

TOGETHER OR PILED UP. A NEW APPROACH TO  
MERCOSUR'S LIFETIME

*JUNTOS O AMONTONADOS. UNA NUEVA APROXIMACIÓN  
A LA TRAYECTORIA DEL MERCOSUR*

*Germán Héctor González*

Universidad Nacional del Sur, Argentina  
[ghgonza@uns.edu.ar](mailto:ghgonza@uns.edu.ar)

*Fernando Delbianco*

Universidad Nacional del Sur, Argentina  
[fernando.delbianco@uns.edu.ar](mailto:fernando.delbianco@uns.edu.ar)

Recibido: febrero de 2020, aceptado: junio de 2020

ABSTRACT

For some time now, the difficulties in consolidating the MERCOSUR are no longer new. Today, economic and political instabilities appear to be the only sustainable and common facet in Latin American countries. Therefore, it is interesting to discuss with some evidence whether MERCOSUR is an institution that evolves consistently with its objectives despite the circumstances, or whether MERCOSUR is just a set of countries that like leaves pile up according to wind and luck. We addressed the periodization of MERCOSUR's lifetime based on a new approach. The main contribution of this paper is a precise delimitation of the stages in the evolution of the MERCOSUR from a method that reduces the risk of diverse types of biases. In fact, we showed evidence in favor of the first characterization, but the second prevails.

*Keywords:* periodization, multivariate techniques, integration, regionalism, MERCOSUR.

## RESUMEN

Desde hace tiempo a esta parte, no son nuevas las dificultades que enfrenta el MERCOSUR para consolidarse. Hoy en día, las inestabilidades políticas y económicas parecen ser las únicas facetas comunes y sustentables de los países latinoamericanos. Por lo tanto, resulta interesante discutir en base a la evidencia si el MERCOSUR es una institución que evoluciona consistentemente con sus objetivos a pesar de las circunstancias, o si el MERCOSUR es solo un conjunto de países que, como las hojas, se amontonan de acuerdo al viento y la suerte. Para ello, se propone una periodización basada en un nuevo enfoque. La principal contribución del artículo es una delimitación precisa de la evolución del MERCOSUR a partir de un método que reduce el riesgo de cometer diferentes tipos de sesgos. De hecho, se ofrece evidencia a favor de la primera caracterización, aunque la segunda es la que prevalece.

*Palabras clave:* periodización, técnicas multivariantes, integración regional, regionalismo, MERCOSUR.

*Clasificación JEL / JEL classification:* F15, C14, N46, N76.

## 1. INTRODUCTION

The tree forges its destiny from the root and despite the hostility of the environment or its own weaknesses. On the floor, the leaves swirl with the wind, at times deceptively so well stacked that seems the result of their own will.

For some time now, the difficulties in consolidating the MERCOSUR are no longer new. Even in several moments, the debate seemed exhausted and the events presaged the end of the treaty. Today, when economic and political instabilities appear to be the only sustainable and common facet in Latin American countries, it is interesting to try to answer the following question. Is the MERCOSUR an institution that evolves, like the tree, consistently with its objectives despite the circumstances, or is MERCOSUR just a set of countries that like the leaves pile up according to wind and luck?

The main purpose is to respond to that question based on the periodization of MERCOSUR's evolution. Periodization is the process of categorizing the past into discrete, quantified named blocks of time in order to facilitate the study and analysis of history (Rabinowitz, 2014). However, our perception could be affected by the changes of scenarios, our reaction to the temperament of the politicians and the mood of the citizens, and even according to our own personal history. In order to simplify the problem of the neutrality, we approached the issue quantitatively from a new periodization proposal. We used an alternative method of periodization that consists in characterizing and grouping the time units according to relatively stable characteristics associated to appropriate indicators.

Our work used statistical information related to the evolution of the trade flows between the founding countries of MERCOSUR for the period 1983-2015, and the decomposition of the Kojima's intensity indicator proposed by Drysdale (1969). We determined the periodization taking the time units (1983 to 2015) as the described variable and through a combination of K-means clustering and MANOVA on the set of indicators of geographical bias. The main contribution of this paper is a precise delimitation of the stages in the evolution of the MERCOSUR from a method that reduces the risk of diverse types of biases, and based on bilateral trade statistics that are jointly determined by complementarity and institutional factors.

The following section is divided into two parts. The first part describes MERCOSUR briefly and presents some periodizations of its evolution proposed

by specialists. The second part shows the indicator and its decomposition, the multivariate techniques and the data sources, in that order. The third section provides the results and the fourth section discusses it with the literature. The fourth section presents the final considerations.

## 2. MERCOSUR REVIEW AND EMPIRICAL APPROACH

### 2.1. MERCOSUR

Despite the fact that a trade agreement between Argentina and Brazil was a repeated proposal since Bunge's reconsideration of the *Union Aduanera del Sur* (Bunge, 1929), it began to take shape between the years 1983 to 1985. During this period, both countries recovered their democracy after several years of military intervention, but faced the urgency of reorienting their economies given the enormous weight of the external debt, the lack of international financing, and the need to make large investments to modernize their economies and face global competition. The governments of both countries believed that the development path would only be possible if they take it associated.

According to Caetano (2011), there is a history of MERCOSUR prior to the 1991 founding treaty. The Foz de Iguazú Act of November 1985, signed by presidents Sarney for Brazil and Alfonsín for Argentina, synthesized that sort of prehistory of MERCOSUR. During the following year, both presidents took a further step forward with the signing of two central acts: the first was the PICE (Programa de Integración y Cooperación Económica Argentina-Brasil), an attempt to achieve a gradual and flexible trade convergence between both countries vis-à-vis third markets. The second was the Argentina-Brazil Friendship Act: Democracy, Peace and Development, which manifested the political will to ensure the success of that agenda.

In 1988 Brazil and Argentina accepted Uruguay's incorporation into the integration process through the Alborada Act. Paraguay, on the other hand, maintained stable political and economic relations with Brazil from the negotiations for the construction of the binational Itaipú dam. In contrast, relations between Argentina and Paraguay were tense during the Alfonsín period, a situation that did not change until 1989 when Paraguay recovered its democracy.

Accompanying the new ideological wave and convinced of the need to deepen the process, Menem for Argentina and Collor de Mello for Brazil signed the Buenos Aires Act in 1990, an agreement that promised a common market formed by both economies. The Treaty of Asunción, signed in 1991 by the previous presidents, as well as Rodríguez for Paraguay and Lacalle for Uruguay, finally redefined that area and created the MERCOSUR.

