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The Impact of South-South Preferential Trade Agreements on Industrial Development: An Empirical Test

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Abstract

Preferential trade agreements could lead to a reallocation of resources across sectors and countries. Production patterns resulting from North-North regional integration initiatives have been documented in several studies. However, empirical evidence on South-South trade agreements is limited. The purpose of this paper is to fill this gap in the empirical literature by looking at the effects of the establishment of MERCOSUR on manufacturing production patterns in Argentina, Brazil, and Uruguay over the period 1985-1998. We find that deepened preferential trade liberalization has fostered a reshaping of manufacturing production structures according to regional comparative advantage in labor and skilled labor. Furthermore, declining internal tariffs have weakened agglomeration forces determined by the distribution of market sizes. By using GMM estimation techniques, we ensure that these results are robust to

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endogeneity and serial correlation.

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• **Key Words:** preferential trade liberalization, production patterns, MERCOSUR

I. Introduction

The number of South-South preferential trade agreements has rapidly increased in recent years. In Latin America 17 trade treaties were signed between 1991 and 2002 (see IADB, 2002). Not surprisingly, there is an ongoing policy debate about the implications of these agreements for the participating nations (see World Bank, 2000, and Panagariya, 2000). Some authors argue that developing countries have small economies with relatively similar and concentrated production structures so that there is a priori not much scope for strong gains in terms of new opportunities for production and trade generated by regional integration (see, *e.g.*, Leamer, 1998, Schiff, 1996).

Formal analyses of the consequences of South-South trade agreements confirm some of these doubts. Thus, Venables (2003) uses the traditional concepts of comparative advantage and trade creation-trade diversion and predicts that these agreements can foster a process of production and income divergence among members, giving rise to a clear pattern of losers and winners. In particular, the economies with regional comparative disadvantage in manufacturing can loose via trade-diversion effects. Puga and Venables (1998) use a framework where cumulative processes triggered by economies of scales and cost and demand linkages can potentially induce concentration of industrial activities in certain countries. Specifically, these authors show that South-South trade arrangements can be associated with a very unequal spread of industry among participating countries, at least during the transition towards internal free trade. Both Venables (2003) and Puga and Venables (1998) therefore conclude that preferential trade agreements between developing countries can potentially generate diverging patterns of industrial development across members. Moreover, both papers argue that developing countries seem to be better served by trade arrangements with developed nations.

To what extent have the above predictions been confirmed in practice? We do not know. The existing empirical evidence on the impact of South-South agreements on industrial production patterns is scarce. This is in contrast to the

numerous studies that analyze the cases of North-North and North-South preferential trade arrangements.[1]

The purpose of this paper is to fill the aforementioned gap in the empirical literature by looking at the effects of the establishment of MERCOSUR on manufacturing production patterns in Argentina, Brazil, and Uruguay over the period 1985-1998.[2] MERCOSUR provides an interesting case study. Established in 1991 by Argentina, Brazil, Paraguay, and Uruguay, this regional integration agreement is undoubtedly one the most important trade initiatives among developing countries. Intra-regional trade was gradually liberalized between 1991 and 1994 for most sectors and a Common External Tariff (CET) was implemented in 1995, which includes tariff rates that vary between 0% and 20%. For some items temporarily excluded from the CET, external barriers were set at larger values. Potential problems stemming from trade diversion might therefore be substantial. Furthermore, MERCOSUR is a customs union formed by countries with important size differences. Brazil, the largest economy in the bloc, has a GDP that is 10 or 15 times that of the smaller countries (Uruguay or Paraguay). This allows us to study whether this size asymmetry is a relevant factor affecting the dynamic of industrial development within the area.

More precisely, we address the following questions: Has MERCOSUR had an impact on the spatial distribution of industrial activity in member countries? To what extent did traditional factor endowments and intensities matter relative to market size and input-output linkages for the location of industry within MERCOSUR? Did the relative importance of these forces change as a result of preferential trade liberalization and the enlargement of the regional market?

While admittedly statistical significance of the results is on average relatively weak, we do find evidence suggesting that higher preferences margins tend to be associated with a higher sensitivity of production patterns to comparative advantage considerations along two dimensions: labor and human capital (skilled labor).[3] Hence, in the presence of larger preference margins, labor and human capital intensive industries seem to show a stronger tendency to locate in countries with larger endowments of labor and human capital, respectively. Interestingly, we

[1] See, *e.g.*, Brulhart and Torstensson (1996), Amiti (1998), Brulhart (1998a, 1998b, 2001), Haaland *et al.* (1999), Midelfart-Knarvik *et al.* (2000a), and Midelfart-Knarvik *et al.* (2000b) for the North-North case, and Hanson (1997, 1998) for North-South integration.

[2] Unfortunately, Paraguay could not be included in the analysis due to missing data.

[3] We use interchangeably skilled labor and human capital throughout the paper.

do not find any significant impact of these preferences on the responsiveness of production patterns of industries using intensively agriculture inputs to countries' endowments of arable land. Argentina, Brazil, and Uruguay have a revealed comparative advantage in these sectors. Thus, as expected from the theory, we find that regional preferences have no significant impact in those sectors in which countries have a global comparative advantage.

On the other hand, lower internal tariffs appear to weaken the tendency of sectors with increasing returns to scale to locate in countries with larger market potentials. This result is consistent with theory suggesting that deepened internal trade liberalization generates a weakening of agglomeration forces determined by the distribution of market sizes. By using GMM estimation techniques, we ensure that all the above results are robust to serial correlation and endogeneity.

The remainder of this paper is structured as follows: Section II reviews theoretical analyses of the effect of preferential trade liberalization among developing countries on production patterns. Section III presents a brief summary of trade policy reforms in MERCOSUR member countries. Section IV introduces the dataset and describes basic stylized facts about industrial development in these countries. Section V explains the empirical methodology. Section VI reports and discusses the estimation results showing the impact of MERCOSUR on manufacturing production patterns. Section VII concludes.

II. Theoretical Framework

How does preferential trade liberalization between developing countries affect industry development patterns? This section reviews the predictions from two alternative theoretical approaches. Each of the analyses assumes a different view as to why countries trade with each other. Venables (2003) emphasizes the traditional comparative advantage mechanism and trade diversion-trade creation effects. On the other hand, Venables and Puga (1998) introduce cumulative processes triggered by economies of scale and cost and demand linkages. We believe that by covering these two approaches we are exhausting most plausible explanations (from a trade theory perspective) of the spatial distribution of industry.

A. Preferential Trade Liberalization and Comparative Advantage

Venables (2003) proposes a model along the lines of traditional trade theory. He shows that the impact of preferential arrangements hinges upon the comparative

advantage of member countries, relative to each other and relative to the rest of the world. In particular, countries with a comparative advantage between that of their partners and the rest of the world benefit at the expense of countries having an "extreme" comparative advantage. The explanation is as follows: Assume that two developing countries, A and B, decide to establish a customs union. There are two sectors: agriculture, which is intensive in unskilled labor, and manufacturing, which is intensive in skilled labor. Further, suppose that both countries are abundant in unskilled labor relative to the rest of the world. Country B is also abundant in this factor relative to the partner. Evidently, this second country has an "extreme" comparative advantage, while the other one has an "intermediate" comparative advantage. As a consequence, the formation of a customs union between these two countries will result in country A exporting manufacturing to B who will export agriculture goods in return. Generally, the launching of a preferential trade agreement among developing countries with different comparative disadvantage relative to the rest of the world tends to induce a restructuring of manufacturing production in favor of the country that, has a comparative advantage within the newly created regional economic space so that consumers would be increasingly supplied with manufactures stemming from that country.

From the discussion above, we can conclude that South-South preferential trade liberalization magnifies the relative importance of regional comparative advantage in shaping manufacturing production patterns across member countries for those sectors where they have a comparative disadvantage *vis-à-vis* the rest of the world. Thus, higher preferential margins will be associated with a greater tendency of sectors to locate in the country that, within the region, is relatively abundant in those factors used intensively in their production processes. Hence, if we were to apply this theory to MERCOSUR, we expect that these preferences will fundamentally affect the pattern of industrial development across member countries in labor intensive and human capital intensive sectors, where these countries do not have a global comparative advantage, but not in agriculture intensive industries, where the region is an internationally efficient supplier (see, *e.g.*, Volpe Martincus, 2003, and Sanguinetti and Bianchi, 2004).

B. Regional Trade Liberalization and Market Enlargement: Scale Economies and Input-Output Linkages

Puga and Venables (1998) explore the implications of different trading arrangements on industrial development and intra-regional disparities using a new

trade model that features cumulative causation through input-output linkages among firms that have increasing returns to scale and operate in imperfectly competitive environments.

