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Incorporation of Services into Natural Resource-Intensive Goods: description and measurament of the phenomenon

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Index of sections

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1. INTRODUCTION

The trade pattern specialization of many Latin American countries (mainly in South America) shows why these countries play a key role in the world market of a basket of goods, which are intensive in the use of natural resources (in particular mining and food). This is not new, it is rather a permanent characteristic of the international insertion of this region in the world. The long tradition of these sectors also implies a huge accumulation and learning experience on how to intensify in a sustainable way the exploitation of this type of resources.

In particular, the last stage of development, characterised by an important process of technical change in natural resources exploitation, has been very relevant. The market size provides a sufficient scale for incorporating service-related activities (specialised knowledge business services – KIBS) and through this mechanism it creates new types of trade specialisation patterns.

The servicification process can be widely defined as a business strategy that entails a shift from pure manufacturing to the production of goods and services. The term can be traced back to Vandermerwe & Rada (1988). One of the consequences of this phenomenon is for national systems of economics statistics: if manufacturing firms increasingly become services providers, then figures potentially involve errors and omissions. At the level of firms, many of them have been undertaking such a path, mainly as a response to increased competition in their original product markets. This is the case, for example, of IBM which turned from being a manufacturer of computers to a supplier of a whole range of system business solutions (Ahamed et al., 2013), or the case of Rolls Royce that changed from being an airplane engine supplier to a supplier of "power-by-the-hour", i.e., their customers firm a contract through which Rolls Royce ensures engines functioning all

along the year by supplying the proper maintenance. In Latin America we also find evidence of servicification where, by incorporating specialized services, some traditional natural resources may upgrade in value chains. In particular, we can mention some examples of KIBS around seed innovation in Argentina and Brazil, the salmon industry in Chile or cattle traceability in Uruguay.

The incorporation of services into commodities ("servicification") is a complementary approach to their industrial processing, e.g. the more traditional use of logistics, transportation, communications, etc. in the production of goods. Both strategies yield simultaneous benefits in terms of employment creation, technical progress, product diversification and quality improvement. However, policy recommendations may be different for each of them. Indeed, while traditional services associated to the production of goods (infrastructure, logistics, communications, insurances, etc.) may have a role on job creation and overall economic activity, servicification may also define new paths of sustainable growth in a highly integrated world. As mentioned above, services also play a key role in the technological upgrading of value chains created in or around natural resources.

How do services can add value to the production and exports of natural resources intensive goods? Incorporating services into the production of goods allows for both the differentiation and consolidation in accessing new markets, as well as to generate an increment in the domestic value added, with higher contents of skilled labour. This is a productive strategy that can achieve similar results in terms of creating greater domestic employment compared to conventional alternatives that focus on increasing production levels and industrial processing. Increasing domestic value added through services incorporation is particularly relevant for natural resources-intensive goods (NRIG), as these products dominate the export baskets of Latin American countries, especially those in South America.

The main objective of the paper is to link the servification literature in the manufacture sector to the NRIG case.

The document is organized in this introduction and four more sections. In section 2 we provide a brief review of the literature, considering topics such as the transformation of the global pattern of specialization, the servicification concept and the impact in the trade policy agenda. Section 3 identifies a set of products and countries for which we analyse specialized production services (innovation, upgrading, etc). Section 4 develops a sectoral

approach using input-output tables (IOTs) to measure the relevance economic infrastructure services (EIS) have in the competiveness of NRIG. Finally, section 5 concludes with the main remarks of the paper.

2. BRIEF REVIEW OF THE LITERATURE

2.1 Fragmentation of economic activities

The most recent phase of the globalization process has led to a deep transformation in the international economy. One of the main characteristics is the permanent increase in both the intensive and extensive margins over the tradability of economic activities (goods and services). One of the sources behind this phenomenon is the acceleration of technical change in information and communication technologies (ICTs), together with a general reduction in trade costs (transport costs and other distance-related costs, plus trade policy variables), facilitating the fragmentation of production at a world scale with an increase in trade specialization.