Between MERCOSUR specialists (about which we will return in the discussion section) there is agreement in pointing the sub-period 1991-1994, that is from the Treaty of Asunción to the Ouro Preto Protocol, as the initial stage of MERCOSUR, and the sub-period 1994-1998 as the “age of gold” or “apogee” in trading terms. While in the first one the gradual, automatic and linear dismantling of the tariff restrictions on the exchange of goods was “successful”, during the next one the common external tariff was established and there were some significant legal advances -mainly, the international legal status-.

However, some authors agreed that, during this second stage, “the gap between the commitments adopted and their effective implementation was increasing” (Bouzas 2001), and trading success was due to the momentum generated by the private sector. In fact, Botto (2015) characterized the sub-period 1995-2002 as “institutional deconstruction”.

There are differences in marking the end of the golden stage or “Phoenician MERCOSUR” (Caetano 2011), despite agreeing that the devaluation of the Real in Brazil in 1999 was critical. That year started a stage of “turbulence” and “crisis” in which the four countries appealed to unilateral decisions, safeguards or bilateral negotiations. According to Caetano, governments did not have the political margin to redirect the integration process. However, the alarm about the progress transcended governments and the most affected interest groups explicitly demanded greater coordination and compliance with the treaty signed (Cimadamore 2001).

During 2000, several agreements tried to strengthen the customs union both internally and externally. The called “Mercosur Re-launch” program caused favorable expectations for a while. However, according to Caetano, it was not until the Convertibility crisis in Argentina, and the consequent 2002 Uruguayan crisis, that governments were not aware of the strong interdependence and the need to generate instruments for coordination of economic policies. The year 2002 seems to be an inflection point because there were some seemingly coincidental phenomena: the pro-MERCOSUR interest of the Brazilian and Argentine governments, the compatibility of their exchange rate regimes, and the need to negotiate jointly in the Free Trade Area of the Americas, the World Trade Organization and with the European Union given the individual weakness of the four economies (Caetano 2011).

This renewed political impulse gave rise to a “social, productive and citizens” MERCOSUR (Perrotta and Porcelli 2016). There were institutional advances in dispute resolution, policy coordination and social cooperation, the inclusion of consultative forums with sub-national actors and forums for productive integration and support policies for small and medium-sized enterprises, together with the creation of the MERCOSUR Structural Convergence Fund (FOCEM, as per its initials in Spanish) and the MERCOSUR Parliament (PARLASUR). In addition, between 2002 and 2006, an unusually benign international environment with cheap credits and record commodities prices boosted the growth of the region's economies.

However, MERCOSUR continued with internal problems. Malamud (2008: 131) stated that during periods with very low interdependence between MERCOSUR partners, the governments were able to agree. However, when the interdependence was greater and it had to be administered, getting consensus was harder. The lack of supranational institutions to which governments delegate policy decisions generated an implementation gap. Thus, “excess of rhetoric” (Malamud 2009) and regional conflicts coincided temporarily, for example the dispute between Argentina and Uruguay about pulp mill (“pastera”, in Spanish) at Uruguay River.

In spite of that “ideological redirection”, in the opinion of Botto (2015: 35), MERCOSUR did not show important institutional changes. She stated, “Despite the promise to create regional funds, the leading governments maintained their resistance to delegate resources and power to supranational institutions, the advances in the agendas were manifested in actions mainly in administrative coordination, and the inclusion of civil society actors was reduced to technical assistance”. Caetano (2019: 61) affirmed that, despite the partial achievements, “neither convergence nor much less this pattern of post-liberal programmatic regionalism could advance in facts despite the ideological affinity.”

This description of MERCOSUR, which seems coherent, actually includes the opinions of authors with significant differences in their assessment of its political evolution. In addition, there is no agreement on the precise delimitation of the sub-periods, although in general terms they seem to coincide. The methodology presented below rectifies this situation.

## 2.2. METHODOLOGY

Changes in trade flows between two countries may be due to changes in the importance of other economies in the world market, changes in complementarity between the patterns of specialization, and other reasons that generate or eliminate bias between them. To eliminate the third parties influences and focus attention on the country specific factors, it is advisable to use the trade intensity indicator proposed by Kojima (1964). This indicator is:

$$I_{ij} = \frac{X_{ij} / X_i}{M_j / \sum_{k \neq i} M_k} = \frac{x_{ij}}{m_j} \quad (1)$$

where  $i, j \in P$  with  $P$  as country set,  $X_{ij}$  is the export flow from  $i$  to  $j$ ,  $X_i$  is the  $i$ 's total exports,  $M_j$ ,  $M_k$  are the  $j$ 's total imports and world's imports, respectively. Then,  $x_{ij}$  is the relevance of country  $j$ 's imports on the  $i$ 's total exports, and  $m_j$  is the relevance of  $j$ 's imports on the world imports (net of  $i$ 's imports).



A value of  $l_{ij}$  equal to the unit denotes geographical neutrality, that is, for  $i$ 's exports, market  $j$  represents exactly the same as what market  $j$  represents for world supply. On the other hand, if it is greater (lesser) than the unit, it indicates that market  $j$  has a greater (lesser) relevance in terms of market share than it should have according to that criterion, so the existence of geographical bias is evidenced in favor of (against) integration between  $i$  and  $j$  countries<sup>1</sup>. Therefore, an increase (decrease) in the value of  $l_{ij}$  when it is above the unit indicates that the geographical bias in favor of trade integration between the two economies has increased (decreased)<sup>2</sup>. If the initial value of  $l_{ij}$  is below the unit, an increase (decrease) denotes the reduction (extension) of the bias against integration between the two economies.

Drysdale (1969) proposed the decomposition of the Kojima indicator to identify the origin of the geographical bias, demonstrating that it is possible to re-express  $l_{ij}$  as the product between a complementarity index and an index of non-complementarity or unexplained bias. The first shows whether the similarity between  $i$ 's basket of exportable goods and the  $j$ 's basket of imports is greater than that between the latter and the global basket of exportable goods. In contrast, the remaining bias index indicates the degree of resistance faced by  $i$ 's exports in the  $j$ 's market in relation to the average resistance that faces in the rest of the global market. Drysdale and Garnaut (1982: 62) defined "resistance" as any factor that prevents or delays immediate movements in response to price differentials of tradable goods. They differentiated between objective and subjective resistances. While the first is a set of obstacles that can be overcome by assuming a monetary cost (distance, tariff and non-tariff barriers, etc.), the second one is a set of difficulties that arise from the fact that entrepreneurs have imperfect information when they make business decisions.