These authors highlight that preferential trade arrangements between developing countries can lead to industrialization of the region as a whole as a consequence of the effective market enlargement induced by reducing intra-South barriers.[4] Moreover, as usual in this kind of settings, agglomeration forces are strongest for intermediate trade costs. Hence, for intermediate tariffs the outcome within the bloc is asymmetric where the manufacturing industry tends to concentrate in one of the member countries. Which country hosts the industry? In the framework considered by Puga and Venables (1998), countries are assumed to be initially identical so that there is no basis to discriminate between them. In addition, in this case, the aforementioned diverging pattern between countries may be only transitional, since industries may start to disperse as tariffs are reduced enough.[5]

However, the indeterminacy may disappear if size asymmetry prevails. In particular, a large domestic market enhances the attraction of a country as a base for industrial sectors with increasing returns to scale. The uneven spread is then driven by cost and demand linkages to other firms in the same country, i.e., as more firms settle in the same location, more intermediate inputs will be locally available at a lower price, and also the intermediate demand increases (see also Venables, 1999). Under these circumstances, there is no guarantee that total elimination of internal tariffs will go far enough to promote the spread of industry to all participating countries, especially when important non-tariff internal barriers persist. Thus, whether South-South regional integration arrangements strengthen or weaken agglomeration forces is largely an empirical question dependent on the involved countries and the level of remaining internal trade costs.

We can therefore conclude that if there are substantial underlying size differences between economies, South-South preferential trade liberalization may be, on average, associated with decreased manufacturing production in the smallest country of the agreement. This is especially the case if, at the starting point tariffs

[4]Puga and Venables (1998) assume that initially there is no industry in the South countries. This analysis can be easily extended to the case where industry is initially present by assuming that transport costs between North and South are large enough.

[5]This is because congestion costs (high wages) could be avoided by establishing plants in neighboring member countries where industry has not been yet developed, while, at the same time, enjoying cost savings by importing inputs from (and exporting output to) the more industrially developed partner.

were high enough so that industry spread over countries in proportion to their initial size, and when significant internal barriers (both natural and artificial) still segment markets after the establishment of the agreement.

If we now apply this theory to MERCOSUR, we thus expect that the presence of higher internal tariffs (lower preferential margins) would accentuate the impact of variables such as countries' market potential and industrial base as determinants of industry development in those sectors with economies of scale or strong cost and demand linkages. On the other hand, for those sectors where a substantial reduction of internal trade obstacles has been reached, these agglomeration forces will be weakened.

III. MERCOSUR: Tariff Policy Reforms

Argentina, Brazil, and Uruguay implemented broad trade reforms over the last two decades.[6] A distinguishing feature of the reduction and elimination of trade barriers in these economies is that the process of preferential trade liberalization overlapped with the latter stages of unilateral programs that had been previously initiated in each country. Given the relevance of these reforms for understanding the changes in manufacturing production patterns, we discuss next the trade liberalization strategy pursued by MERCOSUR member countries.

A. Unilateral Trade Liberalization

Argentina, Brazil, and to a lesser extent Uruguay have traditionally had relatively high tariffs. As shown in Table 1, these countries started to unilaterally reduce MFN tariffs by the mid-1980s, i.e., before the establishment of MERCOSUR. This process of trade liberalization generalized in the early 1990s. In particular, tariff cuts were sizable in the larger economies between 1988 and 1991. It is noteworthy that, while unilateral trade reform seems to have been completed in Argentina by 1991, in the remaining countries, the impulse towards further liberalization continued up to 1994.

B. Preferential Trade Liberalization

Argentina, Brazil, and Uruguay signed a number of bilateral agreements within

[6]As mentioned before, Paraguay is also a member of MERCOSUR, but trade policy developments in this country will not be discussed, because it could not be included in the empirical analysis.

Table 1. MERCOSUR: Preferential Tariffs by Countries (1985-1994)

MFN and Preferential Tariffs			
Country/year	1985	1991	1994
Argentina			
MFN Tariff	39.20	14.22	15.40
Preferential Tariff to Brazil	36.60	7.20	5.10
Preferential Tariff to Uruguay	36.00	8.10	10.70
Brazil			
MFN Tariff	55.09	20.37	9.70
Preferential Tariff to Argentinal	51.90	10.00	3.20
Preferential Tariff to Uruguay	51.10	10.70	4.90
Uruguay			
MFN Tariff	35.87	21.35	13.63
Preferential Tariff to Argentinal	34.60	15.50	12.00
Preferential Tariff to Brazil	34.60	15.80	10.00

Source: Estevadeordal *et al.* (2000)

the LAIA (Latin American Integration Association) framework. These agreements were based on positive lists of products, i.e., products that obtained tariff preferences (with varying degree of preference margins) and also were exempted from non-tariff barriers (Estervadeordal *et al.*, 2000). Nevertheless, as highlighted in Table 1, the level of tariff preference was rather limited by the mid-1980s.

MERCOSUR was established by Argentina, Brazil, Paraguay, and Uruguay in 1991 with the Treaty of Asuncion. The first article of this treaty states that the agreement aims at achieving "the free circulation of goods, services, and production factors among the member countries, through the elimination of the tariff and non tariff restrictions to the circulation of merchandises and of any other equivalent measure". It also established the adoption of a Common External Tariff (CET) and a common trade policy with third countries or groupings of countries. We can split up the evolution of MERCOSUR into two sub-periods: the transition period towards the free trade area and the customs union period.

The transition phase was between 1991 and 1994 and consisted of progressive, linear, and automatic tariff reductions at six months intervals. This sequence aimed to achieve free trade within the bloc by the end of 1994. The drop in preferential tariffs since 1991 reflects this policy (see Table 1). Exemptions from internal free trade were nevertheless allowed for a limited number of products on a temporary basis. Brazil included in its national exemption list only 29 items, including wool products, canned peaches, rubber factories, and wines. In contrast, Argentina had

223 tariff line items on this list, of which 57% were steel products, 19% textiles, 11% paper, and 6% footwear, while Uruguay had an extensive list with 953 items, including textiles (22%), and steel and electric machinery (8%) (see INTAL, 1996). In addition to the general exceptions already indicated, the sugar and automotive sectors were not included in the general intra-MERCOSUR trade liberalization scheme due to significant divergence across member countries in their national policies toward these sectors, especially in the cases of Argentina and Brazil. In the interim, the exchange of these products took place under a specific set of rules and restrictions. For autos, a managed trade arrangement was put in place, which favored local contents, importation of parts under special conditions, and export balancing requirements.

The customs union period began with the establishment of a Common External Tariff (CET) entering into force at the beginning of 1995. The average level of the CET was approximately 11%, but tariff levels were allowed to vary between 0 and 20% across industries. In general, the lowest tariffs were set on input and materials, intermediate tariffs were charged on semi-finished industrial goods, and the highest tariffs were assigned to final manufactures.

During this period, two types of exceptions were established. First, remaining products on national lists that were exempted from internal free trade were included in the so-called "Adaptation Regime". Within this regime tariffs were progressively and automatically reduced so that import taxes would be completely eliminated by January 1, 1999 in the case of Argentina and Brazil, and by January 1, 2000 for Uruguay. Second, just as with intra-MERCOSUR tariffs, exceptions were granted for extra-zone trade so that certain imports faced tariff rates different from the CET. Countries agreed that the import taxes on these products would progressively converge toward the CET by the year 2001. Out of approximately 9000 8-digit tariff lines, Argentina, Brazil and Uruguay initially selected 300 each. In addition, exceptions to the CET were established for capital goods imports (*e.g.*, machines and equipment), computers, and telecommunication equipment.[7]

An overall assessment of the result of the preferential trade reforms in the framework of MERCOSUR up to 1996 can be performed with the help of Table 2, taken from Olarreaga and Soloaga (1998). This table contains data on average 8-digit Harmonized System (HS) tariffs, extra-bloc and intra-bloc, for Argentina,

[7]Though a CET was also established for textiles, countries agreed not to put it into practice immediately. Thus, for example, Argentina maintained specific tariffs on several textiles products as well as on footwear. A similar policy was followed in Uruguay for almost 100 textile items.

Table 2. Mercosur: External and Internal Tariffs in 1996

Country	External Tariff (Simple Average)	Internal Tariff (Simple Average)	Import Weighted External Tariff	Import Weighted Internal Tariff	Tariff Level CET Exemptions	Tariff Level Internal Exemptions
Argentina	11.78	0.36	13.37	0.86	14.33	11.69
Brazil	13.14	0.02	15.44	0.02	21.39	10.20
Uruguay	10.78	0.88	11.01	1.77	5.92	19.73
Mercosur	11.75	0.00	11.09	0.00		

Source: Olarreaga and Soloaga (1998)

Brazil, and Uruguay. We can conclude that countries were on average very close to internal free trade. However, for some specific sectors, non-negligible internal tariffs remained in place. Average external tariffs, even though substantially lower than in the past, were still high relative to those of developed countries. Moreover, for those products excluded from the CET, the average tariffs were relatively high in the case of Brazil and, to a lesser extent, in Argentina.

In summary, the evolution and cross-sectional patterns of external and internal trade barriers in MERCOSUR described above makes this group of countries a particularly interesting case study to assess the implications of preferential trade liberalization on industrial development. But before going to the formal empirical test, we present in the next section some stylized facts about manufacturing production patterns in the region.

IV. MERCOSUR: Production Patterns

The trade policy reforms described before could potentially be associated with significant changes in production patterns across MERCOSUR member countries. After introducing our dataset, this section precisely reports descriptive evidence on the actually observed changes in these patterns.

