Internationalization and technology in MERCOSUR

Isabel Álvarez, Bruno B. Fischer and José Miguel Natera

ABSTRACT

The Southern Common Market (MERCOSUR), widely recognized as one of the most advanced regional integration schemes worldwide, is increasingly attractive to multinational enterprises and also very active in outward investments, despite persistent innovation and competitiveness gaps. In this paper we analyse internationalization and technology trends in MERCOSUR in relation to trade, the activities of multinational enterprises (MNEs) and the features of national systems of innovation. Our empirical findings, based on traditional gravity models, show the impact of foreign direct investment (FDI) (inward and outward) on exports, classified according to their technological content. Income distribution, which shapes the institutional characteristics of MERCOSUR countries, is specifically addressed as a proxy for the structural aspects of MERCOSUR countries. The findings confirm that technological and internationalization capacities —both as host and home countries of FDI— influence trade within the bloc.

KEYWORDS

MERCOSUR, globalization, competitiveness, trade, foreign direct investment, technology transfer, multinational enterprises

JEL CLASSIFICATION

F1, F4, O3

AUTHORS

Isabel Álvarez, Professor of Applied Economics, Department of Applied Economics II and Complutense Institute for International Studies, Universidad Complutense de Madrid, Spain. isabel.alvarez@ccee.ucm.es

Bruno B. Fischer, Research Group on Economics and Innovation Policy (GRINEI) Universidad Complutense de Madrid, Spain, bbfischer@pdi.ucm.es

José Miguel Natera, Research Group on Economics and Innovation Policy (GRINEI) Universidad Complutense de Madrid, Spain. jm.natera@pdi.ucm.es

I
Introduction

Structural changes introduced in the countries of the Southern Common Market (MERCOSUR) have helped to attract more multinational enterprises (MNEs) to the region than during the import-substitution industrialization (ISI) period, but problems associated with weak specialization and innovation still persist in these economies.[1] In this paper we examine the relationship between internationalization trends and the technology content of exports using an empirical framework based on gravity models that can provide new insight into integration processes involving developing countries.[2]

Production in the MERCOSUR countries is characterized by a high proportion of activities in low-growth industries and limited innovation efforts —a characteristic shared by other Latin American countries. Although the manufacturing sector has increased its share in the exports of these economies, commodities continue to predominate, which can be an obstacle to international competitiveness (Cassiolato and Lastres, 1999). This production structure prevents these countries from fully benefiting from the advantages associated with advanced technological specialization, which would lead to greater integration in dynamic international markets. Such specialization ultimately depends on each country's industrial structure, as well as on the characteristics of a complex set of elements referred to as national systems of innovation (Narula and Wakelin, 1995).

Although openness does not necessarily lead to growth and development (Rodrik, 1999; Fagerberg and Srholec, 2008), some national capabilities can be built —or improved— through trade, and a higher degree of openness may enhance competitiveness gains. By carrying out their production activities and generating value added, large, internationalized corporations may help their host countries to enter more technologically sophisticated segments of the global value chain, which could boost national innovation capacity. Those enterprises can then contribute not only to expanding investment flows between countries, but also to promoting the competitiveness of both home and host economies. This last aspect can be seen most clearly in regional contexts (Rugman and Doh, 2008).

In recent years, developing economies have experienced a surge in FDI inflows and the emergence of outward FDI (Chudnovsky, 2001; UNCTAD, 2005 and 2007). In particular, the FDI boom in Latin American countries in the 1990s strengthened the position of MERCOSUR economies as host and home countries that were increasingly used by multinationals as platforms to expand their operations in the region. Some MERCOSUR countries have taken advantage of their potential as active players in terms of outward FDI. These new trends justify an analysis of bilateral flows between MERCOSUR countries to examine the opportunities that international companies may have opened up for the technological integration of the bloc, taking into account some of the structural features of its member countries.

This paper analyses the relationship between trade, FDI and technology in MERCOSUR, based on the assumption that the competitiveness of Latin American countries is conditioned by their technological capabilities and access to knowledge (Rosales, 2009). Data from several recognized international sources will be used to build gravity models in order to identify the factors determining trade flows, while controlling for innovation patterns. To that end, we will test the influence of FDI flows on export performance, disaggregated by the technological level of products. We expand the traditional gravity model to take into account some specific characteristics of the MERCOSUR countries' internationalization and institutional frameworks, including, for example, income distribution as measured by the Gini index.[3] We propose an alternative empirical framework for studying trade that looks at internationalization, level of technological development and the influence of the national institutional features of these Latin American countries.

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1 Latin American countries on the whole continue to make extremely limited investments in research and development (R&D) at the domestic level (see Gonçalves, Lemos and De Negri (2008); and Yoguel, Borello and Erbes (2009)).

2 Several search requests using the ISI Web of Knowledge online platform have shown that scientific articles on the relationship between FDI and innovation in MERCOSUR are scarce (our search yielded only one hit containing the three keywords). This further justifies the analysis of this relationship conducted in this paper.

3 Alonso and Garcimartín (2011) found that the Gini index is a robust indicator of overall institutional quality.

The paper is organized into five sections. Following this introduction, the second section contains a review of the main background literature. The third section describes some of the features of firms' internationalization in the MERCOSUR countries and the region's innovation performance, as well as the trade and FDI flows within the region. Section four presents the theoretical foundation of our empirical analysis and a discussion of the findings. The last section draws some conclusions from our findings and highlights their policy implications, as well as possible avenues for future research.