Thus, if  $C_{ij}$  is the complementarity index and  $B_{ij}$  is the index of unexplained bias, then

$$l_{ij} = C_{ij}B_{ij}, \text{ with}$$

$$C_{ij} = \sum_s \left[ \frac{x_i^s}{t_w^s} \frac{m_j^s}{t_w^s} t_w^s \right] = \sum_s \left[ \frac{x_i^s m_j^s}{t_w^s} \right] \quad (2)$$

1 Due to this interpretation, Frankel (1997) called it concentration rate. Instead, Petri (2016) interpreted it as a particular indicator of the degree of interdependence.

2 The formula shows that the increase in geographical bias may be due to the increase in export flows from  $i$  to  $j$ , accompanied by a minor (or null) increase in total imports of  $j$ , what is interpreted as a displacement of products originating in third countries by the partner's products. On the other hand, we interpret the increase in the participation of  $j$  in the exports of  $i$  with constant  $l_{ij}$ , as the natural result of the growth of the share of the partner in world trade (Cordero and González 2018).

where

$$t_w^s = \frac{\sum_{k \neq i} M_k^s}{\sum_s \sum_{k \neq i} M_k^s} = \frac{M_w^s}{M_w^s} \quad (3)$$

$x_i^s$  is the share of good  $s$  in the  $i$ 's exports ( $= X_{is}/X_i$ ),  $m_j^s$  is the share of good  $s$  in the  $j$ 's imports ( $= M_{js}/M_j$ ), and  $t_w^s$  is the share of good  $s$  in the world imports (net of the  $i$ 's imports).

Then, the complementarity index is the multiplication between the  $i$ 's comparative advantages index and the  $j$ 's comparative disadvantages index. The greater the coincidence between the exportable supply of a country and the demand for imports of its partner, the greater the tendency to trade among them, that is, the value of trade approximates the potential bilateral trade explained by the complementarities between the partners.

The index of unexplained bias is equal to the ratio between the observed intensity ( $I$ ) and the intensity explained by the complementarity ( $C$ ), therefore:

$$B_{ij} = \frac{x_{ij} / m_j}{\sum_s \left[ \frac{x_i^s m_j^s}{t_w^s} \right]} = \frac{X_{ij}}{\sum_s X_i^s \frac{M_j^s}{M_w^s}} \quad (4)$$

The numerator of the expression on the right is the  $i$ 's total export to country  $j$ , and the denominator is the weighted sum of  $i$ 's exports of good  $s$  to country  $j$ , where the weight is the  $j$ 's participation in world imports of goods.

Anderson and Garnaut (1985), Hill (1985), Anderson and Nordheim (1993) and Petri (2006) addressed this decomposition in the context of different trade intensity studies. Terra (1999), Vaillant (2001), Aminian *et al.* (2008), Álvarez (2011), Aponte Jaramillo *et al.* (2012), Cordero and González (2018) did so in studies on Latin America. Iapadre and Plummer (2011) discussed the properties of the indicator and proposed variants with applications for different regions, including MERCOSUR. In addition, Edmonds and Li (2010) integrated this indicator with the empirical specifications of the gravitational model of trade.

We treated time units as observations or subjects of analysis. The intention was to group the years according to the similarities in the bias indexes mentioned above. We use the complementarity index and the index of unexplained bias instead of the aggregate trade intensity indicator because this way we obtain greater analytical capacity and we make better use of the descriptive power of the clustering techniques by having another source of variability in the elements to be grouped. We used two complementary techniques for this: while the first determined the groups, the second verified them.

We grouped the years using clustering techniques, in particular, K-means. The number of clusters is not a trivial decision and generally results the most controversial. We used two techniques: the amount of explained variance as criterion and the elbow method for determining the break (Kassambara 2017), and the gap statistic (Tibshirani *et al.* 2001).

Then, we performed a multivariate analysis of variance (MANOVA) to verify if the differences in variance between groups are statistically significant (Rencher and Christensen 2012). This stage is not redundant. Although, in the previous step, we determined clusters that minimize intra-group variance and maximize inter-group ones, the lack of significance in a MANOVA is sufficient evidence of forced periodization.

The source for bilateral trade flows is the World Integrated Trade Solutions (WITS) database. The series are expressed in value and for industries at one-digit ISIC code<sup>3</sup>. The application has been concentrated on Argentina, Brazil, Paraguay and Uruguay. These countries signed the Asunción Treaty in 1991 and are States Parties of MERCOSUR since then<sup>4</sup>. However, the sample includes the years from 1983 for the reasons mentioned in the previous section, and finalized in 2015 for data availability.

We used the raw data to compute the indicators following expressions (1) and (2). Each exporting country had three importing countries, and each binomial had two bias indexes. Then, 24 series characterized each unit of time.

The number of clusters was determined using *R* with the *factoextra*, *clusterR* and *cluster* packages, and we used *Stata* for the MANOVA estimation.

Finally, it is necessary to clarify the way in which we have interpreted the results in order to meet our objective. Two possible scenarios raise: The first, the unambiguous deepening of the integration process that is favorably reflected in bilateral trade flows. The deepening of a trade agreement consolidates asymmetries in the treatment of imports in favor of the partners. From this situation, there is a margin for changes in the patterns of specialization with a tendency to strengthen complementary productive structures and intra-industrial trade. If this were the case, following Frankel and Rose (1996), we would see a virtuous circularity between both facets of integration.

<sup>3</sup> The codes are: 0. Food and live animals. 1. Beverages and tobacco. 2. Raw materials, inedible, except fuels. 3. Mineral fuels, lubricants and related materials. 4. Animal and vegetable oils, fats and waxes. 5. Chemical products and the like. 6. Manufactured products classified primarily by material. 7. Machinery and transport equipment. 8. Miscellaneous manufactured items. 9. Products and transactions not classified elsewhere.

<sup>4</sup> Paraguay was suspended between June 2012 and August 2013. However, it did not represent a change in economic terms, but in terms of its veto and voting rights. Simultaneously, Venezuela was accepted as a State Party, a condition of which it was suspended in August 2017. However, this acceptance is considered limited in economic terms by the existence of exceptions with respect to the regular treatment of the remaining states party. Regardless of this discussion, the admission was after the period considered in the study.

The second scenario raise if the institutional advance reinforces the prior patterns of specialization, then the inter-industry trade with both partners and third market is probably strengthened. Then, the economic ties would be weak and the virtuous circularity debilitates due to lack of political incentives to move forward in the implementation of what is agreed. This last situation responds to a set of countries that move together or apart depending on the circumstances.

