Trade and infrastructure in the Andean Community

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This paper examines the key role of infrastructure in Andean Community trade patterns, using three gravity models. The first identifies the importance of preferential trade agreements and of geographical adjacency. The second and third models encompass these aspects while focusing on the inclusion of infrastructure in the gravity equation, testing the assumption that infrastructure endowments reduce "distance" (in terms of transport costs) between partners. Under the new trade arrangements, borders and previous agreements will lose significance, trade will be virtually free and bilateral flows will be defined in terms of costs and competitiveness. Competitiveness, however, can be achieved only by means of an improvement in infrastructure at all points in the production-distribution chain.

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I
Introduction

This paper offers further evidence that infrastructure development is a source of integration and competitiveness and shows the dynamic role played by infrastructure in explaining and determining trade flows within and outside the Andean Community.

The work is organized as follows. The following two sections set out the framework for the analysis. Section II briefly reviews the evolution of what is now the Andean Community since it was formed in 1969 as the Andean Pact, focusing on the consolidation of the internal market and the group's trade pattern. An augmented gravity model of bilateral trade flows is applied to yearly data for 1993-1999 in order to determine whether the Andean Pact helped to increase trade within the region and to capture the effect of adjacency on trade among its members. Section III discusses the first gravity model. Section IV looks at the role of infrastructure in trade, reviewing theoretical and statistical evidence that location and resource endowments play a conclusive role in determining whether countries will decide to enhance their trading opportunities by developing infrastructure to reduce transport costs. It then briefly reviews the transport modes employed in Andean Community trade.

Section V, where the effects of the degree of infrastructure development are fully assessed, is the core of the paper. We go beyond a traditional gravity model to discuss the notion that transport costs are not only a function of distance but also of the availability of proper means, such as roads, energy and telecommunications networks. These variables are summarized in an index measuring infrastructure development in the countries examined, modifying the distance variable. The analysis sheds light on the role played by infrastructure and its impact on the relevance of other explanatory variables. We then link the results to the new concept of infrastructure development in the region, in which the relationship between infrastructure and geographical space is regarded as a key integration and competitiveness tool. Lastly, section VI offers conclusions drawn from the work.

II
How the Andean Community has evolved

What is known today as the Andean Community dates back to 1969, when a group of countries signed the Cartagena Agreement, also known as the Andean Pact, in which they established a customs union for the next 10 years.

Since then, Andean integration has come through a series of stages and the initial inward-looking development project, based on the import substitution model, gradually gave way to an initiative more akin to open regionalism. In June 1997, the Andean Community came into being with the Trujillo Protocol modifying the Cartagena Agreement. The Protocol created the Andean Presidential Council and a Council of Foreign Ministers, affording both a critical role in decision-making. It also strengthened the internal cohesion of the integration process by placing all the Community's institutions and mechanisms under the management of the Andean Integration System. The Andean Community is now a regional organization endowed with international legal status. Recently, some friction has arisen among its five members —Bolivia, Colombia, Ecuador, Peru and Bolivarian Republic of Venezuela— and this last country has opted to follow an independent course. At the same time, Mexico applied for full membership of the group. These developments, however, fall outside the scope of this paper.

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In 1987, the members of the Andean Community began to design a new strategy to keep up with the liberalization process taking place in Latin America. A free trade area was formed in 1992 and evolved into an imperfect customs union. As early as 1992, Bolivarian Republic of Venezuela and Colombia eliminated tariffs and other barriers to reciprocal trade. Bolivia joined them in September 1992 and Ecuador in January 1993, when the free trade area became fully operational among these four countries. Peru temporarily suspended its obligations under the liberalization programme, beginning, in 1992, to negotiate bilateral trade agreements with each of its Andean partners and, in some cases, partially liberalizing reciprocal trade flows. These bilateral agreements remained in place until 1997, when an agreement was reached for Peru's gradual incorporation into the Andean free trade area (Decision 414). Tariffs were eliminated on most goods by 2000, with "sensitive products", including agricultural goods, to be totally liberalized by 2005.

