

Infrastructure and Export Performance in the Pacific Alliance



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Executive Summary

The launch of negotiations over the Pacific Alliance (PA) in 2011 gave new life to regional integration in Latin America and the Caribbean (LAC). With more pragmatic, market-oriented expectations and a more functional architecture than prior agreements, the PA offers a clear way out of the predicaments currently being faced by other integration initiatives in the region. It has broken new ground by embracing issues that have traditionally been neglected by trade negotiations, even when the data suggested that these issues should be contemplated. This has been the case, for instance, with transport costs, which have long overtaken tariffs to become the most important obstacle to trade in the region. PA leaders have been quick to move beyond declarations of intent and have set up a fund to address the PA's most pressing infrastructure needs.

However, committing resources is a necessary but insufficient condition for addressing the poor state of the region's transportation infrastructure. Another important challenge is how to allocate these funds efficiently when there is not enough data or policy analyses to guide public investments. This study seeks to make a meaningful, if modest, contribution towards closing this gap. It uses economic theory and a unique georeferenced transport cost database—which includes the municipal origin, route, and destination of exports from Chile, Colombia, Mexico, and Peru (2007–2012)—to estimate the impact of these costs on intra- and extra-PA exports, down to the detailed level of specific infrastructure projects.

The results confirm the expectation that PA trade flows are highly sensitive to transport costs. They suggest, for instance, that a 10% reduction in these costs would raise municipal exports from between 13% in Mexico to 45% in Chile. They also show that it is possible to incorporate this dimension of trade into the assessment of specific infrastructure projects. A simulation exercise using a sample of key PA transportation projects points to positive impacts on both intra- and extraregional exports, but these vary considerably from one country and project to the next, and the intraregional effects are, in general, considerably more modest than those implied by the estimates for the economy as a whole.

There are a number of data-related and methodological issues that suggest that the simulations should not be taken at face value and should instead be seen as a lower bound for potential export gains. However, they do throw considerable light on an area that tends to be overlooked by both transportation and trade officials. For instance, they raise questions as to how far the current PA infrastructure plans go in addressing trade costs. They show that export gains in all PA countries are mainly driven by destinations outside the region, but that intra-PA exports stand to gain the most from improvements in this field. They also reveal that, except in Chile, current infrastructure plans are likely to diminish subnational export disparities, though only modestly. None of these insights would have been observed through a traditional project evaluation.

It is also worth mentioning that the simulations focus only on “hardware” investments, which are just one of the tools available to policymakers to address the transport costs of trade. Regulatory reform to increase competition in cargo shipping, for instance, is another promising area which does not require nearly as many financial resources. Here too, there is a clear need for a more data-driven policy analysis.

Introduction

In 2011, Chile, Colombia, Mexico, and Peru signed the Declaration of Lima: a letter of intent to create the Pacific Alliance (PA), a regional economic bloc that aims to free up the movement of goods, services, capital, and labor. This new regional economic bloc is expected to become one of the most successful in Latin America and the Caribbean (LAC), not only because it accounts for 44.5% of the region's GDP (US\$ 2.1 trillion in 2014), 54.9% of its trade (US\$ 1.3 trillion), and 42.3% of its population (221.9 million), but also because it is expected to become an export platform for local firms to increase their exports outside the PA, particularly in the Asia-Pacific region, where members are expanding their already considerable network of trade agreements, including the Trans-Pacific Partnership (TPP).²

Although the block is only four years old, the rapid pace of negotiations, covering a wide range of topics related to trade, labor, education, and financial integration, has attracted the attention of the international community.³ On trade, during the 2014 Cartagena Summit, member countries agreed to a plan to minimize barriers, based on four pillars: a) tariff elimination—upon enactment, import tariffs will be eliminated for 92% of products, while the remaining 8% (mainly agricultural goods) will be phased out within seven years;⁴ b) harmonized customs procedures—a customs harmonization plan will focus on minimizing the dead-time of clearing cargo through airports, ports, or customs houses; 3) harmonization and elimination of non-tariff barriers—governments will seek to harmonize and reduce non-tariff barriers; 4) infrastructure—an infrastructure investment fund will be used to finance both soft and hard infrastructure projects.

Regarding labor movement, member countries have already agreed to allow nationals to travel up to six months within the bloc without a visa, provided their activities are unpaid.⁵ In addition, the bloc is currently working on a set of agreements that will unify, simplify, and promote the migration process of workers within the bloc. In terms of education, the PA is developing an educational exchange system which will initially target the creation of scholarships to allow students to undertake undergraduate studies anywhere in the bloc. With regard to finance, the 2011 stock exchange market integration between Chile, Colombia, and Peru to create the Integrated Latin American Market (MILA) will be used as a building block to expand financial integration

¹ In February 2014, Costa Rica signed a declaration of intent to become, within one year, the fifth PA member country. In order to do so, Costa Rica must comply with the requirement of having FTAs with each of the existing member countries.

² Since 2005, Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, the United States, and Vietnam have been holding negotiations. Colombia is the only PA member which is not participating in these negotiations. Participation in the TPP is heavily dependent on—though not exclusively limited to—countries being members of the Asian Pacific Economic Cooperation (APEC), which Colombia is currently only an observer of.

³ As of 2015, the PA has 30 observer countries: Australia, Canada, China, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Finland, France, Germany, Guatemala, Honduras, India, Israel, Italy, Japan, Morocco, the Netherlands, New Zealand, Panama, Paraguay, Portugal, the Republic of Korea, Singapore, Spain, Switzerland, Turkey, the United Kingdom, the United States, and Uruguay.

⁴ This means that if there are no delays, by 2020 all traded products produced within the PA bloc will be subject to a 0% import tariff rate.

⁵ These include: tourism, transit, or business travel. For more details see <http://alianzapacifico.net/en/movement-of-people/>.

between bloc members. The first step was taken in December 2014, when Mexico's stock exchange became an official member of MILA. Though currently small, MILA is expected to reach a transaction level comparable to that of Brazil's stock exchange market in the near future.⁶

Although promising, the potential economic benefits of integration may be limited by the magnitude of the remaining trade frictions, such as information and transport costs (Hummels, 2001; and Anderson and Van Wincoop, 2004). Transport costs, in particular, not only can have a significant impact on export performance, as illustrated by Figure 1, but they can also play a major role in shaping the regional distribution of a country's economic activity, with the production of goods and services clustered in locations with better access to customs facilities, airports, or ports (Krugman and Livas, 1996). As discussed by Moreira, Volpe, and Blyde (2009) (MVB) and Moreira, Blyde, Volpe, and Molina (2013) (MBVM), this has been particularly the case for LAC, beset by an unforgiving combination of centuries of underinvestment in transportation infrastructure, challenging geography, and strong comparative advantages in transportation-intensive natural resources.

In this context, the PA governments' decision to include transportation infrastructure among their top priorities is particularly welcome, all the more so because it is backed by a plan to set up an infrastructure financing fund.⁷ If implemented correctly, this initiative could lead to significant reductions in transport costs, allowing member countries to fully exploit the benefits of intra- and extraregional integration. The challenges, however, cannot be underestimated. Evidence on the quality of the bloc's transportation infrastructure and customs efficiency shows that despite a decade of favorable macroeconomic conditions—and of policymakers' repeated declarations of intent to invest in transportation infrastructure—transport costs remain an important obstacle to the region's trade.

For instance, World Bank indicators suggest that the PA transportation infrastructure lags significantly behind that of more industrialized countries in North America, Europe, and East Asia and the Pacific (Figure 2), although there seems to be significant variance among member countries. Chile and, to a lesser extent, Mexico are much better positioned than Peru and Colombia. Though the PA subregion is in a better position than LAC as a whole, its average is close to the bottom of the distribution, comparable only to the levels obtained by Sub-Saharan Africa and South Asia, regions whose infrastructure levels rank lowest in the world.

⁶ For specific details, see the market capitalization volumes and transaction levels for the PA as reported by the World Federation of Exchanges in 2014.

⁷ Though specific details on the infrastructure fund have not yet been disclosed, the Declaration of Lima and the official documents from the third, fourth, and fifth regional meetings have reiterated the intention to consolidate the regional infrastructure fund. For specific details on the general description of the infrastructure fund see <http://alianzapacifico.net/v-reunion-de-ministros-de-finanzas-de-la-alianza-del-pacifico/> (in Spanish).

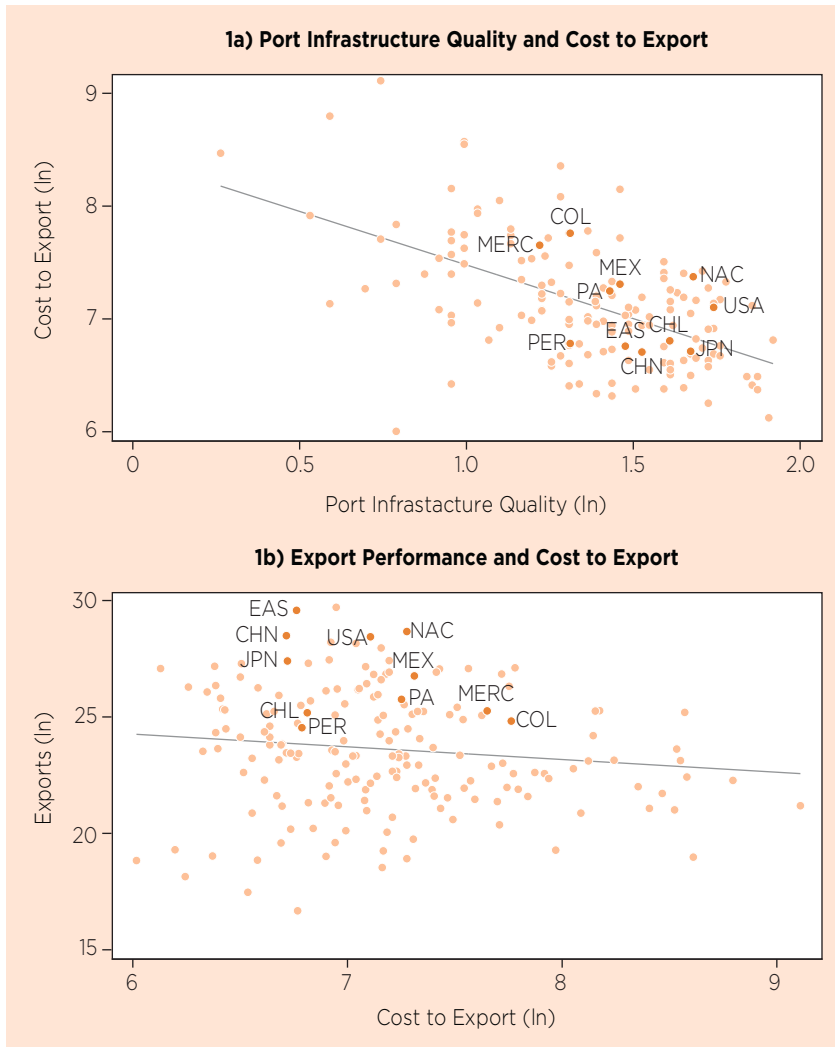


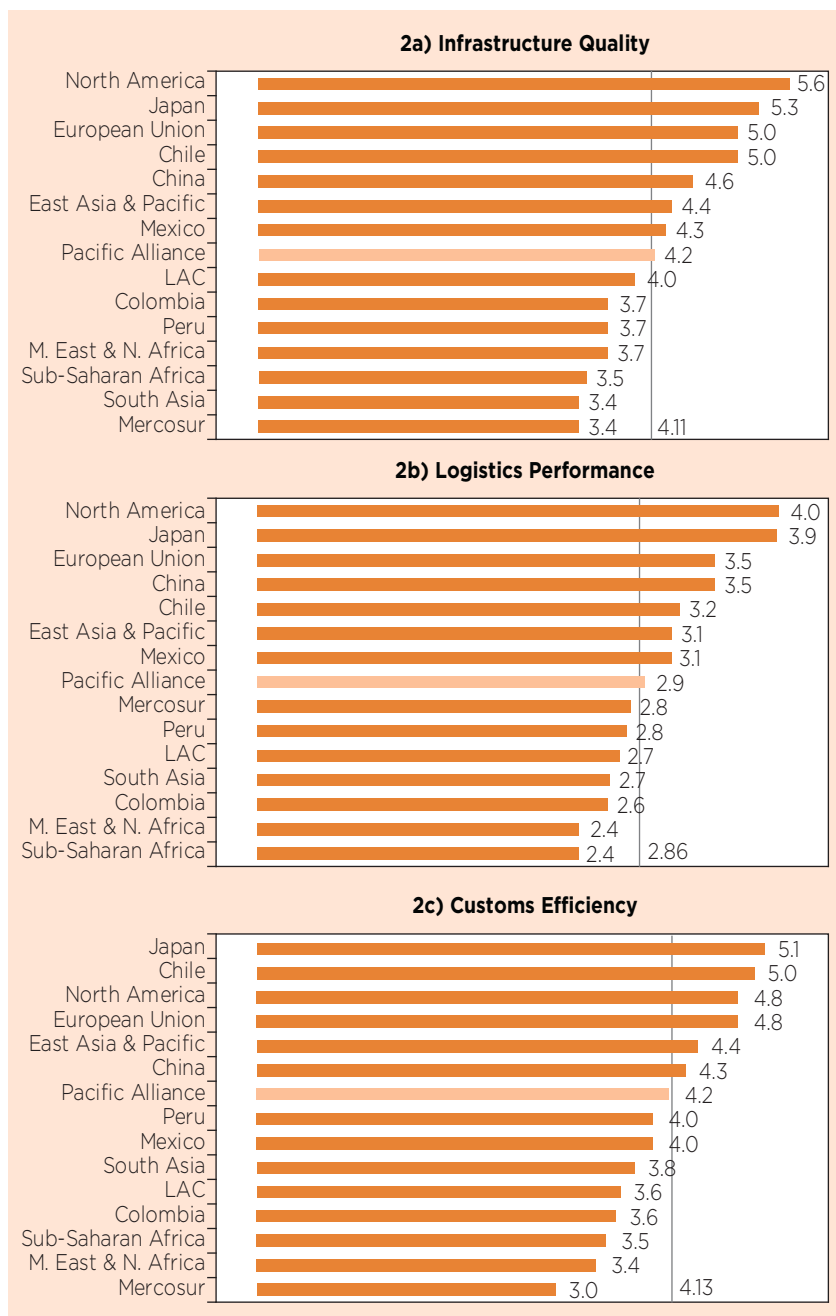
FIGURE 1/
Port Infrastructure
Quality, Cost to
Export, and Export
Performance:
Cross-Country
Evidence, 2014*

Source: Data extracted from WDI (2014). Series used: exports (current US\$), cost to export (US\$ per container), and quality of port infrastructure, WEF (1 = extremely underdeveloped to 7 = well developed and efficient by international standards).

Note: In both graphs the solid line corresponds to the linear fit, specifically in (a) $\ln(\text{cst}) = 8.43 - 0.95 \cdot \ln(\text{PortInf})$ while in (b) $\ln(\text{exp}) = 27.57 - 0.55 \cdot \ln(\text{cst})$, where cst stands for the cost to export, PortInf stands for the port infrastructure quality, and exp stands for exports. * or latest year available since 2012.