II
Background literature

According to the eclectic paradigm, FDI flows can be explained by a combination of ownership, location and internalization advantages (OLI theory) that large companies are able to harness and which justify their internationalization through investments abroad (Dunning, 1977 and 1981). Some economists argue that the effect of regional integration on FDI depends on the attractiveness of the locations and the scope of countries' trade liberalization and investment policies (Blomstrom and Kokko, 1997). The evidence available suggests that the impact of integration among the MERCOSUR countries has been smaller than that of other regional integration processes, such as the European Union (Worth, 1997), while there is only limited information on the location advantages for attracting FDI in different regional blocs. Studies have revealed that the macroeconomic impact of FDI in MERCOSUR countries is not significant, with neither a positive nor a negative effect on growth in the region; however, the microeconomic impact of FDI appears to be much stronger (Chudnovsky and López, 2007) as MNEs have expanded their presence in the region and MERCOSUR countries are more competitive now than during the ISI period. The main motivations for FDI, such as market seeking, efficiency seeking and knowledge seeking, vary depending on the country's stage of economic development (Dunning, 2006; Narula and Dunning, 2000; Dunning and Narula, 1996). In the MERCOSUR countries, MNEs in the services and manufacturing sectors have adopted a predominantly market-seeking strategy and have increased exports flows significantly, especially to neighbouring countries (Chudnovsky, 2001). Nonetheless, there are some differences between countries, with firms in Brazil adopting asset-seeking strategies and those in Uruguay predominantly motivated by resource seeking with a focus on exports, which more closely resembles the traditional strategies of MNEs in the region. Efficiency seeking is becoming an increasingly important motivation: during the ISI period, MNE subsidiaries operated on the basis of a high degree of national integration, but since the 1990s strategies have focused on fostering international trade integration (Chudvnosky, 2001; Chudnovsky and Lopez, 2007).

In the discussion on developing countries' approach to innovation, one interesting argument is that developing economies should focus on the adaptation and efficient use of existing technology, at least in the first stages of development, also known as the industrialization phase (Lall, 1996 and 2000). Countries must first develop their technological capabilities in order to adopt the technical changes and innovations developed elsewhere (Dahlman, Ross-Larson and Westphal, 1987; Lall, 1992). The decision to absorb and adapt existing technologies or create new technologies through the expansion of research and development (R&D) and innovation is unique to each nation and dependent on its level of development (Gerschenkron, 1962) and degree of modernization. These differences in approach are dictated by the industrial structure of many developing economies, which combine traditional labour-intensive industries and technologically complex industrial activities (Uchida and Cook, 2005). Although most of the data are from the Asian economies, other economies have been able to carve out their own technological niches (for example, Brazil in aircraft, electronics and computers) as a result of a combination of government efforts and domestic and foreign capital.

It is generally accepted that the acquisition of technological expertise is a cumulative process, one that necessarily requires the development of absorptive capacities, involvement in a variety of networks, interaction with customers and suppliers, and the acknowledgement of other factors specific to the local environment (Cantwell, 1989; Lundvall and others, 2002; Fagerberg and Srholec, 2008a; Álvarez, Marín and Fonfría, 2009; Álvarez and Cantwell, 2011). The upgrading process can therefore be viewed as the culmination of efforts to build new capabilities in developing countries, which entails two

levels of action: investments at the national level in science and technology, information flows, infrastructure and supporting institutions; and micro-level efforts by firms to develop new organizational and technological skills so that they can tap into new information and select the most advantageous specialization vis-à-vis other firms (Lall, 1997). There is a certain overlap between innovation and diffusion activities and, therefore, they do not take place sequentially in all cases (López and Lugones, 1997). Indeed, technology diffusion often involves continuous (generally incremental) technical change to adapt to specific contexts; nonetheless, the increasing internationalization of productive activities has allowed some countries to fast-track the process of technological upgrading thanks to the technology transfer possibilities inherent to global value chains —a strategy that has been applied systematically in East Asia and North and Central America. Costa Rica, for example, has specialized in high-technology export-oriented production in a short period of time, moving swiftly from agriculture in the 1980s to a high-tech specialization in electronics in the 1990s, then to medical instruments and aeronautics in the 2000s.

Although the technological activities carried out by MNEs in host countries are diverse (Archibugi and Michie, 1995; Cassiolato and Lastres, 1999; Patel and Pavitt, 2000; Cantwell and Janne, 1999), there is a broad consensus regarding the active role that MNEs can play in the generation and diffusion of knowledge at the international level. These companies may be seen as a channel of access to international markets through trade and, in turn, that access may lead to the extension of the productive systems in which MNEs operate. Nevertheless, greater intra-firm interaction in relation to technological change and the increased mobility of MNEs does not detract from the importance of building local capabilities in developing economies. In fact, a study on the effects of technological transfer from United States multinationals confirmed the existence of local factors that have significant positive effects for developed countries, but not for developing countries, with human capital playing a crucial role (Xu, 2000). An analysis of two countries in Latin America by Mortimore and Vegara (2004) showed that the nature of FDI and its effect depends on technological capacities, human capital thresholds and supplier capabilities in the host country, and established that a minimum capability level is required to benefit from technology diffusion from MNEs. These findings support the role of national innovation systems in attracting FDI.

In the case of MERCOSUR, MNE subsidiaries are more involved than domestic companies in international trade (imports and exports) (Chudnovsky and Lopez, 2007). However, the technology content of subsidiaries' exports is lower than that of their imports —particularly those from their countries of origin— and the bulk of these exports are destined for developing countries, especially in Latin America. The specialization patterns of subsidiaries in MERCOSUR have two notable features: they export high added value and technologically sophisticated goods to MERCOSUR and the rest of Latin America, while they import capital goods, inputs and components from developed countries (Chudnovsky, 2001). Moreover, as the results of some case studies have shown, in the sequential internationalization strategies of MNEs from the Latin American economies —the so-called *multilatinas*— production facilities have taken precedence over marketing in the activities of their subsidiaries abroad in order to benefit from location advantages (Cuervo-Cazurra, 2007).

In recent decades, MERCOSUR countries have introduced policies to attract foreign investment and to enhance the quality and productivity of local firms in order to make their economies more competitive, while also giving impetus to the *multilatinas*. Meanwhile, the increasing role of technology flows and the activity of MNEs in the regional integration process has been explored to a lesser degree in the literature, opening a new window of opportunity for research.

III

A short description of the data

Inward FDI trends have been positive for all the MERCOSUR countries in recent decades (see figure 1). Nonetheless, in the period 1980-2008, Argentina and Brazil attracted more FDI in relative terms than Paraguay and Uruguay, as shown by the figures for inward FDI stock as a percentage of gross domestic product (GDP). Inward FDI stock began to falter in the early 1990s in all of the countries except Argentina, and declined sharply at the beginning of

the 2000s for all of the countries, including Argentina, owing not only to the world economic cycle, but also to the domestic economic and political crises affecting these countries. In 2000, Uruguay overtook Brazil and Argentina to take the leading position in this indicator in MERCOSUR (UNCTAD, 2005 and 2007). Overall, FDI has grown as a proportion of GDP in the last decades, though it plateaued and dipped to some extent in the 2000s, except in Uruguay.

