Financial Crises, the Great Recession and the Middle Class in the Americas, an Empirical Analysis

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Work in Progress

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Abstract

We analyse the evolution of the middle classes in five Latin American countries before and after the world financial crisis of 2008, using both traditional income-based middle-class measures, relative bipolarisation indices, and relative bipolarisation Lorenz curves. Despite the relevance of the middle class in modern societies, there is no consensus on its definition, generating a deep discussion among different approaches. The financial crisis of 2008 was one of the most catastrophic events in the modern economic history, leading to a global recession with delayed negative effects on the Latin American region. Our findings show differentiated dynamics on bipolarization among countries after the financial crisis, but also a generalized reduction, suggesting an increase of the middle class in terms of total per capita household incomes. Countries like Brazil and Peru experienced changes in bipolarization a few years after the onset of the financial crisis, while Uruguay follows a particular trend of decreasing bipolarization independent of the 2008 financial crisis.

Key words: Distributional Analysis, middle class, bipolarization analysis.

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1. Introduction

The relevance of the middle class in modern societies is out of question. Economic development, social stability and a good institutional environment is dependent on the strength of the middle class (Thurow, 1984; Foster and Wolfson, 2010; Acemoglu and Robinson, 2009). However, despite its relevance, there is no consensus on a definition of the middle class in the literature. Instead, we have an ongoing debate around the different approaches to define and identify empirically this social group.

The aim of this paper is to analyse the evolution of the middle class in five Latin American countries (Brazil, Chile, Mexico, Peru, and Uruguay) before and after the economic crisis of 2008, following a relative bipolarization approach (Foster and Wolfson, 2010). Bipolarisation indices measure the degree to which a distribution develops bimodality around, and farther apart from, a median partition, thereby signalling the relative emptying of the middle group.

Our empirical assessment is motivated by the following questions: Was there any trend of growth or decline of the middle class in these countries before the crisis? Did the crisis have any effect on these trends? Additionally, this paper also provides the first empirical application of Relative Bipolarization Lorenz curves (RBL) in order to assess the robustness of relative bipolarisation comparisons to alternative choices of relative bipolarisation indices.

Preliminary results show a differentiated evolution of the middle class over this period of time among countries. On one hand, some countries have a clear reduction of bipolarization *only* after the economic crisis of 2008, implying an increase in the middle class after the crisis, while other countries did not experience any changes in their middle class. Finally, other countries show an uninterrupted increase in the relative size of this social group, which seems to be the product of factors other than the effect of the economic crisis. These findings are particularly relevant in terms of public policy in order to gauge the effects of external shocks (or lack thereof) on this social group, as well as to the rest of the society.

The rest of the paper is divided into five sections. The second section describes the economic context of the Latin American countries selected for this analysis. This section is also important in order to better identify the approximate timing of the impact of the 2008 crisis on the countries. The third section presents the methods of

identification and estimation of the middle class over time. The fourth section describes the data sources and shows basic descriptive statistics. Finally, the paper ends with some concluding remarks.

2. The Great Recession of 2008 and Latin America

The autumn of 2008 witnessed the collapse of the financial sector across the world, when the US sub-prime debt and the trade of toxic financial instruments, product of the securitization process, burst a financial speculative bubble. This implosion of the financial sector had its epicentre in the US, where investment and commercial banks were not able to accomplish their debt duties. Then, the debt failure contagion was spread through the interconnected global financial sector rapidly, affecting banks and insurance institutions worldwide.

In general terms, the financial crash of 2008 contracted the world economy 6.0% between 2007 and 2009, global unemployment rose, and the world economy became 10.0% poorer than before the crisis (Temin and Vines, 2013). The size of the 2008 financial burst, and its consequences in the everyday life, had no comparison in recent history, but with the financial crash of 1929 and its subsequent economic recession (Varoufakis, 2013).

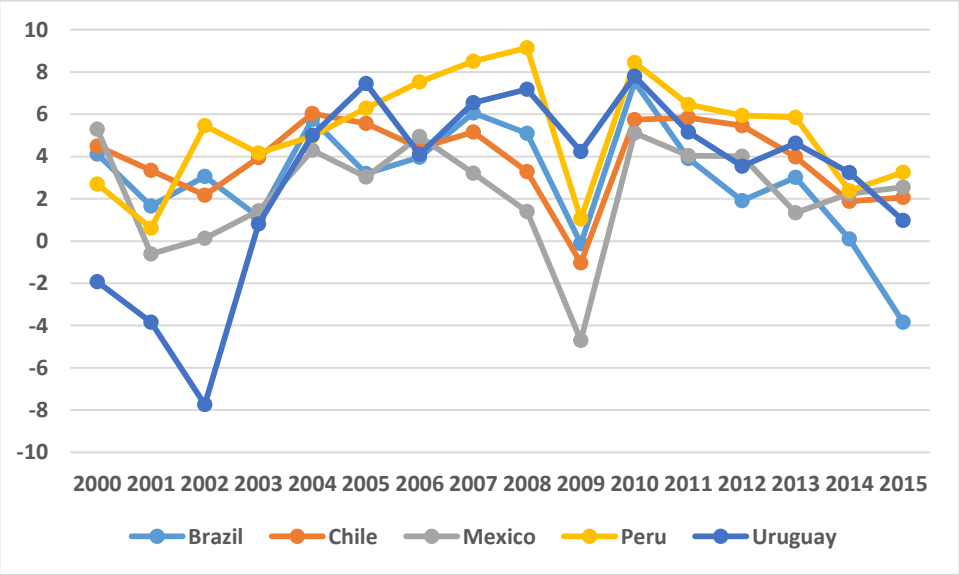
In Latin America, this crisis affected the economy not directly in the form of a financial sector crash or banking failure, but through the deceleration of the main leading economy in the region, the US.[2] Thus, the effects of the financial crisis were not felt immediately after the collapse but delayed. This is an important characteristic of the financial crisis outcomes on Latin America to highlight: the lagged effects on the regional economy; a particular characteristic important to keep in mind when analysing the regional economic dynamics.

The Figure 1 presents the evolution of the annual GDP growth rate, between 2000 and 2015, for the five Latin American countries assessed in this paper. All the countries followed a similar pattern of economic growth during this period, excepting Uruguay who had the most dramatic drop on GDP in 2002, following the Argentine crisis. The general trend was economic growth until 2009, the following year after the

[2] The later deceleration of China might also have contributed through a fall of export commodity prices.

crisis, and then a recovery in 2010 but a contracting trend from 2010 to 2015, revealing a period of recession after the financial crisis where Brazil is the most affected country and Chile, Mexico and Peru experiencing recovery during the last year.

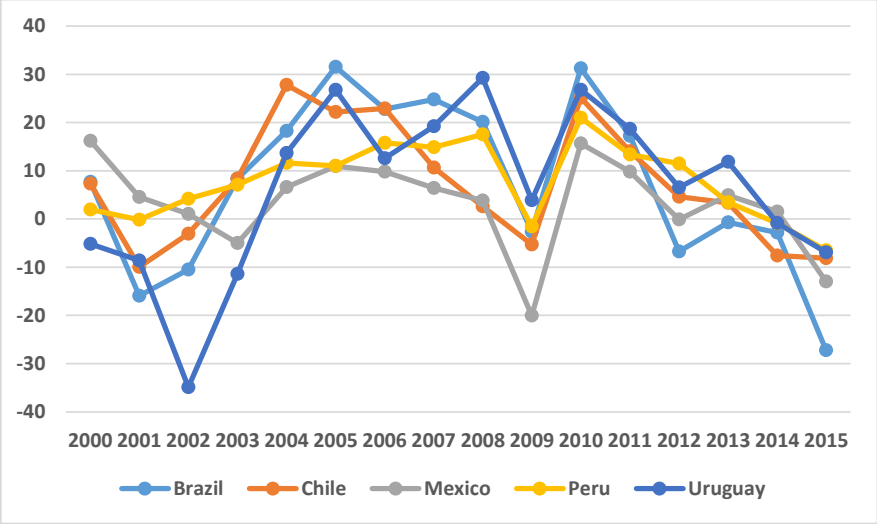
Figure 1. GDP growth rate, 2000-2015



Source: World Development Indicators, The World Bank (2016)

Figure 2 shows the evolution in the GDP per capita growth rate between 2000 and 2005 for the same group of countries. Trends follow similar patterns with respect to the GDP growth rate shown in the previous figure; however, the scale of the drop in the per capita GDP during the recession period is higher. At the beginning of the period, Uruguay, Brazil and Mexico had negative values on their per capita GDP growth; however, they managed to recover their economies by 2004. After the financial crisis, all the countries followed downward trends on their per capita GDP, and none of this countries had recovered by last year. Brazil remains as the most affected country followed by Mexico and Chile.