The different stages of productive processes are now spread over different national jurisdictions. A new international division of labor has been emerged, that new international trade theory names as trade in tasks (Grossman and Rossi-Hansberg, 2006). This process started in the modern manufacturing sector (transport equipment, electronics, optic machines, chemical and pharmaceutics) but is now extended to other economic activities (in particular services). Trade in intermediate goods and business services was traditionally relevant in international trade (Sturgeon and Memedovic, 2010). The channel of circulation was import of intermediate activity to the production of final goods to the domestic market (I2P in Badlwin (2013) terminology). However, a new phenomenon grew significantly over the last three decades: imports of intermediate to export to foreign markets (I2E). So, trade in intermediate inputs is playing an increasing role in explaining aggregate trade flows (Hummels and Klenow, 2005). The same phenomenon happens with services oriented to satisfy demand of inputs in the production process (production services). Trade in intermediates is also an important channel through which technology is transferred from develop to developing countries. Amity and Konings (2007) show that imports of intermediates and capital goods may improve firm productivity.

The process of production fragmentation has initially started in the automotive industry, where the production of inputs in specialized and independent units of production was realized outside the car factory (outsourcing). Then this dynamics expanded to the outsourcing of services activities. The outsourcing inside a domestic jurisdiction is then expanded to the international level through international trade (offshoring). The reduction in international trade costs and coordination costs are main drivers of this process. Miroudot et al. (2009) provide a characterization of the internationalization of intermediates supply taking into account two dimensions: activity location (domestic vs. foreign country) and ownership (inside or outside the firm). Overall, the intense technical change in telecommunications and information technology are one of the main drivers of this phenomenon.

2.2 Servicification

Services are at the core of these new fragmentation phenomena as they have incremented their participation in world trade. Nowadays trade in commercial services –only considering current account Balance of Payments data- represents more than 20% of world trade, however if trade is measured in value added this figure achieves half of world trade (Escaith, 2008).

The conventional theoretical approach associates services to low rates of innovation and a low productivity path. In particular, this applies to services that satisfy final demand, which also gradually increases its weight in total expenditure. Examples of these services are typically haircuts, automotive repairs, travel and tourism, or personal services such as day care, laundry or the like. This sustains the prediction of stagnation in total productivity ("Baumol disease" and Balassa-Samuelson effect). However, the changes we are here describing challenge this conclusion and give a very different picture (Hoekman and Francois, 2010). First, services associated with production as intermediate inputs increase its productivity and so the set of the others activities which they are related to by intersectoral linkages. Second, many services associated with final demand changed positively its pattern of innovation and productivity, influenced by the same fundamentals, i.e. the ICT revolution.

The Kaldorian tradition claims that growth is related to the size of the manufacturing sector because it is associated with its positive externality over technological change and the productivity path (through different explicit and implicit mechanisms). However, there is evidence that things are changing. Di Meglio, Gallego, Maroto and Savona (2015) highlight three elements:

i. Evidence of "premature deindustrialization" of many developing economies[4] in a context of good growth performance.
ii. The tradability of services has progressively increased and value chains of production have globally expanded.
iii. High productivity gains are being experienced by certain services branches.

The authors complement the idea with the following statement: "*Facing the old ideas with the new facts, our research hypothesis regards whether some specific service sectors may be a source of economic growth in developing countries. Potentially, those services embodying knowledge and technology or with strong inter-industry linkages or highly tradable may serve as a mean to catching-up with advanced economies by complementing/replacing manufacturing as an additional/new engine of growth in developing countries*".

It is important to differentiate between services associated with final consumption and services as intermediate inputs. The trade in tasks phenomenon is mainly associated with the latter, which are those demanded as inputs by other production processes. The disentanglement process to be feasible requires an intensification in the use of services sectors mainly in the form of production specialized services. The fragmentation of production needs standardization and imply an intensive use of information technology which are associated with the development of production specialized services

The result is an increase in the intensity in the use of specialized production services that participates as an intermediate input in many different activities and types of firms. The empirical evidence goes from small firms to large multinationals, and from basic and food industries to the engineering industry. Three main factors explain this outcome in manufacturer products (Lodefalk, 2015):

[4] "*The share of manufacturing in employment and value added is shrinking at levels of income per capita that are much lower of those at which the advanced nations began to de-industrialize*" (D&G&M&S, 2015).

i. Services is a relevant factor to the increment in productivity, in particular through the use of services in logistics, management or engineering that save time, materials and improve coordination (Nordas, 2010 quoted by Lodefalk,2015). Also these services are more intense in the use of skilled labour, which means the ability to absorb technical change is higher than in other sectors, with positive effects in terms of productivity.