In 1994, the Common External Tariff (CET) was approved by Decision 370. Its implementation, however, has run up against the typical difficulties. When Decision 370 was made, Bolivia was exempt and Peru, as noted above, was not participating in the process. Here again, Bolivarian Republic of Venezuela and Colombia were the first two countries to adopt the CET in 1994, followed by Ecuador in 1995. The Andean CET is determined by level of processing: a rate of 5% is applied to raw materials and industrial inputs; rates of 10% and 15% to intermediate inputs and capital goods, respectively; and 20% to final goods. The CET average is 13.6%, with a 20% ceiling. Bolivia and Peru are becoming gradually incorporated into the customs union, which already encompasses Bolivarian Republic of Venezuela, Colombia and Ecuador. Full adoption was expected in 2005.

The Andean Community has addressed most of the newer trade issues, such as investment, competition policy, services and intellectual property rights and it has adopted common policies in most of these areas.[1] It has also taken steps to deal with the question of infrastructure, the focus of this paper. Furthermore, the Community is aware that the development of a common foreign policy is a main objective and involves the joint participation of all its members in the World Trade Organization (WTO) and in negotiations concerning regional agreements.

In 2004, the Andean countries formed a market of over 121 million people distributed over an area of 4.7 million square kilometers. Their combined GDP that year stood at US$ 317 billion. The main markets for their exports are the United States, the European Union (EU) and the Community itself.

Liberalization of the internal market has had an important impact on trade among its member countries. Trade flows have reached unprecedented levels, with intraregional trade growing faster than trade with the rest of the world. After a decade of flat or declining growth in the 1980s, intra-Andean trade picked up in 1989 and grew steadily after 1990. At the end of 2004, intra-Andean exports amounted to US$ 7.4 billion, nearly three times the 1992 level. Equally importantly, Andean trade with the rest of the world has also risen; imports and exports from and to countries outside the Community have increased steadily since the agreement was reactivated in the early 1990s.

Though there is a commitment to establish a Common Market, as noted earlier, the Community is still an incomplete customs union, since both the CET and the FTA are subject to a number of exceptions.

[1] For example, Decision 291 replaced Decision 24, which restricted foreign direct investment activities, granting national treatment to foreign investors and eliminating all restrictions on capital and profit remittances. Decision 344 granted patent rights to pharmaceutical products and Decision 351 addressed copyright issues.

III

A first gravity model

In order to create a framework in which to analyse the growth of trade among Andean countries, we first constructed the following gravity equation:

$$\ln M_{ij} = \beta_0 + \beta_1 \ln Y_i Y_j + \beta_2 \sqrt{D_{ij}} + \beta_3 ACP \quad (1)$$
$$+ \beta_4 Border + e_{ij}$$

where: M_{ij} is the value of country *i* imports from country *j*; Y_iY_j is the GDP of both countries multiplied as a proxy for size; D_{ij} is the distance between country *i* and country *j* (to capture trade costs); *ACP* is a dummy to measure the impact of integration on member countries' trade (it takes a value of 1 when both countries are Andean Community members and 0 otherwise); and *Border* is a dummy to measure the impact of adjacency (it assumes a value of 1 when the countries have a common border).[2]

The analysis encompassed the period 1993-1999, since integration gained momentum after the formation of the free trade area in 1992, with the aim of testing the significance and value of the agreement's impact on intraregional trade. The countries on the left side of equation (1) are the five Andean Community members and those on the right are their partners, i.e., suppliers or exporters. The partners selected are those that have bilateral trade with members.

Data on trade flows, in millions of current United States dollars, were obtained from the International Monetary Fund (IMF, 2001). GDP data, in current dollars, are from the World Bank Global Development Network Growth Database[3] and the distance between capital cities, in kilometres, was obtained from Haveman's web page.[4]

Individual regressions were run for each year based on equation (1), following a descriptive analysis of the data, which led to the transformation of imports and GDP by natural logarithm and distance by square root. Ordinary Least Squares (OLS) were employed, with the transformed data on imports as dependent variables. A number of countries in Asia and Africa that did not trade with the Andean Community were removed in each year.

The results, in standardized coefficients, together with the R^2 for each regression and the significance of the coefficients, are shown in table 1. The gravity equation performs well in explaining bilateral trade between the Andean countries and their respective partners. The global adjustment of the regression is satisfactory, since the R^2 values are higher than 0.70. In all cases, the independent variables had the expected sign and were statistically significant according to F and t-tests.