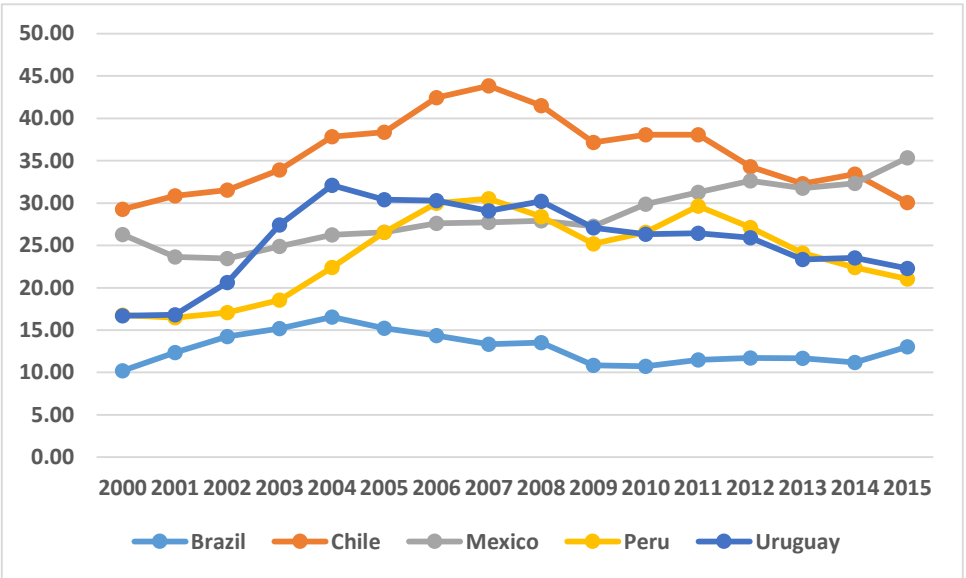
Figure 2. GDP per capita growth rate, 2000-2015



Source: World Development Indicators, The World Bank (2016)

In terms of international trade, Figure 3 presents the evolution of exports of goods and services as a percentage of the GDP for the period 2000 to 2015 in our countries of analysis. Exports grew in general terms from 2005 until 2009, particularly in Chile, Peru and Uruguay, while Brazil and Mexico presented a moderate and stable trend. However, after 2009, Chile, Peru and Uruguay experienced a continuous decrease in their volume of exports while Mexico increased them significantly. On the other hand, Brazil remained without important growth on its exports until 2015, reaching levels previous to 2009.

Figure 3. Exports of goods and services as percentage of the GDP, 2000-2015

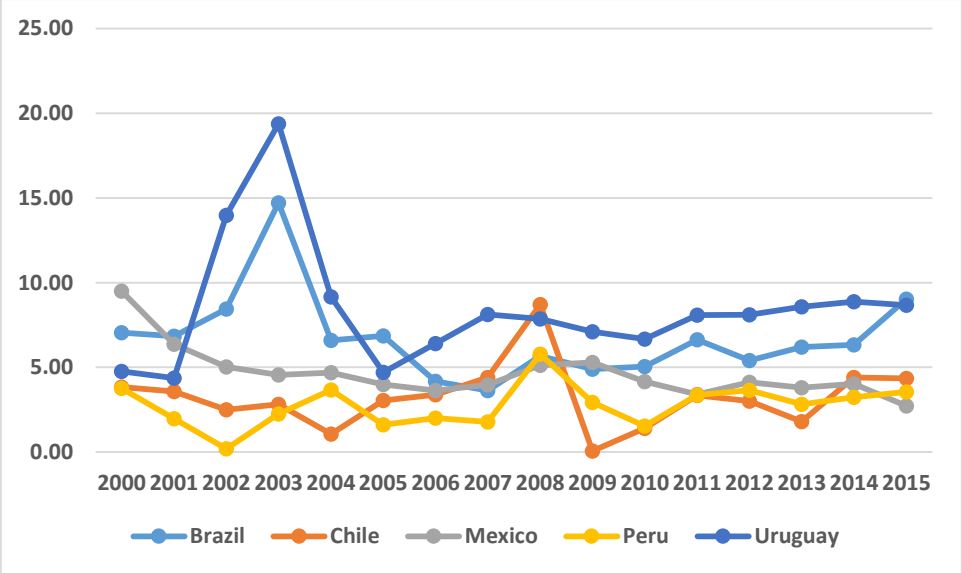


Source: World Development Indicators, The World Bank (2016)

The level of consumption prices has dissimilar evolutions within the different Latin American countries. Figure 4 shows the percent variation on the inflation level of consumer prices between 2000 and 2015. Uruguay and Brazil presented the highest variations in inflation during this period, while Chile and Peru controlled kept their inflation under low levels. Mexico has constantly decreased its inflation levels during this period, passing from a situation like Brazil's and Uruguay's to the lowest inflation level in 2015.

Shortly before the 2008 financial crisis several commodities saw increases in their prices, leading to inflationary pressure, during 2008, in Brazil, Chile, Peru and Mexico. Inflationary controls were implemented in almost all the countries in the region after the crisis, which lead price levels to reach their original stable trends in all the countries after 2009 until 2014. In 2015, Brazil prices rose to nearly 10.0% compared to its previous year price levels, being the only country in the analysis to report a raise in inflation on that magnitude since 2008.

Figure 4. Inflation consumer prices, percent variation, 2000-2015



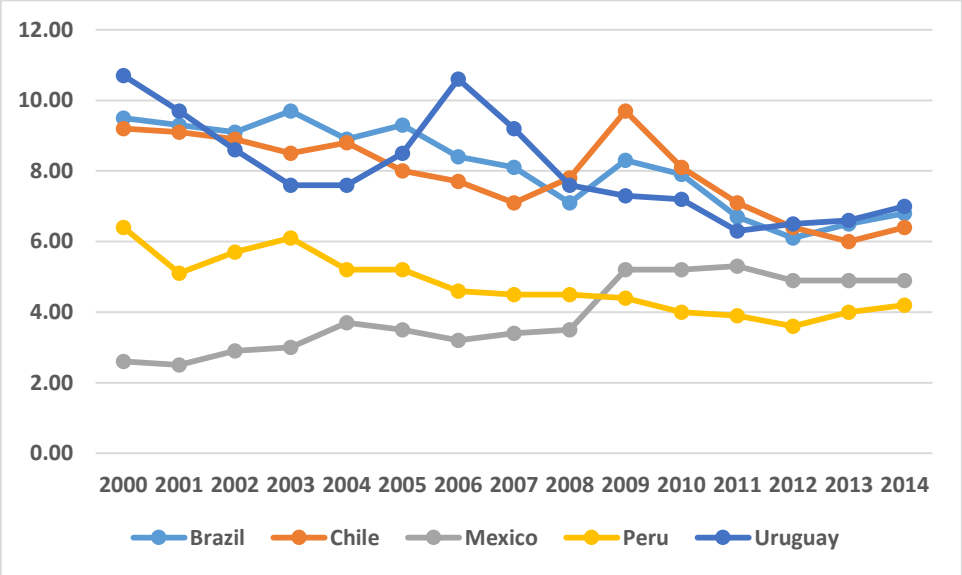
Source: World Development Indicators, The World Bank (2016)

Labour is the most important source of income within households in the Latin American region, representing on average more than 80% of the total income in households (ECLAC, 2007). Considering the lack of a strong welfare state present in the region, which could guarantee the coverage of the basic standards of living conditions, employment status becomes one of the most important survival

conditions for the population. Figure 5 shows the evolution of the unemployment rate for the five Latin American countries selected to analysis in the period 2000 to 2015. Brazil, Chile and Uruguay presented the highest level of unemployment during this period but experiencing downward trends, while Mexico and Peru had the lowest levels of unemployment. The financial crisis of 2008 had a lagged effect on the unemployment rate, increasing its level in almost all the countries by 2009 except on Peru and Uruguay.