Regarding outward FDI stocks as a proportion of GDP, Brazil and Argentina are the countries in the region with the highest capacity for investing abroad as they have the comparative advantages inherent to their size to fuel the capitalization process needed to set up MNEs. The values for this indicator for the smallest countries (Paraguay and Uruguay) pale in comparison with those for Brazil and Argentina (see figure 1). In the period under consideration, MNEs from the two larger economies performed very positively. Argentina saw a remarkable jump in its outward FDI stock in 2002 and for several years posted higher levels than Brazil. The Argentine capital outflows varied substantially over the period as a whole, although the overall tendency was positive; more moderate fluctuations were observed for Brazil. In any case, the differences between the countries are less prominent than those for inward FDI. Brazilian outward FDI stock has been growing steadily since the late 1990s, while Argentine stock was also following that path until it declined sharply in 2002; the data for Paraguay and Uruguay show outward FDI from these two countries has been rather stagnant.

Figure 2 illustrates spending on R&D as a percentage of GDP. This indicator can shed light on innovation in MERCOSUR countries and is a proxy for investment in building technological capabilities, which can be defined as the "ability to search for, create, and use knowledge commercially" (Fagerberg and Shrolec, 2009). Each country's capacity to be more productive in the learning economy is dependent on the scale of its efforts to achieve the higher knowledge levels that lead to greater economic benefits (Lundvall and Johnson, 1994). Although R&D expenditure paints only a partial picture of the efforts that countries are taking to build their technological capabilities, it shows that Brazil is leading the way in creating new opportunities in the region in both absolute (owing to the size of the Brazilian economy) and relative terms (see figure 2). Spending on R&D as a percentage of GDP in the region has remained relatively unchanged over the last 15 years, with Brazil spending the most, followed by Argentina and Uruguay, while Paraguay lags far behind.

FIGURE 1

MERCOSUR: inward and outward FDI stock by country, 1990-2008
(Percentages of GDP)

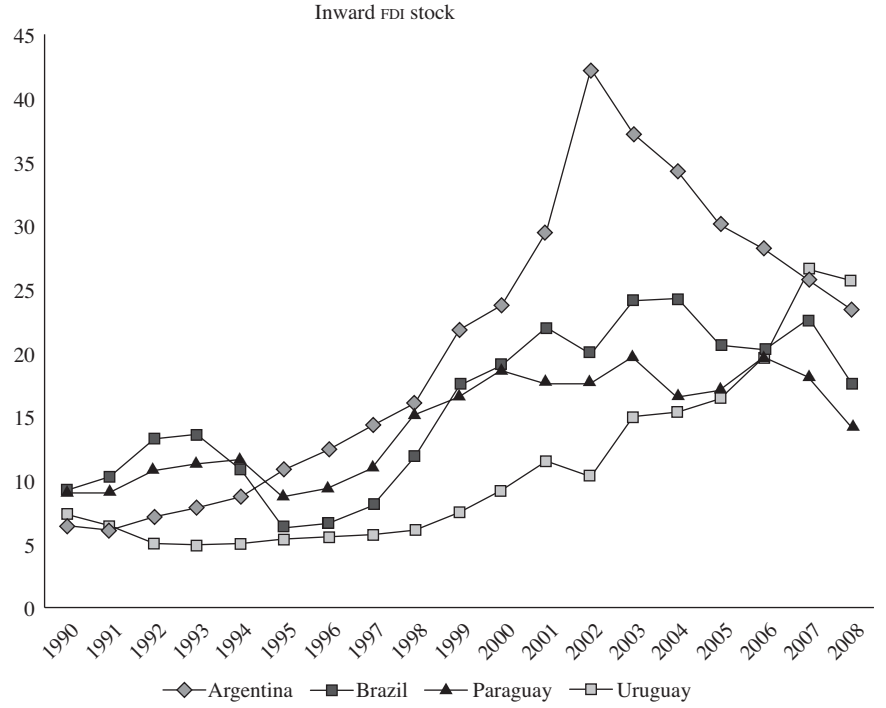
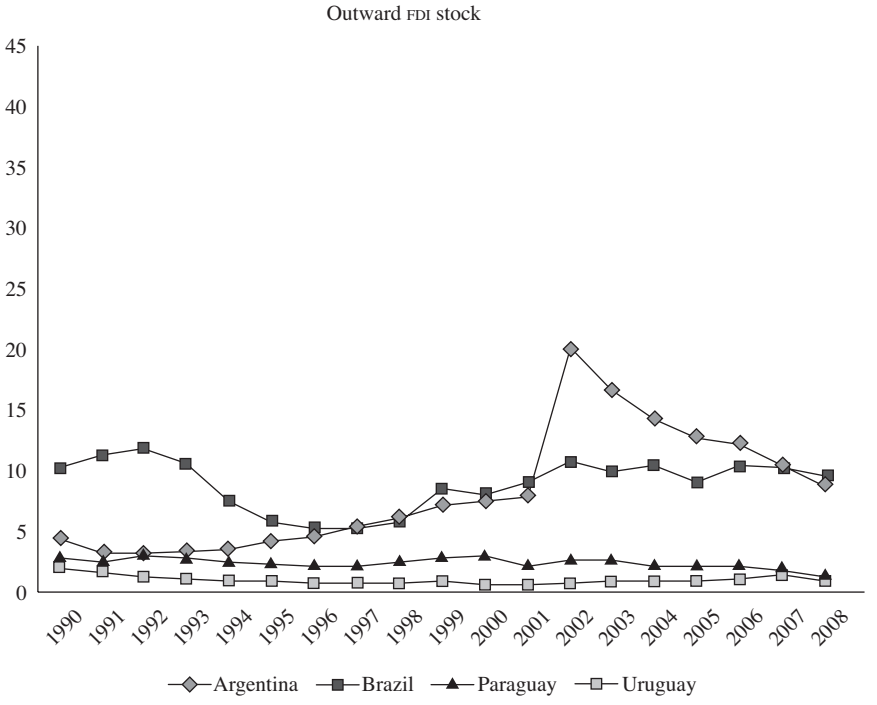
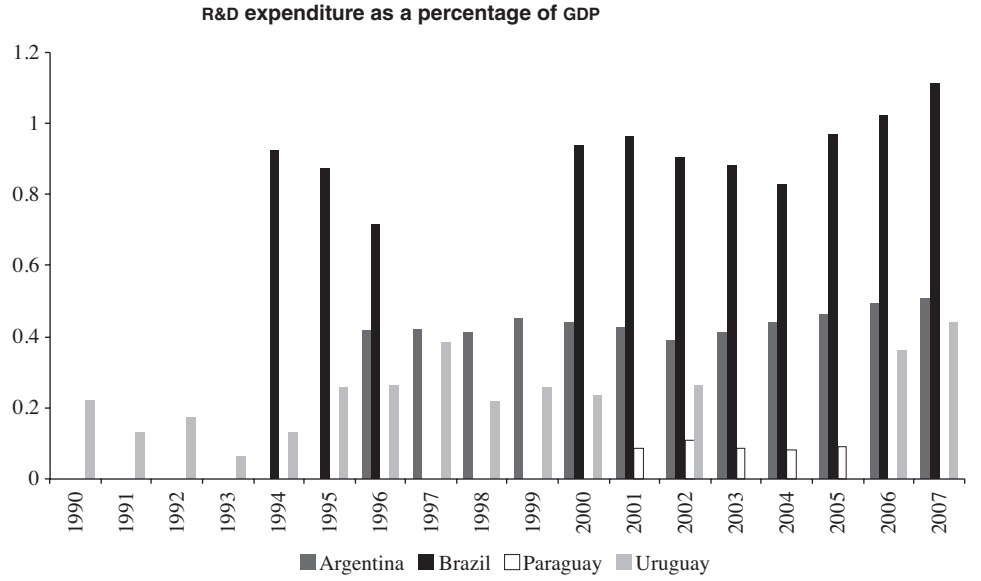