The effect of the multiplication of the countries' GDP is positive and statistically significant, ranging between 0.862 and 0.901. These values are consistent with those found by Frankel (1997) and Echavarría (1998) for the periods 1965-1980 and 1986-1995, respectively, though slightly higher owing to the fact that size plays a more important role in trade nowadays and, of course, that the partners chosen for each analysis are different. The coefficients bear out the assumption that trade increases with economic size and, in the case of the Andean countries, this has a strong effect on their trade.

The distance coefficients have a negative sign, are statistically significant and show values between -0.443 and -0.345. Distance has less impact than GDP, however. The value and sign of the distance coefficients are also similar to those found by Frankel (1997) and Echavarría (1998). Both authors worked with a period before the liberalization of transport services and the reduction of costs, so their coefficients are, in most cases, higher than those found in this work, when the distance effect had diminished.

The coefficients for the preferential agreement dummy fluctuate between 0.101 and 0.160. Their statistical significance (p-values) improves from 1995 onwards and they evolve positively, albeit at low levels

[2] Frankel (1997) used gravity models to show that regionalization could be explained by geographical proximity and preferential trade agreements; Krugman (1991) formalized the role played by geographical proximity in the regionalization process and since then dummy variables have been used to simulate and analyse these effects; Anderson and van Wincoop (2003) offer a more recent and stronger theoretical support for all this.

[3] www.worldbank.org/research/growth/GDNdata.html.

[4] www.haveman.org.

TABLE 1

Gravity model estimates
(Standardized coefficients)

	1993	1994	1995	1996	1997	1998	1999
Y_iY_j	0.897 *	0.862 *	0.896 *	0.882 *	0.901 *	0.867 *	0.865 *
D_{ij}	-0.435 *	-0.403 *	-0.443 *	-0.413 *	-0.377 *	-0.347 *	-0.345 *
D ACP	0.102 *	0.101 *	0.128 *	0.155 *	0.159 *	0.143 *	0.160 *
D Border	0.200 *	0.161 *	0.129 *	0.124 *	0.127 *	0.116 *	0.139 *
No. observations	141	243	240	255	247	261	235
R^2	0.82	0.722	0.755	0.752	0.780	0.714	0.769

Source: authors' estimates.

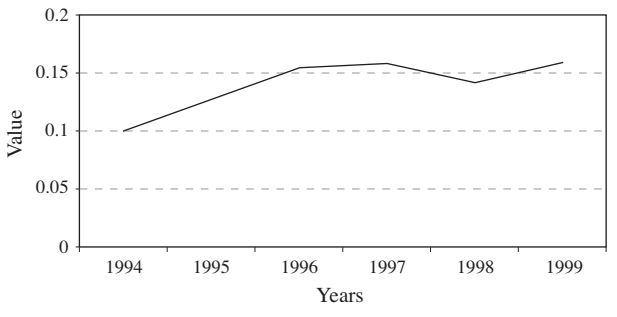
* Significant at 5%.

(figure 1). It is important to recall that the free trade area took effect only in 1993 and that Peru remained outside the agreement until 1997. In addition, a large number of exceptions leading to the application of different regulations diluted the influence of the agreement. The impact of the Pact may be expected to become more powerful as regulations are more uniformly applied by all partners. The positive evolution of the coefficients and their significance gains reflect the fact that, with the exception of 1999, member countries have been trading increasingly among themselves. The year 1999 saw numerous economic and political crises, including the macroeconomic and banking collapse in Ecuador, the political problems in Peru that led to the flight of President Fujimori and flooding in Bolivarian Republic of Venezuela. Overall, our empirical results show that the Pact and the free trade area had a positive impact on trade among member countries.

The dummy for adjacency is used to establish whether common borders, which enable trade in those areas, do in fact increase trade flows. The coefficients for this dummy are positive and statistically significant, though their values are low and tending to decline. The positive values confirm that countries with a common border will trade more, but the low values and the non-positive trend suggest that these economies are relatively small and may trade more with larger economies, even those that are geographically more distant. Importantly, the reason adjacent countries do not engage in more border trade often comes down to poor transport infrastructure and difficult geographical conditions. In this regard, the Andes mountain range can drive up costs considerably for the Andean countries.

FIGURE 1

Evolution of the ACP dummy



Source: Estimates prepared by the authors on the basis of the data shown in Table 1.