A. Data

We describe production patterns in MERCOSUR using production value data for each manufacturing industry at *ISIC, Rev. 2, 3 digit-level*. These data are part of the *PADI* database produced by the Industry and Technological Development Unit at the United Nations' Economic Commission for Latin America and Caribbean (ECLAC) and include homogeneous statistical information for the period from

1985 to 1998 on an annual basis.

We also have data that allow for a suitable characterization of countries in terms of factor endowments as well as sectors in terms of factor intensities. In this respect, we have used Brazilian input-output matrices to construct time variant factor utilization indicators at a disaggregated level. Section A of the Appendix presents a detailed description of our dataset, whereas Section B discusses some specific aspects of this dataset and presents the definition of the variables used in the analysis.[8]

B. Manufacturing Production Patterns

Manufacturing production patterns in MERCOSUR can be described by the distribution of country shares in total production value for each industry in this bloc. Formally, the production value of industry k in country i at time t is denoted by z_{ikt}. This value is expressed as a share of the total production value in the industry within MERCOSUR:

$$s_{ikt} \equiv \frac{z_{ikt}}{\sum_{i} z_{ikt}} \tag{1}$$

and for the whole manufacturing sector we obtain:

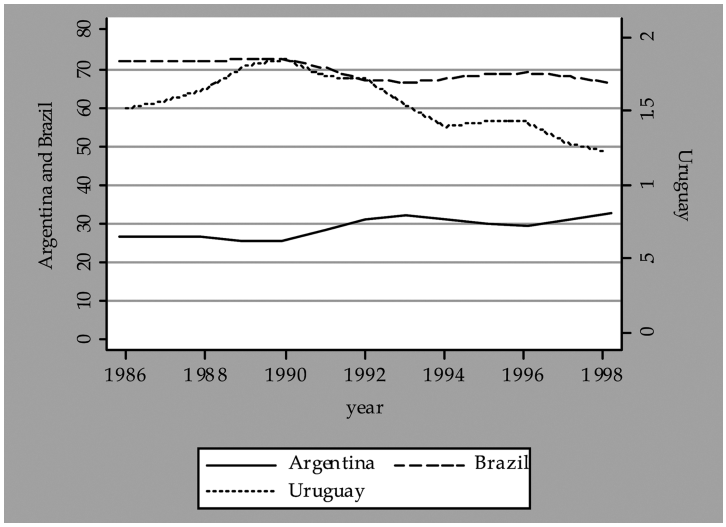
$$s_{it} \equiv \frac{\sum_{k} z_{ikt}}{\sum_{i}\sum_{k} z_{ikt}} \tag{2}$$

Figure 1 plots the evolution of this aggregate indicator over the period 1985-1998 as a two-year moving average. Brazil is the largest country within the bloc. It accounted for roughly 70% of overall manufacturing activity in the MERCOSUR area over the period from 1985 to 1998. The share of this country has declined slightly after 1991. Uruguay seems to have witnessed a more pronounced decrease in its share over the same period, while the opposite is true for Argentina.

Of course, there are noticeable cross-sectional differences around this aggregate indicator. In which specific sectors have the particular countries gained or lost shares over time? In response, Figure 2 shows for each country and industry, the shares in MERCOSUR's total manufacturing production value and their changes

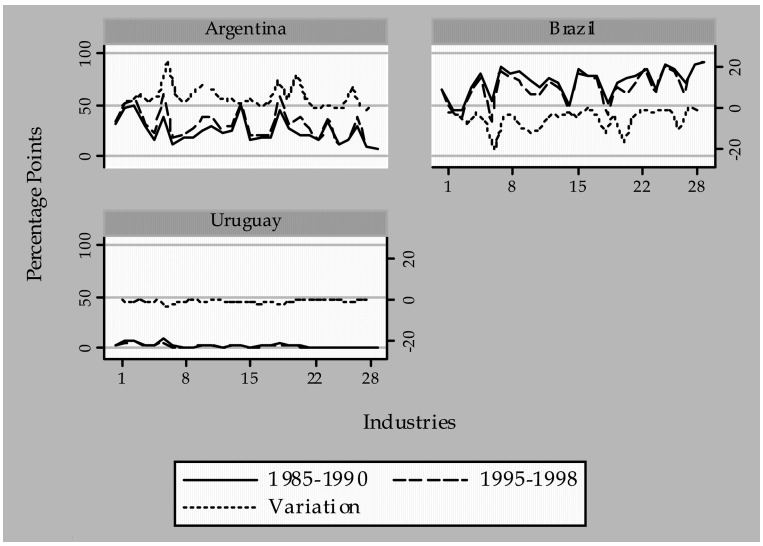
[8]As shown in Section B in the Appendix, using Brazilian technological data does not imply imposing a restrictive assumption.

Figure 1. National Manufacturing Production Value as a Percentage of MERCOSUR Total Manufacturing Production Value-Two-years Moving Average (1986-1998)



Notes : The Figure plots aggregate production shares by country as defined in Equation (2) in text multiplied by 100.

Figure 2. Countries' Shares in MERCOSUR Manufacturing Production Value and Changes (1995-1998 vs. 1985-1990)



Notes : The Figure plots sectoral production shares by country as defined in Equation (1) in text multiplied by 100. These shares are averaged over the sub-periods 1985-1990 and 1995-1998. "Variation" corresponds to the absolute change between these sub-periods. Industries are numbered following the order in which they are listed in Table A1 in the Appendix.

over the sub-periods 1985-1990 and 1995-1998. This figure allows us to assess the main changes in production structures before and after MERCOSUR.

We observe substantial changes over time. Argentina registered increased shares in almost all sectors, but with significant variation over industries. For example, in leather products, Argentina´s share increased, while Brazil and Uruguay experienced a decrease. The higher share of Argentina in pottery, china, and earthenware comes essentially at the expense of the smaller country, Uruguay, while the higher share in other non-metallic minerals at the expense of Brazil. On the contrary, Brazil and Uruguay slightly expanded their shares in professional and scientific instruments.

Simple correlations between the share of each country in each industry and the score in selected industry characteristics show that the two countries with higher specialization in agriculture activities, Argentina and especially Uruguay, have higher shares in industries which intensively use agriculture inputs. Trends are, however, different: increasing in the case of Uruguay and decreasing in the case of Argentina. Similarly, Brazil, the country with the largest industrial base in the region, has a higher relative importance in sectors which intensively use manufactured inputs and sell a large fraction of their output to manufacturing firms (see Sanguinetti *et al.* (2004)). The above correlations are suggestive but they cannot be considered a rigorous examination of the determinants of industry location. Therefore, in the next section we turn to a formal econometric analysis.

V. Empirical Methodology

We have documented that the establishment of MERCOSUR implied important changes in trade barriers among member countries as well as between them and the rest of the world. We have also showed that there have been significant modifications of production patterns. We will now investigate whether or not there is a relationship between both phenomena. The theoretical analysis presented in Section II provides the required background to derive precise hypotheses to link regional trade liberalization with the configuration of manufacturing production across member countries. This section introduces the empirical methodology. We first describe the general empirical strategy and the main hypotheses to be tested and we then define the selected model specification and review relevant estimation issues. Estimation results are presented in Section VI.

A. General Approach and Hypotheses: Capturing the Impact of Preferential Trade Liberalization

The distribution of manufacturing activities across countries will be described by the country shares in total MERCOSUR production value for each industry, as defined in Equation (1). Several empirical studies of production patterns estimate summary statistics (*e.g.*, concentration and specialization indices) on these shares and then regress such measures on industry or country characteristics.[9] This strategy has, however, two main disadvantages (*e.g.*, Combes and Overman, 2003). First, theory does not always provide a clear guidance with respect to the expected relationship between these summary measures and economic unit characteristics. Second, using summary statistics implies wasting information on the distribution of manufacturing industries across countries, since individual industry/country shares are available. Therefore, we take these raw shares as our dependent variable.

In order to explain these shares, we adopt as a starting point the approach that has been proposed by Midelfart-Knarvik *et al.* (2000a) and Midelfart-Knarvik *et al.* (2000b). As we will see below, this approach allows us to come closer to the theory than those based on summary statistics. More importantly this framework permits an easy and intuitively clear adaptation to empirically assess the consequences of preferential tariff liberalization.

In general, industries intensively using a given "factor" tend to locate in countries relatively abundant in this "factor". Thus, if countries differ in their endowments of human capital, then industries that intensively use this factor will be drawn to countries with relatively high shares of highly educated workers. This suggests explaining production patterns through a set of interactions resulting from a specific pairing of industry and country characteristics. The particular correspondence of country and industry characteristics mirrors a set of hypotheses identified from traditional and new international trade theories. These theories are the frameworks in which Venables (2003) and Puga and Venables (1998), respectively, derive their predictions of the impact of preferential trade liberalization on manufacturing production patterns across member countries. The interactions we will consider are listed in Table 3. We discuss next the relevant testable hypotheses.

According to the traditional comparative advantage trade theory, production

[9]See, among others, Amiti (1999) and Haaland *et al*. (1999) as well as previous research by the authors, *e.g.*, Traistaru-Siedschlag and Volpe Martincus (2006).