ii. Adding services to goods can also be a profitable strategy: firms may differentiate their supply (augmenting their value) by bundling services with products, or offer them in connection to their sales. Doing so, it will be easier for them to deal with the increasing international regulation on environmental and social issues. Many different types of barriers to trade require diverse types of certification that are associated with specialized services. With this strategy the firms fulfil the norm and obtain a certification that is crucial to jump the trade barrier.

iii. Manufacturing firms need services to establish, join and manage international production networks and value chains, including headquarter or business partner services such as data processing and R&D services (Kelle, 2013 quoted by Lodefalk, 2015). All of them are associated with the coordination cost dimension related to the process of fragmentation of production in many different stages (Grossman and Rossi-Hansberg, 2012).

At the level of the firm the process of servicification could have different types of origins. Many times innovative manufacturing firms develop the process of some specialized service activity that will eventually become another source of income for the firm (maybe the main one). It could also happen that a firm outside the manufacturing sector specializes on providing a particular specialized service.

However, the capacity of penetration of new technologies in all kind of activities is one of the main drivers of the transformation of production functions all over the world. This means servicification may be possible in many different activities and not only in dynamic manufacturing sectors[5]. In particular, this paper focuses on the identification of the phenomenon in the case of natural resources-intensive goods (NRIG). This last phenomenon is really relevant for South American countries. The fundamentals of the

[5] The literature does not give too much attention to those others cases. For other examples in maturate industries (textile and apparel, footwear, food industry, etc.) see Cattaneo, Gereffi yStaritz (2010).

servicification process are the same of the just reviewed for the case of manufacturing products, but with different highlights depending of the type of sector.

Arbache (2015) proposes a classification of services in two groups based on their role as inputs in the manufacturer sector:

i. Specialized production services. It includes value and innovation services, and refers to functions that contribute to adding value, differentiating and customizing products and, therefore, raising their market price and increasing labour and global productivity and the return on capital[6].
ii. Cost services. It refers to activities that affect production costs through the use of economic infrastructure services (logistics and transportation, general infrastructure services, financial services, etc).

We apply the typology to the case of NRIGs. For the first type of services, in section 3, we present a summary of a previous paper (Vaillant, 2015) and for cost services we develop and apply a methodology of value added services contents in commodities exports in a selected set of South American countries (section 4).

2.3 Trade policy impacts

In coherence with the globalization of service production, it is possible to observe a process of expanding the scope of trade rules and topics in different types of trade agreement covering services activities[7]. Typically, services are a non-tradable and so regulations are established on a domestic perspective, i.e. covering national jurisdictions. When trade increasingly involves services activities the demand for new international rules and the treatment of related topics also increase.

All these phenomena have an impact on the international trade policy agenda, which is usually dominated by market-access issues. How much access in my own market should be provided in order to get better access conditions in the neighbors' market? The

[6]Usually composed of services that require relatively high levels of human capital (R&D, design, engineering and architecture projects, consulting services, software, specialized technical services, high-end IT services, branding, marketing, trading, among others).

[7]There are 120 preferential trade agreements in services notified to the WTO and actually in force. Almost all of them covers also goods and complementary matters, which shows through international agreements and disciplines the linkages between them.

fragmentation of international economic activity has strengthened the link between protection of one's own market and foreign market access conditions. Baldwin and Nicoud (2008) have pointed out that this is good news from the perspective of expected results related to the endogenous mechanisms of trade liberalization. The more it is perceived that reducing own barriers will also reduce the neighbor's barriers, the more open unilateral domestic trade policy will be. This mechanism seems to have started gradually acting in the trade of goods and particularly in certain manufacturing sectors that tend to converge to a trade of "zero tariff for zero tariff". However, a negotiating effort is required to get improvements in some markets characterized by deeper distortions (certain sectors of agriculture and manufacturing, services, complementary matters).