The first implies successive periods with deepening integration, while the second implies a process with comings and goings without a visible trend in the facts.

### 3. RESULTS

#### 3.1. STATISTICAL DESCRIPTION OF THE BIAS INDEXES AND END-TO-END ANALYSIS

Table 1 shows statistical information about the 24 series that resulted following expression (1) and (2).  $C_{ij}$  is the complementarity index between economies  $i$  and  $j$ , with  $i \neq j$ , and  $B_{ij}$  is the index of unexplained bias between economies  $i$  and  $j$ ,  $i \neq j$  (in both case, ARG: Argentina, BRA: Brazil, PRY: Paraguay, URY: Uruguay).

In general, the mean values of the complementary bias have been close to unity. This means that it was low in both senses, for and against trade partners. Among the first, Paraguay-Uruguay and Argentina-Uruguay presented the upper averages, although their standard deviation were higher. Argentina-Brazil, Brazil-Uruguay and Paraguay-Brazil followed them with higher values but closer to the unity. It is interesting to note that the favorable bias due to complementarity was not reciprocal, given that the mean values were less than unity in all those cases when we reversed the order of the partners. In fact, Uruguay-Argentina and Uruguay-Paraguay resulted the most adverse in average terms.

The unexplained bias showed mean values that exceed the unity in all cases. That is, the average values were consistent with a reduction of resistance to intra-MERCOSUR trade. It is notorious that Paraguay presented the highest values, both when taken as the origin and destination of the trade flows. Argentina-Uruguay's average complementary bias was high too. However, all of them had the greatest standard deviation.

The average end-to-end values, this is the mean values of the period for each indicator by setting the partners, shows an incomplete reading of the geographical bias. There were notable variations in the values throughout the 33 years that may have several possible sources –v.g. changes in the political scenario, on macroeconomic conditions, or the differences in the degree of vulnerability to external shocks, among other factors- from which the correct one cannot be discerned with a univariate analysis of the statistics.

TABLE 1. DESCRIPTIVE STATISTICS

Variable	Obs	Mean	st. dev.	Min	Max
C_ARG-BRA	33	1.02	0.15	0.79	1.30
C_ARG-PRY	33	0.83	0.19	0.45	1.20
C_ARG-URY	33	1.15	0.18	0.89	1.63
C_BRA-ARG	33	0.92	0.07	0.77	1.06
C_BRA-PRY	33	0.90	0.14	0.70	1.28
C_BRA-URY	33	1.02	0.09	0.87	1.27
C_PRY-ARG	33	0.83	0.28	0.55	1.49
C_PRY-BRA	33	1.00	0.20	0.49	1.30
C_PRY-URY	33	1.16	0.26	0.79	1.94
C_URY-ARG	33	0.80	0.12	0.59	1.02
C_URY-BRA	33	0.87	0.12	0.64	1.05
C_URY-PRY	33	0.79	0.22	0.44	1.34
B_ARG-BRA	33	19.13	5.57	4.95	27.80
B_ARG-PRY	33	49.39	15.12	29.70	75.54
B_ARG-URY	33	42.80	10.11	22.55	60.57
B_BRA-ARG	33	23.08	7.19	9.67	32.85
B_BRA-PRY	33	38.81	13.42	21.03	76.74
B_BRA-URY	33	21.54	6.92	12.08	38.08
B_PRY-ARG	33	45.14	23.53	19.45	102.30
B_PRY-BRA	33	42.06	12.33	25.16	71.37
B_PRY-URY	33	64.46	68.70	16.08	274.71
B_URY-ARG	33	37.65	7.95	20.56	48.82
B_URY-BRA	33	27.96	6.81	17.60	45.57
B_URY-PRY	33	47.11	24.45	19.25	119.67

Note: ARG: Argentina, BRA: Brazil, PRY: Paraguay, URY: Uruguay.

Figures 1 and 2 show the variability in both bias indexes for each binomials. In order to reduce the difficulty in interpretation, we created the C\_MERCOSUR and B\_MERCOSUR series computing the means per year of all C and all B values, respectively. Figure 1 displays the existence of adverse bias to intra-MERCOSUR trade, explained by the lack of coincidence between the basket of exportable goods and the imports one. That is visible through C\_MERCOSUR values smaller than unity (right axis) except during the period 1996-2004. However, a growing adaptation of the production structure of the founding countries is evident from time before the signing of the agreement and until 2003, consistent with intra-regional trade. Since then, we observed the destruction of the average complementarity achieved.

Figure 2 shows that this behavior was apparently reinforced by factors other than complementarity. There was a bias - always, in general terms - in favor of intra-MERCOSUR trade decidedly since the mid-1990s, reversing its trend thereafter. B\_MERCOSUR showed a favorable break in 1997 with a maximum in 2004, and then changed the trend by copying the path followed by C\_MERCOSUR.

Although the joint reading for the entire period is consistent, the indexes of complementarity bias and unexplained bias presented opposite behavior at certain times. An example is what happens during the first stage of MERCOSUR, from its foundation and until 1997: while the complementarity indicator had an upward trend, the unexplained bias indicator showed the opposite, resulting counterintuitive if we take into account that B\_MERCOSUR would directly capture the geographical bias generated by the institutional progress of the integration process.

A possible explanation for this behavior is that the C\_ and B\_MERCOSUR, by construction, hide the variability at the binomial level. Even when setting the exporter (ARG-BRA, ARG-PRY, etc.) or the importer (PRY-BRA, URU-BRA, etc.), dissonant results are observed, that is, neither the production structures adapted coincidentally over time nor the governments changed their national regulations as agreed in MERCOSUR.