After 2009 most of the countries followed a decreasing path on their unemployment until 2013, when a generalized increase in this indicator is observed. Mexico, on the other hand, had an important increase in its unemployment rate from 2009, keeping this trend since then over Peruvian levels. An important factor to take into consideration is that the estimation of unemployment in Latin America does not take into consideration conditions of informality or under-employment.

Figure 5. Unemployment rate, 2000-2015



Source: World Development Indicators, The World Bank (2016)

The financial crisis of 2008 had a deep negative influence in the world's economy, generating economic recession, uncertainty and unemployment. The Latin America area has not been the exception. However, due to the characteristics of this crisis, its impact has not felt immediately in this region but delayed, following the growth path of the US and China. In general terms, the region has experienced a slowdown of economic activity, without recovering its strength to pre-crisis levels. After 8 years

from the financial crisis, the economy in the Latin American region is not recovering; on the contrary, seems that the region has entered into a period of economic recession.

Moreover, not all the countries were affected in the same way. Countries more integrated to the US economy suffered the worst falls in productivity and rise of unemployment immediately after the economic shock occurred but recovering relatively faster than other countries, as the Mexican case shows. On the other hand, economies less integrated to the US but more integrated among them at regional level, or more dependent on exports to other emerging markets, present a delay on the negative impact of the, but delayed effects after few years, like the Brazilian, Chilean and Uruguayan cases. In conclusion, differentiated, country-specific evolutions of the middle class should be expected.

3. Methodology

The importance of the middle class in societies has been well documented by different scholars. History offers many examples of people from middle class backgrounds who had a deep influence in many aspects of social life (Boyle, 2013). According to Foster and Wolfson (2010), the middle class provides skilled workers to the labour market and plays an important role in consumption and the development of industrial economies. Thurow (1984) mentions the middle class as a moderator between rich and poor. Acemoglu and Robinson (2009) have suggested that relatively larger middle classes may explain why countries like Colombia or Costa Rica have had a longer history of uninterrupted democracy compared to their neighbours. They claim that a large middle class may act as a buffer against social conflict fed by potential demands of high level of redistribution by the poor and by temptation to face them with political repression by the rich (p. 256-8). Chakravarty (2015) concurs in that a solid middle class reduces the risk of political instability. Loayza *et. al.* (2012) have found an important link between a mature middle class and its influence in good political practices diminishing corruption.

However, despite the relevance of this social group, there is no consensus about its definition in the economic and sociological literature, leading to debate among scholars. The main focus of this debate concerns the approaches followed to define

those characteristics which determine if individuals or households belong to this social class, and the establishment of boundaries differentiating the middle class from other social groups.

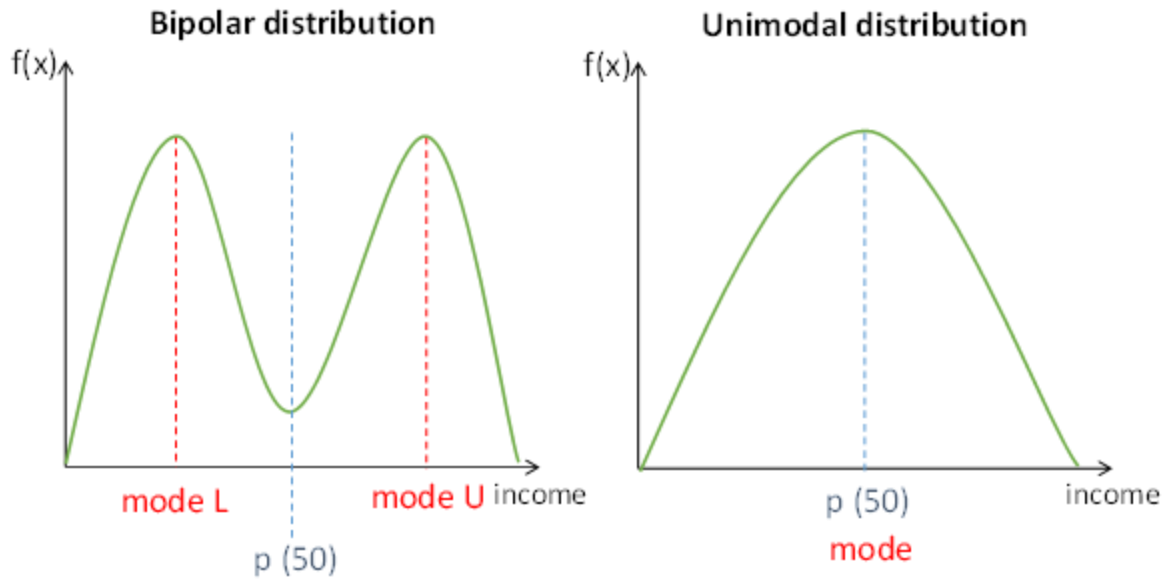
Traditionally, economists have defined the middle class in terms of wellbeing conditions, usually characterized as household income, in opposition to sociological approaches focused on socio-cultural characteristics. Motivated by the economic crises experienced during the 70's decade, economists looked into the definition of the middle class with particular interest, in order to see whether this social group was shrinking or expanding as an effect of the economic crisis at that time.

Initial definitions of the middle class proposed by economists suggested the delimitation of the income distribution with thresholds; then, those individuals within these boundaries were considered as middle class. We can call this type of definitions *absolute measurements*, with examples proposed by Thurow (1984), where the middle class was the percentage of population with income between 75% and 125% of the median, and by Levy (1987), who defined the middle class as the population in the three medium quintiles of a given distribution.

All absolute measurements, nevertheless, are subject of debate due to the arbitrary selection of thresholds. Foster and Wolfson (2010) raised this arbitrariness question when measuring changes of the middle class over time for the USA and Canada, and suggested the use of bipolarization approaches instead. Also related to the notion of convergence clubs (Quah, 1996), the bipolarization measurement approach estimates the degree of distributional bimodality around the median, giving an intuitive approximation to the size of the middle class.

Figure 6 shows two examples of distributions to illustrate the bipolarization approach. On the left panel, the distribution has two modes around the median, i.e. it is bipolar. By contrast, the distribution on the right panel exhibits only one mode over the median. If the middle class is the social group located at the middle of an income distribution, then a bipolar distribution would suggest a smaller middle class while a unimodal distribution around the median would suggest a larger middle class.

Figure 6. Differences on bipolar and unimodal distributions



We will measure the relative size of the middle class with a relative bipolarisation approach, in which the benchmark of minimum bipolarisation coincides with a situation of perfect equality, which in turn, represents the most “middle-classy” distribution. On the other extreme, maximum relative bipolarisation is attained when the bottom half of the population has zero incomes and the top half has an equal strictly positive amount (Yalonetzky, 2016). Moreover, Chakravarty (2015) mentions that any index of relative bipolarization ought to fulfil these basic axioms:

- Decreased spread: if a progressive transfer between two individuals always on opposite sides of the median renders them closer, then the transfer reduces the bipolarization level.
- Clustering-increasing: if a rank-preserving progressive transfer between two individuals on the same side of the median renders them closer, then the transfer increases the bipolarization level.
- Principle of population: if the whole population increases in a certain constant value, then the level of bipolarity will not change.
- Continuity: the index is a function of the continuous distribution of the wellbeing indicator.