A by-product of the globalization process is that the range of economic activities in the international economy expands the subjects that require consideration in trade agreements. The adaptation speed in the multilateral arena is structurally low. Countries are less willing to establish rules on the basis of Most Favored Nation (MFN) than within the framework of Preferential Trade Agreements (PTAs). Hence the demands to expand and deepen negotiations in new topics have been channeled through the phenomenon of the proliferation of PTAs. The content of commitments and topics in the international trade negotiations agenda between national jurisdictions has widened: from the trade of goods to the trade of services, as well as to the mobility of some production factors. At the same time, the field where compromises are achieved has exponentially multiplied: bilateral agreements, plurilateral agreements, agreements between groups of countries, extension of agreements.

For a diagnosis of what is happening it would be necessary to build a large (and complex to build) matrix of information that combine the fields of commitment (columns of the matrix) with its themes or contents (rows). The biggest threat that looms over the international trade system is the consistency, applicability and use of the established set of rules. In terms of the previously mentioned matrix, it is possible to verify that what is committed in a certain "line" is different and often difficult to translate in what is committed in another, not to mention the case of rules being frankly inconsistent. It is necessary to find issues that enable a systematic approach to this problem, as to apply a methodology that is plausible of being applied and then replicated to other themes. This is one of the biggest challenges that the global system of international rules needs to deal

with: how to incorporate an extended set of production activities (goods and services) in a coherent framework.

Latin American countries have a very different perspective related to the new trade agenda. In the Pacific side almost all countries sign trade agreements that include rules and disciplines in services and complementary matters (investment, government procurement, property rights, competition policy, among others). In countries of the Atlantic side the new trade agenda is practically out of the coverage of trade agreements.

Considering the new specialization phenomena that we contribute to identify in this paper, in the near future the role of the services sector will be seen as an essential topic of the trade agreements negotiations agenda. Given the heterogeneous nature of this sector, which as we mentioned before includes final demand services but also specialized production services, domestic trade policies should take a differentiated approach.

Besides trade policies, these new developments call for renovated public policies for the development of specialized service providers that add value to natural resources, or increase its productivity capacity through innovation activities in a sustainable way. Traditionally, public policies for both the service sectors and the NRIGs are designed without any link, and its implementation is frequently in charge of different government agencies. The new phenomena imply a challenge to associate and to integrate different sectors in policies and regulations, new institutions, trade agreements, specific incentives, and specialized education at the technological and university levels.

3. PRODUCTS, COUNTRIES AND SPECIALIZED PRODUCTION SERVICES

3.1 Identification of products and countries

The specialization pattern of South American countries is concentrated in NRIG (Vaillant, 2015), and the region's insertion in the international economy is limited to a small set of goods: only 52 products account for 70% of total exports[8]. The region has actually the highest rate of concentration of the first decile in the average period 2009-

[8] COMTRADE, Harmonized System at 6 digits (second edition).

2012 compared to other regions of the global economy. Almost all goods in the first decile are NRIGs, the share of manufacture products is very low. Moreover, the set of products with revealed comparative advantage is also reduced: less than 500 products, which is much less than the world average of 800 products (Vaillant, 2015). In conclusion South American countries are economies with very low level of diversification in the exports of goods. As we shall see later this is both a problem and an opportunity.

Table 1
Selection of products and South American countries in dynamic worlds markets
(Millions of USD and %)

HS2	Name of the product	Exports 2009-2012		
		South America (millions USD)	Market share (%)	South American countries with highest index of RCA
a) Food and raw materials				
20721	Chicken meat frozen	2548	66	Brazil; Argentina
150710	Soya crude oil	6479	65	Argentina; Paraguay
230400	Soya oilcake	15872	62	Argentina; Paraguay
170111	Cane sugar	10087	51	Brazil
120100	Soya beans	21017	47	Paraguay, Brazil
90111	Coffee	9123	44	Colombia
80300	Bananas	3961	36	Ecuador
20230	Bovine meat boneless	5033	35	Uruguay; Paraguay
240120	Tobacco	3173	32	Argentina; Brazil
80610	Fresh graves	2099	30	Chile
220710	Ethyl alcohol	1778	29	Brazil
100590	Maize	6887	25	Argentina
170199	Other sugar	3639	23	Brazil
b) Minerals				
720293	Ferroniobium	1483	75	Brazil
261610	Silver	1593	57	Bolivia, Peru
260300	Copper	23086	48	Chile, Peru
740311	Copper cathodes	24656	38	Chile
260112	Agglomerated iron	7890	33	Brazil
260700	Lead	2066	29	Peru
260111	Non agglomerated iron	26484	28	Brazil
720712	Iron and steel	3020	19	Brazil

Source: see Vaillant, 2015.