The main motivation behind this study is to offer PA policymakers an analytical tool regarding the trade dimension of this infrastructure challenge, in a context where public funds are scarce. More precisely, it tries to address the vexing question of how to sift through a huge backlog of transportation infrastructure projects when the main objective is boosting

**FIGURE 2/
Infrastructure
Quality, Logistics
Performance, and
Customs Efficiency:
Cross-Country
Evidence, 2014**



Source: Data on infrastructure quality, logistics performance, and customs efficiency was extracted from WDI.

Note: Authors' own calculations. Regional aggregates correspond to sample averages within the corresponding regional classification.^a The line across figures a, b, and c corresponds to the world average excluding LAC.

^a See Appendix G.

trade. The traditional strategy of estimating the project's internal rate of return usually fails to incorporate the trade dimension, and when it does, the wood cannot be seen for the trees. Such strategies cannot possibly lead to relevant observations, for instance, about the network effects on trade resulting from the simultaneous implementation of a selected group of projects. By contrast, the methodology developed by this study allows policymakers to answer questions such as: which infrastructure project or group of projects will be more effective in reducing transport costs and boosting exports? What type of transportation investments is more likely to boost intraregional trade? How will a recently developed logistical plan impact both the volume and composition of exports? Which infrastructure projects may help to improve the subnational distribution of trade gains?

To demonstrate the advantages of this methodology, this study offers some useful answers to these questions by conducting a thorough analysis of the impact of transport costs on PA members' exports. It includes an attempt to estimate the effect of the implementation of some of the most relevant transportation infrastructure projects on the PA governments' portfolios. As with any rigorous attempt to understand the trade consequences of transport costs, this analysis had to overcome empirical and analytical challenges. These difficulties began with the fact that the bloc does not systematically survey transport costs and the information available on the geographical origin of exports is generally not reliable. As in most parts of the world, PA firms report their headquarters as being their production location for customs purposes, which makes it harder to identify the true origin of exports and thus to estimate transport costs to the port of exit.

Following MVBm, a number of alternative sources of information are used to overcome these hurdles, including transportation service surveys, firm statistical directories, and limited private firm surveys. The result is a detailed, georeferenced, country-specific firm dataset that identifies the exporter's geographical location (municipality), the customs facility used to export products, and shipping costs. These costs have both domestic ("factory to port") and international ("port to foreign destination") components.⁸

The data challenges are compounded by the issue of causality. Whereas lower transport costs are likely to increase exports, economies of scale in transportation suggest that there might be an important effect in the other direction. That is, higher volumes of exports allow cargo carriers

⁸ Ideally, the international component should be measured port to port, but the lack of detailed records in the data only allowed us to identify the country that is the final destination of exports, rather than the specific final port of destination of cargo.

to operate on a larger scale, which reduces operational and eventually freight costs. This two-way relationship makes it more complicated to estimate the impact of transport costs on exports and requires robustness checks that take this feedback mechanism into account. A number of econometric techniques are used to address this issue and the result is a set of more reliable country-product-specific estimates of the impact of transport costs on exports.

To identify the key government projects to be included in this analysis, official infrastructure plans were reviewed and government officials interviewed.⁹ Using the country-product-specific estimates mentioned above and detailed information on project locations and the expected impact these projects will have on transport costs, the study is able to offer a more reliable assessment of how they would change the volume, composition, and spatial distribution of countries' exports. The latter dimension is particularly important in light of these countries' great regional disparities and the heavy concentration of exports in a handful of municipalities. As a final step, these assessments are used to build a transportation project ranking for each of the PA countries, based on the impact these would have on export performance. As mentioned earlier, the objective is to better inform policymakers' decisions about investments in trade-related logistics, and the results can be used as a tool to complement other more standard project evaluation methods.

Although this methodology is clearly a step forward in terms of capturing the trade dimension of infrastructure projects, it is also important to bear in mind that it has its limitations. These arise, first, from its focus on the so-called static, one-off impact of changes in transport costs as opposed to their dynamic effect across the years, which is considerably harder to estimate and interpret. Second, from the fact that it overlooks second-order effects such as how projects would impact non-exporters or even the establishment of new firms that may eventually become exporters—a limitation that reflects data restrictions on output at the firm and municipality level. The final factor is the use of operational costs rather than market freight rates, which are not systematically available. This might introduce some bias in the results, although for the routes and countries where data on these two variables is available, the correlation between them is, as expected, very high.¹⁰ As a consequence of all these limitations, the results of this study should be probably seen as a lower bound for the positive impact that reduced transport costs could have on exports,

⁹ Appendix E includes a general characterization of the transportation projects that we used in this project. Specific details regarding project types, schedule, and geographical location can be found in Candel and Parimbelli (2014).

¹⁰ When the pricing strategy of cargo carriers is equal to the competitive outcome or when the markup of cargo pricing is constant, the bias in our estimates due to the use of marginal cargo costs rather than the actual shipping prices is equal to zero. The reason lies in the fact that in either of these two cases, a price adjustment for cargo shipping can only be reached by adjusting the marginal cost of cargo handling.

a result to build on as the methodology is further refined and better and more detailed data becomes available.

The study is organized into five sections, including this introduction. Section Two provides a complete characterization of the export patterns and transport costs of all four PA countries. Section Three provides statistical evidence on the trade effects of high transport costs. Section Four estimates the impact of selected infrastructure projects on the volume, composition and spatial distribution of each country's exports, as well as their effects on the firms' probability to export. Section Five contains the conclusions.

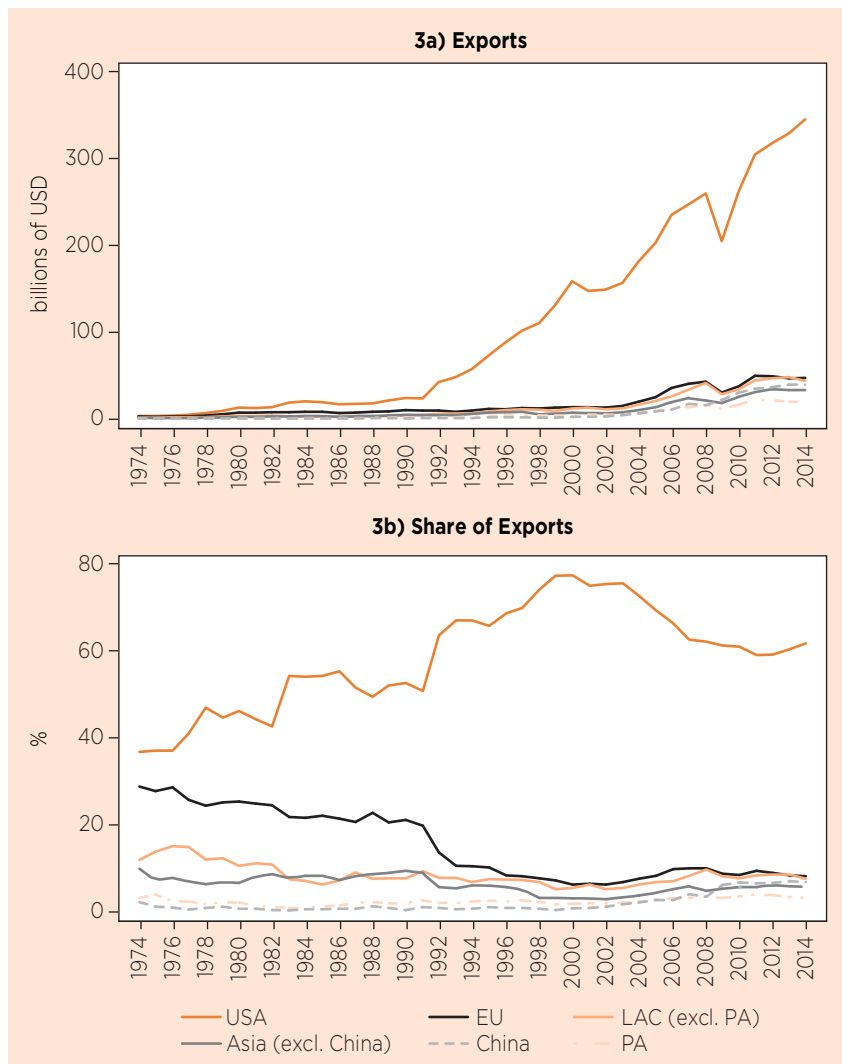
Export Patterns, Infrastructure, and Transport costs in the Pacific Alliance

Even though the PA is likely to provide a significant boost to intraregional trade, historical trade patterns suggest the most significant gains are to be found elsewhere. As with the rest of LAC, the US has historically been the bloc's most important export destination, and intraregional trade has only accounted for a limited share of the total. The most significant recent change has been the growth in Asia's share since the early 2000s. Over the last 40 years, the US has been the destination for 64% of PA exports (62% in 2014), while trade within the bloc accounted for only 3.1% (3.5% in 2014), and Asia for 9.6% (Figure 3).

While an optimist would view these figures as an opportunity to boost intraregional trade, it seems more realistic to expect that most of the bloc's trade gains will come from the development of regional value chains linked with players outside the PA. Two facts seem to support this view. First, the bloc's relatively small market and the current composition of intraregional trade: without exception, exports between PA members are concentrated in manufactured goods (see Figure 4a). Second, extraregional exports can access a significantly larger market and their potential for diversification is also considerably higher. With the exception of Mexico, exports to extraregional markets are highly concentrated in mining products, the region's historical comparative advantage. Data for 2014 reveals that, on average, 62% of exports from Chile, Colombia, and Peru correspond to products classified in the mining sector (see Figure 4b).

However, any prospect of developing subregional manufacturing value chains connected with global markets will depend not only on making the best use of the bloc's comparative advantages in relation to labor and natural resources, but also on governments' ability to build an efficient logistical infrastructure. In the context of global production chains, international manufacturers can only afford to outsource production of intermediate inputs if shipments are delivered at competitive prices and at the right production times. This objective can only be accomplished if public policies are oriented towards designing transportation networks that are able to supply reliable transportation services at the most competitive prices. Recent evidence from Blyde (2014) and Blyde and Molina (2015) shows that LAC's low participation in global production networks is partly

**FIGURE 3/
PA Exports
by Regional
Destination
1974–2014**



rooted in the region's substandard transportation infrastructure. Authors' estimates reveal that a 10% improvement in the quality of a country's transportation infrastructure would imply a 3.9% increase in that country's number of global value chains.

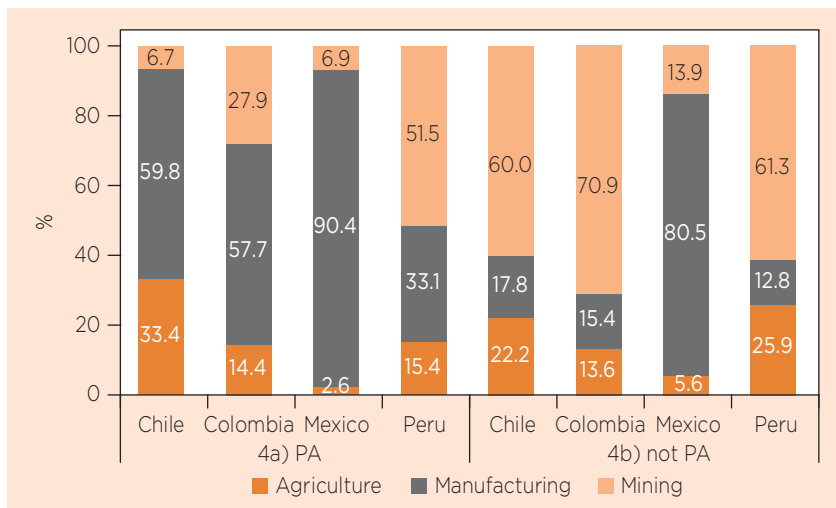


FIGURE 4/
Sectoral
Composition of
Exports within and
outside of the PA,
2014

Source: Authors' own calculations.

Note: Export data obtained from Comtrade, 2014.

The Past and Present of Infrastructure, Exports, and Transport costs in the PA

As with most of LAC, the design of the PA's transportation network is linked to the pre-Hispanic period. Prior to the Spanish invasion in the 15th century, the Mexica and Inca Empires had established wide networks of roads in the areas now known as Chile, Colombia, Ecuador, Mexico, and Peru. The Spanish centralized and used this network to their advantage to ship large volumes of gold, silver, and copper from the region. The ports of Veracruz, Cartagena, Callao, and Valparaíso emerged as transportation hubs that enabled cargo to be consolidated before finally being transported to Spain.

The region's political instability in the aftermath of its independence from colonial rule delayed railroad development until the late 19th century, when private investment in this field began to facilitate the flow of commodities from the mining/agricultural centers to the seaports. By the 1900s, every country in Latin America had built at least one railroad line, but financial constraints, low profitability, and political instability stood in the way of denser, more extensive railroad networks.¹¹

The lack of an extensive, integrated rail network, combined with high regional concentration of economic activity, made the development of alternative and more affordable modes of transportation an imperative, particularly in the context of the post-war import substitution industrialization (ISI), which required integrated national markets. The rise of the automobile industry and the lower financial requirements for establishing paved networks provided a solution that seemed convenient and timely. However, these road networks eventually hampered the development of a multimodal network that would be more efficient in the transportation of mass volumes over long distances.

The focus of ISI on the domestic market, coupled with transportation infrastructure that was slow to develop even in the form of roads, further deepened the agglomeration of economic activities in a few, long-established metropolises such as Santiago, Bogotá, Mexico City, and Lima.¹² This process exacerbated all the social and economic dimensions of regional economic inequalities and was marked by a relentlessly self-reinforcing dynamic, particularly in infrastructure development, with the wealthiest regions continuing to attract most investment.¹³

¹¹ Bignon, Esteves, and Herranz-Loncán (2013).

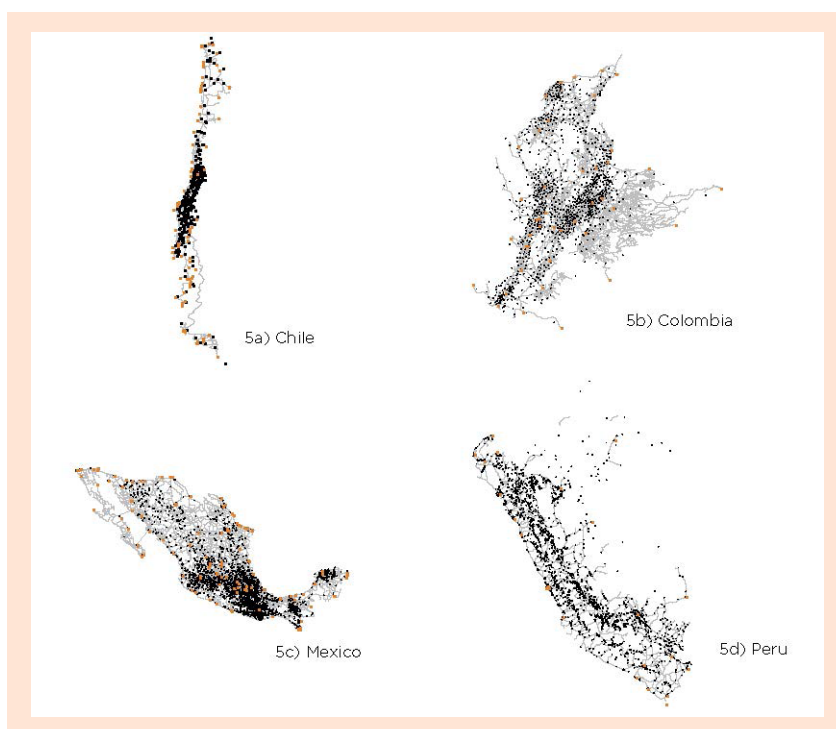
¹² See Krugman and Livas (1996).