Figure 1 (concluded)



Source: United Nations Conference on Trade and Development (UNCTAD), UNCTADSTAT [online] http://unctadstat.unctad.org/.

FIGURE 2



Source: Ibero American Network of Science and Technology Indicators (RICYT).

Tables 1 and 2 show the distribution of the largest MNEs from MERCOSUR countries and from outside the region.[4] As shown in table 1, nearly 70% of the largest Argentine MNEs have affiliates in Brazil or Uruguay, which reveals how attractive the regional bloc is to Argentine companies. Similarly, Uruguayan firms tend to focus on other countries in the region, with more than 90% of the largest Uruguayan MNEs located in Argentina, Brazil or Paraguay. However, the pattern for Brazilian multinationals is rather different since the MERCOSUR countries are not among their main FDI targets (with the exception of Argentina which hosts 21.2% of Brazil's largest MNEs). Data for Paraguay were not available.

Table 2 shows that the share of MERCOSUR economies playing host to the largest foreign MNEs is quite small. In fact, none of the largest foreign-owned firms operating in Brazil and Argentina are originally from the MERCOSUR economies. Although Brazilian and especially Argentine companies account for a proportion of the largest foreign-owned firms operating in Paraguay and Uruguay, MNEs from other countries still predominate, accounting for roughly 75% in both cases. These two tables thus illustrate that MERCOSUR is an important destination for FDI from MNEs within the bloc (outward FDI from MERCOSUR countries), while inward FDI is mostly dominated by companies from countries outside the region.

Finally, information on trade flows between MERCOSUR countries adds further detail to the picture of internationalization trends. Figure 3 presents the export profiles of the MERCOSUR countries (only intra-MERCOSUR trade flows are considered) according to the technological classification of exports suggested by Hatzichronoglou (1997).[5] The vast majority of Paraguay's exports are low technology, with other types of products accounting for a

[4] Data are from the United Nations Conference on Trade and Development (UNCTAD) investment country profiles, which list the largest foreign multinational enterprises in the host economy and the largest foreign affiliates of home-based transnational corporations.

[5] Data are not available for 1994 for Brazil and for 1992 for Uruguay.

TABLE 1

Location of largest foreign affiliates of home-based MNEs in MERCOSUR
(Percentages)

Host country / Home country	Argentina	Brazil	Paraguay	Uruguay	Other
Argentina	-	34.3	0.0	34.3	31.4
Brazil	21.2	-	0.0	3.0	75.8
Paraguay	-	-	-	-	-
Uruguay	58.1	29.0	3.2	-	9.7

Source: United Nations Conference on Trade and Development (UNCTAD) foreign direct investment country profiles.

TABLE 2

Host position of the largest affiliates of foreign MNEs in MERCOSUR
(Percentages)

Home country / Host country	Argentina	Brazil	Paraguay	Uruguay	Other
Argentina	-	0.0	0.0	0.0	100.0
Brazil	0.0	-	0.0	0.0	100.0
Paraguay	11.5	7.7	-	3.8	76.9
Uruguay	22.7	2.3	0.0	-	75.0