- Scale invariance: if the unit of measurement of a wellbeing indicator is multiplied by a constant, then relative bipolarisation does not change. *This property is very helpful toward ensuring the comparability of bipolarisation values across countries and time periods.*

Foster and Wolfson (2010) proposed the measurement of relative bipolarization partitioning the distribution into two halves through the median. Their Gini-based relative bipolarisation index is:

$$FT = (G_B - G_w)\frac{\mu}{m} \quad \textbf{(1)}$$

Where G_B represents the between-group Gini index; G_w represents the within-group Gini index; μ is the total mean; and finally m is the median. However, Yalonetzky (2016) found that the *FT* index actually violates the basic transfer axioms of bipolarisation. Therefore, for this paper, the bipolarization index used is a version of the original one without the standardization by the median, as follows:

$$FT_{adj} = G_B - G_w \quad \textbf{(2)}$$

We also use an index which is a member from the following class derived by Wang and Tsui (2000):

$$WT = \frac{1}{N}\left[\sum_{i=1}^{\frac{N}{2}} a_i y_i^L + \sum_{i=1}^{\frac{N}{2}} b_i y_i^U\right] \quad \textbf{(3)}$$

Where the incomes, denoted by y, are ordered in the following way: $y_{\frac{N}{2}}^L \leq y_{\frac{N}{2}-1}^L \leq \cdots \leq y_2^L \leq y_1^L \leq m \leq y_1^H \leq y_2^H \leq \cdots \leq y_{\frac{N}{2}-1}^H \leq y_{\frac{N}{2}}^H$. Wang and Tsui show that the class in (3) satisfies the two transfer axioms (decreasing spread and clustering increasing) if and only if the weights a_i and b_i fulfil the following inequality: $a_1 < a_2 < \cdots < a_{\frac{N}{2}} < 0 < b_{\frac{N}{2}} < b_{\frac{N}{2}-1} < \cdots < b_2 < b_1$. Besides, in order for any index in (3) to be equal to a minimum value of zero only when perfectly equality holds, it must be the case that:

$$\sum_{i=1}^{\frac{N}{2}} a_i + \sum_{i=1}^{\frac{N}{2}} b_i = 0 \quad \textbf{(4)}$$

If we also want the indices in (3) to be equal to a maximum value of 1 only when maximum relative bipolarisation holds, then it must be the case that:

$$\sum_{i=1}^{\frac{N}{2}} b_i = \frac{N}{\mu_U} \qquad \textbf{(5),}$$

and:

$$\sum_{i=1}^{\frac{N}{2}} a_i = -\frac{N}{\mu_U} \quad \forall\ i \in \left[1, \frac{N}{2}\right] \ \textbf{(6)}$$

Even with the above constraints, there are plenty of sensible choices for a_i and b_i. We opt for the following option:

$$b_i = \frac{4\left[\frac{N}{2} - i + 1\right]}{\mu_U\left[\frac{N}{2} + 1\right]} = -a_i \ \textbf{(7)}$$

In addition to the two indices ((2) and (3)-(7)), we also check within each country whether the distributions of different years can be ranked robustly in terms of their relative bipolarisation. For this purpose we used the Relative Bipolarization Lorenz (RBL) proposed by Yalonetzky (2014), which represents bipolarization using some of the intuition behind Lorenz-type curves (Cowell, 2013). Its mathematical expression is:

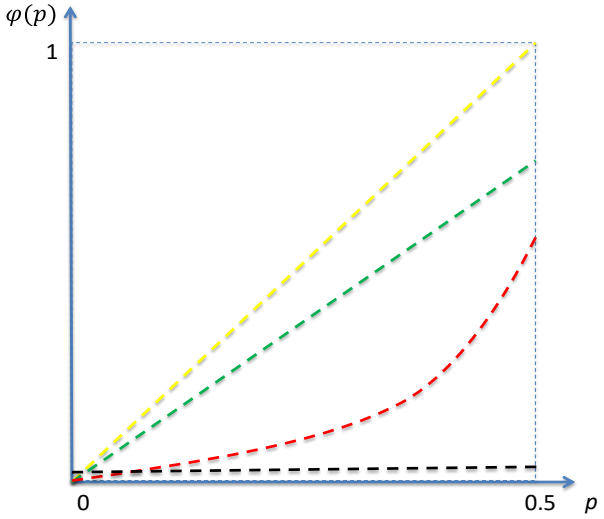
$$\psi(p) = \frac{\int_0^p [y_H(q) - y_L(q)]dq}{\mu};\ p \in [0,\ 0.5] \quad \textbf{(8)}$$

Where y_H and y_L represent the income levels of the population above and below the median, respectively, q a determined income percentile, and μ the mean of the distribution. The incomes are ordered so that: $0 \leq y_L(0.5) \leq \cdots \leq y_L(0) \leq m \leq y_H(0) \leq \cdots \leq y_H(0.5)$, where $y_L(0.5)$ and $y_H(0.5)$ are the lowest and highest income in the distribution, respectively. Then, this curve represents the differences between the mean of the p poorest individuals located above the median and the mean of the p richest individuals below the median, standardized by the total mean. Note also that $\psi(0.5)$ is equal to G_B multiplied by a constant.

The Figure 7 shows the different shapes that the RBL curve could take. The black dashed line overlapping with the horizontal axis represents the level of minimum bipolarity or perfect equality; the yellow dashed line shows a situation of maximum bipolarization. A straight line (green dashed) represents a perfect bimodality situation

but not the maximum bipolarity benchmark. Finally, any situation between perfect equality and maximum bipolarization, without perfect bimodality, is represented by the red dashed line.

Figure 7. The RBL curve



Source: Yalonetzky, 2014

Now, let the vertical difference between to RBL curves at a percentile i be given by:

$$Diff_i = RBL_{t1i} - RBL_{t2i} \quad \textbf{(9)}$$

where RBL_{t1i} and RBL_{t2i} represent values of a RBL curve in period 1 and 2, respectively, at the "*i-th*" percentile. Then Yalonetzky (2014) shows that If and only if $Diff_i \leq 0$ for all i (with at least one strict inequality) then RBL_{t2} will be more bipolarized and have a lower middle class than RBL_{t1}, according to any relative bipolarization index satisfying the key axioms (symmetry, population principle, scale invariance, decreasing spread, cluster increasing, and normalization axioms). If this condition holds, but with reverse sign, then RBL_{t1} will be more bipolarized and has lower middle class compared to RBL_{t2}. Otherwise, if the two RBL curves cross, then we cannot ascertain that one period is more bipolarised than another one for every relative bipolarisation index fulfilling the key axioms.

Finally, we also compute two traditional indices based on the older tradition of absolute measurement: the Thurow index and the Levy index. Their definitions have already been described at the beginning of this section.

4. Data

In order to guarantee comparability, we require homogeneous series of income data at the household level, i.e. without any major methodological changes on data collection over time. In the Latin American region, this type of statistical information is not always available for all countries, limiting the outreach of this work.

After examining household surveys in the region, five Latin American countries were selected: Brazil, Chile, Mexico, Peru and Uruguay. Their household surveys offer detailed information on household's income, statistical representativeness at urban and rural areas, and enough observations over time. These surveys are also of public access, and their micro-datasets are free to download from each country's national statistics institute website.

These surveys offer different type of households' income information according to local requirements of information. Nevertheless, all of them provide information about total household income per month, along with the total number of household members. Thus, we compute current total monthly per capita household income, dividing total household income by the total number of household members.

Even though for several surveys we have inflation-adjusted data, we can actually use nominal income directly if necessary, instead of deflated values, thanks to the scale invariance property satisfied by all relative bipolarisation indices.

The time period for analysis was established according to data availability. Only two countries provided information since 1990, while more countries have frequent series of data since early 2000. Then, the analysis time frame ranges from 2000 to 2014, depending on the country data availability. In the following section, a detailed description of all the micro-datasets for each country used in this work is provided, as well as basic descriptive statistics of per capita household incomes for each year.

Brazil

The *Instituto Brasileiro de Geografia e Estadistica* (Brazilian Institute of Geography and statistics - IBGE) publishes the *Pesquisa Nacional por Amostra de Domicilios* (National Survey by Household Sampling – PNAD) every year since 2004 until the latest dataset available for 2014, except for the year 2010 when the survey was not

collected due to overlapping with the Census data. Descriptive statistics of household per capita income in real Brazilian Real (BRL) are shown in Table 1.

Table 1. Real* monthly household per capita income, Brazil 2004 – 2014

Year	Observations	Mean	Median	Minimum	Maximum	Gini
2004	110,351	475.57	260.00	0.00	61,250.00	0.5784
2005	114,576	499.36	278.93	0.00	61,017.55	0.5749
2006	116,334	538.32	302.18	0.00	91,568.37	0.5675
2007	115,112	552.68	321.11	0.00	52,784.68	0.5596
2008	114,822	585.44	342.57	0.00	123,822.14	0.5545
2009	117,827	597.93	354.41	0.00	74,394.86	0.5497
2011	106,449	631.57	382.22	0.00	87,664.75	0.5359
2012	110,508	680.64	413.73	0.00	120,241.22	0.5318
2013	111,029	693.84	423.97	0.00	51,276.99	0.5271
2014	115,021	722.76	426.96	0.00	195,317.89	0.5227

Source: own estimations using the PNAD micro-dataset for each year (IBGE, 2016).
*Note: Real income estimation is based on an average value of the Brazilian National Price Index (ĬNPC) per year, published by the IBGE. Base year 2004.