¹³ See Gordon (1997); and Chiquiar (2005).

Trade liberalization in the 1990s offered the prospect of faster, export led-growth, and more even regional development as incentives shifted away from local metropolises to external markets. Although some developments were made in this direction—notably along Mexico’s northern border—on the whole, economic activity remained highly concentrated in the same cities and regions as always, which have been reaping most of the benefits of trade liberalization. The protracted, regionally uneven, and dysfunctional development of transportation infrastructure, the costly legacy of underinvestment and poor modal choices, has probably played a major role in explaining these results.¹⁴

This conjecture seems to be supported by the current geographical distribution of road networks and exporters in the PA, shown in Figure 5. It

**FIGURE 5/
Road Networks
and Georeferenced
Locations of
Exporters in the PA,
2012**



Source: Authors' own geographical depiction.

Note: Georeferenced data on location of exporters was obtained from each country's transactional exports data. Georeferenced data on exit nodes was obtained from customs agencies and the ministries of transportation of Chile, Colombia, Mexico, and Peru. Georeferenced data on the country's municipal road network was directly obtained from each country's ministry of transportation. In each figure, the black dots correspond to the municipal location of exporters. Orange dots correspond to the geographical location of the country's exit nodes. In Chile these are ports and airports, while in Colombia, Mexico, and Peru they are customs facilities.

¹⁴ See, for instance, Chiquiar (2005) and MBVM.

seems clear that both are heavily clustered around the traditional economic centers mentioned above, leaving no doubt as to the scale of the challenge if the objective is not only to bring down transport costs and boost exports, but to do so in a way that provides wide distribution of opportunities. The following paragraphs examine the relevance of the trade and transportation axis in each of the member countries, particularly with regard to intraregional trade.

Chile. In Chile, economic activity is mostly concentrated in the center of the country, with the exception of copper-producing Antofagasta. The regions of Santiago, Antofagasta, Valparaíso, and Bío Bío account for 65% of the country's total population and nearly 75% of its GDP.¹⁵ The country's approximately 350 municipalities are connected to 93 export nodes—airports, ports, and customs facilities—through a road network that covers 77,603 km, 45% of which corresponds to the municipal or national road network while the other 55% corresponds to the regional road network. Quality is not an issue in this regard: recent cross-country evidence shows that the quality of Chile's road network is the best in the PA, and is classified among the top 25 in the world.¹⁶ As with the regional distribution of production, the largest share of the road network is found in the center of the country (Figure 5a).

In 2012, US\$ 75.6 billion worth of exports were shipped through the country's transportation infrastructure. Though 71% (249) of municipalities export, the top five accounted for 70% of all exports. Not surprisingly, these municipalities are all located within the most important industrial nodes: Las Condes, Santiago, and Providencia are in Santiago's metropolitan area, while Valparaíso and Antofagasta are located within the country's traditional agricultural and mining nodes.

Exports to the PA are not only small—4.7% of the total—but they are heavily concentrated in a few municipalities. Only 50% (175) of the country's municipalities export to the PA and the top ten account for 52% of these exports.

This heavy concentration of exports in a few municipalities is mirrored by the uneven distribution of export shipments across ports and airports. Whereas 78% of all exports are handled by the top ten ports, 50.1% are concentrated in the top five, all of which are near the country's main industrial clusters—the ports of Angamos, Valparaíso, and San Antonio, in the Valparaíso region, and Antofagasta and A.M. Benítez Airport, situated in Antofagasta and in Santiago's metropolitan area, respectively.

¹⁵ As reported by the Central Bank of Chile in 2012.

¹⁶ Global Competitiveness Index, WEF, 2006–2015, Series 2.02.

Colombia. In Colombia, the top three industrial nodes of Bogotá, Medellín, and Cali account for 41% of the country's population and 46% of its GDP.¹⁷ The country's 1,123 municipalities—including Bogotá—are interconnected by a road network that covers 202,102 km, divided into primary, secondary, and tertiary systems (the latter accounts for 71% of the network). Not surprisingly, the layout of the network closely follows that of the regional distribution of economic activity, with the municipalities that concentrate the bulk of the country's economic activity showing the highest road densities (Figure 5b). In contrast with the situation in Chile, road quality would seem to be a significant problem. Though the country has made recent efforts to improve the quality of its road network, cross-country evidence suggests that these efforts have not been sufficient: in 2014, the quality of the country's network was classified within the world's lowest decile, well below Chile's position.¹⁸

In terms of export connectivity, the country's transportation infrastructure connects 1,123 municipalities with 47 customs facilities. In 2012, this network handled US\$ 60.5 billion worth of exports. The regional concentration of exports is high: only 10.9% (123) of municipalities were able to export, and the top ten accounted for 98.4% of the country's exports volume. Cargo shipping is also regionally concentrated: the top three ports of Cartagena, Santa Marta, and Buenaventura account for 74% of all exports. The fact that Bogotá is landlocked and far from these ports does not prevent it from being the top exporter, accounting for 62% of all exports. In this context, the logistical disadvantages of Bogotá's geographic location have been offset by scale economies in production and by sizeable investments in transportation infrastructure which favor the city's interconnection with the rest of the country.

As is the case with Chile, Colombia's exports to the PA are small—7.6% of the total—and are heavily concentrated in a few municipalities (3.5%), and the top ten municipalities account for 97.6% of the country's exports to the PA.

Mexico. As in Chile and Colombia, the development of Mexico's transportation infrastructure has played a fundamental role in consolidating and deepening the country's regional economic disparities. Developed in the 1950s and 1960s to connect Mexico City—the country's primary industrial cluster—with the rest of the country, this radial road system has become the backbone of the country's transportation network. Running

¹⁷ Regional composition of population and GDP were extracted from Colombia's National Administrative Department of Statistics (DANE). For regional specific details see <http://www.dane.gov.co/index.php/pib-cuentas-nacionales/cuentas-departamentales> (in Spanish).

¹⁸ Global Competitiveness Index, WEF, 2006–2015, Series 2.02. Of 144 countries, Colombia ranks 126th.

the length and breadth of the country, 377,659 km of roads connect 2,457 municipalities to 49 export customs facilities, 102 ports, and 85 airports. Although 82% of the network is characterized as being in good condition, its radial shape and years of underinvestment have hindered the government's plans to address the country's regional economic disparities.¹⁹

As discussed elsewhere, the lack of infrastructure in the less developed regions has limited their ability to successfully engage in production and trade, which led to them to forgo most of the trade gains from NAFTA.²⁰ As a result, the country's regional distribution of manufacturing GDP, exports, and road infrastructure continues to be concentrated in the East-Central Region, which includes Mexico City. In 2011, Mexico's transportation network handled US\$ 234.3 billion worth of exports. The regional concentration of exports is high, as only 38% (955) of municipalities export, and the top ten account for 49% of all exports. As is the case with other bloc members, the PA accounts for only a small share of the country's exports (3.25%), which come from 10.2% (266) of its municipalities, with the top ten accounting for as much as 62% of the country's exports to the PA.

Reflecting the high concentration of Mexico's trade with the U.S., 36% of its exports are processed through customs facilities at Nuevo Laredo and Ciudad Juárez. Exports to the PA, in contrast, are mainly shipped through Manzanillo and Veracruz, which are better positioned to reach these markets. In 2011, these two customs facilities processed 48% of the country's exports to the PA.

Peru. Running mainly north-south, Peru's 43,596 km road network connects 1838 municipalities with 25 export customs facilities. The largest region—La Selva—contains 50% of the country's territory but has the smallest share of GDP (5.3%).²¹ In contrast, La Costa, a long desert region that borders the Pacific Ocean, has the largest share of the country's population (56%) and GDP (68.7%) despite being the smallest in size (13% of the territory). As is the case with the other members of the PA, the geographical distribution of Peru's road network replicates the country's regional economic concentration.²² While La Costa has the highest road density ratio (0.079 km/surface area), La Selva is at the bottom of the ranking, with a road density that is 56% that of La Costa's.²³ In contrast to the other PA countries, Peru's logistics network concentrates cargo processing throughout the customs facility at Callao: in 2012, 65% of all exports and 63% of exports to the PA left the country through this point. As was the case with Colombia,

¹⁹ In terms of WEF quality index, within the PA Mexico's quality level is second only to Chile.

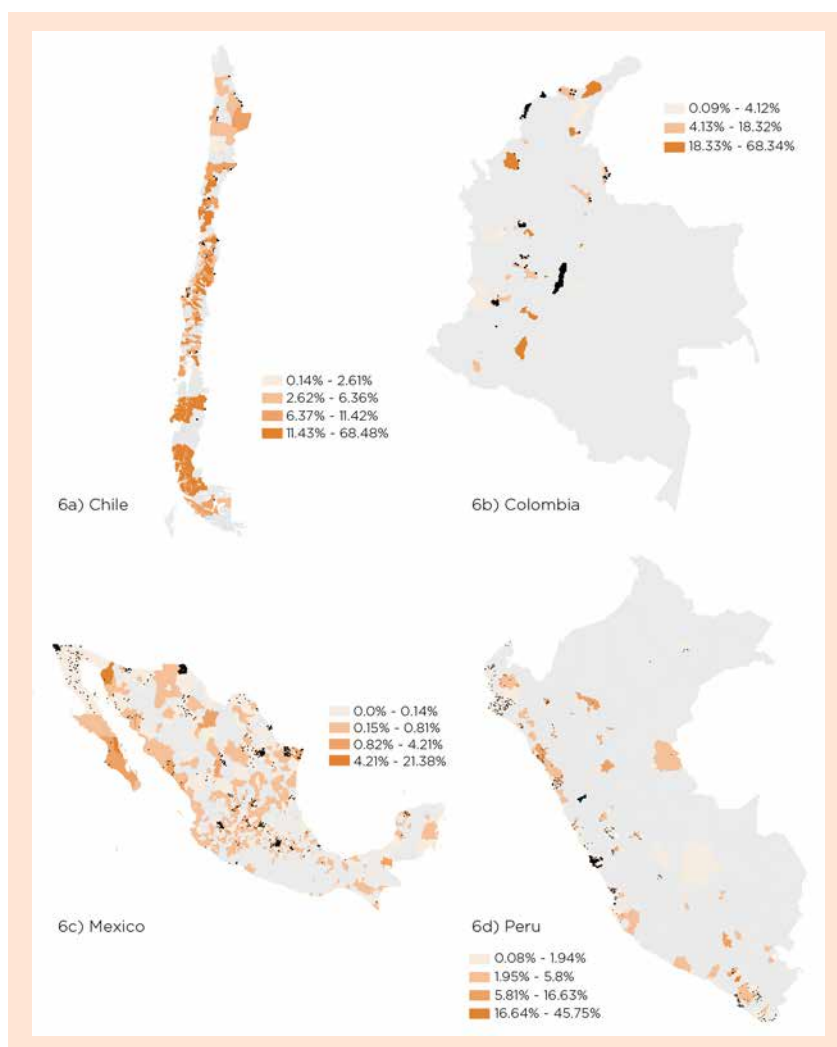
²⁰ See Chiquiar (2005) and MBVM.

²¹ Geographically, Peru is divided into three regions: La Selva, La Sierra, and La Costa. La Selva includes the following departments: Amazonas, Loreto, Madre de Dios, San Martín, and Ucayali. La Sierra includes: Áncash, Apurímac, Arequipa, Ayacucho, Cajamarca, Cusco, Huancavelica, Huánuco, Junín, Pasco, and Puno. La Costa includes: Callao, Ica, La Libertad, Lambayeque, Lima, Moquegua, Piura, Tacna, and Tumbes.

²² This includes the national and department-level road networks.

²³ Calculated by taking the regional average of the ratio of each department's number of kilometers of roads (taking into account both the national and department-level networks) to the department's surface area. Authors' own calculations obtained using the surface area data reported by Peru's National Institute of Statistics, available at <http://www.inei.gob.pe/> and road network data reported by Peru's Ministry of Transportation and Communications and available at http://www.mef.gob.pe/contenidos/presu_publ/capacita/2_Raul_Torres.pdf (in Spanish) and http://www.aate.gob.pe/transparencia_aate/upload_obras/situacion_redes_viales_SINAC.pdf (in Spanish).

FIGURE 6/
Regional Exports
and Regional *Ad*
***Valorem* Transport**
Costs in the PA,
2012



Source: authors' own geographical depiction.

Note: In each figure the black dots correspond to the municipal agglomeration of exporters. In all cases, the represented total *ad valorem* transport costs correspond to the average municipal total *ad valorem* transport costs. Total *ad valorem* transport costs include both the foreign and domestic costs of shipping cargo. International transport costs were obtained directly from ALADI's dataset, while domestic cargo shipping costs were calculated using detailed route-specific georeferenced data on roads, location of exporting firms, and shipper-specific information on the cost structure of moving cargo, as suggested by Combes and Lafourcade (2005). For specific details, see Appendix C.

the quality of Peru's road network is a problem. Though the country has made substantial investments to improve it, the network continues to fall below the average quality level of the PA and is 102nd in the WEF 2014 rankings; that is, half of Chile's level.²⁴

²⁴ Global Competitiveness Index, WEF, 2006–2015, Series 2.02.

In sum, throughout the PA there is a clear coexistence of uneven regional distributions of both transportation infrastructure and exports. Without exception, the design and the development of each country's transportation network favors the regions where most economic activity is concentrated, leaving the poorest and remotest regions struggling with low road densities and high transport costs, which, in turn, appear to be associated with little or no export activity (Figure 6). For instance, Santiago, Bogotá, Mexico City, and Lima experience average *ad valorem* transport costs of 2.2%, while for the least export-oriented municipalities this figure is as high as 51%.²⁵

²⁵ The estimates for the capital cities were obtained by using the average of the upper bound of the first category of *ad valorem* transport costs as reported in figures 6(a), 6(b), 6(c), and 6(d). That is, $2.2 = (2.61 + 4.12 + 0.14 + 1.94)/4$. In the case of other municipalities, estimates were obtained by using the average of the upper bound of the highest category of *ad valorem* transport costs as reported in figures 6(a), 6(b), 6(c), and 6(d). That is, $51 = (68.48 + 68.34 + 21.38 + 45.75)/4$.