FIGURE 1. COMPLEMENTARITY BIAS INDEX

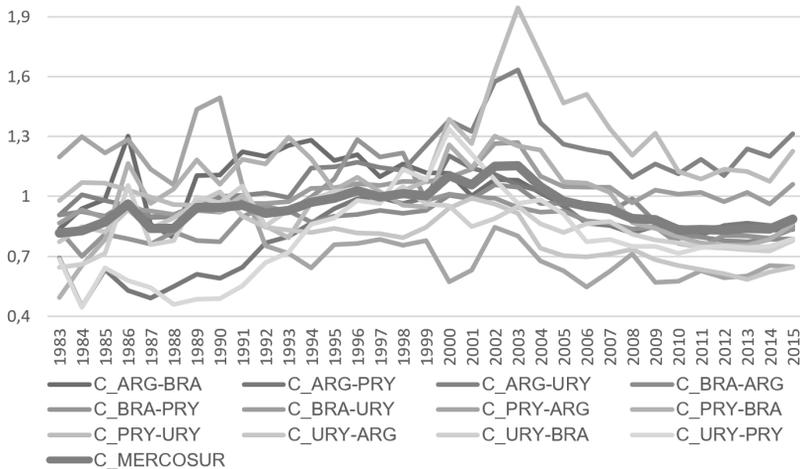
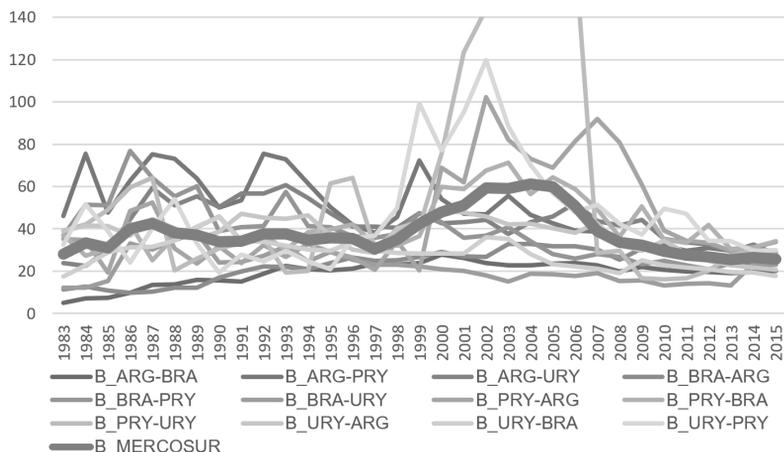


FIGURE 2. UNEXPLAINED BIAS INDEX



Note: The B\_PAR-URU values from 2002 to 2006 is out of range.

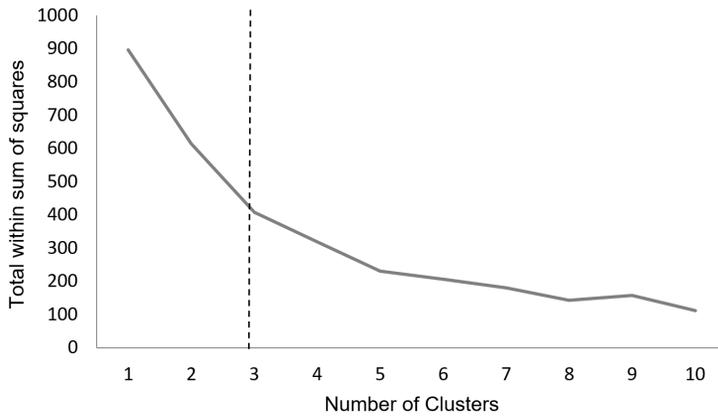
### 3.2. MULTIVARIATE ANALYSIS

Neither the interpretation of the bias indexes taking end-to-end averages at the level of binomials nor the description of the evolution over time of the cross-section average value offer a complete description of the phenomenon. Instead, a multivariate analysis allows us to take advantage of the time and cross-section variability of both bias indexes at the binomial level for characterizing the time units. In this way, it is possible to offer a unified explanation of both bias indexes and describe the evolution of trade integration without forcing an explanation centered on a specific binomial or a particular variable. Clearly, this technique offers an alternative to ad-hoc periodization.

We then used the 33 observations from each of the 24 series to characterize and group the years into clusters. Figure 3 shows the gain on the total within sum of squares by each additional cluster into which the period 1983-2015 could be divided. According to the elbow technique<sup>5</sup>, three clusters is optimal. To support this, we proceeded to estimate the Gap statistic mentioned in the methodological section. With 100 simulated samples, in all cases the optimal number of clusters is three. We compare different criteria to compare the fit of different number of clustering options, as noted in Table 2. In bold case we show that the better fit is reached with 3 clusters. Finally, we used medoids instead of K-means clustering, and the grouping is the same for both the cases of 3 and 4 clusters.

5 For elbow technique, see Thorndike (1953) and Liu and Deng (2020).

FIGURE 3. NUMBER OF CLUSTERS



Note: The choice is marked in dashed lines.

TABLE 2. OPTIMAL CLUSTER SELECTION

Criterion	Number of clusters			
	1	2	3	4
Variance explained	1	0.74	0.48	0.48
AIC	952	776.2	601.8	657.8
BIC	993.9	860.1	727.5	825.4
Adjusted R2	0	0.23	0.48	0.47

Note: Results obtained using Optimal\_Clusters\_KMeans function in the ClusterR package of R.

Then, we applied K-means clustering with three and four clusters for robustness analysis. Table 3 shows the periodization for three and four clusters. In addition, it indicates the means of the complementarity and the unexplained bias indexes for each year, graphed previously and called C\_MERCOSUR and B\_MERCOSUR, respectively.

The periodization with three clusters divides the period 1983-2015 into the following sub-periods: The sub-period 1986-1999 is shown as an intermediate stage between the unfavorable complementarity-biased sub-period 1983-85 and the slightly favorable complementarity-biased sub-period 2000-2006.

An accentuation of favorable bias is observed as a result of institutional efforts. However, there was a significant setback in the sub-period 2007-2015. Our approach characterizes and groups the years included in this segment in cluster 1 together with the years 1983-1985, so its average is significantly



lower than that of the period 2000-2006 (cluster 3). Table 4 shows the average values for each stage.

When the periodization is extended to four clusters, the sub-periods of greater intensity and of less intensity are, respectively, 2000-2006 and 2007-2015. Therefore, the delimitation of these sub-periods is robust to the number of clusters. The only difference arises in the previous chronological stages, with a later delimitation and coincident with the signing of the Treaty of Asunción. The sub-period 1983-1990 was decidedly adverse in terms of complementarity bias and the sub-period 1991-1999 kept the sense, but with an average scale very close to neutrality. Institutional efforts were favorable, although without substantial differences between the two stages despite the signing of the agreement.