This survey has an average sample size of 113,203 households interviewed every year, which reported any income during this period. Households which did not report any income were taken out of the analysis. The real household per capita income has constantly increased on average in 52.0% during this period, increasing the median from 260.00 to 426.96 BRL. The minimum income reported was 0.00 RBL while the maximum income reported was 195,317.89 RBL. Gini inequality has constantly decreased during this period, moving from 0.5784 in 2004 to 0.5227 in 2014.

Chile

In the Chilean case, the national Ministry of Social Development collects and publishes the *Encuesta de Caracterizacion Socioeconomica Nacional* (National Survey for Socioeconomic Characterization - CASEN), in order to obtain information about poverty and income distribution. This survey is conducted every 2 or 3 years since 1990. The years selected for analysis in terms of income comparability are 2000, 2003, 2006, 2009 and 2011. Descriptive statistics of household per capita income in real Chilean Pesos (CLP) are shown in Table 2.

Table 2. Real* monthly household per capita income, Chile 2000 – 2011

Year	Observations	Mean	Median	Minimum	Maximum	Gini
2000	64,650	78,677.69	38,556.07	46.04	39,961,317.54	0.6086
2003	68,153	132,090.51	73,676.99	0.00	41,177,599.24	0.5451
2006	73,720	147,803.21	87,122.83	0.00	30,154,164.08	0.5192
2009	71,460	150,269.20	95,992.01	0.00	12,339,736.61	0.4824
2011	86,854	257,466.60	151,517.78	0.00	45,930,776.00	0.5133

Source: own estimations using the CASEN micro-dataset for each year (MSD-Chile, 2016).
*Note: Real income estimation is based on an average value of the Chilean Price Index (IPC) per year, published by the National Institute of Statistics (ĬNE). Base year 2004.

The CASEN survey has an average sample size of 72,967 households every year. The average household per capita income has increase in real terms 227.2% from 2000 to 2011, and the median has increased from 38,556.07 to 151,517.78 CLP. The minimum income registered in the period was 0.00 CLP, while the maximum income reported was 45,930,776.00 CLP in 2011. Finally, Gini inequality has constantly decreased from 0.6086 in 2000 to 0.4824 in 2009, but then it increased in 2011 to 0.5133.

Mexico

For Mexico, the National Institute for Statistics and Geography (INEGI) captures and publishes the *Encuesta Nacional de Ingresos y Gastos de los Hogares* (National Household Incomes and Expenditures Survey - ENIGH), with a biannual periodicity, plus the year 2005, since 1992 to 2012. However, due to comparability purposes, this analysis only considers the surveys from 2000 to 2012. The main objective of this survey is to provide information about the incomes and expenditures of Mexican households, but not to measure the official poverty index. Descriptive statistics of household per capita incomes in real Mexican Pesos (MXN) are shown in Table 3.

Table 3. Real* monthly household per capita income, Mexico 2000 – 2012

Year	Observations	Mean	Median	Minimum	Maximum	Gini
2000	10,108	7,436.92	4,524.92	144.32	361,072.22	0.5197
2002	17,167	7,462.67	4,619.09	162.41	2,451,120.92	0.5073
2004	22,595	9,861.72	5,634.25	119.26	3,572,218.50	0.5420
2005	23,174	8,974.71	5,235.50	0.00	962,697.90	0.5331
2006	20,875	9,572.65	5,725.76	0.00	491,590.31	0.5188
2008	29,468	9,941.99	5,846.05	0.00	3,693,558.43	0.5269
2010	27,655	8,369.87	5,211.22	0.00	515,132.48	0.5025
2012	9,002	8,340.45	5,046.66	164.84	570,154.72	0.5039

Source: own estimations using the ENIGH micro-dataset for each year (INEGI, 2016).

*Note: Real income estimation is based on an average value of the Mexican National Price Index (ÍNPC) per year, published by INEGI. Base year 2004.

The average sample size in ENIGH was of 21,577 households. However, in 2012 it decreased to 9,002. This dramatic fall in the sample size was a result of the introduction of a new official methodology to measure poverty which requires a new survey not comparable to the ENIGH series. The sample design was developed in 2012 to compensate this fall in the sample size and to make all the series comparable.

During this period, real average household per capita income increased 12.1%, while the median increased from 4,524.92 to 5,046.66 MXN. The minimum income in the period was 0.00 MXN while the maximum income registered in the period was 3,693,558.43 MXN in 2008. Gini inequality increased at the middle of the series from 0.5197 in 2000 to 0.5420 in 2004, but then decreased to 0.5039 in 2012.

Peru

In Peru, the National Institute of Statistics and Informatics (INEI) elaborates the *Encuesta Nacional de Hogares sobre Condiciones de Vida y Pobreza* (National Survey of Households Living Conditions and Poverty - ENAHO). The main objective of this survey is to assess the households' socioeconomic conditions, and was implemented every year from 1995 to 2014; however, for comparability analysis, this study focuses on the years 2004 to 2014. The descriptive statistics of household per capita incomes in real Peruvian Nuevo Sol (PEN) are shown in Table 4.

Table 4. Real* monthly household per capita income, Peru 2004 – 2014

Year	Observations	Mean	Median	Minimum	Maximum	Gini
2004	19,502	4,247.98	2,601.01	0.00	316,435.47	0.5188
2005	19,895	4,191.03	2,485.32	5.90	370,051.91	0.5314
2006	20,577	4,661.51	2,805.59	0.00	207,604.01	0.5297
2007	22,204	5,412.22	3,236.69	0.00	340,085.60	0.5352
2008	21,502	5,677.55	3,533.13	0.00	339,043.51	0.5226
2009	21,753	5,918.85	3,643.03	0.00	269,427.56	0.5199
2010	21,496	6,175.05	4,004.06	51.44	286,641.20	0.4988
2011	24,809	6,468.66	4,280.29	60.55	314,222.79	0.4969
2012	25,091	6,634.05	4,482.05	68.82	443,498.78	0.4863
2013	30,453	6,935.28	4,613.10	0.00	288,427.30	0.4866
2014	30,848	7,153.88	4,685.43	0.00	711,791.72	0.4894

Source: own estimations using the ENAHO micro-dataset for each year (INEI, 2016).
*Note: Real income estimation is based on an average value of the Peruvian Price Index (IPC) per year, published by INEI. Base year 2004.

During this period, the ENAHO had an average sample size of 23,466 households. Real household per capita income has increased 68.4% during this period, and the median increased from 2,601.01 in 2004 to 4,685.43 PEN. The minimum household per capita income value registered was 0.00 PEN, while the maximum value was registered in 2014 as 711,791.72 PEN. Finally, Gini inequality has decreased during this period, from 0.5188 in 2004 to 0.4894 in 2014.

Uruguay

The Uruguayan National Institute of Statistics (INE) publishes every year the *Encuesta Continua de Hogares* (Continuous Households Survey – ECH), since 1968 to 2015; however, comparable micro-datasets published by INE are available from 2006. The main objectives of this survey is to collect relevant information about the labour market, household incomes, and the living conditions among the population. Descriptive statistics of household per capita incomes in real Uruguayan Peso (UYU) are shown in Table 5.

Table 5. Real* monthly household per capita income, Uruguay 2006 – 2015

Year	Observations	Mean	Median	Minimum	Maximum	Gini
2006	85,313	5,367.53	3,800.90	0.00	262,098.09	0.4378
2007	49,136	6,646.06	4,605.71	0.00	357,157.42	0.4504
2008	50,397	7,229.29	5,118.44	0.00	378,233.42	0.4364
2009	46,936	7,987.65	5,575.23	0.00	563,093.09	0.4413
2010	46,550	8,190.79	5,837.51	0.00	409,919.51	0.4273
2011	46,669	8,372.32	6,168.56	0.00	288,859.10	0.4074
2012	43,839	8,680.88	6,521.59	0.00	485,533.23	0.3976
2013	46,622	8,798.25	6,718.09	0.00	526,223.87	0.3871
2014	48,583	9,244.03	7,018.96	0.00	272,129.59	0.3878
2015	45,391	9,498.61	7,116.66	0.00	574,147.92	0.3992

Source: own estimations using the ECH micro-dataset for each year (INE, 2016).
*Note: Real income estimation is based on an average value of the Uruguayan Price Index (IPC) per year, published by the INE. Base year 2004.