The literature mentions many problems related to being specialized in a reduced bundle of commodities: risk of exposures of terms of trade volatility; reduced inter linkages with other sectors of the economy; low productivity path, among other elements. However, the opportunity is associated with the scale and the relevance of the region in these markets

combined with the evidence of intense technological transformation in the goods intensive in the use of natural resources. As we are going to illustrate later, all this transformation follows the path previously characterized as the servicification process, despite the level of servicification does not get to the levels seen in the developed world.

There is a main methodological problem to study this phenomenon. It is not possible to obtain consistent datasets of services embodied in commodity production. In fact, considering the characteristics of the data it is not possible to identify independent sector of services oriented to the NRIG. Usually the activities of this type of services are accounted together with the primary sector.

Our methodological approach to study the phenomena must start with an identification of the set of NRIG. Which are the products and countries that have some characteristics that make possible to conjecture that the servicification process is present or could be developed? Vaillant (2015) defines a set of indicators that must be taken into account: the revealed comparative advantage (RCA) index; the size of exports market and dynamic evolution both related with own and international supply. In Table 1 the chosen set of products are presented. All selected products fulfil the condition to increase participation in world trade and South American exports in the reference period (Vaillant, 2015).

A clear regional pattern emerges from the information of Table 1. The Atlantic countries of South America are specialized in a basket of products mainly composed by food commodities, whereas in the Pacific–side countries minerals prevail. Brazil shares with the latter the fact of being an important and specialized exporter of iron products.

3.2 Specialized production services in NRIG

The focus is on the presence and development of specialized production service providers for natural resource sectors linked to exports of commodities. In this category we also include technology services that are not necessarily associated to the incorporation of value but to the innovation in the technology of production of the natural resources, which makes them important in the global sustainable productivity process. All these types of services are commonly knowledge intensive business services (KIBS) that were first defined in the servicification of manufactures literature.

For the analysis of specialized production services (innovation and value services) we propose to use secondary information to systematize the data and to know the types of relevant services associated with each particular product (see Vaillant, 2015). The objective is to construct a matrix with the products in the rows and the characteristics of the specialized production services in the columns. This methodology was applied to a set of seven cases (four in agriculture, two in the fish sector, one in minerals) that are available as they are recently presented in an academic Congress, which took place in Montevideo[9]. This set of cases is not a representative sample of all the commodities of the region. However, almost all the revised cases are in the set of products we identify in subsection 3.1 based on the analysis of trade data. The cases are useful to illustrate the type of services and the main mechanisms associated to their development.

The results are presented in Table 2. In the four first columns we identify the country, the sector, the product and the main definition of the particular phenomena under study. The cases show the incorporation of specialised production services (mainly in the class of KIBS) to upgrade the NRIG and/or to change its sustainable global productivity.

This topic focused into how the incorporation of specialized services in the value chain of natural resources can improve the intrinsic (product) and extrinsic characteristics of commodities and how these can increase their differentiation potential in the world market. Two types of specialized production services are identified. First different types of international and domestic regulation triggered new services that are ultimate used to increase value in each of this type of services. For example in the meat and in the fish sector a set of environmental and technical quality standards and certifications, branding, and marketing are observed. All of them are associate with the development of specialized productions services.

The second alternative is to focus on the role of innovation in natural resource sectors and its global productivity performance. This is the case presented in cereals, oleaginous, and agriculture seeds. In the nineties there was a major technological change in their production that was associated to a large diversification process in different stages of production. This, in turn, was associated to the development of different specialized production services. In this new framework, the traditional agriculture producer was

[9] IV REDLAS CONFERENCE, SERVICES, NATURAL RESOURCES, TRADE POLICY and TRADE PATTERNS IN LATIN AMERICA 27-28 May 2015, Montevideo, Uruguay Local organisers: dECON, FCS, UdelaR, ORT University International: ECLAC, IADB, UNCTAD, In cooperation with Zonamerica and Smart Services Uruguay XXI.

replaced by an agricultural firm, which coordinated production through a set of contracts with different type of firms (mainly services production firms). The hard core of the change are sophisticated biotechnological firms who are responsible for the production and improvement of new seeds which embodied KIBS.