Table 3. Definition of Interactions Included in Regressions

Category	Variables				
Basic Interaction Terms	Agriculture abundance	*	Agriculture intensity		
	Labor abundance	*	Labor intensity		
	Human capital abundance	*	Human capital intensity		
	Market potential	*	Economies of scale		
	Industrial market potential	*	Industrial intermediate consumption		
	Industrial market potential	*	Sales to industry		
Preferential Trade Liberalization	Agriculture abundance	*	Agriculture intensity	*	Preferential margin/Internal tariff
	Labor abundance	*	Labor intensity	*	Preferential margin/Internal tariff
	Human capital abundance	*	Human capital intensity	*	Preferential margin/Internal tariff
	Market potential	*	Economies of scale	*	Preferential margin/Internal tariff
	Industrial market potential	*	Industrial intermediate consumption	*	Preferential margin/Internal tariff
	Industrial market potential	*	Sales to industry	*	Preferential margin/Internal tariff

patterns are determined by the exogenous spatial distribution of natural resources and production factors. Activities settle in locations abundant in the factors which those activities use most intensively. This general proposition can be translated into the following three specific hypotheses:

Hypothesis 1: Industries that intensively use agriculture inputs tend to locate in countries with a large endowment of arable land.

Hypothesis 2: Labor intensive industries tend to be drawn to countries which are relatively labor abundant.

Hypothesis 3: Industries that intensively use human capital tend to be drawn to countries which are relatively well endowed with human capital.

New trade theories predict that sectors with increasing returns tend to settle in locations with good access to the markets of their respective products (see, *e.g.*, Krugman, 1980, and Helpman and Krugman, 1985). This result is derived from the interaction between scale economies and trade costs. In the presence of economies of scale, producers operate more efficiently by spatially concentrating their activities. In turn, the existence of trade costs induces firms to concentrate in the country which has the larger effective market for their goods, since they are thus able to avoid such costs in a larger fraction of their sales. The following hypothesis can therefore be established:

Hypothesis 4: Industries with increasing returns to scale tend to locate in countries with large market potentials.

In particular, when imperfectly competitive industries are linked through an input-output structure and trade costs are positive, the firms in the upstream industry are drawn to locations where there are relatively many firms of the downstream industry because in this way they can reach their customers more easily (demand linkage). Moreover, having a larger number of upstream firms in a location benefits downstream firms, which obtain their intermediate goods at lower costs, by saving transport costs and having easier access to a larger variety of differentiated inputs (cost linkage). Hence, the joint action of such linkages might result in an agglomeration of vertically linked industries and could give such an equilibrium location a certain inherent stability (Venables, 1996). In this sense, the above reasoning provides a rationale for the notion of an industrial base. It follows that *industries that intensively use manufactured intermediate inputs and industries for which demand comes to a large extent from the manufacturing sector itself tend to locate in regions with large industrial bases.* This is stated in the following hypotheses:

Hypothesis 5: Industries that rely to a large extent on industrial intermediate inputs tend to locate in countries with a large industrial base which ensure a better access to their relevant suppliers.

Hypothesis 6: Industries for which the manufacturing sector itself is an important user of their products find it advantageous to locate in countries with a large industrial base and hence providing a better access to a significant demand source.

So far we have derived hypotheses that allow us to assess the relevance of traditional comparative advantage forces and of agglomeration factors in the allocation of industrial activities across MERCOSUR countries. But how can we empirically identify the effect of preferential trade liberalization within the region? One strategy is to report estimation results for different sub-periods and argue that observed changes in the relative importance of the different determinants, i.e., estimated coefficients on the interaction terms, are driven by economic integration.[10]

We believe that this methodological approach is not entirely adequate for our purposes. First, member countries of MERCOSUR implemented nearly simultaneously several structural reforms including privatizations and de-regulations, which went well beyond the trade dimension. We need therefore to explicitly disentangle the effect of trade policy. Second, as mentioned in Section IV, Argentina, Brazil, and Uruguay reduced unilaterally their trade barriers to the rest of the world and concertedly to their partners within the agreement. In particular, these economies are relatively small and trade with the rest of the world is significant. In addition, while intra-bloc trade was to a large extent tariff-free by 1996, MFN tariffs on manufacturing goods are relatively high when compared with those of developed countries. Hence, the preferential nature of trade liberalization should be explicitly taken into account. In fact, establishment of this

[10]Midelfart-Knarvik *et al*. (2000a) and Mideldart-Knarvik *et al*. (2000b) perform such an analysis for Europe. They run cross-section regressions for specific years over the period 1980-1997 and compare the coefficients on the interactions over time. These authors find that the location of industries intensive in R&D and skilled labor have become increasingly responsive to countries' endowments of researchers and well educated labor force in general, respectively. Similarly, industries using intensively agriculture inputs have become overrepresented in countries with abundant agriculture production. Moreover, according to Midelfart-Knarvik *et al*. (2000a), the tendency of industries with economies of scale to locate in central countries has decreased over time, while the opposite is true for industries with strong cost and demand linkages. Midelfart-Knarvik *et al*. (2000b) use specific and hence different measures of market access (i.e., supplier and demand access). In this case, their econometric results suggest that supplier access is not significant for the location of manufacturing industries and that demand linkages are significant but their effect is declining over time.

trade agreement seems to have had a significant impact on aggregate and sectoral trade flows. Various empirical analyses confirm this conclusion. In particular, Yeats (1998) shows a pronounced increase in the regional orientation of exports for those goods benefiting from higher tariff preferences. Sanguinetti *et al* (2004) find that preferences due to MERCOSUR have affected Argentina's manufacturing exports pattern to the region *vis- à-vis* the rest of the world.

We will therefore extend the basic setting suggested by Midelfart-Knarvik *et al.* (2000a) and Midelfart-Knarvik *et al.* (2000b) by including measures of sectoral preferential margin and internal tariffs (Section C in the Appendix has details on the construction of these indicators). As discussed in Section II, both variables are relevant for capturing the effect of regional integration on the spread of industrial activity across member countries. Preferences are important from the point of view of the impact of comparative advantage. On the other hand internal tariffs may play a key role in strengthening or weakening agglomeration forces. Thus we can state the following two propositions:

Hypothesis 7: Higher preferential margins strengthen the responsiveness of manufacturing production patterns to regional comparative advantage patterns, i.e., to the matching of country and industry characteristics within the region, for those sectors where member countries have a comparative disadvantage with respect to the rest of the world.

Hypothesis 8: Higher internal barriers (i.e., lower preferential margins) increase the responsiveness of production patterns to the distribution of market potentials over member countries of the arrangement for those sectors featuring economies of scale and significant cost and demand linkages.

B. Model Specification and Estimation Issues

As previously indicated, the dependent variable is the share of a country in total manufacturing production value in each industry, s_{ik}. Note that this ratio can only take values within [0,1] so that the dependent variable is bounded, while explanatory variables are not. As a consequence, error terms may not be normally distributed and this would lead to biased estimates. Therefore, we perform a logistic transformation, similar to Balassa and Noland (1989). The variable becomes $ln[s_{ik}/(1-s_{ik})]$ and ranges between $(-\infty, +\infty)$.

The dependent variable is expressed as a function of the interactions between industry and country characteristics, and country, industry, and time fixed effects, which control for the non-conditional effects of these characteristics. Formally, the

baseline model is:

$$\ln\left(\frac{s_{ikt}}{1-s_{ikt}}\right) = \sum_j \beta(j)\,\varpi_{it}(j)\,\theta_{kt}(j) + \varsigma_i + \upsilon_k + \tau_t + \varepsilon_{ikt} \quad (3)$$

where $\varpi_i(j)$ is the level of the j^{th} characteristic in country i and $\theta_k(j)$ is the industry k value of the industry characteristic paired with the respective country characteristic, ς_i, υ_k, and τ_t are country, industry, and time fixed effects, respectively.[11]

As mentioned in the previous sub-section, we extend this model incorporating a variable that captures preferential trade liberalization in the following way:

$$\ln\left(\frac{s_{ikt}}{1-s_{ikt}}\right) = \sum_j \beta(j)\,\varpi_{it}(j)\,\theta_{kt}(j) + \sum_j \gamma(j) pt_{kt}\,\varpi_{it}(j)\,\theta_{kt}(j) + \delta pt_{kt} + \zeta_i + \upsilon_k + \tau_t + \varepsilon_{ikt} \quad (4)$$

where pt denotes sectoral preferential margins or internal tariffs.

We interact the sectoral preferential margins (internal tariffs) with each matching pair of country and industry characteristics. The coefficients on the original interactions will thus measure the responsiveness of production patterns to these characteristics matching when there is no tariff preference (internal tariffs equal the external tariff) and the new interactions will capture to what extent preferences (internal tariffs below the external duty) accentuate or ameliorate such responsiveness.

Our sample includes 27 industries, 3 countries, and 14 years, 1985-1998, *i.e.*, it contains 1,134 observations.[12] Moreover, we condition on the standard deviation of the underlying variables in order to make comparison across variables more appropriate so that the coefficients that will be presented are standardized ones. In addition, there are three potential sources of heteroscedasticity: across countries, across industries, and across time.[13] Hence, Huber/White heteroscedastic consistent standard errors are reported and used for hypothesis testing.

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[11] This paper aims at analyzing the influence of preferential trade liberalization on production patterns across MERCOSUR member countries. Unfortunately, available data do not allow us to discriminate between pure internal relocation and the new settlements. In order to perform such an examination we would need data on sectoral foreign direct investment. This is, however, beyond of the scope of this study.