The Impact of Transport costs on Exports

To better grasp this negative relationship between transport costs and exports in the PA—which are summarized in Figure 7—it is important to go beyond observing simple correlations and try to establish some sort of causality between these two variables. As mentioned earlier, there are two possible directions for this. There is a direct price effect, with lower

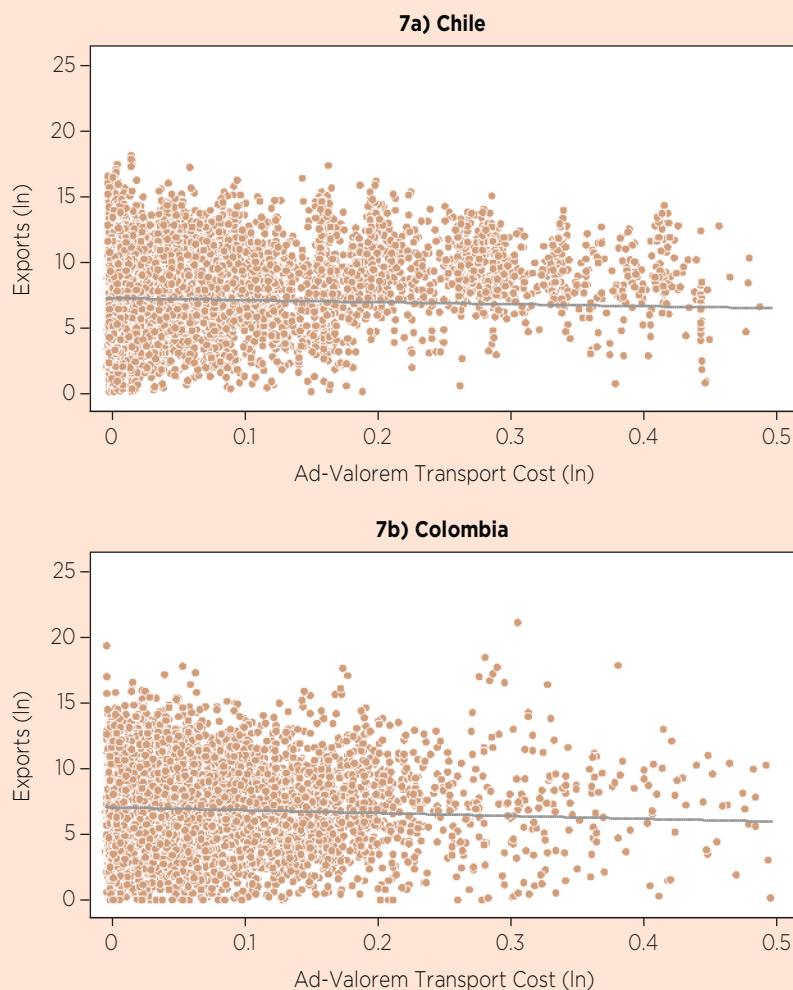
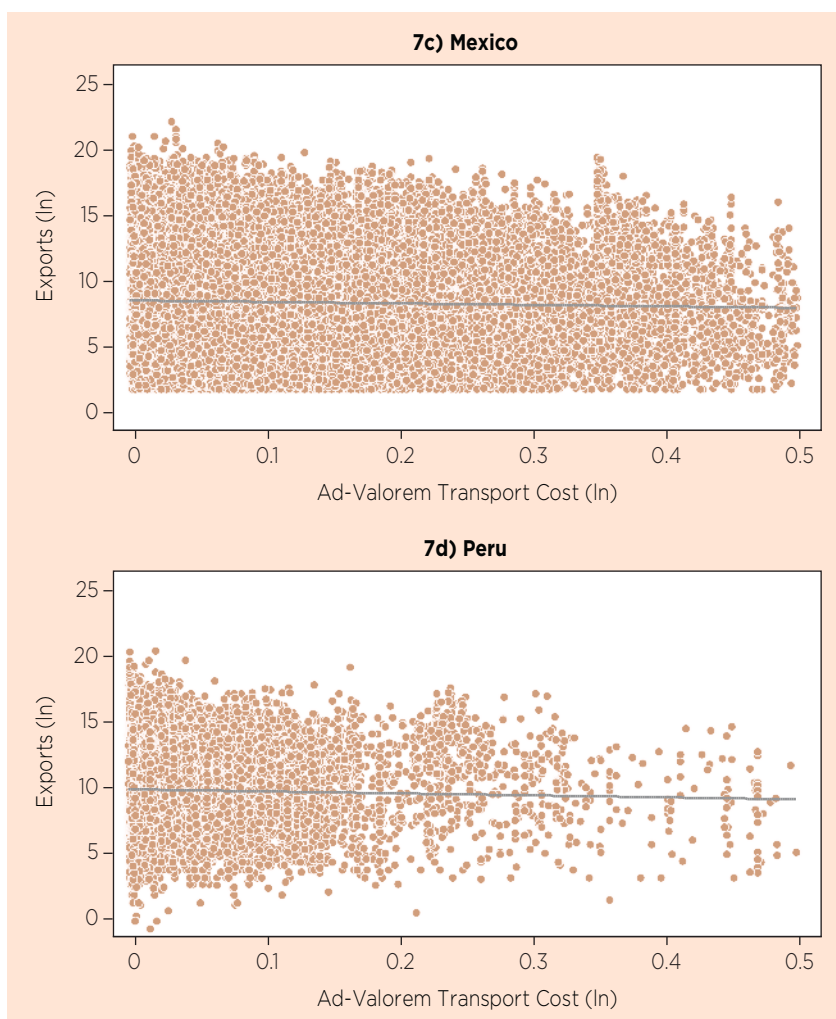


FIGURE 7/
Transport costs and Municipal Exports in the Pacific Alliance

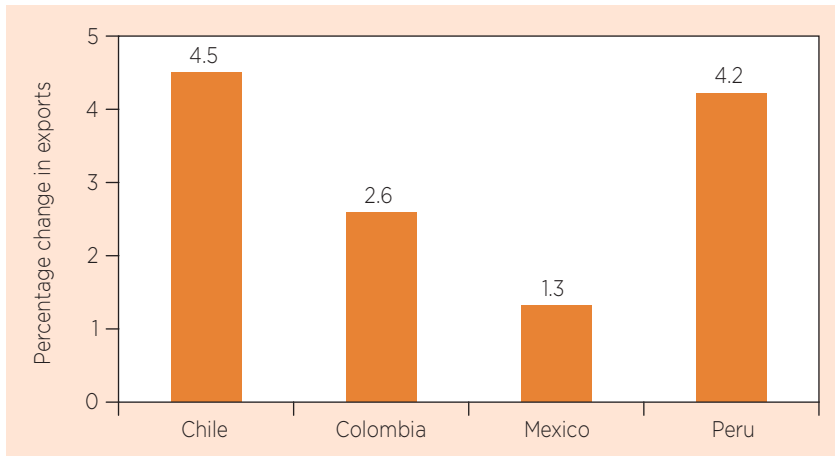
FIGURE 7/
Transport costs
and Municipal
Exports in the
Pacific Alliance
(continued)



Source: Authors' own calculations. The linear fit for the logarithm of exports (exp) as a function of the logarithm of *ad valorem* transportation costs (tc) is $\text{exp} = 9.31 - 1.54 \cdot \text{tc}$ for Chile, $\text{exp} = 9.19 - 2.18 \cdot \text{tc}$ for Colombia, $\text{exp} = 9.00 - 1.13 \cdot \text{tc}$ for Mexico, and $\text{exp} = 7.74 - 1.801 \cdot \text{tc}$ for Peru.

Note: Figures a), b), and d) report cross-correlation for year 2012, while figure c) corresponds to cross correlation for year 2011.

transport costs leading to greater export opportunities as producers can be more price competitive; but there is also the reverse, scale effect, with larger export volumes leading to lower freight rates due to economies of scale in cargo shipping. If the objective is to accurately assess, for instance, the impact of transportation infrastructure projects on trade, as is the case in this study, it is important to measure the price effect net of a possible reverse scale effect. Likewise, the analysis also has to weed out the influence



Source: Authors' own estimations.

Notes: Cross-country coefficients correspond to the estimated coefficients reported in Table D1, column (8). Estimates correspond to baseline specification as derived in Appendix B1, equation (b1.4).

* For Chile, Colombia, and Peru, the data sample corresponds to 2007–2012. In the case of Mexico, the data sample corresponds to 2007–2011.

**FIGURE 8/
The Impact
of Transport
Costs on the Level
of Exports:
Pacific Alliance,
2007–2012***

²⁶ See Appendix A.

²⁷ See Appendix B, equation b1.4. Following the SITC Revision 3 Industrial Classification, the primary sector corresponds to products (HS at 6-digit level) classified within the industrial sectors: 0-Food and live animals; 1-Beverages and tobacco; 2-Crude materials, inedible, except fuels; 3-Mineral fuels, lubricants, and related materials; 4-Animal and vegetable oils, fats, and waxes; 68-Non-ferrous metals; and 97-Gold, non-monetary (excluding ores and concentrates). Likewise, the manufacturing sector corresponds to products (HS at 6-digit level) classified within the industrial sectors: 5-Chemicals and related products; 6-Manufactured goods classified by material (except 68); 7-Machinery and transportation equipment; 8-Miscellaneous manufactured articles; and 9-Commodities and transactions n.e.s. (except 97).

²⁸ See Appendix B, equation b2.1, for details of the probability exercise and equation b3.1 for the number of products exercise. This is the so-called extensive margin.

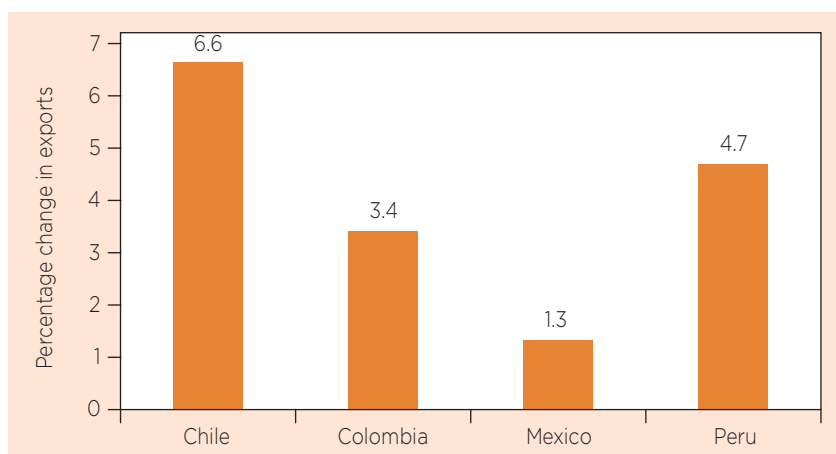
of other determinants of export performance to avoid misinterpreting their impact as being due to variations in transport costs.

Drawing inspiration from standard trade theory, these issues were addressed by an econometric exercise that related the quantity of a given good being exported from a specific municipality to the *ad valorem* transport costs incurred to reach a particular customs export facility, using a particular route, while controlling for product, municipalities, country of destination, and the characteristics of customs facilities/ports of exit that might also affect export performance.²⁶

All estimates were carried out for total exports and for primary and manufacturing exports from each PA economy, as the impact might vary across product categories. For instance, the fact that manufactured goods, unlike mining and agricultural commodities, are mostly shipped by container might introduce a different dynamic into the relationship between shipping costs and exports.²⁷ Aside from the value of exports, the exercise also looked into the relationship between transport costs and the municipality's probability of exporting and the number of products it exports.²⁸

Figure 8 summarizes the results and, as expected, the estimates point to transport costs having a negative and statistically significant impact on

**FIGURE 9/
The Impact
of Transport
Costs on the Level
of Exports:
Manufacturing,
Pacific Alliance,
2007-2012***



Source: Authors' own estimations.

Notes: Cross-country coefficients correspond to the estimated coefficients for the manufacturing sector only as reported in Table D3, column (8). Estimates correspond to baseline specification as derived in Appendix B1, equation (b1.4).

* For Chile, Colombia, and Peru, the data sample corresponds to 2007-2012. In the case of Mexico, the data sample corresponds to 2007-2011.

municipal exports in all PA countries.²⁹ More precisely, a 1% decrease in *ad valorem* transport costs is expected to produce an increase in exports that ranges from 1.3% in Mexico to 4.5% in Chile.

Estimates at the sectoral level showed a similar pattern for manufacturing, but the magnitude of the impacts is considerably higher than the economy-wide averages for Chile and Colombia (Figure 9). Results for primary products were not as conclusive. Though they still pointed to a negative relationship, in most cases they were not statistically significant. This probably reflects the fact that production is concentrated in a few mining- and agriculture-oriented municipalities with strong comparative advantages, and, therefore, there is insufficient variation across municipalities to allow for the effects of transport costs to be identified.³⁰

Estimates measuring the impact of transport costs on export product diversification (Figure 10) confirmed that lower transport costs would lead to a significant increase in the number of exported products.³¹ A 1% decrease in *ad valorem* transport costs would raise the number of exported products between 0.5% in Colombia and 3.1% in Chile.³² The fact that the magnitude of the impact varied significantly across countries suggests that the export benefits of lower transport costs are obtained through different channels. For Chile and Mexico, export gains are the result of both higher

²⁹ As reported in Appendix D, Table D1, all of our estimates are significant at the 1% level, even when we cluster our standard errors by sector, municipalities, and sector/municipalities. Clustered standard error results are reported in Table D2.

³⁰ See Appendix D, Tables D3 and D4.

³¹ Product head count at HS 8-digit level. Alternatively, the results reported in Appendix D, Table D5 and Table D6, also include estimates for when the product head count is defined at the HS 6-digit level. As reported, our findings are robust to this alternative product head count.

³² See Appendix D, Table D5, column (2).

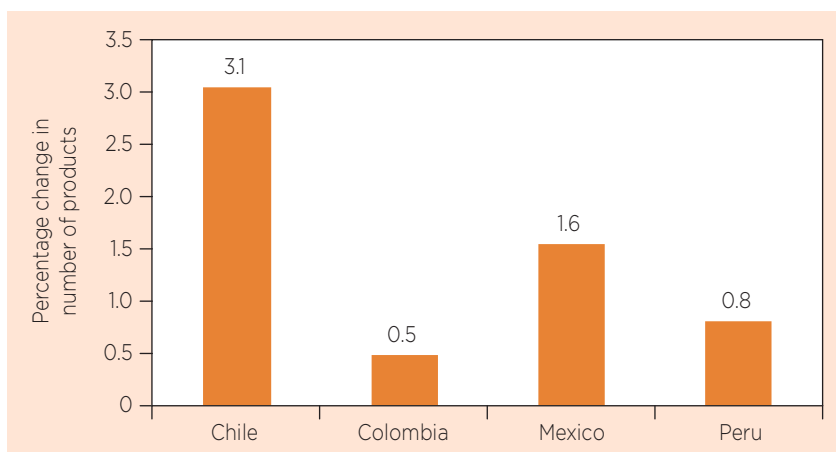


FIGURE 10/
The Impact of
Transport
Costs on
Export Product
Diversification.
Pacific Alliance,
2007-2012*

Source: Authors' own estimations.

Notes: Cross-country coefficients correspond to the estimated coefficients reported in Table D5, column (2). Estimates correspond to baseline specification as derived in Appendix B2, equation (b2.1).

* For Chile, Colombia, and Peru, the data sample corresponds to 2007-2012. In the case of Mexico, the data sample corresponds to 2007-2011.