In the case of copper there is a similar phenomenon, but in this case it is the pressure over natural resources the factor that provides the incentives for the development of different types of related services. In particular, the need to increase efficiency in production and to solve environmental problems associated with over production are among the main causes of the servicification process.

In both the cereals and copper cases, many of these specialized production services have matured in the domestic market, and they could achieve a level of competitiveness that permits to make countries direct exporters. However, until now this phenomenon is still in process: the highest level of internalization of KIBS in NRIG is just medium and oriented to regional markets (agriculture and minerals).

The starting point of the NRIG servicification process is the huge scale of those regional markets in an international comparison. In fact, more than a half of the global supply comes from South American countries (Vaillant, 2015). Traditionally this specialization is considered an advantage for the industrial transformation; however the specialization pattern path shows that servicification could also be an alternative to:

i. increase value added with sustainable international insertion that could fulfil the dynamic requirements of the world markets;
ii. change the productivity performance of the set of commodities exported by regional countries facilitating the process of technological transformation.

Summarizing, the large scale of regional markets in NRIG, the intensification of production combined with the acceleration of technical change together with the increasing requirements in standardization and certification (both at the domestic and international levels) are necessary elements to the environment where KIBS are developed.

Gonzalez, Meliciani y Savona (2015) sustain that this type of pattern reflects the combined hypothesis of Hirschman and Linder. Sectors with RCA generate domestic interlinkages, which imply an incentive to develop new economic activities. These

markets are huge at international level and they can create a representative demand in particular for the regional countries. Based in this critical mass, new competitive services activities could be developed which have the potential to be internationalized.

Trade and industrial policy tools to develop this type of services need to know the nature of the process that generate this new comparative advantages, and requires a deep understanding of the process of internationalization of this type of specialized product services.

Table 2

KIBS and NRIG in Latin America, seven selected cases

Country	Sectors	Products	Definition	Origin servicification	Type of services	Internationalization
Argentina [a)]	Agriculture	Cereals (trigon,maize, rice) and oleaginous (soya,sunflower)	New technological package: diversification in different stages of production	Increment use of specialized production service, agriculture firm as coordinator actor	Innovation services	Medium-Low
Argentina/Brasil [b)]	Agriculture	Agriculture seeds	Knowledge intensive products with embodied KIBS	Adaptation to particulars environments, new value to agriculture genetics by local firms	Innovation services	Medium
Uruguay [c)]	Agriculture	Bovine Meat	Certification of quality (traceability)	International regulation and certification process	Value services	Low
Uruguay [d)]	Agriculture	Bovine Meat	Traceability and innovation KIBS	Available new information trigger new specialized services	Innovation services	Low
México [e)]	Fish sector	Japanese Osteon Red “abulón”	New technological services to control production	Research and Technological regional centers in the fish sector	Value services and innovation services	Low
Chile [f)]	Fish sector	Salmon	KIBS in reproduction, sanity and certification	Increase in pressure over natural resources and sanitary problems	Value services and innovation services	Medium-Low
Chile [g)]	Minerals	Cooper	KIBS and specific technological solutions	Maturation growth process demand specific technological solutions	Innovation services	Medium

[a)] Anllo, Bizang y Katz, 2015; [b)] Marin, Sturbrin y da Silva, 2015; [c)] Labraga y Ferreira, 2015; [d)] Rius, 2015; [e)] Celaya, Alvarez y Hualde, 2015; [f)] Zanlungo y Katz, 2015; [g)] Meller y Gana, 2015.

Source: authors’ calculations.

4. ECONOMIC INFRASTRUCTURE SERVICES AND NRIG COMPETITIVINESS

4.1 Methodological approach

In this section we link economic infrastructure services (EIS) to the set of commodities exported by South American countries. We will address the role of services such as communications, finance, transport, distribution and logistics in the exports of natural resources. One way to measure their contribution is through the value added of those services embodied in the exports of NRIGs. At the same time we will also look at the impact of the Service sector productivity and performance on the exports of natural resource intensive products. This type of services is included in the second category (cost services) defined by Arbache (2015) and may be studied using conventional Input Output techniques.

Within that framework a first approach to assess on the role of services in NRIG can be conducted by analysing the intensities in production. This allows identifying industries which make a more intense use of services as intermediate inputs. A second approach to tackle the same objective is to analyse the value added content of services included in the exports of NRIGs.