[12] The industry "Other manufacturing industries", which is a residual component, was dropped out.

[13] We applied the White's general test for heteroscedasticity (Greene (1997)). This test suggests that heteroscedasticity is present. The corresponding chi-square statistic is highly significant.

Two main issues, which may result in biased and inconsistent estimates, are usually not properly addressed in the literature. First, most empirical studies use a static framework, i.e., they perform static panel data analysis (see, *e.g.*, Kim, 1995, Amiti, 1999). However, production patterns are likely to display inertia (see, *e.g.*, Baldwin *et al.*, 2003 and Robert-Nicoud, 2004). In fact, the Baltagi-Lee test for autocorrelation in our fixed-effects model suggests that there is serial correlation of first order in the disturbances.[14] It is well known that LSDV (Least Square Dummy Variables) estimates are biased and inconsistent when lagged dependent variables are included in the regression equation (*e.g.*, Nickell, 1981, and Kiviet, 1995). A dynamic panel estimation is then required. Second, endogeneity is potentially a severe problem for the kind of estimations we are proposing. For example, human capital-intensive industries tend to locate in skill abundant countries, but causation can run also in the opposite direction: by settling in a country, industries employing highly qualified workers may end up changing its relative human capital abundance through induced migration. A similar reasoning also applies to firms with input-output linkages, as suggested by the new trade theories. We therefore treat all right-hand size variables as endogenous. The panel structure of our data allows us to generate appropriate instruments and thus to improve on previous works.

Specifically, to address both econometric problems, we perform GMM estimations using the method developed by Arellano and Bond (1991), which incorporates one lag of the dependent variable on the right hand side. This method first-differentiates the regression equation and permits obtaining additional instruments using the orthogonality conditions existent between lagged values of the dependent variable and the disturbances.[15]

VI. Estimation Results

Table 4 shows the estimation results corresponding to Equation (3) for the whole period, 1985-1998, according to alternative econometric techniques. These methods allow for different ways of correcting for heteroscedasticity and autocorrelation of the error term. In the last column we present the Arellano-Bond regression. The Sargan test for overidentifying restrictions indicates that the

[14]These test statistics are not reported, but are available from the authors upon request.
[15]For additional details see Arellano and Bond (1991) and Baltagi (1995).

Table 4. Alternative Estimation Strategies

Explanatory Variables - Interactions			LSDV lnts	PCSE lnts	PW lnts	AB lnts
Agriculture Abundance	*	Agriculture Intensity	0.563	0.563	0.347	0.252
			(0.086)***	(0.035)***	(0.093)***	(0.049)***
Labor Abundance	*	Labor Intensity	0.029	0.029	-0.070	-0.070
			(0.067)	(0.040)	(0.023)***	(0.030)**
Human Capital Abundance	*	Human Capital Intensity	0.120	0.120	0.056	0.045
			(0.048)**	(0.018)***	(0.024)**	(0.026)*
Market Potential	*	Economies of Scale	0.047	0.047	-0.007	0.086
			(0.089)	(0.054)	(0.020)	(0.033)**
Industrial Market Potential	*	Intermediate Inputs Intensity	0.297	0.297	0.270	0.192
			(0.128)**	(0.046)***	(0.053)***	(0.056)***
Industrial Market Potential	*	Intensity of Sales to Industry	0.205	0.205	-0.004	-0.006
			(0.186)	(0.144)	(0.075)	(0.069)
Year Fixed-effects			Yes	Yes	Yes	Yes
Number of Observations			1134	1134	1134	972
Sargan Test for Overidentification, $\chi^2(539)$						62.96
Test for Second Order Autocorrelation, z						-0.38
Hausman Test $\chi^2(18)$						13.40

The table reports estimates of Equation [3] with alternative econometric methods:

LSDV: Least Square Dummy Variable estimation (with country and industry fixed-effects) with Huber/White corrected standard errors.

PCSE: Least Square Dummy Variable estimation (with country and industry fixed-effects) with standard errors corrected for groupwise heteroscedasticity and cross-sectional correlation.

PW: Prais-Winsten estimation (with country and industry fixed-effects) with standard errors corrected for groupwise heteroscedasticity and cross-sectional correlation.

AB: GMM one-step estimation based on the procedure developed by Arellano and Bond (1991). In this model, one lag of the dependent variable is included (not reported) and all right-hand side variables are treated as endogenous. Robust standard errors are in parentheses. The Sargan test statistics is based on the two-step estimations. The last row shows the result of the Hausman specification test of the null hypothesis that the estimated coefficients obtained when estimating Equation [3] are not systematically different from those obtained when estimating an augmented version of Equation [3] including the time-varying factor abundance and intensity variables. Dependent variable *(lnts)* is the (logistically transformed) location share as defined in Equation [1] in the text.

* significant at 10%; ** significant at 5%; *** significant at 1%.

instruments are valid. Moreover, we cannot reject the null hypothesis of absence of serial correlation of second order. Accordingly, these estimations are consistent. Qualitatively, the results do not change significantly, though we clearly observe that when the econometric method allows correction of biases generated by persistence and endogeneity, the value of the estimated coefficients are significantly reduced. Since both problems seem to be important, we take the procedure proposed by Arellano and Bond (1991) as our preferred estimation strategy. Importantly, the Hausman test statistics suggests that the relevant estimated coefficients obtained when estimating Equation [3] do no significantly differ from those obtained when estimating instead the augmented equation that explicitly includes time-varying factor abundance and intensity variables. In other words, our strategy seems to properly account for the direct impact of these variables on production patterns. Hence, we adopt the former as the baseline equation for our analysis, as it provides us with a more parsimonious specification.[16]

Overall the results show a pattern of matching between specific country and industry characteristics, which confirms some of the hypotheses previously stated. Thus, arable land and skilled labor seem to be factors that have played an important role in shaping the distribution of manufacturing activities in MERCOSUR economies. With respect to agriculture this is clearly not surprising, given the world leadership of these countries in this activity. On the other hand, we do not find a clear link between labor abundance and labor intensity. If anything, we obtain a negative partial correlation. This again can be interpreted as showing that MERCOSUR nations have not developed global comparative advantage in this type of industries. Concerning the variables derived from the new trade theories, we observe that market potential interacted with economies of scale has had an impact on industry allocation within the region. Moreover, we find that industrial market potential has been a significant factor in attracting sectors that use intermediate inputs intensively. Hence, we can conclude that agglomeration forces have also been an important determinant of industrial development in MERCOSUR countries.[17]

The key issue is whether these forces have been affected by preferential trade policies. In particular, the relevant question is: Is there any specific role for

[16]This is particularly important given that we will assess the effects of trade policy on production patterns through triple interactions.

Table 5. The Impact of Preferential Margins (1985-1998)

Explanatory Variables - Interactions			(1) lnts	(2) lnts
Agriculture Abundance	*	Agriculture Intensity	0.221	0.256
			(0.079)***	(0.070)***
Labor Abundance	*	Labor Intensity	-0.105	-0.081
			(0.032)***	(0.034)**
Skilled Labor Abundance	*	Skilled Labor Intensity	0.004	-0.001
			(0.042)	(0.038)
Market Potential	*	Economies of Scale	0.064	0.071
			(0.032)**	(0.033)**
Industrial Market Potential	*	Intermediate Inputs Intensity	0.261	0.237
			(0.054)***	(0.057)***
Industrial Market Potential	*	Intensity of Sales to Industry	-0.044	-0.028
			(0.076)	(0.078)
Preferential Margin	*			
Agriculture Abundance	*	Agriculture Intensity	0.018	0.006
			(0.020)	(0.012)
Labor Abundance	*	Labor Intensity	0.069	0.013
			(0.040)*	(0.010)
Skilled Labor Abundance	*	Skilled Labor Intensity	0.041	0.025
			(0.029)	(0.012)**
Market Potential	*	Economies of Scale	-0.048	-0.022
			(0.024)**	(0.014)
Industrial Market Potential	*	Intermediate Inputs Intensity	-0.055	-0.013
			(0.056)	(0.012)
Industrial Market Potential	*	Intensity of Sales to Industry	0.025	0.015
			(0.023)	(0.012)
Year Fixed-effects			Yes	Yes
Number of Observations			972	972
Sargan Test for Overidentification, χ^2			64.11	55.09
Test for Second Order Autocorrelation, z			-0.43	-0.30

The table reports one-step GMM estimations of Equation [4] based on the procedure developed by Arellano and Bond (1991). Dependent variable (*lnts*) is the (logistically transformed) location share as defined in Equation [1] in the text. One lag of the dependent variable included (not reported). All right-hand side variables in Equation [4] are treated as endogenous. The Sargan test statistics is based on the two-step estimations. Robust standard errors are reported in parentheses. *significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6. The Impact of Internal Tariffs (1985-1998)