IV

Trade and infrastructure in the Andean Community

1. Trade, infrastructure and regional integration

Since Krugman (1991) recalled the importance of geography to trade, several authors, including Hummels (1998), have attempted to measure the effect of distance and the role of infrastructure in a bilateral trade model. A number of empirical works, such as Porojan (2000), have used investment data as a proxy for infrastructure. But the use of investment data to estimate infrastructure capital can present problems, as Summers and Heston (1991) argued. The effectiveness of the same investment flow may vary from one country to another, owing to differences in public sector efficiency and in the prices of infrastructure capital.

Bougheas, Demetriades and Morgenroth (1999) sought to examine the role of infrastructure in a bilateral trade model and in determining the cost of transport. According to their findings, a pair of countries in which infrastructure investment is optimal will exhibit a directly proportional relationship between infrastructure endowment and volume of trade. Consequently, variations in transport costs among countries may account for differences in their ability to compete in international markets. Furthermore, differences in the volume and quality of infrastructure may account for differences in transport costs and, hence, variations in competitiveness. As a result, reducing the cost and improving the quality of transport systems improves international market access and stimulates an increase in trade.

There is categorical evidence linking improvements in transport services and infrastructure in general to improvements in export performance. Hummels (1999) estimated that for every reduction of 1% in shipping costs, exporters will enjoy a market share gain of 5%-8%. Limão and Venables (2001) calculated that the elasticity of trade flows with respect to the trade cost factor is approximately –3. Their research into the extent to which transport costs depend on geography and infrastructure found that differences in infrastructure account for 40% of the variation in transport costs for coastal countries and up to 60% for landlocked countries. Wilson (2003) showed that trade performance gaps among the Asia-Pacific Economic Cooperation countries were attributable to substantial differences in the quality of their transport infrastructure and level of logistics and trade services. This study concluded that upgrading the transport and service infrastructure of the lagging countries would substantially boost trade.

Martinez-Zarzoso and Nowak-Lehman (2002) examined the role of economic and geographical distance for a number of MERCOSUR sectoral exports to EU. Their findings reveal that geographical distance, defined as the physical distance in kilometres between capitals modified by an infrastructure index, has a negative impact on trade. Transport costs increase with distance but may be reduced by infrastructure improvements.

The real costs of trade, including transport and the costs of doing business internationally, are important determinants of a country's ability to participate in the world economy. As Limão and Venables (2001) pointed out, remoteness and poor transport and communications infrastructure isolate countries and limit their capacity to participate in international production chains. Any strategy aimed at increasing a region's international competitiveness must include improvement of the channels that facilitate the exchange of goods and services and the movement of people.

In terms of regional integration, as noted by the Inter-American Development Bank (IDB, 2000), geographical interaction creates flows that do not necessarily circulate freely, but do so through infrastructure networks. These networks provide the physical support for flows to circulate: they cannot be a positive influence on integration and development without an appropriate legal and institutional framework combined with efficient infrastructure-related services. Moreover, like the integration process itself, infrastructure networks constitute regional public goods (IDB, 2004) and therefore require joint, coordinated action from all the countries involved in order to fully realize their status as such.

2. Andean Community trade by mode of transport

In order to determine the variables that affect transport costs in members' intra-community trade, it is important to analyse the modes of transport used. Table 2 shows trade information by mode of transport within the Andean Community. Between 1997 and 1999, intra-community exports were delivered mainly by road —nearly 49% of the value traded. Maritime transport occupied second place, with around 38% of the total value traded, and air transport took third place with approximately 8% of the total.

TABLE 2

Andean Community: intra-community exports by mode of transport, 1997-1999
(Percentages of export value)

Mode of transport	1997	1998	1999
Road	49.5	51.0	45.7
Sea	38.5	36.5	39.9
Rail	0.5	0.3	0.7
Air	5.7	8.7	9.2
Multimodal	0.1	0.0	0.0
Waterway	5.6	2.9	4.4
Others	0.0	0.6	0.1

Source: www.comunidadandina.org

In 1997, road transport was the main delivery method for Bolivarian Republic of Venezuela, Bolivia, Colombia and Ecuador. The proportion of maritime transport increased in Ecuador in 1998, likewise in Bolivarian Republic of Venezuela in 1999. Between 1997 and 1999, 48% of Venezuelan exports were delivered to other Andean countries by road and 39% by sea. Of Venezuela's imports from its Andean partners, 62% arrived by road and 29% by sea. In this period, 55% of Colombian exports were delivered by road and 35% by sea, while the proportions of its imports arriving by road and sea were 60% and 33%, respectively.