The ECH average sample size during this period has been 50,944 households. In this period, the average per capita household income has increased 77.0%, and the

median rose from 3,800.90 to 7,116.66 UYU between the years 2006 to 2015. The minimum income value reported was 0.00 UYU while the maximum value reported was 574,147.92 UYU during 2015. Gini inequality decreased significantly, from 0.4378 in 2006 to 0.3992 in 2015.

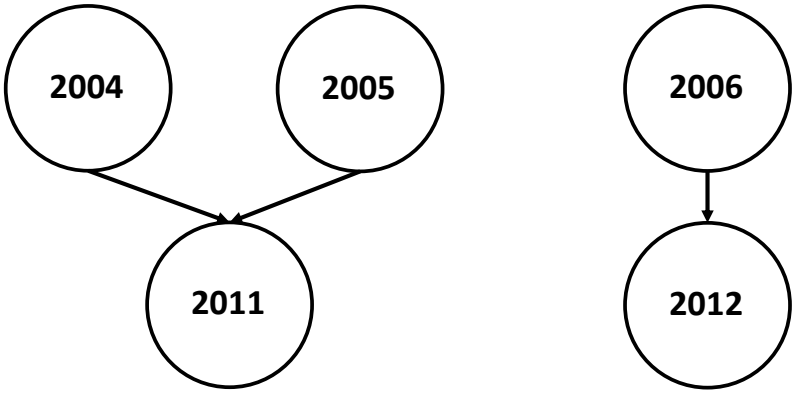
5. Results

Firstly, we computed the RBL curves for all country-years, and then compared them in order to detect any robust relative bipolarisation comparisons. Since, as happens often with similar comparisons of distributional curves (e.g. Lorenz curves) in the empirical literature, the differences between RBL curves are usually are very small and difficult to observe in graphs.

Therefore, the robustness relationships are represented by Hasse diagrams. These diagrams represent a relationship of dominance among elements in one set, one year vis-a-vis another in this case, which is identified by the arrows' direction, and also represents transitivity between more than two years, fulfilling the basic properties of partial ordered sets (reflexive, transitive and antisymmetric; Kolmogorov and Fomin, 1970). In the case when a pair of RBL curves cross, those years simply do not appear related to each other in the diagram.

Diagram 1 represents the Brazilian case of stochastic dominance among RBL curves. From all the possible pairwise comparisons of years, the relationships 2004-2011, 2005-2011, and 2006 to 2012, were the only clear cases without curves crossings. A first interpretation of this Figure is that bipolarization has *robustly* diminished from 2004 and 2005 to 2011, and from 2006 to 2012. These results seems to be consistent with the reduction in inequality shown in the Gini index.

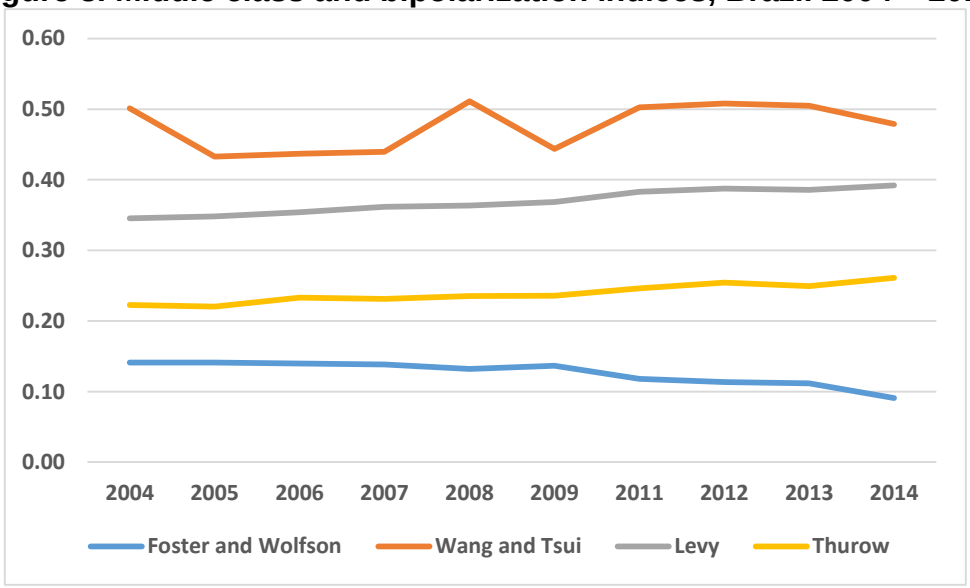
Diagram 1. Hasse diagram of RBL dominance, Brazil 2004 – 2014



Source: own estimations using the PNAD micro-dataset for each year (IBGE, 2016)

These results are also consistent with the estimation of the two relative bipolarization indices, but contrast with more traditional definitions of middle class as the Levy and Thurow indices show. Figure 8 present the evolution of these middle class indices between 2004 and 2014. While our versions of the Foster-Wolfson and the Wang-Tsui indices were decreasing, meaning less bipolarization, the Levy and Thurow indices where increasing over this period.

Figure 8. Middle class and bipolarization indices, Brazil 2004 – 2014



Source: own estimations using the PNAD micro-dataset for each year (IBGE, 2016)

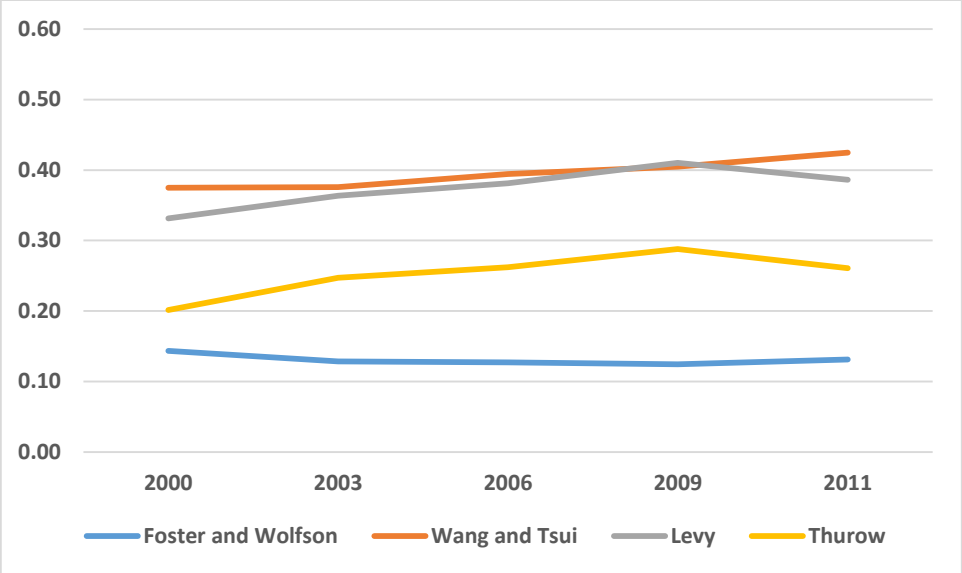
An important issue to highlight is that the bipolarization trend was not immediately affected in 2008, the year of the crisis' outburst; there seems to have been a lagged

effect until 2011 and 2012. The values for all these indices are reported in the Appendix, Table A.I.

On the other hand, in the Chilean case all possible combinations of years experienced crosses among the LRB curves. Therefore, there is no possible to determine any dominance relationship between those years and the rankings stemming from bipolarization comparisons depend on the choice of bipolarisation index. In other words, we cannot ascertain any bipolarisation trend robustly during the period.

The Figure 9 presents the trends followed by the four indices measuring the evolution of the middle class in Chile during the period of analysis. A clear difference in trends is drawn between the bipolarization indices and the traditional measures of middle class. All these indices are reported in Annex A.II.