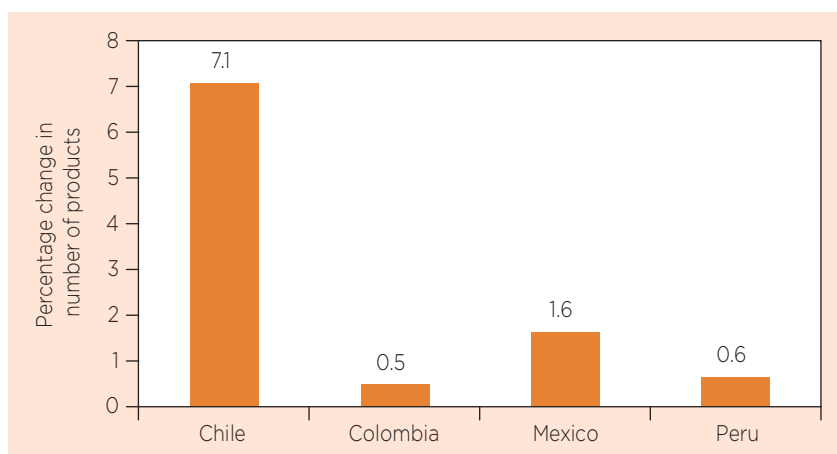
volumes and greater product diversification, whereas for Colombia and Peru they are mainly driven by volume (i.e. greater market penetration).

Estimates by sector not only confirmed that Colombia's and Peru's export gains are mainly driven by higher market penetration, but also that diversification gains in Chile and Mexico are due to the exporting of new manufacturing products (Figure 11). Results for primary products were not as conclusive. Though they still pointed to a negative relationship between transport costs and export diversification, they were not statistically different from zero.³³

The final exercise looked at the impact of transport costs on the municipality's probability of exporting. The results in Figure 12 confirmed that lower transport costs may improve a municipality's chance of exporting, although these impacts seemed to be modest: a 1% reduction in *ad valorem* transport costs would raise the probability of exporting from between 0.2% in Peru up to 1.3% in Mexico.

³³ See Appendix D, Table D6, column (2).

FIGURE 11/
The Impact
of Transport
Costs on Export
Diversification
of Manufactured
Products. Pacific
Alliance,
2007-2012*

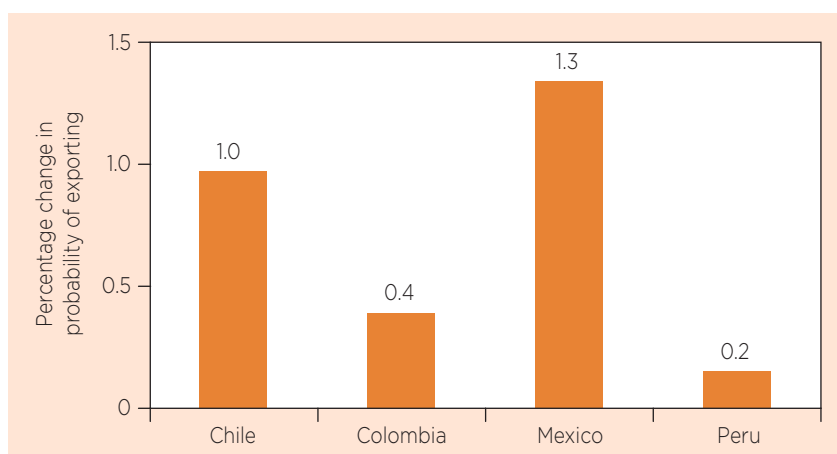


Source: Authors' own estimations.

Notes: Cross-country coefficients correspond to the estimated coefficients reported in Table D6, column (6). Estimates correspond to baseline specification as derived in Appendix B2, equation (b2.1).

* For Chile, Colombia, and Peru, the data sample corresponds to 2007-2012. In the case of Mexico, the data sample corresponds to 2007-2011.

FIGURE 12/
The Impact
of Transport
Costs on the
Probability of
Exporting.
Pacific Alliance,
2007-2012*



Source: Authors' own estimations.

Notes: Cross-country coefficients correspond to estimates reported in Table D7, columns (2), (4), (6), and (8). Estimates correspond to baseline specification as derived in Appendix B3, equation (b3.1).

Infrastructure Projects and PA Exports

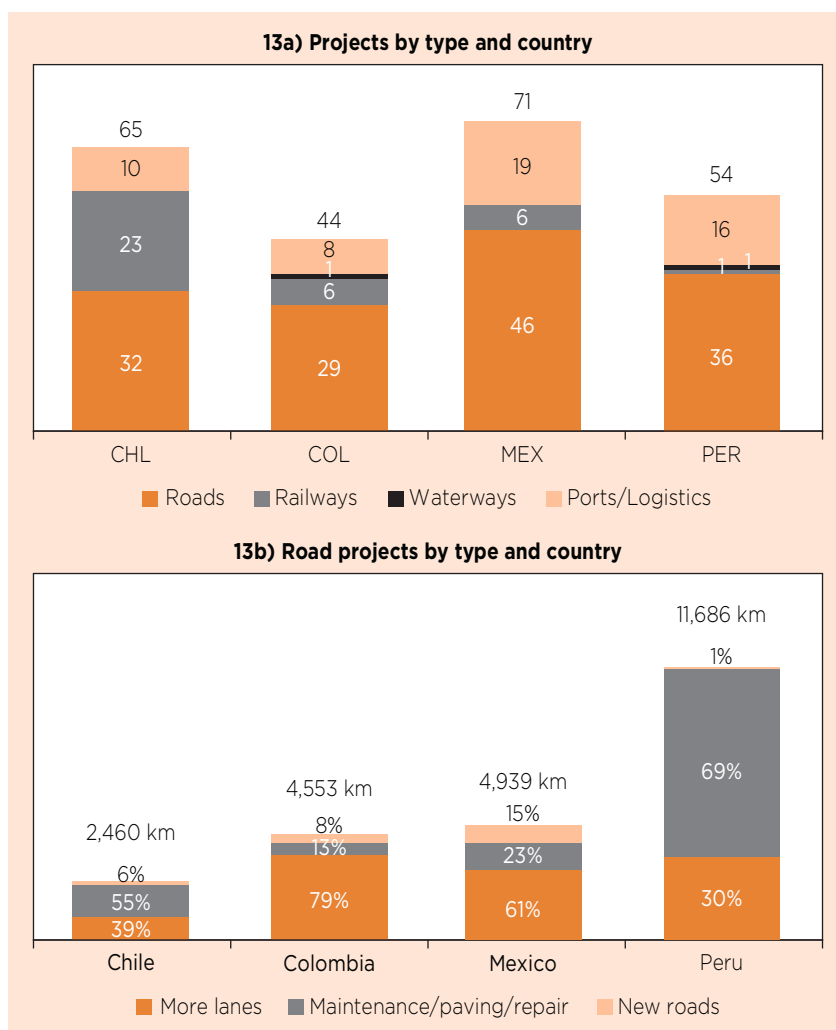
Though suggestive, these results only go as far as showing what the expected average impact on exports would be after a percentage reduction in transport costs. However, they do not identify either how the most significant reductions in transport costs could be made or which reductions would have the greatest impact on exports. For policymakers who are concerned with boosting their municipalities' exports, this is precisely the type of information that could help direct scarce resources towards the most effective solutions.

This section takes a step in this direction and makes an attempt to simulate the impact of infrastructure projects on PA exports within and outside PA member countries. This was done by developing an analytical framework that combines the georeferenced network databases and the econometric estimates discussed earlier with a standard trade model and detailed information on the expected savings in transport costs for a subset of infrastructure projects.³⁴ The results were used to build rankings based on the projects' aggregated impact on exports. Though far from being an exhaustive evaluation, this framework sheds light on a dimension that is usually missed in traditional cost-benefit analysis: outcomes in terms of the level, composition, and regional distribution of exports.

The simulations were divided into three steps. First, the most relevant transportation projects within PA countries were selected. The selection process combined information from the georeferenced origin-destination database, so as to identify the PA cargo routes that account for at least 75% of intraregional exports, with official documents and interviews with domestic cargo carriers, so as to identify the most relevant transportation projects that are needed to improve product shipment along these cargo routes. A total of 234 projects were identified, of which 65 are in Chile, 44 are in Colombia, 71 in Mexico, and 54 in Peru (See Figure 13a and Appendix E). Though the total selection includes roads, railways, waterways, and port projects, the simulations were restricted to road transportation and port projects due to the limited availability of data for the other transportation modes. The selected projects involve the extension, repair, or maintenance of 23,638 km of the road network (Figure 13b).

³⁴ See Appendix E for technical details on the structure of simulations.

FIGURE 13/
Selected
Transportation
Projects. PA, 2013

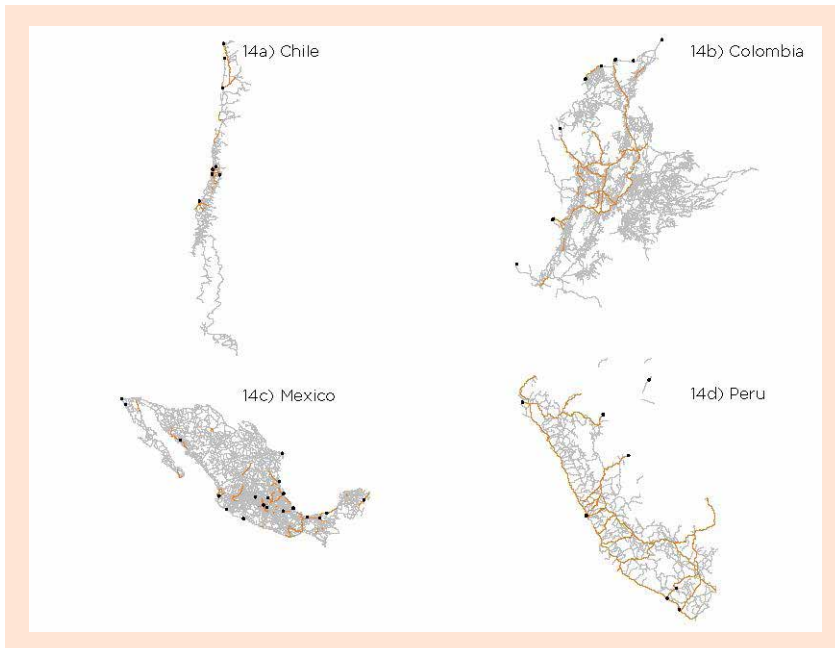


Source: Authors' own selection.

Note: Project selection based on an origin-destination selection rule based on the share of a country's export volume. The subset of projects for each country is based upon the potential projects in 2013.

These projects are part of the countries' multi-year infrastructure plans and are expected to be executed within the next decade. In Chile, they amount to US\$ 7.3 billion or 2.8% of the country's 2014 GDP, a level that is in line with the government's per year infrastructure expenditure goal, which has recently been set at 3.5% of GDP (Chile's Infrastructure, Development, and Inclusion Plan for 2014–2021).³⁵ In Colombia, the selected projects are valued at approximately US\$ 19.1 billion or 5% of the country's 2014 GDP. This amount is not far from the country's annual expenditure goal for

³⁵ See Candel and Parimbelli (2014).



Source: Authors' own geographical representation.

Note: For each country, the black dots correspond to the origin/destination nodes. The gray road network corresponds to the countries' 2013 road networks before the construction of the road projects represented by the orange lines. All road projects correspond to those included in Appendix E.

FIGURE 14/
Georeferenced
Locations of
Selected
Transportation
Projects. PA, 2013

transportation infrastructure for the next decade, which is currently set at US\$ 11.3 billion.³⁶ In Mexico, the projects amount to US\$ 15.1 billion, which corresponds to 31% of the country's planned investment in transportation infrastructure for 2013–2018 (US\$ 48.8 billion) and 1.2% of the 2014 GDP.³⁷ In Peru, the projects are valued at US\$ 12.4 billion; the equivalent of 6% of the country's 2014 GDP.³⁸ In all countries, some of the projects are already being executed or have recently been concluded.³⁹

Since the selection of these projects was partly based on the identification of the most important cargo routes (as of 2013), the regions where these routes are located are expected to have the higher export gains and, in most cases, they are the countries' most important clusters of economic activity and contain the most important exit cargo nodes (Figure 14).

The second step of the simulations used the projects' georeferenced locations to insert them into a digital road network, which led to a recalculation of optimal export routes and related transport costs. The projects' impact on transport costs was estimated by comparing transport costs before and after their execution.

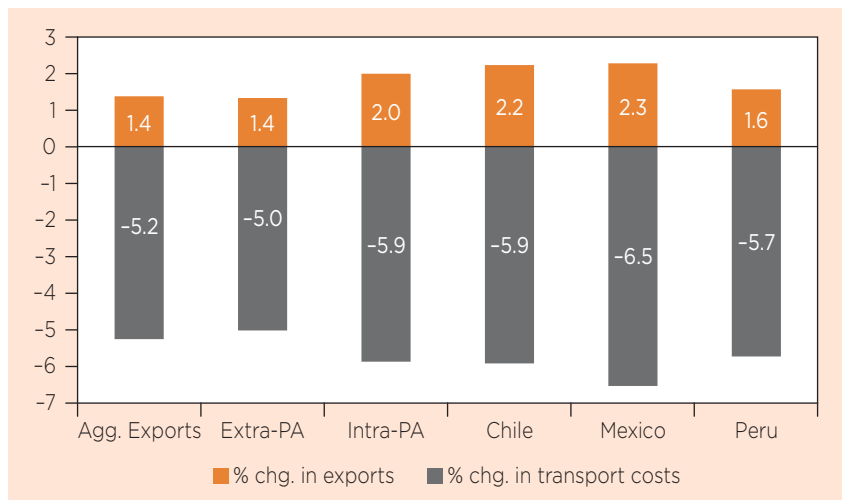
³⁶ Departamento Nacional de Planeación, Colombia, "Bases del Plan Nacional de Desarrollo 2014–2018," <https://colaboracion.dnp.gov.co/CDT/Prensa/PND%202014-2018%20Bases%20Final.pdf> (in Spanish).

³⁷ Secretaría de Comunicaciones y Transportes, Mexico, "Programa de Inversiones en Infraestructura de Transporte y Comunicaciones, 2013–2018," http://www.sct.gob.mx/fileadmin/GITS/PIITC_-_SCT.pdf (in Spanish).

³⁸ Ministerio de Transportes y Comunicaciones, Peru, "Informe de Evaluación del Plan de Acción Anual 2012 al I Semestre" (in Spanish).

³⁹ See Appendix E for the execution status for all projects.

**FIGURE 15/
Impact of Road
Investments on
Chilean Exports:
Aggregate,
Rest of the World,
and PA
Destinations**



Source: Authors' own calculations using the estimates reported in Table D1, column (8).

Note: Simulations as structured in Appendix F.

In the final step, the effect on the level and composition of exports was obtained by combining these percentage changes in transport costs with the econometric estimates for the relationship between *ad valorem* transport costs and exports discussed earlier (Figures 10 to 12). For each PA country, the combined effect of the portfolio of projects is assumed to be the sum of the export gains for each municipality involved.⁴⁰

The results are discussed in the following paragraphs and for each country they include: (1) an estimate of the impact on overall, extraregional, and intraregional exports; (2) a subnational distribution of these impacts; (3) the impact on product diversification for overall and intraregional exports; (4) the percentage change in the probability of exporting and; (5) a ranking of the projects based on their export gains.