In common with other Community members, Peru uses mainly maritime transport for all deliveries to non-bordering partners, since inland transport is expensive and slow in such cases. Shipping is the Andean countries' traditional method of delivery for trade with geographically distant partners such as the United States and EU and is therefore the second most important mode of delivery to and from the Andean region. Nevertheless, in most cases, goods carried by sea must also be transported over an additional inland stretch by either road or rail at both origin and destination. Bolivia's landlocked position makes it the prime illustration of this point. For both exports to and imports from non-bordering countries, Bolivia usually combines shipment to or from a Chilean port with inland road transportation (Andean Community, undated).

Generally speaking, the Andean Community members do not engage in inland waterway transportation because the areas where it would theoretically be feasible lack well-developed corridors. Moreover, the locations of the counties' business clusters often preclude transport modes other than road and sea.

Air cargo is relatively limited: shipping merchandise by road is quicker, especially between bordering countries. Also, road transport is the delivery mode with the most expedite border crossing.[5] Air cargo involving partners outside the Andean region is limited and confined to highly perishable goods.

Between 1997 and 1999, border trade among the members represented 98% of intra-community trade by road and 49% of total intra-community trade. Trade in road-freighted goods among non-bordering members was thus limited. As table 3 shows, Bolivarian Republic of Venezuela and Colombia have a very significant road-freighted border trade, accounting for around 66% of all trade of this type in the subregion. Trade between Colombia and Ecuador comes in second position, with slightly over 23%, and trade between Bolivia and Peru occupes third place (8%), though nearly half of all trade between these two countries —during the same period— was carried by road. The lowest level occurs between Ecuador and Peru, with only 2% of the total value carried.

In the late 1980s, the lack of infrastructure and the limited relevance of the Andean Pact meant that having a common border was extremely important for all the members' trade. Trade was conducted at borders and there was less interest in more distant trading, because logistics and transport services were few and expensive. At that time distance was certainly crucial and borders marked out natural trading partners. In the 1990s, however, the significance of border trade decreased considerably, as the coefficients for the dummy in model (1) show.

[5] Personal discussions with the firm ZaiMella del Ecuador S.A, which operates export-import activities in most of the Andean Community member countries.

TABLE 3

Andean Community: intra-community border trade by road, 1997-1999
(Millions of dollars)

Bordering country of destination	1997	1998	1999	1997-1999	%
Bolivia to Peru	143	120	68	331	4.50
Colombia to Ecuador	353	360	198	911	12.38
Colombia to Peru	7	2	0	9	0.12
Colombia to Venezuela (Bol. Rep. of)	802	847	688	2 337	31.77
Ecuador to Colombia	336	269	207	812	11.04
Ecuador to Peru	23	11	13	47	0.64
Peru to Bolivia	92	91	84	267	3.63
Peru to Colombia	3	1	2	6	0.08
Peru to Ecuador	64	34	14	112	1.52
Venezuela (Bol. Rep. of) to Colombia	982	1 073	470	2 525	34.32
Total	*2 805*	*2 807*	*1 744*	*7 357*	*100.00*

Source: www.comunidadandina.org.

V
Evaluating the infrastructure effect

1. Model specification and data

The results of model (1) showed that economic size (GDP) is probably the most important variable in the choice of trading partner and established that distance plays a decisive role in cost. Nevertheless, the absolute value of the distance coefficients declined throughout the period, suggesting that other factors, apart from physical distance, may be affecting transport costs (and therefore trade) in the Andean region. Indeed, given that the economic size of bilateral partners did not change

networks. These public infrastructure dimensions are summarized in an index that measures the degree of infrastructure development in the countries, modifying the distance variable.

Rewriting equation (1), bilateral trade is thus modeled as:

$$\ln M_{ij} = \beta_0 + \beta_1 \ln Y_i Y_j + \beta_2 GeoD_{ij} + \beta_3 ACP + \beta_4 Border + e_{ij} \quad (2)$$