Explanatory Variables - Interactions			(1) lnts	(2) lnts
Agriculture Abundance	*	Agriculture Intensity	0.246	0.238
			(0.053)***	(0.057)***
Labor Abundance	*	Labor Intensity	-0.062	-0.068
			(0.028)**	(0.027)**
Skilled Labor Abundance	*	Skilled Labor Intensity	0.045	0.049
			(0.026)*	(0.027)*
Market Potential	*	Economies of Scale	0.001	-0.003
			(0.019)	(0.021)
Industrial Market Potential	*	Intermediate Inputs Intensity	0.264	0.237
			(0.052)***	(0.054)***
Industrial Market Potential	*	Intensity of Sales to Industry	-0.023	0.009
			(0.065)	(0.065)
Internal Tariff	*			
Agriculture abundance	*	Agriculture Intensity	-0.013	-0.004
			(0.022)	(0.013)
Labor Abundance	*	Labor Intensity	-0.170	-0.038
			(0.064)***	(0.016)**
Skilled Labor Abundance	*	Skilled Labor Intensity	-0.013	-0.011
			(0.026)	(0.020)
Market Potential	*	Economies of Scale	0.078	0.029
			(0.039)**	(0.015)*
Industrial Market Potential	*	Intermediate Inputs Intensity	0.100	0.030
			(0.073)	(0.016)*
Industrial Market Potential	*	Intensity of Sales to Industry	-0.022	-0.012
			(0.028)	(0.015)
Year Fixed-effects			Yes	Yes
Number of Observations			972	972
Sargan Test for Overidentification, χ^2			55.15	55.77
Test for Second Order Autocorrelation, *z*			-0.44	-0.39

The table reports one-step GMM estimations of Equation (4) based on the procedure developed by Arellano and Bond (1991). Dependent variable (*lnts*) is the (logistically transformed) location share as defined in Equation [1] in the text. One lag of the dependent variable included (not reported). All right-hand side variables in Equation (4) are treated as endogenous. The Sargan test statistics is based on the two-step estimations. Robust standard errors are reported in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

MERCOSUR? To answer this question we turn to the estimation of Equation (4).[18]

The results presented in Table 5 suggest that higher preferences margins tend to be associated with a higher sensitivity of production patterns to comparative advantage considerations along two dimensions: labor and human capital. More precisely, the terms in which labor and skilled labor are not interacted with tariff preferences are not significant or they have a negative sign suggesting that, in the absence of these preferences, regional comparative advantage is not a relevant determinant of industrial location. Once we condition on tariff preferences, we find positive effects both for labor (for the contemporaneous regression) and for skilled labor (in the case of the lagged estimation). Thus, in the presence of larger preference margins, labor and human capital intensive industries show a stronger tendency to locate in countries with larger endowments of these factors. This can be interpreted as being consistent with the idea that MERCOSUR countries do not

[17] We have performed several robustness checks. First, we tested the stability of parameters by sequentially introducing the explanatory variables. Second, we used the absolute production value and the share of national sectoral manufacturing production value to total GDP instead of the shares as dependent variable. Third, we have also utilized alternative measures of labor abundance, labor intensity, and market potential (see Section C in the Appendix for more details). Fourth, the differentiation performed when applying the method of Arellano and Bond (1991) implies removing country-fixed effects. We have therefore included either population or GDP in the GMM estimations to control for time-varying size. Fifth, if series being used were highly persistent, a weaker instrument problem arises when using the Arellano and Bond (1991) procedure because lagged levels of the variables become inappropriate instruments for their first differences (Bond, 2002). Hence, we have re-estimated Equation (3) using the "GMM system" method as proposed by Blundell and Bond (1998). In all cases, results were qualitatively the same. These results are not reported, but are available from the authors upon request.

[18] As discussed above, one indirect and commonly used method to empirically identify the effects of preferential trade policies enacted when MERCOSUR was established consists of running separate regressions for different sub-periods and to compare the estimated coefficients measuring the responsiveness of these patterns to the matching of specific country and industry characteristics. Detected changes are then implicitly or explicitly attributed to the process of integration. Following this procedure, we find that interactions involving factor endowments and factor intensities, specifically abundance and intensity of agriculture and human capital, show an upward trend. Production patterns across MERCOSUR member countries seem to be more sensitive to comparative advantage considerations. This is exactly what we would expect in an environment where trade is being liberalized. On the other hand, interactions between market potential and economies of scale and industrial market potential and intensity in intermediate manufactured inputs do not display a clear trend. If anything, they seem to have declined in recent years suggesting that agglomeration forces have somewhat diminished with the full implementation of MERCOSUR. These results are not reported here, but are available from the authors upon request. Notice, however, that these regressions have a main drawback. They do not represent a direct test of the impact of the trade policies. Thus, in the case of MERCOSUR, observed changes in the relative importance of explanatory factors could be the net result of the multiple reforms implemented in the region since the second half of the 1980s. In Particular, They could be driven not only by preferential trade liberalization, but also by the general unilateral opening of the economies.

have global comparative advantage in these industries and that respective regional comparative advantage affects the regional pattern of manufacturing distribution across countries only when tariff preferences are large enough.[19] Interestingly, we do not find any significant impact of these preferences on the responsiveness of production patterns of industries using intensively agriculture inputs to countries' endowments of arable land. Argentina, Brazil, and Uruguay have a revealed comparative advantage in these sectors, as measured by the Balassa-Index, especially in food products (see, *e.g.*, Volpe Martincus, 2003). Thus, as expected from the theory, we find that regional preferences have no significant impact in those sectors in which countries have a global comparative advantage.

On the other hand, higher preferential margins weaken the tendency of sectors with increasing returns to scale to locate in countries with larger market potentials. If high preferences reflected low internal tariffs, this result would be consistent with theory suggesting that deepened internal trade liberalization generates a weakening of agglomeration forces. In order to test the plausibility of this interpretation, we re-estimate Equation (4), this time with internal tariffs as a trade policy instrument instead of preferential margins. The results are presented in Table 6. They confirm our priors. Lower intra-bloc tariffs weaken the tendency of sectors with increasing returns and strong cost linkages to locate in countries with larger market potentials.[20]

These results support Hypothesis 7. It appears that preferential tariffs lead to a restructuring of production patterns across MERCOSUR member countries along the lines of regional (as opposed to global) comparative advantage as suggested by Venables (2003). Furthermore, consistent with Hypothesis 8, regional trade liberalization seems to have weakened agglomeration forces. This is in line with the theoretical prediction by Puga and Venables (1998) when intra-bloc trade obstacles are low enough.

VIII. Concluding Remarks

Argentina, Brazil, Paraguay, and Uruguay have actively engaged in trade

[19] As shown in Venables (2003), this would be associated with trade diversion and welfare reduction for some countries. In our empirical analysis, we consider other factors than comparative advantage such as economies of scale and input-output linkages. Drawing robust conclusions on the welfare implications of production developments would require an explicit theoretical model combining both sets of factors. This is beyond the scope of this paper

[20] We use the level of internal tariff as interacting term, so the positive sign on the interactions suggests that higher internal tariffs are associated with higher sensitivity to market potentials.

liberalization initiatives during the last two decades. These initiatives have resulted in significant changes in the spatial distribution of economic activities. This paper has uncovered the determinants of these changing manufacturing production patterns over the period 1985-1998 in Argentina, Brazil, and Uruguay. We contribute to the literature by providing empirical evidence on developing countries and by explicitly assessing the impact of preferential trade liberalization on industrial development.

In order to distinguish the role played by increased economic integration in shaping manufacturing production patterns, we explicitly use measures of sectoral preferential margin and internal tariffs interacted with each matching pair of country and industry characteristics. Although in some cases relatively weak from a statistical significance point of view, our econometric results are in line with theoretical predictions suggesting that preferential trade liberalization in the Southern Cone has driven a spatial reorganization of production along internal comparative advantage in labor and human capital. Moreover, declining internal tariffs have weakened agglomeration forces determined by the interplay of distribution of market sizes and scale economies and input-output linkages.

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Appendix

A. Dataset Description

Table A1. Definition and Sources of Variables

	Data			
Variable	Aggregation	Country coverage	Period	Source
Production value	ISIC. Rev. 2, 3digits	Argentina, Brazil, Uruguay	1985-1998	PADI/ECLAC
	IBGE Subsector Classification	Brazil	1985, 1990-1998	IBGE
Exports and Imports	ISIC. Rev. 2, 3digits	Argentina, Brazil, Uruguay	1985-1998	BADECEL/ECLAC
Employment	IBGE Subsector Classification	Brazil	1985-1998	RAIS/Ministry of Labor
Value added	IBGE Subsector Classification	Brazil	1985, 1990-1998	IBGE
Number of establishments	IBGE Subsector Classification	Brazil	1985-1998	RAIS/Ministry of Labor
Labor compensation	IBGE Subsector Classification	Brazil	1985-1998	IBGE
Workers qualification	IBGE Subsector Classification	Brazil	1985-1998	RAIS/Ministry of Labor
Intermediate inputs	IBGE Subsector Classification	Brazil	1985, 1990-1998	IBGE
Sales to industry	IBGE Subsector Classification	Brazil	1985, 1990-1998	IBGE
Agricultural inputs	IBGE Subsector Classification	Brazil	1985, 1990-1998	IBGE
Intermediate demand	IBGE Subsector Classification	Brazil	1985, 1990-1998	IBGE
Total demand	IBGE Subsector Classification	Brazil	1985, 1990-1998	IBGE
Tariffs	IBGE Subsector Classification	Brazil	1987-1998	Kume, Piani, Souza (2000)
Total GDP	Country	Argentina, Brazil, Uruguay	1985-1998	PADI/ECLAC
Industrial GDP	Country	Argentina, Brazil, Uruguay	1985-1998	PADI/ECLAC
Skill level of population	Country	Argentina, Brazil, Uruguay	1985, 1990, 1995, 1999	Barro and Lee (2000)
Arable land	Country	Argentina, Brazil, Uruguay	1985-1998	FAO