TABLE 3. PERIODIZATION WITH THREE AND FOUR CLUSTERS AND ANNUAL MEANS OF B\_ AND C\_MERCOSUR

YEAR	3 clusters	4 clusters	B_MERCOSUR	C_MERCOSUR
1983	1	2	28.01	0.82
1984	1	2	33.46	0.83
1985	1	2	30.86	0.87
1986	2	2	39.92	0.96
1987	2	2	42.57	0.84
1988	2	2	38.05	0.84
1989	2	2	37.07	0.94
1990	2	2	33.99	0.95
1991	2	3	34.24	0.96
1992	2	3	37.53	0.91
1993	2	3	37.50	0.93
1994	2	3	34.68	0.97
1995	2	3	35.80	0.99
1996	2	3	35.39	1.03
1997	2	3	30.53	1.00
1998	2	3	34.89	1.02
1999	2	3	42.38	1.00
2000	3	4	48.04	1.11
2001	3	4	51.25	1.06

2002	3	4	59.31	1.15
2003	3	4	59.14	1.15
2004	3	4	61.30	1.05
2005	3	4	59.89	0.98
2006	3	4	50.83	0.95
2007	1	1	38.97	0.93
2008	1	1	33.58	0.89
2009	1	1	32.32	0.88
2010	1	1	29.45	0.83
2011	1	1	27.42	0.83
2012	1	1	26.64	0.83
2013	1	1	25.40	0.84
2014	1	1	26.53	0.84
2015	1	1	25.65	0.89

Note: Each number in the second and third columns identifies the cluster to which the year corresponding to the row belongs.

TABLE 4. MEANS FOR THREE AND FOUR CLUSTERS

3 clusters	mean_B	mean_C
1	29.86	0.86
2	36.75	0.95
3	55.68	1.06
4 clusters	mean_B	mean_C
1	29.55	0.86
2	35.49	0.88
3	35.88	0.98
4	55.68	1.06

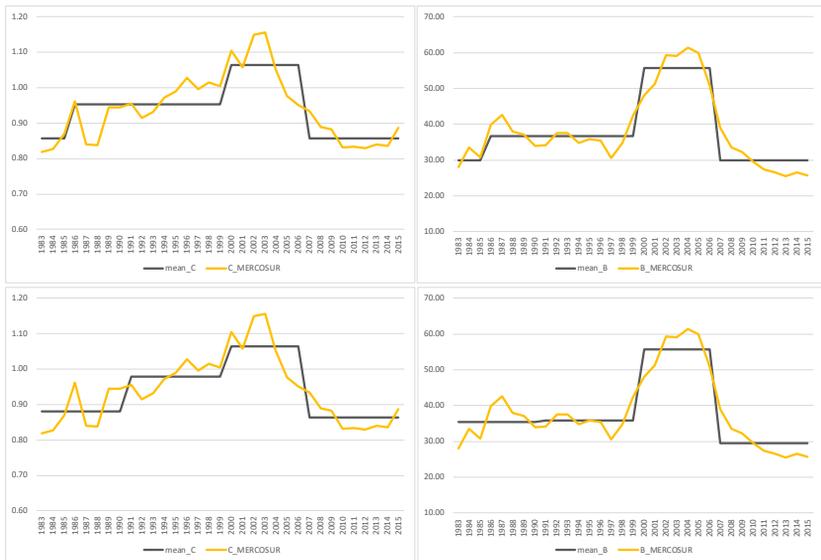
Finally, figures 4 to 7 contrast the results of univariate and multivariate techniques by comparing the C\_MERCOSUR and B\_MERCOSUR and the evolution of bias means by cluster. Although there are coincidences in the general reading, the main difference arises in the precise identification of the limits between stages of the trade integration process. It is evident that the periodization following the behavior of C\_ and B\_MERCOSUR marks segments of length somewhat different and less defined<sup>6</sup>.

<sup>6</sup> The graphs of the evolution of the indicators by binomials in contrast to the means by sub-periods for three periods, and the individual regressions used for computing the Tibshirani et al. (2001) analysis of variance are available upon request.

For example, as commented previously and shown in the aforementioned graphs, there was a significant drop in the mean of the bias since 2003. This could have been a regime change. However, the multivariate analysis contradicted that impression and extended the period until 2007.

Something similar occurs with the years from 1992 to 1997. While the univariate analysis led to seemingly contradictory results and, therefore, difficult to classify, the multivariate analysis with three clusters grouped those years with 1985 to 1991, or identified them as a sub-period with greater favorable bias when four clusters are taken.

FIGURES 4 TO 7. MEAN VALUES PER SUB-PERIODS FOLLOWING TABLE 4 AND EVOLUTION OF THE VALUES OF  $C_{-}$  AND  $B_{-}$ MERCOSUR WITH THREE CLUSTERS (UPPER FIGURES) AND FOUR CLUSTERS (LOWER FIGURES)



### 3.3. ANALYSIS OF VARIANCE

Taking the bias indexes as dependent, we performed a MANOVA analysis of the clusters in order to verify the existence of differences between the groups. As explained in the methodological section, low  $p$ -values were expected.

The results are displayed in table 5. Following Tibshirani *et al.* (2001), the selection of the number of clusters was validated. All statistics reject the null hypothesis indicating a significant difference in the variances between the groups.

TABLE 5. MANOVA

Bias	Clustering	Statistic		$F$	$Prob > F$	
B	3 clusters	Wilks' lambda	0.00	25.18	0	exact
		Pillai's trace	18.80	26.04	0	approximate
		Lawley-Hotelling trace	323.66	24.27	0	approximate
		Roy's largest root	192.86	32.14	0	upper limit in F
B	4 clusters	Wilks' lambda	0.00	17.26	0	approximate
		Pillai's trace	27.41	17.62	0	approximate
		Lawley-Hotelling trace	346.62	16.05	0	approximate
		Roy's largest root	159.71	26.62	0	upper limit in F
C	3 clusters	Wilks' lambda	0.01	12.11	0	exact
		Pillai's trace	17.50	11.64	0	approximate
		Lawley-Hotelling trace	167.22	12.54	0	approximate
		Roy's largest root	119.48	19.91	0	upper limit in F
C	4 clusters	Wilks' lambda	0.00	16.02	0	approximate
		Pillai's trace	26.67	13.34	0	approximate
		Lawley-Hotelling trace	408.50	18.91	0	approximate
		Roy's largest root	281.80	46.97	0	upper limit in F
B and C	3 clusters	Wilks' lambda	0.00	13.89	0	exact
		Pillai's trace	1.95	13.37	0	approximate
		Lawley-Hotelling trace	113.08	14.14	0	approximate
		Roy's largest root	87.29	29.1	0	upper limit in F
B and C	4 clusters	Wilks' lambda	0.00	16.99	0	approximate
		Pillai's trace	2.93	14.5	0	approximate
		Lawley-Hotelling trace	264.63	17.15	0	approximate
		Roy's largest root	164.71	54.9	0	upper limit in F

#### 4. DISCUSSION

We compared our periodization with four proposals offered by the MERCOSUR literature (Bouzas 2001, Botto 2007, Caetano 2011, and Alvarez 2011). While our proposal relies exclusively on the statistical information provided by trade flows, the four proposals of the mentioned authors and the other texts that we used to complete the period under study (Bouzas 2010, Botto 2015 and 2017, Caetano 2019) are based on institutional and economic episodes.