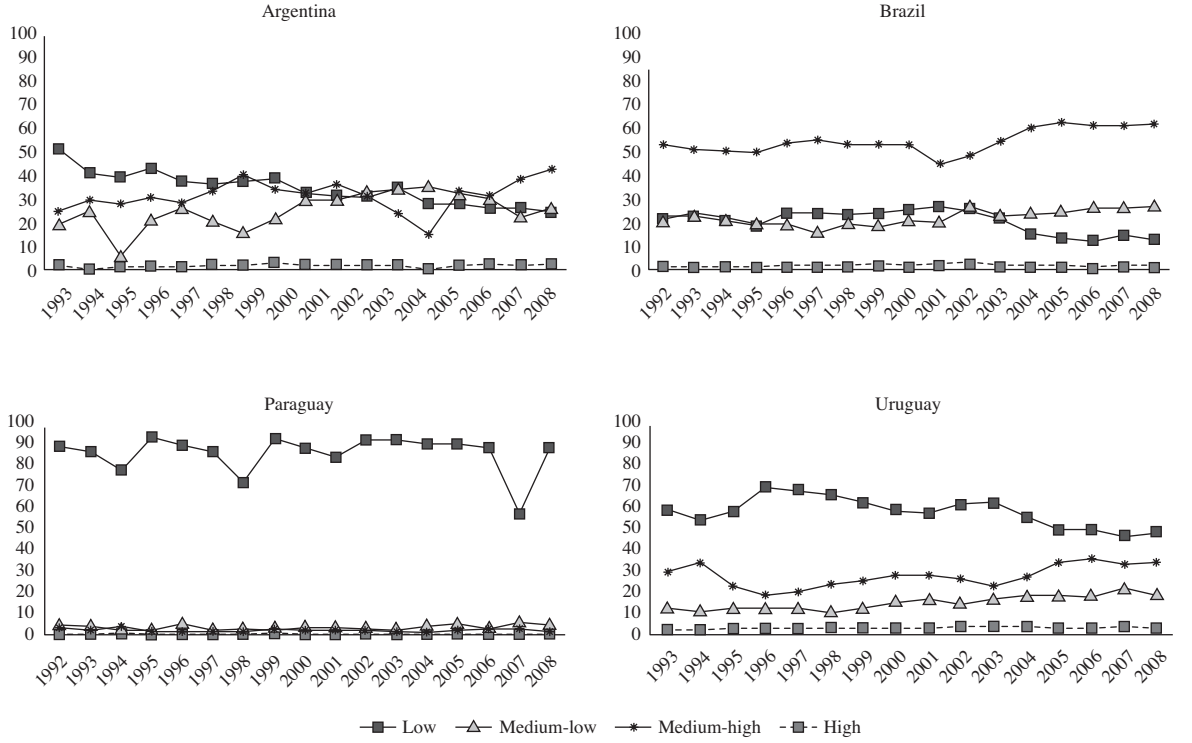
Source: United Nations Conference on Trade and Development (UNCTAD) foreign direct investment country profiles.

negligible proportion of its export structure. Overall, the export breakdown of Argentina, Brazil and Uruguay is more technologically advanced. The share of low-tech products has decreased in Argentina and Brazil, but remains significant in Argentina and is high in Uruguay. It is worthy of note that the medium-high technology category has expanded in the most recent years of the period under consideration.

The proportion of high-tech products exported by Brazil and Argentina to their MERCOSUR partners is very small and has not increased over time, which denotes an important weakness that may have interesting implications for intra-MERCOSUR trade, perhaps ultimately fostering greater specialization in higher value added activities, especially in Brazil and Argentina, in relation to neighbouring markets.

FIGURE 3

Country export profiles according to the technological classification of products, 1992-2008
(Percentages)



Source: Based on data from the Inter-American Development Bank (IDB), *DATAINTAL: Sistema de estadísticas de comercio de América*, Washington, D.C., 2010.

IV
Empirical model and findings

The estimation of international trade models has a long tradition in economics and the use of gravity equations in relation to bilateral trade, in particular, has dominated empirical research on international trade. Thus, the volume of trade between two countries is proportional to the size of their economies, and the factor of proportionality depends on measures of trade resistance between them (Anderson, 1979; Helpman and Krugman, 1985; Helpman, 1984; Feenstra, 2002; Anderson and Van Wincoop, 2003). This approach has been supplemented with theoretical underpinnings and better estimation techniques since most of the studies

have estimated the gravity equation using samples of countries that have only positive trade flows between them, disregarding countries that do not trade with each other. Standard specifications of the gravity equation impose symmetry that is inconsistent with the data and this leads to biased estimates. This problem was corrected in Helpman, Melitz and Rubinstein (2008) where a simple model of international trade with heterogeneous firms predicted positive as well as zero trade across pairs of countries, allowing the number of exporting firms to vary across destination countries.[6]

Some methodological issues should be considered in the analysis of bilateral trade flows using the gravity model. One crucial issue is the econometric specification of the gravity equation, as well as the validity and reliability of the estimation (Greenaway and Milner, 2002; Gil and others, 2005). Very often, gravity equations that have been estimated using cross-section or pooled data on total trade have been challenged because, among other reasons, conventional ordinary least squares (OLS) estimations are unable to deal with the heterogeneity that is inherent to bilateral trade flows. Using panel data is accepted as an appropriate solution to this problem because they allow for individual country-pair characteristics. However, it was not possible to apply this solution here owing to limited data availability and a lack of panel data for the empirical analysis of internal trade within MERCOSUR since bilateral flows in the given period provide few observations. To address this limitation, we applied a pooled regression model for the period 1992-2008,[7] which justifies the use of simple OLS estimations.

The objective of this empirical analysis is to study trade flows between the MERCOSUR countries and how the internationalization processes of these countries are conditioned by both FDI patterns and institutional contexts. We use the framework provided by gravity models, which we extend in the following two directions: first, we assume that technology transfer processes help to define a country's innovation system, which justifies the consideration of the absorption of technologies from abroad (inward FDI) and the development of a country's own capabilities (outward FDI), introducing a control for trading disembodied knowledge (using royalty receipts as a proxy[8]); second, we include certain indicators in the model to reflect the structural characteristics of the institutional set-up of these economies.

One of our contributions to the literature on this topic is a modified version of the gravity model that takes account of the structural aspects of trading economies. Income distribution, which can be measured for most Latin American economies, is used as a proxy indicator of countries' institutional set-up (Alonso and Garcimartín, 2011). Although the precise theoretical foundations have not yet been established for the inclusion of these determinant factors in trade or FDI models, greater specialization in high-tech activities is expected to be positively related to a more unequal economy (Freeman, 2011). In fact, countries with higher levels of technological internationalization are expected to score higher Gini values and thus score a positive sign in relation to this variable. In addition, to analyse the different levels of technology in the goods traded between the MERCOSUR countries, we use the classification of trade flows defined by the Organisation for Economic Cooperation and Development (OECD), distinguishing between low, medium-low, medium-high and high technological content. Since this taxonomy was constructed for developed countries, we combine medium-high and high technological content into a single category for the countries included in our study.