Manufacturing sectors according to the ISIC, Revision 2, at the 3 digit level: 311- Food products; 313- Beverages; 314- Tobacco; 321- Textiles; 322- Wearing apparel, except footwear; 323- Leather and leather products, except footwear and wearing apparel; 324- Footwear, except vulcanized or moulded rubber or plastic footwear; 331-Wood and wood and cork products, except furniture; 332- Furniture and fixtures, except primarily of metal; 341-Paper and paper products; 342- Printing, publishing and allied industries; 351- Industrial chemicals; 352- Other chemicals product; 353- Petroleum refineries; 354- Miscellaneous products of petroleum and coal; 355- Rubber products; 356- Plastic products not elsewhere classified; 361- Pottery, china, and earthenware; 362- Glass and glass products; 369- Other non-metallic mineral products; 371- Iron and steel; 372- Non-ferrous metals; 381- Fabricated metal products; 382- Machinery, except electrical; 383- Electrical machinery apparatus; 384- Transport equipment; 385- Professional, scientific, measuring, controlling, photographic and optic equipment; 390- Other manufacturing industries.

Manufacturing sectors according to the IBGE Sub-sectors Classification: Non metallic minerals; Metallurgy; Mechanics; Electrical and communication equipment; Transport equipment; Woods; Furniture; Paper; Printing and publishing; Rubber; Leather and hides; Chemicals; Pharmaceuticals; Perfumes, soaps, and candles; Plastics; Textiles; Clothing, footwear, and cloth goods; Food products; Beverages; Tobacco; Other manufacturing industries.

B. Specific Aspects of the Dataset and Variable Definition

First, the data for several variables, such as the number of establishments, qualifications of workers, intensity of use of intermediate inputs, were available only for Brazil. Similar statistical information for Argentina and Uruguay was not found. In the case of Argentina, there are data only for a few particular years.[21] A simple inspection of such available data suggests that using the Brazilian data should not be, however, significantly misleading.[22]

Data on intensity in consumption of manufactured intermediate inputs, sales to industry as a share of total demand, labor compensation, and agricultural inputs are derived from the Brazilian input-output tables published by the *IBGE*. These data are available for 1985 and 1990-1998. Data for the period 1986-1989 are linearly interpolated or simply assumed to be the same as in 1985 with no major impact on results. The reason is that industry characteristics have not changed significantly over the second half of the 1980s. This is plausible, because most important changes in economic environment took place since the beginning of the 1990s when trade liberalization deepened.

Tariff data for each manufacturing sector are taken from Kume *et al.* (2000). Our econometric analysis focuses on the period 1985-1998. However, our tariff data are available beginning with 1987. We assume that sectoral tariffs rates in 1985 and 1986 did not significantly differ from those in 1987.[23]

These sectoral data are reported according to the *IBGE* Sub-sectors classification. In order to get comparable figures, we have mapped them into the *ISIC Rev. 2* Classification using a concordance table supplied by the *IBGE*.

Data on the skill level of population reported by Barro and Lee (2000) is available on a 5 years basis. Following Harrigan (1997), we have interpolated the values for intermediate years.

The specific variables used in the analysis will be defined next.

Agriculture abundance: Share of arable land to total land area.

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[21] Information on the number of establishments is only available for the years 1985 and 1994 from the National Economic Census. Data on intermediate intensity exist also for 1997 (Input-output table published by the INDEC).

[22] For example, the Spearman-rank correlation coefficient for establishment size between Argentina and Brazil was 0.57 in 1985 and 0.66 in 1994, in both cases significant at the 1% level. On the other hand, the simple correlation between Argentinean and Brazilian external tariffs for the ISIC Classification at 4 digits was 0.68 in 1992 and 0.77 in 1994 (see Sanguinetti and Sallustro, 2000).

[24] Kume *et al*. (2000) state that the Brazilian import policy at the starting year of their study, 1987 was essentially based on a tariff structure set in 1957.

Labor abundance: Share of population older than 25 years with incomplete primary education. We have also used as an alternative proxy the raw share of each country's population in MERCOSUR's total population.

Skilled labor abundance: Share of population older than 25 years which have attained at least high school.

Market potential and Industrial market potential: The market potential of a country is captured through the index proposed by Keeble *et al.* (1986). Formally:

$$MP_i \equiv \sum_{j \neq i} \frac{Y_j}{d_{ij}} + \frac{Y_i}{d_{ii}}$$

where i is the country under examination , j corresponds to remaining countries in the bloc, Y_i is the GDP (industrial GDP) of country i, d_{ij} measures the distance between the most important cities from an economic point of view in countries i and j and d_{ii} is the intra-state distance, given by 1/6 of the radius of a circle with the same area as the country i.[24] The value of the measure is higher, the higher the own GDP (industrial GDP), viewed as a proxy for own market size, the lower the own area, and the lower the distance to the main markets of other countries.

Distances between cities have been estimated using the formula of geodesic distances by CEPII (http://www.cepii.fr). Formally, the distance between two points i and j is given by:

$$d_{ij} = 6370 * arcos\left[\begin{array}{l} cos((lat_j/57.2958) * cos(lat_i/57.2958) * cos(min(360\text{-}abs(long_j - long_i)) \\ , abs(long_j - long_i)/57.2958) + sin(lat_j/57.2958) * sin(lat_i/57.2958) \end{array}\right]$$

where *lat* is latitude and *long* means longitude.

We have also considered a tariff-adjusted measure of market potential defined as follows:

$$MP_i \equiv \sum_{j \neq i} \frac{Y_j}{(1 + \overline{PT}_j) d_{ij}} + \frac{Y_i}{d_{ii}}$$

where $\overline{PT}$ is the average preferential tariff applied by the country on intra-MERCOSUR trade flows.

[24] We use 1/6 instead of 2/3 as in Head and Mayer (2003) and Redding and Venables (2004) for two related reasons. First, population and economic activity shows a high spatial concentration in the two larger countries, i.e., Argentina and Brazil, so that using this conventional measure would result in a factual understatement of domestic market potentials. Second, we wanted to ensure that internal distance is smaller the international distance (see also Redding and Venables, 2004).

Agriculture intensity: Share of agriculture inputs in total sectoral production value.

Labor intensity: Share of labor compensation in sectoral value added. We have also used as an alternative proxy a measure of unskilled labor intensity (i.e., share of employees with incomplete primary education to total sectoral employment).

Skilled labor intensity: Share of employees with at least incomplete high school education in total sectoral employment.

Economies of scale: Following Kim (1995) and Amiti (1998), economies of scale are captured by average establishment size, i.e., the average number of employees per establishment in the industry in question. Measuring scale economies is problematic, since they might be product-specific, plant-specific or due to multi-plant operations (see Amiti, 1998). There are other possible measures, such the one developed by Pratten (1988) and extensively used by other authors. Pratten ranked industries "in order of the importance of the economies of scales for spreading development costs and for production costs". This classification is based on two criteria: engineering estimates of the minimum efficient plant scale relative to the industry's output, and estimates of the cost gradient below the minimum efficient scale. Thus, the ranking is based on observed plant size but also on (unexploited) potential for scale economies (Brülhart, 1998). However, estimations are exclusively based on information from developed countries. Given the evident technological differences between countries at different levels of development, using this rank for developing countries appears to be inappropriate.

Industrial intermediate consumption: Share of manufactured inputs in total sectoral production value.

Sales to industry: Share of intermediate demand (i.e., sales to the manufacturing sector) in total demand.

Preferential margin/Internal tariffs: The preferential margin is derived as follows. Starting from Brazilian sectoral tariff data, we have constructed a proxy for the preference tariff variable, which measures the degree of intra-bloc trade impediments in each sector. These internal tariffs were calculated applying the internal trade liberalization schedule set in the Asunción Treaty on the (Brazilian) MFN sectoral tariffs. Then we combined these sectoral preferential tariffs with the respective MFN tariffs into the following indicator of preferential margin (see, *e.g.*, Estevadeordal *et al.*, 2000):

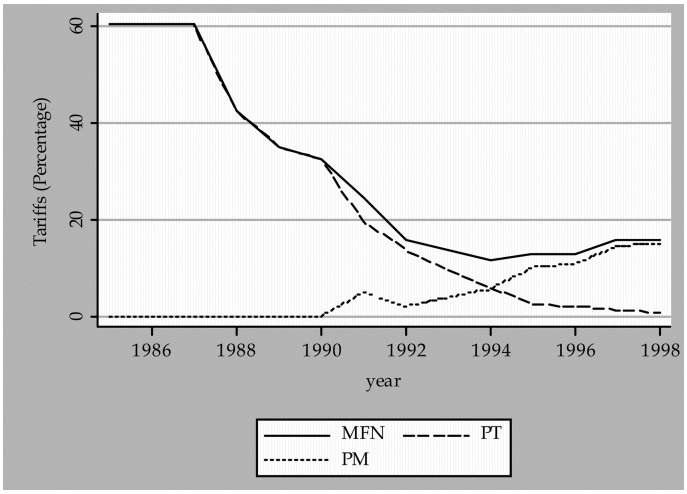
$$PM = \frac{(1 + MFN_k)}{(1 + PT_k)} - 1$$

where δ_k is the MFN tariff in sector k for trade flows with the rest of the world and ρ_k is the preferential tariff in sector k for trade flows within MERCOSUR.