Chile. As reported in Figure 15, the execution of the selected road and logistic projects would reduce transport costs by 5.2%, which would translate into a total increase in exports of 1.38%.⁴¹ Using 2012 as a base year, this would be equivalent to a permanent increase in exports of US\$ 1 billion, implying an investment payback period equal to 6.5 years.⁴² Though this increase in exports would be mainly driven by destinations outside the PA, the impact of the investments in infrastructure is higher for PA destinations, with exports to Colombia, Mexico, and Peru increasing by 2.23%, 2.28%, and 1.56%, respectively.

⁴⁰ See Appendix F, equation f.5.

⁴¹ See Appendix E, Table E1.

⁴² Provided that the permanent export gain is an annuity that will be discounted at a constant interest rate of 3.25% (the 2015 US Prime Rate), the time it would take for the total investment to break even is

$$6.5 = - \frac{\ln \left(1 - r \frac{I}{A} \right)}{\ln (1 + r)}.$$

In the case of Chile, $r = 3.25\%$, $I = \text{US\$ } 6069$ million, $A = \text{US\$ } 1043$ million.

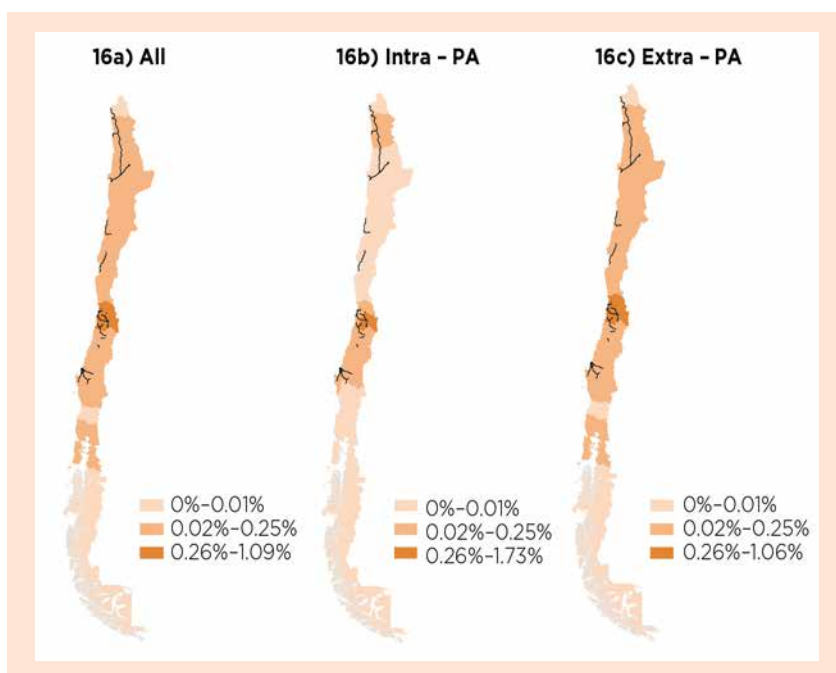


FIGURE 16/
Impact of Road
Investments on
Chilean Regional
Exports: PA and
Rest of the World
Destinations

Source: Authors' own calculations using estimates reported in Table D1, column (8).

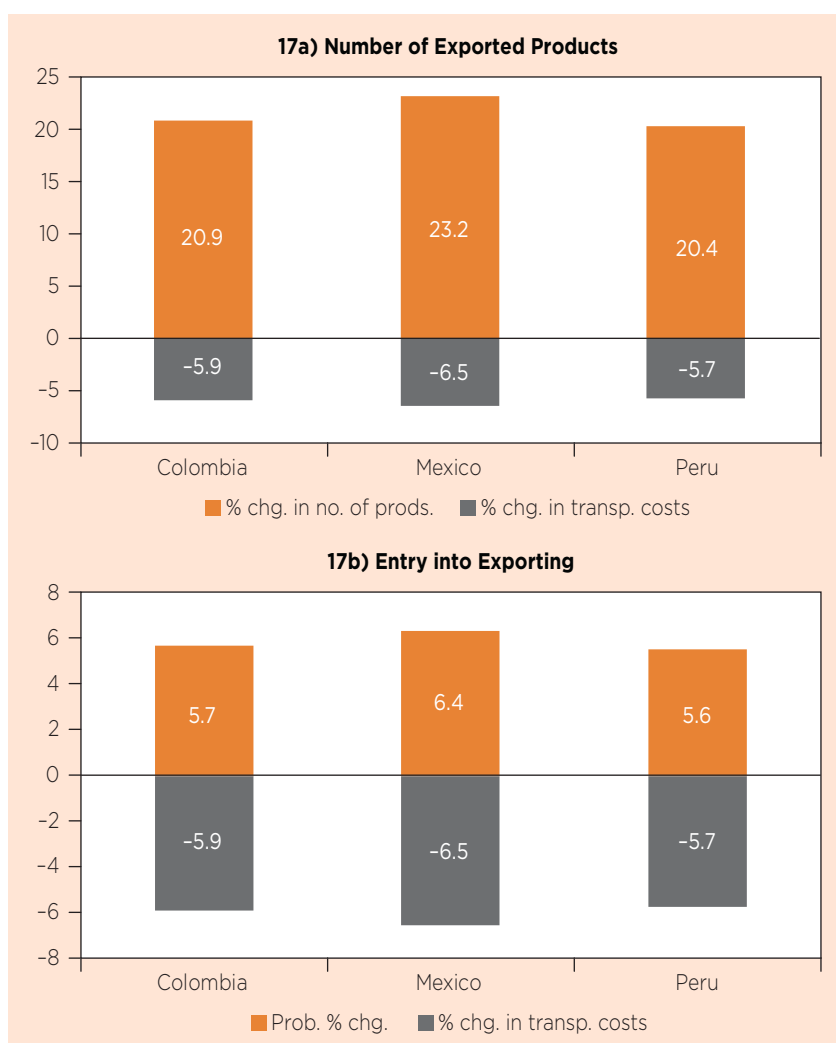
Note: Simulations as structured in Appendix F. Black lines correspond to the georeferenced location of all transportation projects as listed in Appendix E1.

At the subnational level, the top exporter—the Santiago Metropolitan Region—tends to benefit the most, thus pushing the geographical concentration of exports yet further (Figure 16a). This largely reflects a bias in the project selection process, which as explained earlier, is partly determined by the country's current most important cargo routes (Figure 14a). The impact on exports to the PA, however, is more widespread than on those to the rest of world, and would particularly benefit the north of Chile. In contrast, the south, which has the highest transport costs in the country and the lowest export activity, would barely benefit from these investments (Figures 16b and 16c).

This portfolio of investments is also likely to have a notable impact on the number of products exported by each municipality and on their probability of exporting. As reported in Figure 17a, transport cost savings produced by these projects would increase the number of products exported to Colombia, Mexico, and Peru by 20.9%, 23.2%, and 20.4%, respectively.⁴³ This is equivalent to exporting 236, 190, and 436 new products to the PA, while shipping 680 new products to the rest of the

⁴³ For example, in the case of Colombia, $20.9 = -3.553 \times -5.89$, where -3.553 corresponds to the estimated coefficient reported for Chile in Table D5, column (4). The value -5.89 corresponds to the simulated average decrease in transport costs reported in Figure 17a.

FIGURE 17/
Impact of Road
Investments on
Product
Diversification and
on Entry into
Exporting
for Chile:
PA Destinations.



⁴⁴ Since the estimated coefficient corresponds to one reported in Table D5, column (4), and given that the average decrease in transport cost is equal to the average reduction effect as reported in Figure 17a (6.06), one only needs to know that Chile exports a head count of 3162 products (HS 6-digit level) to the rest of world, hence $680 = -3.553 * -6.06 * 3162 / 100$.

⁴⁵ Probability increase obtained by taking the average over the results reported in Figure 17b, columns (1)–(3). Due to its construction this probability increase is not destination specific.

⁴⁶ Since the top three projects would lead to an average 0.35% increase in exports (see Figure 18); and given that Chile's aggregate export change is 1.38% (see Figure 15) then $0.258 = 0.35 / 1.38$.

Source: authors' own calculations. Figure 17a uses the coefficients reported in Table D5, column (4). Figure 17b uses the coefficients reported in Table D7, column (2).
 Note: simulations as structured in Appendix F.

world.⁴⁴ Likewise, improvements in the road network are also likely to have a positive impact on municipalities' probability of exporting, boosting their odds by as much as 5.9% (Figure 17b).⁴⁵

In terms of projects, the simulations suggest that the top three account for most of the aggregate impact on Chile's exports. As Figure 18 shows, the execution of the River Maipo Bridge and Highway R160 projects and the improvements to the Port of Valparaíso would account for 25% of all the portfolio gains.⁴⁶

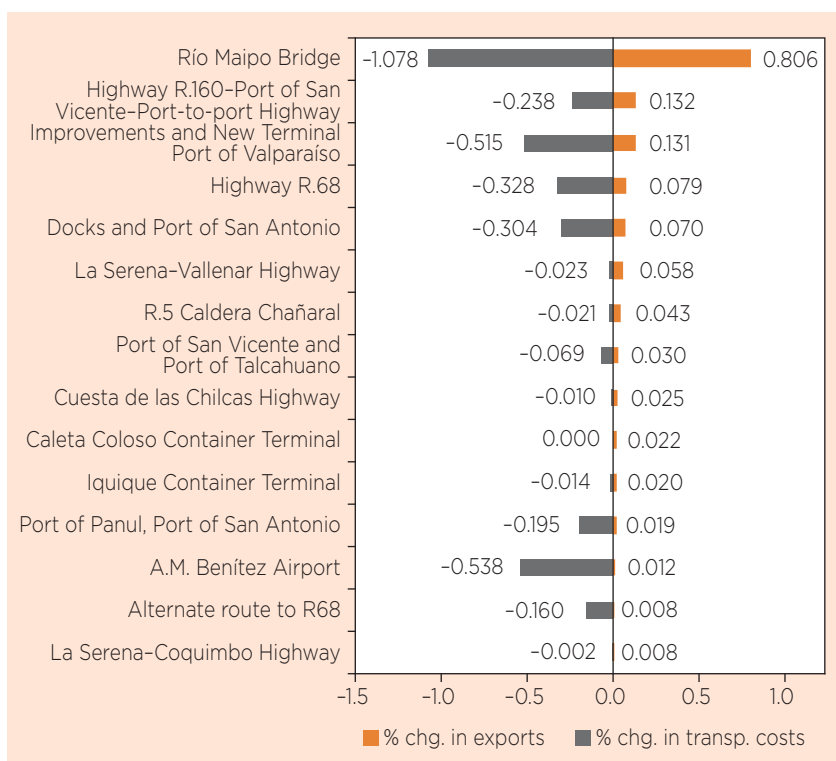


FIGURE 18/
Ranking of Chile's
Projects by
Aggregate Effect
on Exports

Source: authors' own calculations using the coefficients reported in Table D1, column (8).

Note: simulations as structured in Appendix F.

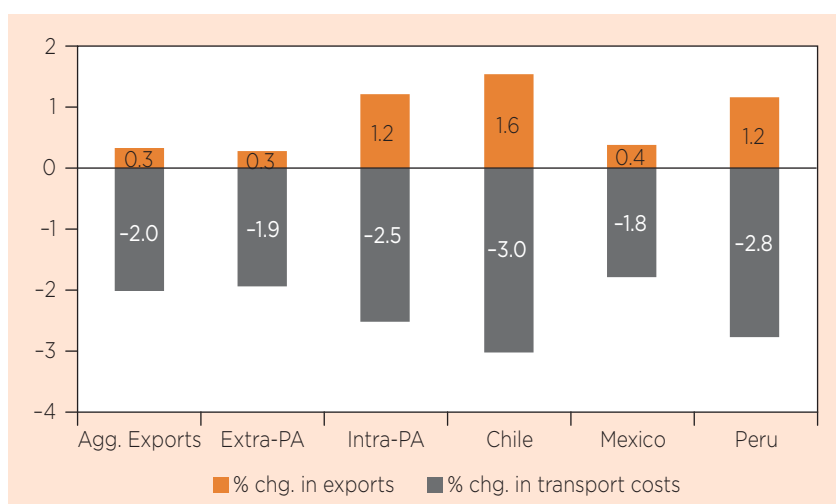
Colombia. The selected investments in transportation infrastructure are expected to reduce transport costs by 2.0% on average, thus boosting overall exports by 0.34% (Figure 19).⁴⁷ Using 2012 as a base year, this would be equivalent to a permanent increase in Colombian exports of US\$ 205.7 million. This increase would be driven mainly by destinations outside the PA, although the growth in exports to the PA would be 0.94 percentage points higher, ranging from 0.39% in exports to Mexico to 1.55% in exports to Chile.

Regionally, the execution of this investment plan would favor the municipalities located in less developed areas. While the impact on all exports is expected to favor established exporters in the departments of Antioquia, Cauca, Chocó, and Valle del Cauca (Figure 20a), the gains in extraregional exports would favor municipalities located in the department of Chocó, one of the poorest in the country (Figure 20c).

This investment package is also likely to increase export diversification and each municipality's probability of exporting. Figure 21a shows that Colombia would increase the number of products it exports to Chile,

⁴⁷ See Appendix E, Table E2.

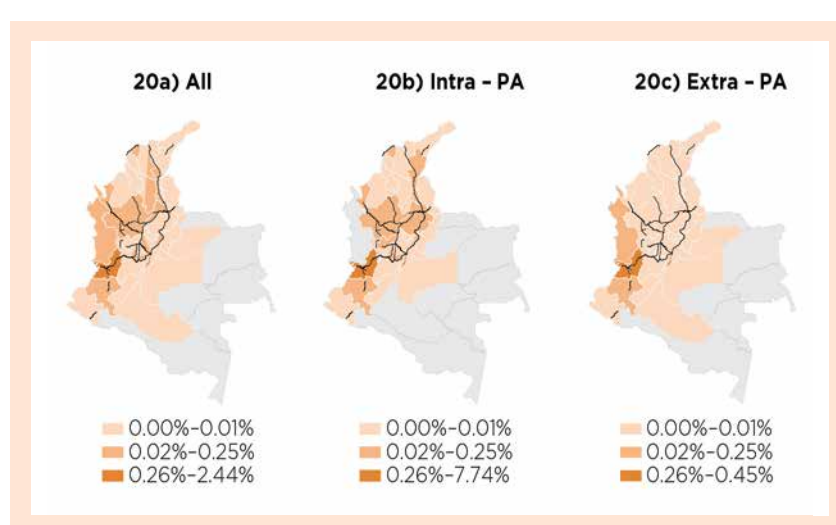
FIGURE 19/
Impact of Road
Investments on
Colombian
Exports: Rest of
the World and
PA Destinations



Source: authors' own calculations using coefficients reported in Table D1, column (8).

Note: simulations as structured in Appendix F.

FIGURE 20/
Impact of Road
Investments on
Colombian
Regional Exports:
PA and Rest of the
World Destinations



Source: authors' own calculations using coefficients reported in Table D1, column (8).

Note: simulations as structured in Appendix F.

⁴⁸ Probability increase obtained by taking the average over the results reported in columns (1)-(3), Figure 21b.