Accordingly, equation (1) is the estimation of the basic model of trade including international flows of capital and technology, while equation (2) also includes the institutional variable described above (for a description of variables see table 3):

$$lnTRD_{ijt} = lnGDPPC_{jt} + lnPOP_{jt} + lnDIST_{ij} + lnFDI_{it} + lnROYALTYRCPT_{it} + \varepsilon_{ijt} \quad (1)$$

$$lnTRD_{ijt} = lnGDPPC_{jt} + lnGINI_{jt} + lnPOP_{jt} + lnDIST_{ij} + lnFDI_{it} + lnROYALTYRCPT_{it} + \varepsilon_{ijt} \quad (2)$$

where:

TRD_{ijt}: Trade flows from country "i" (exporter) to country "j" (importer) in period "t".

$GDPPC_{jt}$: GDP per capita of importing country "j" in period "t".

POP_{jt}: Population of importing country "j" in period "t".

6 This involves a two-stage estimation procedure that uses an equation for selecting trade partners in the first stage and a trade flow equation in the second.

7 Anderson (1979) suggests that pooled data models are a functional form of operating gravity equations in his seminal article "A Theoretical Foundation for the Gravity Equation". The ordinary least squares (OLS) estimation method is used.

8 We chose not to use royalty payments after testing this variable in the models and discovering that it introduces collinearity effects into the model, meaning that no additional information could be obtained from it.

$DIST_{ij}$: Distance measured in kilometres between the capitals of country "i" and country "j".
FDI_{it}: Inward FDI stocks for exporting country "i" in period "t" used to verify foreign multinationals' impact on the country's exporting capacity; and outward FDI stocks in period "t" as a representation of the country's level of internationalization. This variable takes into account total FDI flows and does not reflect only internal FDI stocks in the MERCOSUR countries.
$ROYALTYRCPT_i$: Royalty receipts by exporting country "i" in period "t".
$GINI_{jt}$: Gini index for country "j" (importer) in period "t".
ε_{ijt}: Error term for trade flows between country "i" and country "j" in period "t".

We expect GDP per capita and the population size of the importing country to have a positive impact on trade flows, with larger markets attracting more trade. A greater distance between capitals is expected to have a negative impact, as we assume that markets located near to each other are more likely to trade. Although GDP is usually one of the variables applied in gravity models (see, for example, Brenton, Di Mauro and Lücke, 1999; Bloningen and others, 2007; Feenstra, Markusen and Rose, 2001; Anderson and Van Wincoop, 2003; Frankel, Stein and Wei, 1995; Feenstra, 2002; Anderson, 1979), in our analysis we use GDP per capita because it gives a measure of purchasing power that reflects development levels within the MERCOSUR markets. By including GDP per capita and population size, we can control for market size in a basic decomposition of GDP.

Highlighting some relevant social and economic characteristics can help to frame the countries under analysis. First, Brazil is the clear leader in terms of GDP and population size, but it ranks third among MERCOSUR countries in terms of GDP per capita. Second, with regard to income distribution, Brazil and Paraguay have the highest Gini index coefficients in MERCOSUR. These characteristics pose a clear challenge for the application of the gravity models since the outcomes might be conditioned by expectations stemming from the institutional features of Brazil —the most influential economy in the bloc. Thus, it is relevant to include the institutional features that foster development to avoid biased results, especially considering the institutional complexity of Latin American countries.

TABLE 3

Codes, description and sources of operational variables

Variable	Description	Source
TRD	Bilateral trade flows, 1992-2008, classified into three groups by technological content, as defined by Hatzichronoglou (1997): low; medium-low; and medium-high and high	DATAINTAL, Inter-American Development Bank
GDPPC	Gross domestic product per capita, 1992-2008	World Development Indicators, World Bank
POP	Population, 1992-2008	World Development Indicators, World Bank
DIST	Distance between countries' capitals (for Brazil the economic centre, São Paulo, was used instead of Brasilia)	-
FDIIN	Total inward FDI stock, 1992-2008	UNCTADSTAT
FDIOUT	Total outward FDI stock, 1992-2008	UNCTADSTAT
ROYALTYRCPT	Total royalties receipts, 1992-2008	World Development Indicators, World Bank
GINI	Gini index, 1992-2008	CANA Database

Source: Prepared by the authors.

The results of the estimations calculated using equations (1) and (2) justify our interest in national innovation systems. The estimations have been conducted both on aggregate trade data (total trade flows) and on data disaggregated by the technological content of exports (low technology, medium-low technology, and medium-high/high technology products). In addition, separate estimations were replicated for bilateral flows with the Latin American region as a whole, as well as with the United States and Europe, including MERCOSUR as a control variable. The estimations confirm that this regional trade agreement has an effect on trade and FDI flows.

Table 4 contains the results for a typical gravity model examining the effect that foreign capital plays on the export capacity of a host country by looking at the inward FDI stock and the usual gravity variables for the importing markets, without regard to the amount

of royalties received by the exporting economy. As expected, the DIST variable (measured in kilometres) has a consistently negative impact on trade.[9] The coefficients corresponding to population size (the POP variable) are all significant and positive, though it is worth taking into account that the Brazilian population is significantly larger than those of the other South American countries. The variable for GDP per capita is only statistically significant in relation to the trade of medium-low and medium-high/high technology products and the negative sign of the estimated coefficient —contrary to what is normally expected from gravity models— reveals the least sophisticated patterns of consumption in these economies. This could be explained by the notable influence in the bloc of Brazil, which has a lower GDP per capita than Uruguay and Argentina, despite being the market leader in the region. For the period under consideration, the ROYALTYRCPT indicator is not significant in relation to the trade flows with the highest technological content. Meanwhile, the impact of inward FDI on trade between MERCOSUR countries is significant and positive, and its influence (coefficients) increases in line with the technological content of the exports. This suggests that foreign capital and intra-firm trade resulting from the integration of global value chains may boost the export capacity of MERCOSUR countries, promoting the generation of capabilities and higher value added commerce within the bloc. However, one intriguing implication of this is that countries' export capacity could become dependent on multinational firms from third countries.

