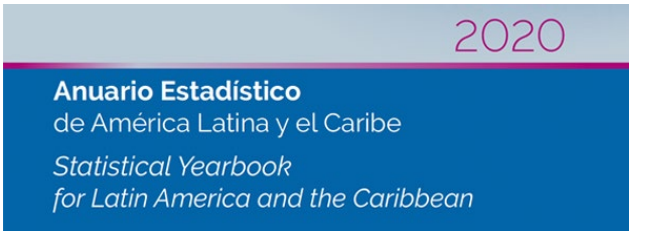

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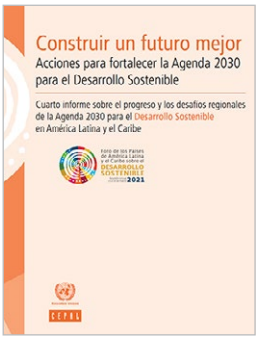

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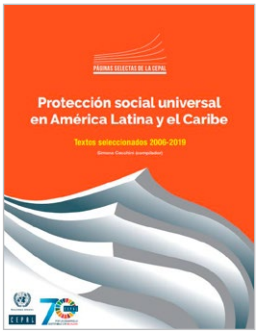

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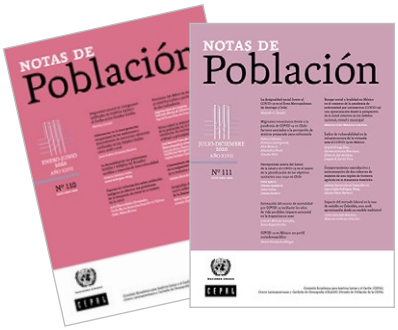

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MIGUEL TORRES
Editor

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