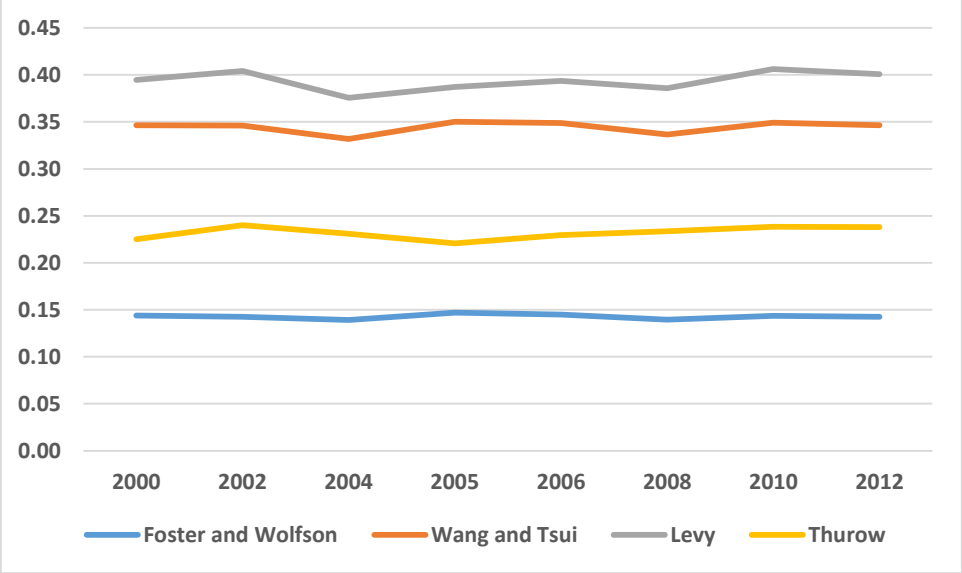
Figure 9. Middle class and bipolarization indices, Chile 2000 – 2011



Source: own estimations using the CASEN micro-dataset for each year (MSD-Chile, 2016)

The Mexican case is similar to the Chilean. The RBL curves crossed for all possible pairwise year comparisons. The Figure 10 shows the movements of the four indices of bipolarization and middle class identification, showing no significant change in levels for any index during this period. The estimated values for all of these indicators is available in the Annex, Table A.III.

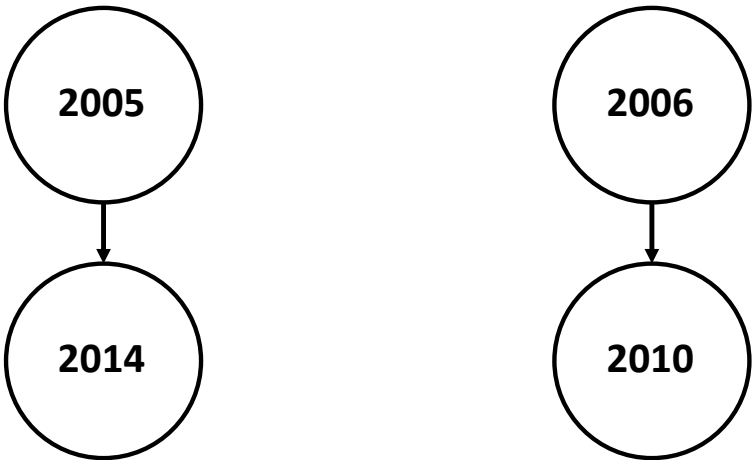
Figure 10. Middle class and bipolarization indices, Mexico 2000 – 2012



Source: own estimations using the ENIGH micro-dataset for each year (INEGI, 2016)

The Peruvian analysis of RBL curves, in Diagram 2, shows stochastic dominance of 2005 over 2014 and of 2006 over 2010, meaning a high degree of bipolarization before the 2008 economic crisis, and a less bipolarized society after the crisis. A relatively constant decrement on the inequality levels in the country seems to support these results. These changes, nevertheless, are reported some time before and after the economic crisis of 2008, suggesting a delayed effect of this crisis in Peru.

Diagram 2. Hasse diagram of RBL dominance, Peru 2004 – 2014

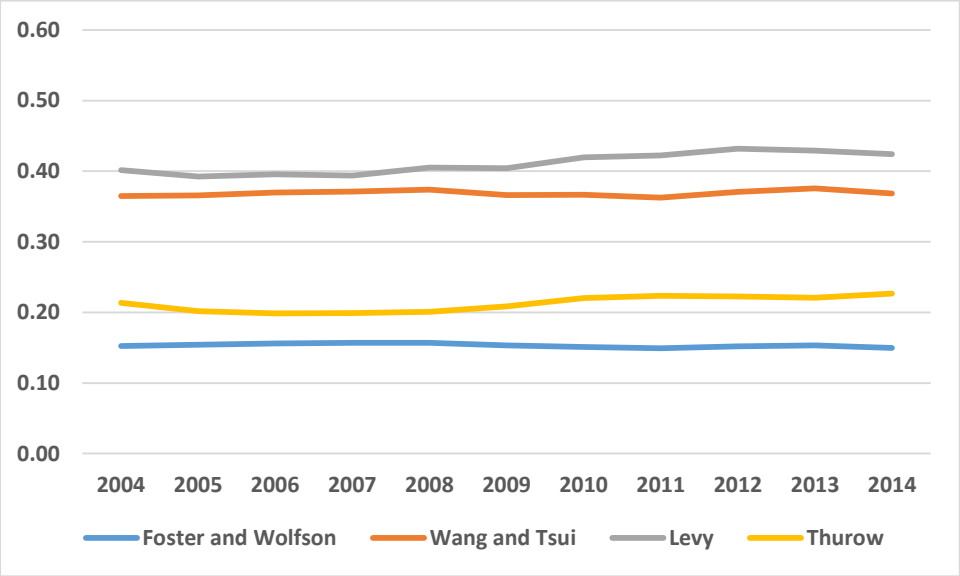


Source: own estimations using the ENAHO micro-dataset for each year (INEI, 2016)

The Peruvian indices for middle class show a mirror effect between the Levy and Thurow, and the bipolarization indices. They also report a small variation during the

period of analysis. These results could be seen in the Figure 11. The table of values for all these indices is presented in Annex A.IV.

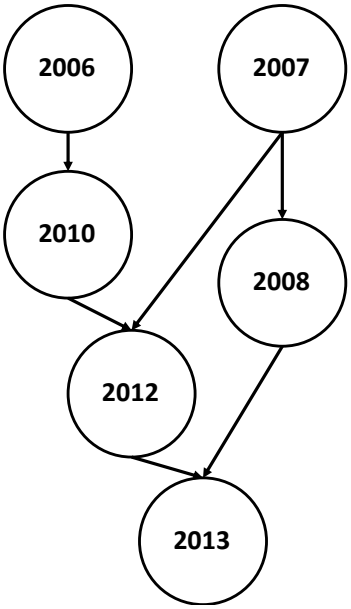
Figure 11. Middle class and bipolarization indices, Peru 2004 – 2014



Source: own estimations using the ENAHO micro-dataset for each year (INEI, 2016)

In the case of Uruguay, the RBL curve analysis shows several robust relationships characterized by earlier years dominating more recent years, i.e. a process of decrement on bipolarization, which show an expansion on the middle class. Diagram 3 represents the Hasse diagram of the RBL dominance analysis. This phenomena seems not to be related with the economic crisis of 2008 because it has been ongoing since the beginning of the series. 2013 is robustly less bipolar rather than all the preceding years, except for 2009 and 2011.