The periodization approach of the mentioned authors tend to present the evolution of MERCOSUR as a “two-speed” process. A priori, it differentiates between trade integration and institutional integration, and then identifies sources of change. In contrast, our proposal based on the statistical characterization of time units from two indicators of bias that jointly represent the both faces of integration. In this way, it eliminated the possibility of selection bias. Coincidentally, our approach and the four mentioned authors consider the faces of integration mutually dependent.

Table 6 shows the four periodizations proposed by the literature on the left of the year's column, while our periodization is on the right. The authors identified each stage identified with a descriptor, *e.g.* Bouzas (2001) named “Transition period” to years 1991 to 1994. In addition, each cell was painted to differentiate the degree of engagement that the authors observed in the partners. The lower the intensity of the colour, the more unfavorable or less favorable the bias for MERCOSUR. There is coincidence among them that the period between the Treaty of Asunción and the Ouro Preto Protocol was a construction phase that would result in a later trade boom.

However, there are interesting discrepancies between the periodization of the mentioned authors and our results. Considering three clusters, our methodology found no significant differences between the sub-periods 1986-1990 and 1991-1999. While 1986 correspond to the signing of the Act for Argentine-Brazilian Integration, which established the PICE, 1999 coincides with the Brazilian crisis and the devaluation of the Real. This thirteen-year sub-period was divided only when we take the control case with four clusters: the “prehistory” of MERCOSUR extended until 1990 (instead of 1985) and the deployment extended from 1991 to 1999.

The multivariate analysis has divided section 2000-15 into two sub-periods. Here we find some similarities with the reference authors that highlight a change in the integration program. However, our periodization is consistent with a discouraging reading of the process. The first of the sub-periods extended from 2000 to 2006, and coincided with the “new” MERCOSUR presented by the bibliography. However, our descriptor word is “fullness” because it corresponded simultaneously with the moment of greater formal development of integration (FOCEM, PARLASUR, Consultative Forums, etc.) and with the highest average levels of both geographical biases.

In contrast, the following MERCOSUR sub-period was associated with a regressive transformation process. The years between 2007 and 2015 corresponded, in terms of geographical bias, with a setback to integration levels and trade bias similar to the prehistory of MERCOSUR (1983-85) if we take three clusters, or with an even greater setback when we considered the control case with four clusters. Phenomenally, this period coincides on the political level with the resurgence of the dispute over the “pastera” between Argentina and Uruguay, with the request of Uruguay -accompanied by Paraguay- to be authorized to sign bilateral trade agreements with third countries, with the suspension of Paraguay

and the admission of Venezuela as full member. While, at the trade level, it coincides with the context of the global crisis of 2008, the use of greater non-tariff barriers with each other (for example, non-automatic import licenses, antitrust measures, etc.) and the increase in requests for exceptions to the common external tariff.

## 5. FINAL REFLECTIONS

We addressed the periodization of MERCOSUR's lifetime based on a new approach. This approach grouped the years between 1983 and 2015, minimizing intra-group variances and maximizing the inter-group ones. We used two trade bias indexes taken by binomials for characterizing the unit of time. Finally, we contrasted our outcomes with those carried out by MERCOSUR specialists. In this way, we verified the historical coherence of the results and remarked the advantages of the method.

The results showed a process of accumulating asymmetric behavior in favor of MERCOSUR until 2006. The three clusters had increasing means supported by the overlap of two different forces, sometimes in contrast. The sub-period 1983-1985 corresponds to the prehistory of the agreement, and was characterized by the low complementarity and reduced political commitment with the strengthening of the economic ties. The sub-period 1986-1999 revealed a significant change in trade explained by a growing complementarity, although with an erratic behavior in the institutional facet. Furthermore, the erratic character of both facets explained the sub-period 2000-2006. Finally, we found similarity between the sub-period 2007-2015 and the prehistorical one. That is, an adverse geographical bias explained by low trade complementarity and low institutional efforts. The control case with four clusters reinforced this description.

In conclusion, we observed a positive evolution of MERCOSUR with obvious internal difficulties until 2006. Initially, bilateral trade enjoyed an interesting impulse from the adaptation of the productive structure, which pushed policymakers to maintain the institutional support. However, these economic ties lost strength just as political support did, probably, when domestic problems were most urgent. In fact, the last sub-period is the result of both domestic problems and conflicting political relationships.

Back to the initial question, our evidence suggest that the circumstances set the pace of the integration process. The partners behave as leaves that are piled up by the wind instead of acting as a rising and willing uniform body.

TABLE 6. MAIN AUTHOR'S APPROACHES VIS-À-VIS CLUSTER PERIODIZATION

Bouzas (2001 and 2010)	Botto (2007, 2015 and 2017)	Caetano (2011 and 2019)	Álvarez (2011)		3 clusters (OPTIMAL)	4 clusters (Control)
		Background	Beginning	1983	1 Prehistory	3 Prehistory
				1984		
				1985		
				1986	2 Deployment	
				1987		
				1988		
				1989		
				1990		
Transition period	Origen	Foundation and primer deployment	Construction	1991	2 Deployment	2 Deployment
				1992		
				1993		
				1994		
Market era	Apogee (#)	Institutional consolidation and crisis preview	Age of Gold	1995	3 Fullness	
				1996		
				1997		
				1998		
Turbulence time	Crisis (#)	Crisis	Re-launch	1999	4 Fullness	
				2000		
		Other model of integration	Re-launch	2001		
	Re-foundation			2002		
		2003				
		2004				
		2005				
	Impulse and inflexion (##)	Deepening agenda (##)		2006	1 Prehistory	1 Involution
				2007		
				2008		
				2009		
				2010		
				2011		
				2012		
				2013		
				2014		
				2015		

(#) Botto (2015) characterized the period 1995-2002 as "institutional deconstruction". While Botto (2017) calls 1991-2001 as the "trade stage" and 2002-15 as the "stage of productive integration" (##) Caetano (2019) identified, despite partial achievements, the 2004-14 as the "post-liberal regionalism" failure. The lower the intensity of the color, the more unfavorable or less favorable the bias for MERCOSUR.