For sectors included in national exception lists, *e.g.*, textiles-wearing apparel, footwear, paper, and iron and steel (for more details see INTAL, 1996), tariff on intra-zone trade flows are kept equal to MFN tariffs over the transition period towards the customs union, i.e., 1991-1994 so that preferential margins are equal to zero for these sectors during this sub-period. These tariffs are thereafter automatically and linearly reduced according to the prescriptions of the Regime for the Final Adaptation to the Customs Union (Régimen de Adecuación Final a la Unión Aduanera).

We have thus a variable that measures the level of trade barriers within the bloc relative to those with the rest of the world. This variable is an appropriate empirical counterpart to the theoretical one to assess the effect of preferential trade agreements among developing countries with relatively high extra-zone trade barriers.

Figure B1. Average MFN and Preferential Tariffs and Average Preferential Margin (1985-1998)



The figure plots simple (unweighted) averages of Most Favored Nation (MFN) and Preferential Tariffs (PT) and of preferential margins. MFN tariffs correspond to Brazil and have been taken from Kume *et al.* (2000). Preferential tariffs have been calculated applying the schedule of tariff reductions set in the Treaty of Asuncion and taken into account major sectoral exceptions. Preferential margins have been estimated from MFN and Preferential Tariffs as indicated above.

References

Amiti, M.(1998), "New Trade Theories and Industrial Location in the EU: a Survey of Evidence", *Oxford Review of Economic Policy*, 14(2).

Amiti, M.(1999), "Specialization Patterns in Europe", Weltwirtschaftliches Archiv, 135(4).

Amiti, M.(2001), "Location of Vertically Linked Industries: Agglomeration versus Comparative Advantage", *CEPR Discussion Paper* 2800.

Arellano, M., and Bond, S.(1991), "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations", *Review of Economic Studies*, 58.

Balassa, B., and Noland, M.(1989), "The Changing Comparative Advantage of Japan and the United States", *Journal of the Japanese and International Economics*, 3.

Baldwin, R., Forslid, R., Martin, P., Ottaviano, G., and Robert-Nicaud, F.(2003), "Economic Geography and Public Policy", Princeton University Press.

Baltagi, B.(1995), *Econometric Analysis of Panel Data*, Wiley, New York.

Barro, R., and Lee, J.(2000), "International Data on Educational Attainment: Updates and Implications", *CID Working Paper* 42.

Bevilaqua, A., Catena, M., and Talvi, E.(1999), "Macroeconomic Interdependence in MERCOSUR", Documento de Trabajo. CERES.

Blundell, R., and Bond, S.(1998), "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models", *Journal of Econometrics*, 87.

Bond, S.(2002), "Dynamic Panel Data Models: a Guide to Micro Data Methods and Practice", *CEMMAP Working Paper* CWP09/02. The Institute for Fiscal Studies.

Brülhart, M.(1998a), "Economic Geography, Industry Location and Trade: the Evidence", *The World Economy*, 21(6).

Brülhart, M.(1998), "Trading Places: Industrial Specialization in the European Union", *Journal of Common Market Studies*, 36(3).

Brülhart, M., and Torstensson, J.(1996), "Regional Integration, Scale Economies, and Industry Location in the European Union", *CEPR Discussion Paper* 1435.

Combes, P., and Overman, H.(2003), "The Spatial Distribution of Economic Activities in the European Union", in Henderson, V., and Thisse, J., Handbook of Regional Economics, 4.

Estevadeordal, A., Goto, J., and Saez, R.(2000), "The New Regionalism in the Americas: the Case of MERCOSUR", *INTAL Working Paper* 5.

Greene, W.(1997), *Econometric Analysis*, Prentice Hall, New Yersey.

Haaland, J., Kind, H-J., Ulltveit-Moe-Knarvik, K., and Torstensson, J.(1999), "What Determines the Economic Geography of Europe?", *CEPR Discussion Paper* 2072.

Hanson(1997), "Increasing Returns, Trade, and the Regional Structure of Wages", *Economic Journal*, 107.

Hanson, G.(1998), "Regional Adjustment to Trade Liberalization", *Regional Science and*

Urban Economics, 28.
Harrigan, J.(1997), "Technology, Factor Supplies, and International Specialization: Estimating the Neoclassical Model", *American Economic Review*, 87(4).
Head, K., and Mayer, T.(2003), "The Empirics of Agglomeration and Trade", *CEPII Working Paper* 2003-15.
Helpman, E., and Krugman, P.(1985), "Market Structure and Foreign Trade", MIT Press, Cambridge.
IADB(2002), IPES(2002), "Beyond Borders: the New Regionalism in Latin America", IADB, Washington.
INTAL(1996), *Informe MERCOSUR N° 1. INTAL*, Buenos Aires.
Kim, S.(1995), "Expansion of Markets and the Geographic Distribution of Economic Activities: the Trends in U.S. Regional Manufacturing Structure, 1860-1987", *Quarterly Journal of Economics*, 110.
Keeble, D., Offord, J., and Walker, S.(1986), "Peripherial Regions in a Community of Twelve Member States", Commission of the European Communities, Luxembourg.
Kiviet, J.(1995), "On Bias, Inconsistency, and Efficiency of Various Estimators in Dynamic Panel Data Models", *Journal of Econometrics*, 68.
Krugman, P.(1980), "Scale Economies, Product Differentiation, and the Pattern of Trade", *American Economic Review*, 70(5).
Kume, H., Piani, G., and Bráz de Souza, C.(2000), "A Política Brasileira de Imoprtacao No Periodo 1987-1998: Descricao e Avaliacao", IPEA, Rio de Janeiro.
Midelfart-Knarvik, K. H., Overman, H., Redding, S., and Venables, A.(2000a), "The Location of European Industry", Economic Papers 142. European Commission, Luxembourg.
Midelfart-Knarvik, K. H. , K., Overman, H., and Venables, A.(2000b), "Comparative Advantage and Economic Geography: Estimating the Location of Production in the EU", *CEPR Discussion Paper* 2618.
Nickell, S.(1981), "Biases in Dynamic Models with Fixed Effects", *Econometrica*, 49.
Panagariya, A.(2000), "Preferential Trade Liberalization: the Traditional Theory and New Developments", *Journal of Economic Literature*, 38.
Pratten, C.(1988), "A Survey of the Economies of Scale", in The Cost of Non Europe, Vol. 2: Studies on the Economics of Integration, Commission of the European Communities, Luxembourg.
Puga, D., and Venables, A.(1998), "Trading Arrangements and Industrial Development", *World Bank Economic Review*, 12(2).
Redding, S., and Venables, A.(2004), "Economic Geography and International Inequality", *Journal of International Economics*, 62.
Robert-Nicoud, F.(2004), "The Structure of Simple New Economic Geography Models", *CEPR Discussion Paper* 4326.
Sanguinetti, P., and Sallustro, M.(2000), "MERCOSUR y el Sesgo Regional de la Política Comercial: Aranceles y Barreras No Tarifarias", CEDI. Documento de Trabajo 34.
Sanguinetti, P., Traistaru, I., and Volpe Martincus, C.(2004), "Economic Integration and

Location of Manufacturing Activities: Evidence from MERCOSUR", *ZEI Working Paper* B11-04.

Sanguinetti, P., Pantano, J., and Posadas, J.(2004), "Regional Integration and Trade Diversification in South-South Agreements: Evidence from MERCOSUR", Universidad Torcuato Di Tella.

Sanguinetti, P., and Bianchi, E.(2004), "Improving the Access of MERCOSUR's Exports to United States: Lessons from NAFTA", *INTAL-ITD Working Paper*.

Schiff, M.(1996), "Small is Beautiful: Preferential Trade Agreements and the Impact of Country Size, Market Share, Efficiency, and Trade Policy", *World Bank Policy Research Working Paper* 1668.

Traistaru-Siedschlag, I., and Volpe Martincus, C.(2006), "Economic Integration and Manufacturing Concentration Patterns: Evidence from MERCOSUR", *Open Economies Review*, 17(3).

Venables, A.(1996), "Equilibrium Locations of Vertically Linked Industries", *International Economic Review*, 37(2).

Venables, A.(1999), "Regional Integration Agreements: a Force for Convergence or Divergence?", *World Bank Working Paper* Series on International Trade, 2260.

Venables, A.(2003) "Winners and Losers from Regional Integration Agreements", *Economic Journal*, 113.

Volpe Martincus, C.(2003), "Changing Specialization Patterns in MERCOSUR", Paper Presented at the 5th Annual Meeting of ETSG, Madrid.

World Bank(2000), "Regional Integration Agreements", Washington.