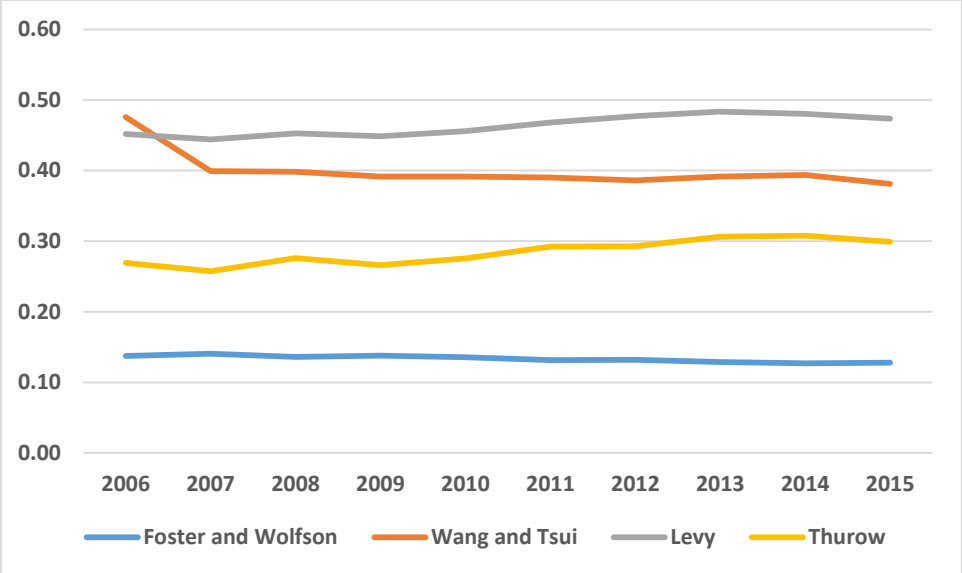
Diagram 3. Hasse diagram of RBL dominance, Uruguay 2006 – 2015



Source: own estimations using the ECH micro-dataset for each year (INE, 2016)

Figure 12 shows the bipolarization indices estimated for Uruguay from 2006 to 2015, where bipolarization indices are falling down over time. This result could be explained due to Uruguay has the lowest levels of inequality among the countries analysed in this paper. Moreover, inequality in Uruguay decreased constantly during this period.

Figure 12. Bipolarization indices, Uruguay 2006 – 2015



Source: own estimations using the ECH micro-dataset for each year (INE, 2016)

6. Conclusions

The aim of this paper is to analyse the evolution of the middle class in five Latin American countries (Brazil, Chile, Mexico, Peru, and Uruguay) before and after the 2008 financial crisis. For this purpose we relied on a relative bipolarization approach (Foster and Wolfson, 2010; Yalonetzky, 2014), but absolute measurements (Thurow, 1984; Levy, 1987) were also estimated in order to compare results.

The financial crisis of 2008 was one of the most devastating events in the modern economic history since the crash of 1929. Its negative effects were spread worldwide and nowadays, after 8 years of its outburst, the world economy is still under a process of recession and slow recovery. The Latin American region was not exempted from the negative outcomes of this crisis; however, due to its particular characteristics, this region was not immediately affected, rather falling progressively into a recession process. Moreover, countries within this region were affected in different ways accordingly to their degree of engagement to the US economy and other world and emerging markets.

Our empirical results show different stories among these countries. However, a trend on reduction of bipolarization after the 2008 financial crisis is clear. These results are consistent with the reduction on inequality observed in the Gini index trends for all the countries. Results also suggest that reductions in inequality brought about greater spread effects rather than clustering effects, i.e. inequality between groups is falling faster than within groups for those countries in which bipolarization goes down.

Then, following a bipolarization approach to define the evolution of the middle class in terms of total per capita household income, an increase of the middle class in Latin America is observed after the 2008 economic crisis. These results are consistent with the World Bank report on economic mobility and middle class in Latin America, which finds a reduction in extreme poverty and an increase of income among the population of low income, leading to a rise of a middle class in the region during the last 15 years (Ferreira et. al., 2013).

This empirical analysis is not intended to find a causal relationship between the 2008 financial crisis and the evolution of the middle class but to analyse the trends on

bipolarization before and after this crisis. In some countries, like Mexico and Chile, trends seem to show a closer relationship between the timing of the onset of the 2008 financial crisis and the evolution of the middle class; while in other countries like Brazil and Peru this relationship seems to be delayed. On the other hand, the downward bipolarization trend in Uruguay seems to be unrelated to the crisis.

Future agenda on this work consist in the development of statistical tests for the RBL curves in order to assess the stochastic dominance relationships considering sampling and estimation errors. Considering that the geometry and intuition behind the RBL curve is similar to the Lorenz curve, a whole family of indicators could be derived to estimate the severity of changes in bipolarity between years. Moreover, the estimation of clustering and spread effects is an intrinsic challenge in order to obtain a clearer lecture of the bipolarization dynamics. Finally, the inclusion of new countries to the analysis is always an ambitious goal to achieve, restricted by data availability; the comparison with the situation in the US and Canada could enlighten on the crisis and post-recession process.

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Appendix

Table A.I. Bipolarization indices Foster and Wolfson, Wang and Tsui, and middle class definitions of Levi and Thurow for Brazil, 2004-2014

Year	Foster and Wolfson	Wang and Tsui	Levy	Thurow
2004	0.1410	0.5011	0.3453	0.2227
2005	0.1410	0.4327	0.3482	0.2203
2006	0.1395	0.4369	0.3540	0.2331
2007	0.1381	0.4396	0.3618	0.2311
2008	0.1321	0.5111	0.3636	0.2354
2009	0.1367	0.4435	0.3683	0.2356
2011	0.1181	0.5023	0.3832	0.2463
2012	0.1136	0.5080	0.3874	0.2541
2013	0.1117	0.5048	0.3859	0.2493
2014	0.0908	0.4792	0.3921	0.2612

Source: own estimations using the PNAD micro-dataset for each year (IBGE, 2016)

Table A.II. Bipolarization indices Foster and Wolfson, Wang and Tsui, and middle class definitions of Levi and Thurow for Chile, 2000-2011

Year	Foster and Wolfson	Wang and Tsui	Levy	Thurow
2000	0.1432	0.3749	0.3315	0.2015
2003	0.1284	0.3760	0.3635	0.2473
2006	0.1272	0.3945	0.3813	0.2621
2009	0.1243	0.4048	0.4104	0.2879
2011	0.1314	0.4248	0.3863	0.2606

Source: own estimations using the CASEN micro-dataset for each year (MSD-Chile, 2016)

Table A.III. Bipolarization indices Foster and Wolfson, Wang and Tsui, and middle class definitions of Levi and Thurow for Mexico, 2000-2012

Year	Foster and Wolfson	Wang and Tsui	Levy	Thurow
2000	0.1441	0.3463	0.3945	0.2251
2002	0.1427	0.3460	0.4040	0.2401
2004	0.1392	0.3317	0.3756	0.2308
2005	0.1470	0.3502	0.3871	0.2206
2006	0.1450	0.3488	0.3937	0.2295
2008	0.1396	0.3365	0.3859	0.2338
2010	0.1435	0.3491	0.4063	0.2383
2012	0.1425	0.3463	0.4009	0.2382

Source: own estimations using the ENIGH micro-dataset for each year (INEGI, 2016)

Table A.IV. Bipolarization indices Foster and Wolfson, Wang and Tsui, and middle class definitions of Levi and Thurow for Peru, 2004-2014

Year	Foster and Wolfson	Wang and Tsui	Levy	Thurow
2004	0.1524	0.3647	0.4013	0.2134
2005	0.1541	0.3658	0.3924	0.2016
2006	0.1558	0.3698	0.3956	0.1986
2007	0.1570	0.3711	0.3937	0.1990
2008	0.1570	0.3739	0.4052	0.2010
2009	0.1531	0.3664	0.4043	0.2086
2010	0.1512	0.3664	0.4194	0.2204
2011	0.1492	0.3625	0.4226	0.2235
2012	0.1517	0.3706	0.4317	0.2225
2013	0.1531	0.3758	0.4290	0.2209
2014	0.1498	0.3683	0.4240	0.2268

Source: own estimations using the ENAHO micro-dataset for each year (INEI, 2016)

Table A.V. Bipolarization indices Foster and Wolfson, Wang and Tsui, and middle class definitions of Levi and Thurow for Uruguay, 2006-2015

Year	Foster and Wolfson	Wang and Tsui	Levy	Thurow
2006	0.1373	0.4758	0.4520	0.2691
2007	0.1408	0.3993	0.4440	0.2575
2008	0.1359	0.3986	0.4525	0.2762
2009	0.1378	0.3916	0.4488	0.2659
2010	0.1357	0.3915	0.4561	0.2758
2011	0.1317	0.3903	0.4681	0.2922
2012	0.1322	0.3860	0.4773	0.2926
2013	0.1290	0.3917	0.4834	0.3064
2014	0.1269	0.3938	0.4806	0.3078
2015	0.1277	0.3810	0.4737	0.2992

Source: own estimations using the ECH micro-dataset for each year (INE, 2016)