## REFERENCES

- Álvarez, M. (2011). Los 20 años del MERCOSUR: Una integración a dos velocidades. *CEPAL, Serie Comercio Internacional*, 108.
- Aminian, N., Fung, K., and Nung, F. (2008). Integration of Markets vs. Integration by Agreements. The World Bank, *Development Research Group, Policy Research Working Paper*, 4546.
- Anderson, T. (2003). An Introduction to Multivariate Statistical Analysis. Third Ed. *New York: Wiley*
- Anderson, K. and Garnaut, R. (1985). Australia's Trade Growth with Developing Countries. *The Developing Economies*, 23, 2, 121-137.
- Anderson, K., and Norheim, H. (1993). From Imperial to Regional Trade Preferences: Its Effect on Europe's Intra- and Extra- Regional Trade. *Review of World Economics*, 129, 1, 78-102.
- Aponte Jaramillo, E., Castro Urbano, E. and González Rodríguez, C. (2012). Relaciones comerciales y crecimiento económico de los países de la Comunidad Andina de Naciones (1990-2010). *Gestión y Región*, 14, 105-118.
- Botto, M. (2007) La integración regional en América Latina: ¿es el MERCOSUR una alternativa para el crecimiento? Article prepared for the course of teachers organized by the CIEE Argentina.
- Botto, M. (2015) América del Sur y la integración regional: ¿Quo vadis? Los alcances de la cooperación regional en el MERCOSUR. *Confines de Relaciones Internacionales y Ciencia Política*, 11, 21, 9-38.
- Botto, M. (2017). El MERCOSUR y sus crisis: análisis de interpretaciones sobre el fracaso de la integración regional sudamericana. *Estado & comunes, revista de políticas y problemas públicos*, 2, 5, 155-176.
- Bouzas, R. (2001). El MERCOSUR diez años después: ¿proceso de aprendizaje o déjã vu? *CEMLA Boletín*, XLVIII, 1, 30-44.
- Bouzas, R. and Kosacoff, B. (2010). Cambio y continuidad en las relaciones económicas de la Argentina con Brasil. *Universidad de San Andrés, Departamento de Ciencias Sociales, Documento de trabajo*, 8.
- Bunge, A. (1929). Una gran unidad económica: La unión aduanera del Sud. *Revista de Ciencias Económicas*, 12(135), 185-196.
- Caetano, G. (2011). Breve historia del MERCOSUR en sus 20 años. Coyuntura e instituciones (1991-2011). En: Caetano, G., coord., MERCOSUR 20 años, Montevideo: *CEFIR*, 21-74.
- Caetano, G. (2019). Los nuevos rumbos del MERCOSUR. Cambio de modelo y las consecuencias de la crisis brasileña. *Foro internacional*, LIX, 1 (235), 47-88.
- Ciadamore, A. (2001). Crisis e instituciones: hacia el MERCOSUR del siglo XXI. En: de Sierra, G., comp., Los rostros del MERCOSUR. El difícil camino de lo comercial a lo societal, *Buenos Aires: CLACSO*, 229-255.
- Cordero, S. and González, G. (2018). Intensidad de la integración en el MERCOSUR: Complementariedad y sesgo geográfico no explicado. *Anales*

- de la Asociación Argentina de Economía Política*, LIII Reunión Anual. Buenos Aires: AAEP.
- Drysdale, P. (1969). Japan, Australia and New Zealand: The Prospects for Western Pacific Economic Integration. *Economic Record*, 45, 111, 321-342.
- Drysdale, P and Garnaut, R. (1982). Trade Intensities and the Analysis of Bilateral Trade Flows in a Many-country World-A Survey. *Hitotsubashi Journal of Economics*, 22, 2, 62-84.
- Edmonds, Ch. and Li, Y. (2010). A New Perspective on China Trade Growth: Application of a New Index of Bilateral Trade Intensity, *U. Hawaii, Research-Working Papers*, WP\_10-25.
- Frankel, J. (1997). Regional Trading Blocs in the World Economic System. Washington: *Institute of International Economics*.
- Frankel, J. and Rose, A. (1996). The endogeneity of the Optimum Currency Area Criteria, *NBER Working Paper No. 5700*. NBER Program(s). International Trade and Investment, International Finance and Macroeconomics.
- Hill, H. (1985). Australia-Philippine Trade Relations. *Journal of Philippine Development*, 22, 12, 2, 253-273.
- Iapadre, L. and Plummer, M. (2011). Statistical Measures of Regional Trade Integration. En: P. De Lombaerde, R. Flores, L. Iapadre y M. Schulz, eds. The Regional Integration Manual. *Quantitative and Qualitative Methods*. London: Routledge, 98-123.
- Kassambara, A. (2017). Practical Guide to Cluster Analysis in R: Unsupervised Machine Learning (Vol. 1). *STHDA*.
- Kojima, K. (1964). The Pattern of International Trade among Advanced Countries. *Hitotsubashi Journal of Economics*, 5, 1, 16-36.
- Liu, F., and Deng, Y. (2020). Determine the Number of Unknown Targets in Open World Based on Elbow Method. *IEEE Transactions on Fuzzy Systems* (Early access). DOI: 10.1109/TFUZZ.2020.2966182
- Malamud, M. (2008). The Internal Agenda of Mercosur: Interdependence, Leadership and Institutionalization. En: Grace Jaramillo, ed.: Los nuevos enfoques de la integración: más allá del regionalismo. *Quito: FLACSO*, 115-35.
- Perrotta, D. and Porcelli, E. (2016). MERCOSUR 25 años: desafíos en su nueva etapa. Márgenes. *Revista de Economía Política*, II, 2, 51-86.
- Petri, P. (2006). Is East Asia Becoming more Interdependent? *Journal of Asian Economics*, 17, 381-394.
- Rabinowitz, A. (2014). It's about Time: Historical Periodization and Linked Ancient World Data. *Institute for the Study of the Ancient World Papers*.
- Rencher, A., and Christensen, W. (2012). Methods of Multivariate Analysis. *Wiley Series in Probability and Statistics*, 709, 19.
- Terra, M. (1999). Uruguay en el MERCOSUR: perspectivas del comercio intrarregional. *Revista de Economía-Segunda Época*, 6, 2, 189-242.
- Tibshirani, R., Walther, G., and Hastie, T. (2001). Estimating the Number of Clusters in a Data Set via the Gap Statistic. *Journal of the Royal Statistical Society: Series B (Statistical Methodology)*, 63(2), 411-423.

Thorndike, R. (1953). Who Belongs in the Family? *Psychometrika*, 18(4), 267–276.

Vaillant, M. (2001). Impacto del ALCA en el comercio intrarregional y en el comercio de los países miembros de la ALADI con Estados Unidos y Canadá. *Asociación Latinoamericana de Integración*.