Mexico, and Peru by 1.2%, 0.7%, and 1.1%, respectively; the equivalent to exporting 16, 11, and 23 new products, respectively. In comparison, the number of products exported to the rest of world would increase by just 44 new products. As to the probability of exporting, the investment plan would produce an average improvement of 0.96% (Figure 21b).⁴⁸

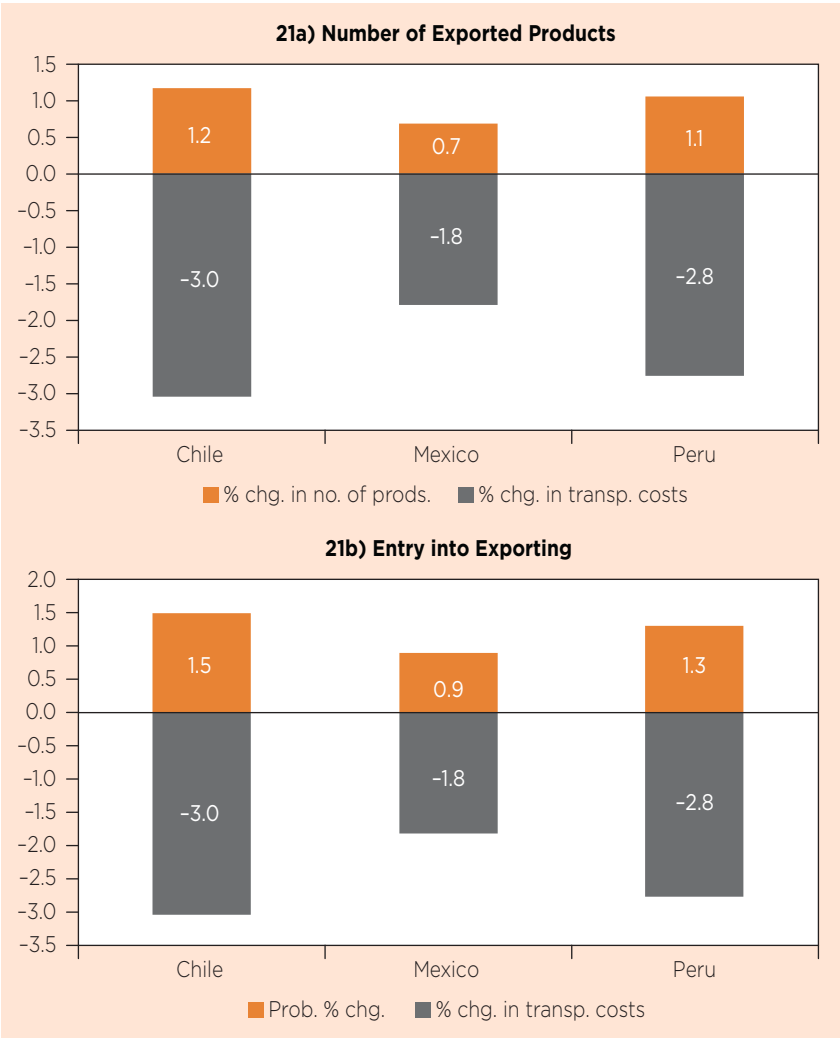


FIGURE 21/
Impact of Road Investments on Product Diversification and on Entry into Exporting for Colombia: PA Destinations

Source: authors' own calculations. Figure 21a uses the coefficients reported in Appendix D, Table D5, column (4). Figure 21b uses the coefficients reported in Appendix D, Table D7, column (4).
Note: simulations as structured in Appendix F.

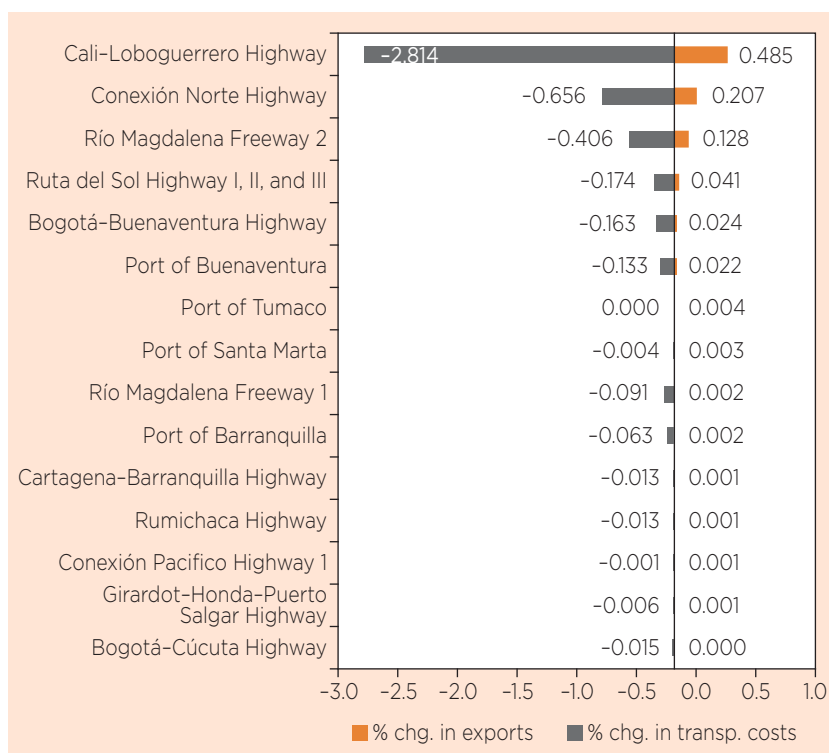
In terms of projects, the simulations suggest that the top four projects—the Cali-Loboguerrero Highway, the Conexión Norte Highway, the Río Magdalena 2 Freeway, and the Ruta del Sol Highway (sections I, II, and III)—would explain 78% of the plan’s export gains (Figure 22).⁴⁹

Mexico. The selected investments in transportation infrastructure are expected to reduce transport costs by 1.4%, which would translate into a total increase in exports of 0.04% (Figure 23).⁵⁰ Taking 2012 as a base

⁴⁹ Provided that the top three projects equate to an average net percentage increase in exports of 0.26% (see Figure 22); $0.78 = 0.26/0.34$, where 0.34 is obtained from the results reported in Figure 19.

⁵⁰ See Appendix E, Table E3.

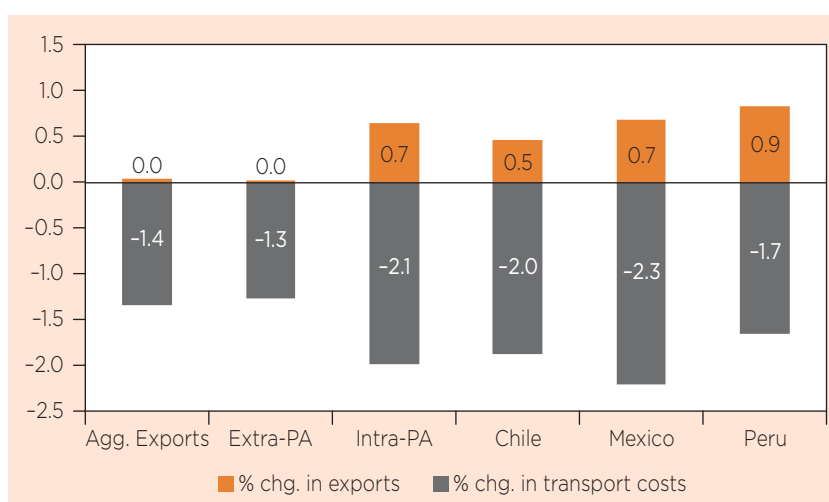
**FIGURE 22/
Ranking of
Colombia's Projects
by Aggregate
Effect on Exports**



Source: authors' own calculations using the coefficients reported in Table D1, column (8).

Note: simulations as structured in Appendix F.

**FIGURE 23/
Impact of Road
Investments on
Mexican Exports:
Rest of the
World and
PA Destinations**



Source: authors' own calculations using the coefficients reported in Table D1, column (8).

Note: simulations as structured in Appendix F.

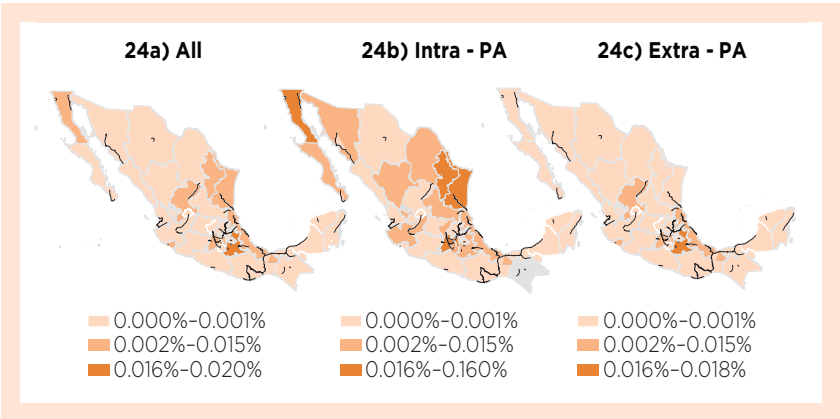


FIGURE 24/
Impact of Road
Investment on
Mexican
Regional Exports:
PA and Rest of
the World
Destinations

Source: authors' own calculations using the coefficients reported in Table D1, column (8).
Note: simulations as structured in Appendix F.

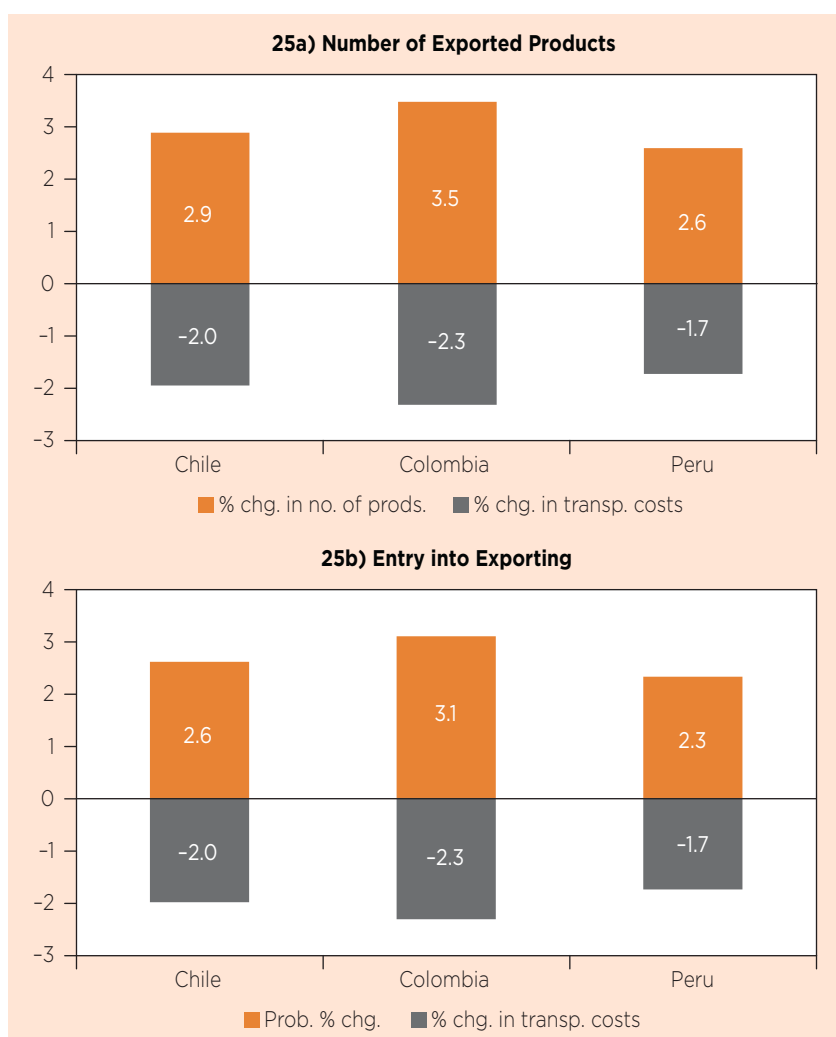
year, this would be equivalent to a permanent increase in exports of US\$ 93.7 million. Though the net aggregate increase in Mexican exports would mainly be driven by the increase in exports to destinations outside the PA, it should be noted that the percentage increase in exports to the PA is 0.65 percentage points higher than the percentage increase obtained when exporting to destinations outside the PA. As reported in Figure 23, columns (4)–(6), exports to Chile, Colombia, and Peru would increase by 0.5%, 0.72%, and 0.88%, respectively.

Regionally, the execution of this investment plan would favor the export participation of less developed municipalities. While the aggregate regional increase in exports seems to favor the states of Baja California, México, Nuevo León, Tamaulipas, and Puebla (Figure 24a), the intraregional export gains favor the poorer departments (Figure 24b). Clearly, the effect of regional convergence on exports is strictly linked to the location of the infrastructure projects.

As with the other PA countries, part of the export gains would be driven by an increase in the number of products exported. Figure 25a, columns (1)–(3), show that Mexico would increase the number of products it exports to Chile, Colombia, and Peru by 2.9%, 3.5%, and 2.6%, respectively; the equivalent of 68, 57, and 43 new products, respectively. Extraregional exports would see an increase of 135 new products.

In addition, improving the road network would have a positive impact on each municipality's probability of exporting. As reported in Figure 25b, columns (1)–(3), it is estimated that the plan would boost this probability

FIGURE 25/
Impact of Road
Investments on
Product
Diversification
and on Entry into
Exporting for
Mexico.
PA Destinations



Source: authors' own calculations. Figure 25a uses the coefficients reported in Table D5, column (4). Figure 25b uses the coefficients reported in Table D7, column (6).
 Note: simulations as structured in Appendix F.

by 2.68%.⁵¹ In terms of projects, our simulations suggest that the top two projects—the Mexico-Toluca Freeway and the Atizapán-Atlacomulco Highway—would account for most of Mexico's export gains (Figure 26).

Peru. The selected investments in transportation infrastructure would bring an average reduction in transport costs of 5.9%, creating the conditions for a 1.18% increase in exports (Figure 27).⁵² This would be equivalent to a

⁵¹ Probability increase obtained by taking the average over the results reported in Figure 25b columns (1)–(3).

⁵² See Appendix E, Table E4.