Next, we estimate a similar model, this time using outward FDI to assess the influence of the internationalization capacity of MERCOSUR nations on their intra-bloc trade structure (see table 5). GDP per capita again performs poorly as a gravity variable, while the population size coefficients remain robust and significant, similar to the finding for the set of

[9] Although we would expect a less significant coefficient for more high-tech products.

TABLE 4

Typical gravity model: analysis of inward FDI stock by the technological content of trade

	All trade flows	Low technology	Medium-low technology	Medium-high and high technology
$lnGDPPC_{jt}$	-0.056 [0.105] (-.54)	0.024 [0.102] (.24)	-0.457*** [0.191] (-2.40)	-0.501*** [0.213] (-2.35)
$lnPOP_{jt}$	0.847*** [0.029] (29.23)	0.709*** [0.028] (25.33)	1.104*** [0.052] (21.12)	1.038*** [0.058] (17.77)
$lnDIST_{ij}$	-0.324*** [0.056] (-5.79)	-0.201*** [0.054] (-3.71)	-0.624*** [0.101] (-6.17)	-0.577*** [0.113] (-5.11)
$lnFDIIn_{it}$	0.700*** [0.019] (35.83)	0.541*** [0.018] (28.68)	0.865*** [0.035] (24.54)	1.086*** [0.039] (27.59)
$lnROYALTYRCPT_{it}$	0.082*** [0.015] (5.31)	0.037*** [0.015] (2.47)	0.146*** [0.028] (5.24)	0.009 [0.031] (.30)
Constant	-6.055*** [0.969] (-6.24)	-4.04*** [0.937] (-4.31)	-8.889*** [1.749] (-5.08)	-7.429*** [1.954] (-3.80)
Adjusted R^2	0.915	0.882	0.837	0.838

Source: Prepared by the authors.

Note: The sources of the individual variables are available in table 3. Standard errors are reported in the square brackets. The figures in parentheses are the t-test values.
*** Significant at 1%.

models assessing inward FDI. The results for the distance variable ($DIST_{ij}$) are also similar to those found in the previous estimation. By contrast, the estimated coefficient for the royalties receipts variable ($ROYALTYRCPT_{it}$) is more irregular where outward FDI is concerned. The internationalization strengths of MERCOSUR countries measured in relation to outward FDI vary according to the technological content of exports, but to a lesser extent than in relation to inward FDI. These findings support the evidence presented in the related literature: the generation of internal capabilities fosters internationalization in both investment and trade.

TABLE 5

Typical gravity model: analysis of outward FDI stock by the technological content of trade

	All trade flows	Low technology	Medium-low technology	Medium-high and high technology
$lnGDPPC_{jt}$	0.212***	0.234***	-0.128	-0.081
	[0.104]	[0.099]	[0.194]	[0.210]
	(2.05)	(2.35)	(-0.66)	(-0.39)
$lnPOP_{jt}$	0.835***	0.700***	1.087***	1.019***
	[0.028]	[0.027]	[0.052]	[0.057]
	(29.59)	(25.83)	(20.61)	(17.80)
$lnDIST_{ij}$	-0.296***	-0.179***	-0.587***	-0.534***
	[0.054]	[0.052]	[0.102]	[0.110]
	(-5.42)	(-3.42)	(-5.75)	(-4.82)
$lnFDIOut_{it}$	0.568***	0.441***	0.698***	0.883***
	[0.015]	[0.014]	[0.028]	[0.031]
	(36.81)	(29.71)	(24.18)	(28.19)
$lnROYALTYRCPT_{it}$	0.002	-0.025*	0.049*	-0.114
	[0.015]	[0.014]	[0.029]	[0.031]
	(0.16)	(-1.68)	(1.68)	(-3.63)
Constant	-5.055***	-3.287***	-7.586***	-5.887***
	[0.939]	[0.902]	[1.755]	[1.905]
	(-5.38)	(-3.64)	(-4.32)	(-3.09)
Adjusted R^2	0.919	0.889	0.833	0.843

Source: Prepared by the authors.

Note: The sources of the individual variables are available in table 3. Standard errors are reported in the square brackets. The figures in parentheses are the t-test values.

* Significant at 10%. *** Significant at 1%.

In the last stage of our study, we use an adapted gravity model that reflects certain institutional characteristics. We have included the Gini index as a control variable for institutional set-up —unprecedented in previous research on the topic— with the aim of providing a more precise assessment of the bloc under analysis (see tables 6 and 7). The estimations show that the population variable (POP_{jt}) is again consistently positive and represents a special distinction for the case of medium-high technology trade within MERCOSUR, which could indicate the import profile of the leading economy in this context. The distance variable ($DIST_{ij}$) is again negative (see table 6). The role of inward FDI is similar to that seen in the previous estimations and we thus assume that it will have the same implications as already mentioned above. Although findings coincide with the model that estimated the influence of inward FDI on trade by technological content (see table 4), they indicate that GDP per capita remains negative and that the income distribution variable has no significant effect. When we analyse trade flows controlling for their technological content, income inequality does not seem to have any marked effect as the Gini coefficients are

not found to be significant.[10] The results for outward FDI are dramatically different (see table 7): this variable is significant across all the estimations, which shows that the home countries of MNEs experience a positive effect. Meanwhile, GDP per capita is positive in the estimation of all trade flows and low-tech trade, and the Gini index is positive and significant in the whole set of models. The remaining variables follow the same patterns seen in the previous estimations.

These last two estimations incorporating the Gini index provide some interesting insights: the Gini coefficient offsets the effect of GDP per capita in MERCOSUR as it is correlates positively with trade flows in relation to outward FDI. Our findings proved the significance of countries' internationalization capacity —as both host and home countries of MNEs— in terms of trade within the bloc. This finding was especially significant in the case of inward FDI stock, revealing the positive influence of MNEs on these countries' trading patterns, which could lead, in particular, to a stronger capacity to invest abroad and the increased competitiveness of domestic companies. When looking at outward FDI in relation to the Gini index, outward FDI is significant and has a positive coefficient that increases in line with the technological content of exports and also with the values of the Gini index. The relationship between income distribution inequality and technological capabilities offers a profusion of possibilities for further study beyond the scope of this paper; however, our findings provide some support for a positive association between technological content and inequality.