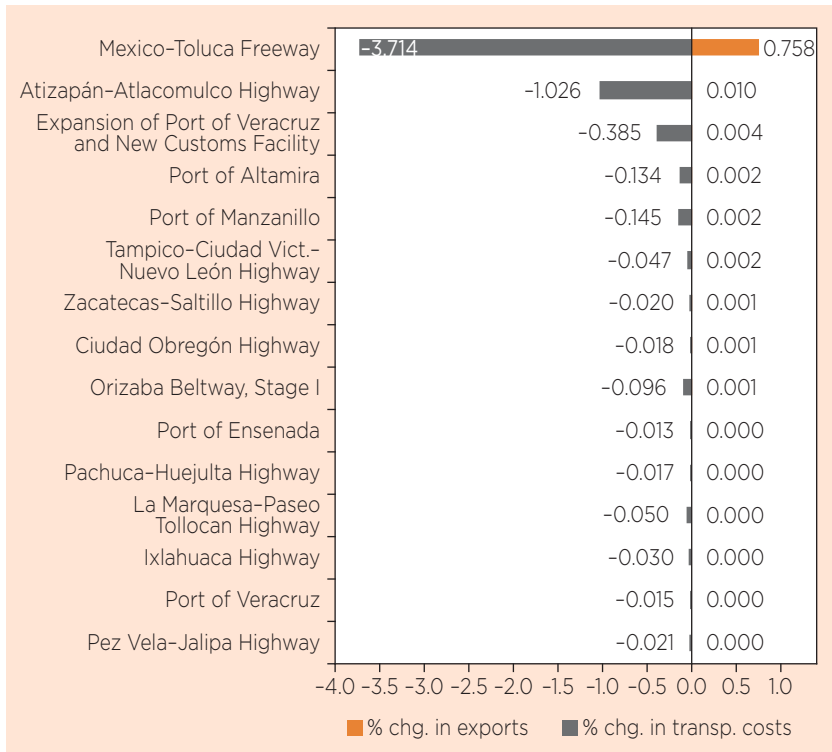


FIGURE 26/
Ranking of Mexico's
Projects by
Aggregate Effect
on Exports

Source: authors' own calculations using the coefficients reported in Table D1, column (8).

Note: simulations as structured in Appendix F.

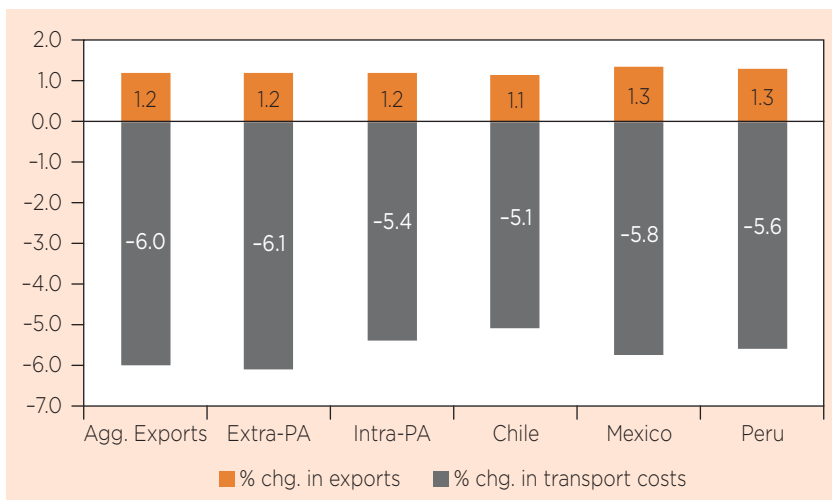
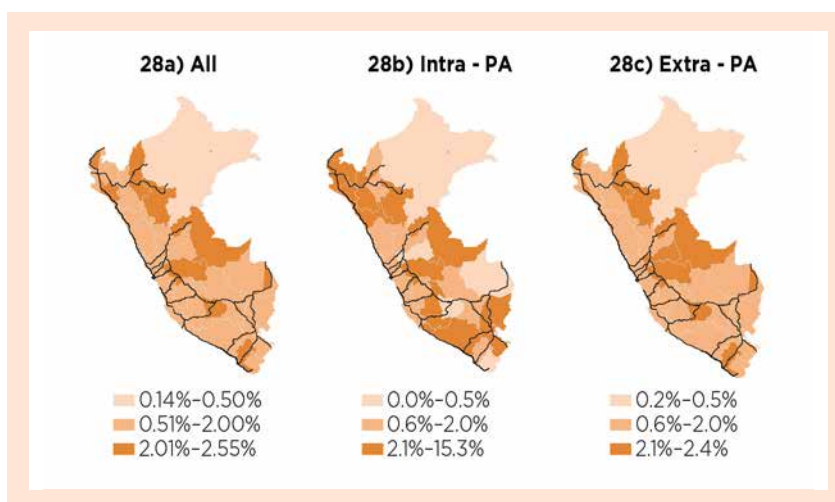


FIGURE 27/
Impact of Road
Investments on
Peruvian Exports:
Rest of the World
and PA Destinations

Source: authors' own calculations using the coefficients reported in Table D1, column (8).

Note: simulations as structured in Appendix F.

**FIGURE 28/
Impact of Road
Investments on
Peruvian Regional
Exports: PA and
Rest of the World
Destinations**



Source: authors' own calculations using the coefficients reported in Table D1, column (8).

Note: simulations as structured in Appendix F.

permanent increase in exports of US\$ 526.7 million based on 2012 figures. Even though this gain would be mainly driven by extraregional exports, exports to the PA would grow 0.03 percentage points faster. As reported in Figure 27, columns (4)–(6), exports to Chile, Colombia, and Mexico would increase by 1.13%, 1.34%, and 1.3%, respectively.

Regionally, the execution of this investment plan would favor the export participation of municipalities located in less developed areas (Figure 28a). Extraregional exports would benefit particularly the Selva and Sierra regions, whereas intraregional exports seem to potentially favor a broader spectrum of departments, including less developed municipalities in the coastal region (Figure 28b).

Part of these export gains would be driven by an increase in the number of products exported to Chile (4.5%), Colombia (5.1%), and Mexico (4.9%), equivalent to 78, 72, and 37 products, respectively. There would also be diversification gains in extraregional exports, with 156 new export products. These investments in the road network would also increase each municipality's probability of exporting by 0.86% on average.⁵³ In terms of projects, the simulations suggest that the top three—the Pativilca-Trujillo Highway, Highway Network 4, and the Ica-Chilean Border Highway—account for 17% of all export gains (Figure 30).⁵⁴

⁵³ Probability increase obtained by taking the average over the results reported in Figure 29b, columns (1)–(3).

⁵⁴ Provided that the top three projects equate to an average net percentage increase in exports of 0.205 (see Figure 30); with $0.173 = 0.205/1.18$.

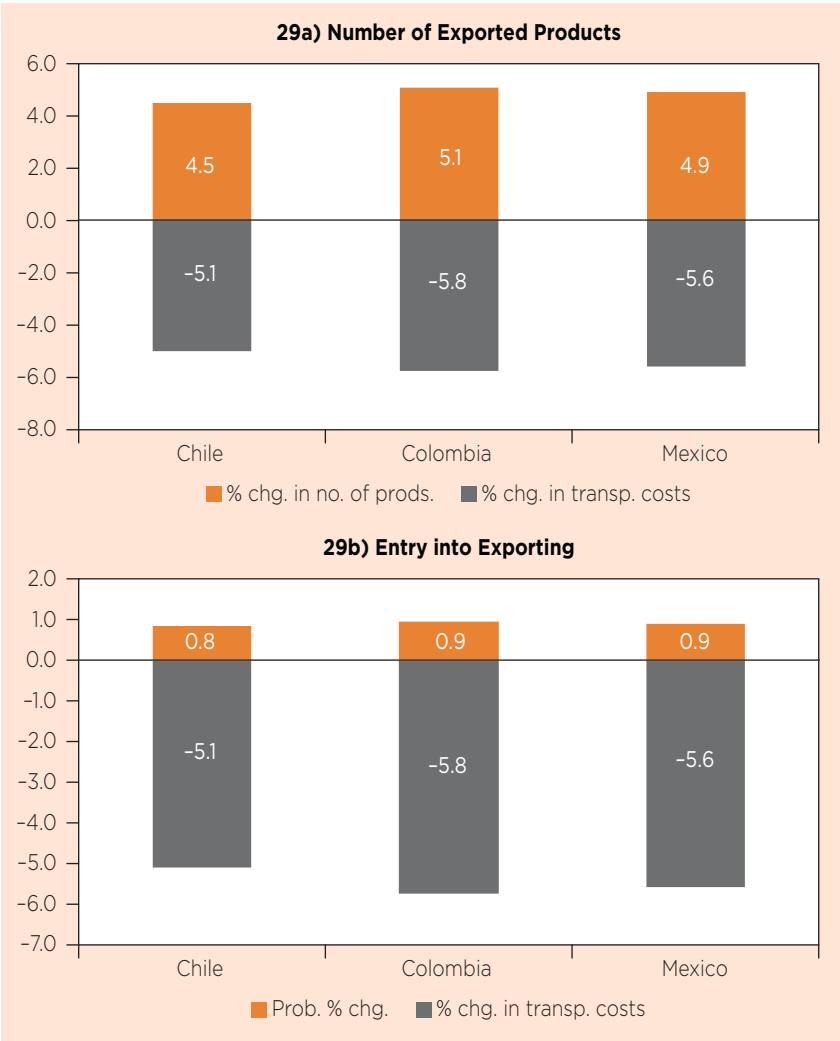
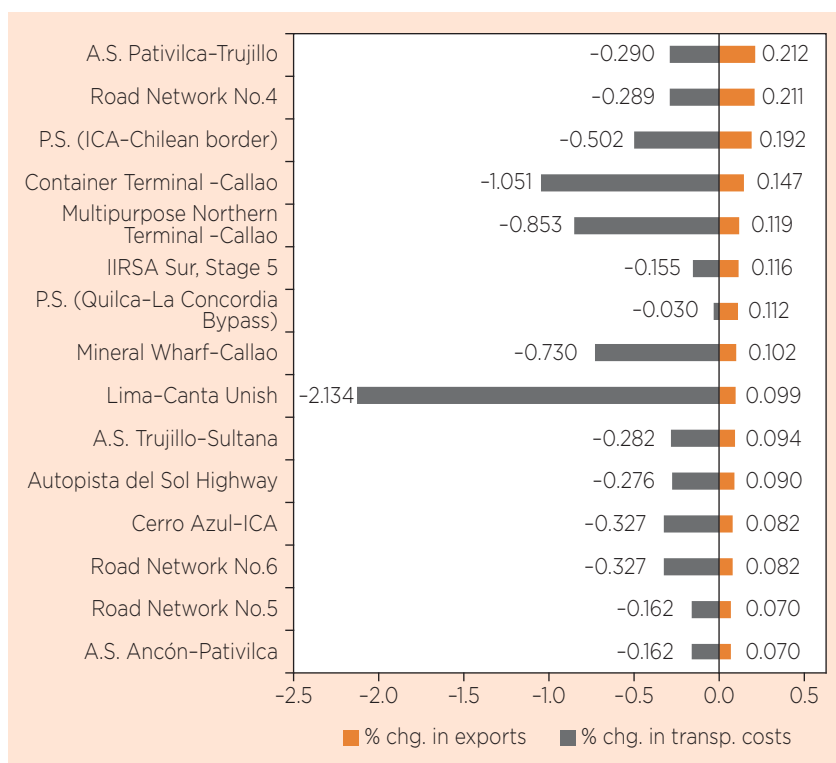


FIGURE 29/
Impact of Road Investments on Product Diversification and on Entry into Exporting for Peru: PA Destinations

Source: authors' own calculations. Figure 29a uses the coefficients reported in Table D5, column (4). Figure 29b uses the coefficients reported in Table D7, column (8).
Note: simulations as structured in Appendix F.

**FIGURE 30/
Ranking of Peru's
Projects by
Aggregate Effect
on Exports**



Source: authors' own calculations using the coefficients reported in Table D1, column (8).

Note: simulations as structured in Appendix F.

Conclusions

The launch of the PA negotiations in 2011 raised great expectations not only because of the potential integration gains that could derive from the project, but also because its more realistic, pragmatic, and market-oriented architecture offers a clear way out of the predicaments that have beset other ambitious integration initiatives in LAC.

The leaders of the agreement were also very careful in managing these expectations, acknowledging that even though intraregional trade gains are likely to be significant, they are bound to be dwarfed by what can be gained by expanding the bloc's trade with the rest of the world, particularly with Asia. Likewise, they were quick to acknowledge that eliminating tariffs is not enough to fulfill the bloc's integration potential. As it has been argued elsewhere, the prohibitive costs arising from a dysfunctional transportation infrastructure and cumbersome customs procedures are today by far the most important obstacles to trade in the region.⁵⁵ These costs matter not only because they hold back trade flows, but also because they limit the gains from trade to a handful of wealthy and well-connected municipalities and regions.

Uncharacteristically for a region with no shortage of empty rhetoric, the PA leaders went beyond declarations of intent and took immediate action by setting up an infrastructure fund to address both these concerns. This step sets the PA apart from virtually all other FTAs in LAC, which have been slow to put transport costs at the top of their agenda.

The importance of making funds available can hardly be overestimated, but the PA leaders will face another formidable challenge: as elsewhere in LAC, there is not enough data or policy analysis to guide public investments in trade-related infrastructure. This study sought to make a modest contribution to closing this gap. It uses economic theory and a unique georeferenced database of municipal origin, route, transport costs, and destination of exports from Chile, Colombia, Mexico, and Peru to estimate the impact of transport costs on intra- and extraregional exports, down to the detail of specific infrastructure projects.

The results confirm the expectation that trade flows in the PA are highly sensitive to transport costs, with a 10% reduction in these raising municipal exports by between 13% in Mexico and 45% in Chile. They also show that

⁵⁵ Moreira, Volpe, and Blyde (2009), and Moreira, Blyde, Volpe, and Molina (2013).

it is possible to incorporate this dimension of trade into the assessment of infrastructure projects. A simulation exercise using a sample of key PA transportation projects points to positive impacts on both intra- and extraregional exports, but there is considerable variance across countries and projects, and, in general, the results are considerably more modest than the aggregate elasticity figures mentioned above might suggest.

At least three groups of factors come into play here. First, the size, geographical distribution, and nature of the investments in the exercise matter, and they vary considerably across countries. For instance, investment in the exercise focusing on Mexico is equivalent to 1.2% of the country's GDP, whereas in Peru it reaches 6%. Geographical distribution also plays a part—investments concentrated in a small number of municipalities, particularly if they barely export, are likely to see smaller impacts at the aggregate level. Likewise, the nature of a given project might mean that it does not translate into significant savings in transport costs, thus dampening its potential impact on exports.

Second, due to data availability and methodological limitations, the exercise focused on the impact on municipalities that already export. As suggested by the positive impact on the probability of exporting, lower transport costs could prompt non-exporters to enter international markets, but since neither the potential products nor routes could be observed, these “second-order” gains were not factored into the projects' overall results. It can be argued, then, that what is being estimated is a lower bound for the export benefits these projects may offer.

Third, data on domestic and international transport costs and on the savings in transport costs for each project could definitely be improved, particularly the former, since none of the PA countries systematically monitors domestic or international freight rates.

Even with these qualifications in mind, the simulations throw considerable light on an area which tends to be overlooked by both transportation and trade officials. For instance, they raise questions regarding how far the current PA infrastructure plans go in addressing the trade dimension. They show that in all countries, export gains are mainly driven by destinations outside the PA, but that intra-PA exports stand to gain the most. They reveal that, with the exception of Chile, the current infrastructure plans are likely to diminish subnational export disparities, though only modestly. None of these insights could be seen through traditional project evaluations.

In conclusion, it is worth mentioning that “hardware” investments are just one of the tools available to policymakers to address the transport costs of trade. Regulatory reform to raise competition in cargo shipping, for instance, is another promising area, one which does not require as many financial resources. Here too, there is a clear need for more data-driven policy analysis.

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