[10] The GINI coefficient is significant only for the estimation pertaining to "all trade flows". Since the results in relation to the different levels of technological content are not significant, we have no evidence to support that inequality is an important factor to consider in the model.

TABLE 6

Gravity model: analysis of inward FDI stock by the technological content of trade, controlling for income inequality using the Gini index

	All trade flows	Low technology	Medium-low technology	Medium-high and high technology
$lnGDPPC_{jt}$	-0.215 [0.140] (-1.53)	-0.115 [0.135] (-0.85)	-0.540** [0.255] (-2.12)	-0.705** [0.284] (-2.48)
$lnGINI_{jt}$	-0.920* [0.538] (-1.71)	-0.814 [0.521] (-1.56)	-0.481 [0.980] (-0.49)	-1.187 [1.091] (-1.09)
$lnPOP_{jt}$	0.903*** [0.043] (20.69)	0.759*** [0.042] (17.96)	1.134*** [0.079] (14.27)	1.111*** [0.088] (12.55)
$lnDIST_{ij}$	-0.322*** [0.055] (-5.79)	-0.199*** [0.053] (-3.70)	-0.623*** [0.101] (-6.15)	-0.575*** [0.112] (-5.09)
$lnFDIIn_{it}$	0.708*** [0.020] (35.35)	0.549*** [0.019] (28.31)	0.869*** [0.036] (23.86)	1.097*** [0.040] (27.03)
$lnROYALTYRCPT_{it}$	0.081*** [0.015] (5.25)	0.035** [0.014] (2.39)	0.145*** [0.028] (5.19)	0.007 [0.031] (0.25)
Constant	-2.033 [2.544] (-0.80)	-0.485 [2.462] (-0.20)	-6.785 [4.627] (-1.47)	-2.242 [5.155] (-0.43)
Adjusted R^2	0.916	0.883	0.836	0.838

Source: Prepared by the authors.

Note: The sources of the individual variables are available in table 3. Standard errors are reported in the square brackets. The figures in parentheses are the t-test values.

* Significant at 10%. ** Significant at 5%. *** Significant at 1%.

TABLE 7

Gravity model: analysis of outward FDI stock by the technological content of trade, controlling for income inequality using the Gini index

	All trade flows	Low technology	Medium-low technology	Medium-high and high technology
$lnGDPPC_{jt}$	0.471***	0.417***	0.301	0.358
	[0.133]	[0.130]	[0.251]	[0.273]
	(3.53)	(3.21)	(1.20)	(1.31)
$lnGINI_{jt}$	1.505***	1.062**	2.504***	2.565**
	[0.504]	[0.491]	[0.949]	[1.032]
	(2.98)	(2.16)	(2.64)	(2.48)
$lnPOP_{jt}$	0.746***	0.637***	0.939***	0.867***
	[0.040]	[0.039]	[0.076]	[0.083]
	(18.36)	(16.13)	(12.30)	(10.44)
$lnDIST_{ij}$	-0.301***	-0.183	-0.597***	-0.543***
	[.053]	[.051]	[.100]	[.109]
	(-5.65)	(-3.53)	(-5.95)	(-4.98)
$lnFDIOut_{it}$	0.563***	0.437***	0.689***	0.874***
	[0.015]	[0.014]	[0.028]	[0.031]
	(37.03)	(29.56)	(24.11)	(28.11)
$lnROYALTYRCPT_{it}$	0.004	-0.023	0.052*	-0.110***
	[0.015]	[0.014]	[0.028]	[0.031]
	(0.31)	(-1.59)	(1.84)	(-3.56)
Constant	-11.741***	-8.007***	-18.706***	-17.278***
	[2.422]	[2.357]	[4.554]	[4.953]
	(-4.85)	(-3.40)	(-4.11)	(-3.49)
Adjusted R^2	0.923	0.891	0.839	0.848

Source: Authors – sources of individual variables are available in table 3.

Note: The sources of the individual variables are available in table 3. Standard errors are reported in the square brackets. The figures in parentheses are the t-test values.

* Significant at 10%. ** Significant at 5%. *** Significant at 1%.

V

Concluding remarks

In this paper we have explored the potential internationalization capacity of the MERCOSUR countries, considering both trade and FDI flows as engines for technological integration in the region. Results of our analysis show that MNEs still have a rather limited influence on technological integration in the region, with intra-bloc knowledge transfer being more likely to take place by trade. Building on the concept of absorptive capacities and the importance of national systems of innovation, our first conclusion is that the relationship between international flows and the common goal of improving regional innovation and competitiveness can be mutually reinforcing, and reinforced by the integration process in MERCOSUR. One indirect implication from our findings is the potential impact of MNEs inside the bloc through the generation and improvement of technological capabilities; however, this would require the definition of more precise common innovation policies that acknowledge the role of international companies in order to take advantage of their operations in the region. In the same vein, the

potential of outward FDI from the MERCOSUR member countries should be explored and exploited to enhance the region's learning from its partners abroad. In fact, a look at the effect on trade in the largest (Argentina and Brazil) and smallest economies (Paraguay and Uruguay) highlights some important policy implications, as mentioned by Bekerman and Rikap (2009), such as the importance of harmonizing national technological capabilities through regional initiatives.

Other implications arise in relation to the expansion of gravity models to reflect internationalization and institutional factors. The "gravity variables" and the Gini index were treated as exogenous variables,[11] while improvements in export capacity —both in quantitative and qualitative aspects— depend largely on FDI stocks. Our findings reveal that policies aiming to promote outward FDI and attract inward FDI can boost a country's exports to its MERCOSUR partners, which suggests the need for more integrated economic and technology policies at the MERCOSUR level. Therefore, our future research will seek to explore the relationship between inequality and technological progress, on the basis that economic development should improve countries' absorptive capacity. In order to garner a more complete vision of developing countries, aspects of their institutional structure must be investigated. If our preliminary results were to be supported by further evidence, solid redistribution policies would be crucial to ensure a more sustainable international integration process for catching-up economies.

[11] Distance is exogenous by definition. GDP per capita, population size and the Gini index can be considered as relatively exogenous for the approach adopted here given its focus on institutional and technological aspects.

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