It is also possible to study the role of Services in the competitiveness of NRIG. To that end, we develop the Leontief price model as proposed in Gilles and Vallecilla (2015), which main result is the change in sectorial prices as a result of changes in the value added (VA) of a given sector. We will use this framework to simulate the effects of an increase in productivity in the Services sector: such a process would translate into a decrease in value added. Indeed, as a sector becomes more productive we should observe a decrease in its share of VA in gross output. The model has been used in several environments to analyze different objectives. For example, Bazzazan et al. (2003) use it in the context of energy assessment policy; Davar (2006) discusses price discrimination issues with the model, while Folloni et al. (1993) evaluate different price formation hypothesis.

We perform the above three analyses for six South American countries: Argentina. Brazil, Chile, Colombia, Peru and Uruguay. In order to have a unified framework we use the input-output tables provided by GTAP, which correspond to 2007 and are expressed in

millions of US dollars. The full description and details of the methodologies is found in the Appendix A.

We analize the commodities shown in Table 1. In order to determine the sector they belong to, we use correspondence tables between products in the HS and the GTAP sectors[10]. Results are presented in table 3.

Table 3
Products and sectors

HS	PRODUCTS	COUNTRIES	SECTORS GTAP
a) Foods and raw materials			
20721	Chicken meat frozen	Brazil; Argentina	20
150710	Soya crude oil	Argentina	21
230400	Soya oilcake	Argentina	21
170111	Cane sugar	Brazil	24
120100	Soya beans	Brazil	5
90111	Coffee	Colombia	8
20230	Bovine meat boneless	Uruguay	19
240120	Tobacco	Argentina; Brazil	8
80610	Fresh graves	Chile	4
220710	Ethyl alcohol	Brazil	26
100590	Maize	Argentina	3
170199	Other sugar	Brazil	24
b) Minerals			
720293	Ferroniobium	Brazil	35
261610	Silver	Peru	18
260300	Copper	Chile, Peru	18
740311	Copper cathodes	Chile	36
260112	Agglomerated iron	Brazil	18
260700	Lead	Peru	18
260111	Non agglomerated iron	Brazil	18
720712	Iron and steel	Brazil	35

Source: authors' calculations using table 1 and correlation with GTAP sectors.

Services are going to be aggregated in six main categories (big sectors), which include infrastructure economics services (transport, trade, financial, public services), plus construction and other business services (see table B2).

[10]See https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=1916.

4.2 Results

4.2.1 Domestic Value added contents of NRIG exports in EIS

The results on direct requirements in the use of economic infrastructures services (EIS) by NRIGs can be seen in Table B3. With this information we compute the domestic value added contents of exports, considering the aggregate use of the different EIS (see table 4).

Table 4
NRIG Domestic Value Added (VA) contents of services (millions dollars in 2007 and %)

Countries	Sectors	(1) Exports	(2) VA contents	(3) % Services VA	(4) VAX ratio % (VA/Exports)	(5) Imports contents (%)
Argentina	3	2706	2253	14,5	83,3	16,7
	8	432	403	4,7	93,3	6,7
	20	488	355	22,8	72,6	27,4
	21	10716	8688	23,0	81,1	18,9
	Rest	49612	37552	27,5	75,7	24,3
	Total	63953	49250	25,9	77,0	23,0
Brazil	5	6889	6334	16,5	91,9	8,1
	8	5844	5378	16,8	92,0	8,0
	18	19804	17829	34,5	90,0	10,0
	20	7090	6645	23,7	93,7	6,3
	24	5013	4631	23,7	92,4	7,6
	26	1610	1471	31,9	91,4	8,6
	35	8491	6980	39,9	82,2	17,8
	Rest	121470	100689	43,6	82,9	17,1
	Total	176209	149957	38,6	85,1	14,9
Uruguay	19	901	771	18,5	85,5	14,5
	Rest	5772	3970	36,8	68,8	31,2
	Total	6673	4741	33,8	71,0	29,0
Chile	4	3014	2698	19,8	89,5	10,5
	18	17285	14113	27,1	81,7	18,3
	36	24820	19611	26,0	79,0	21,0
	Rest	23980	16899	40,5	70,5	29,5
	Total	69098	53321	30,6	77,2	22,8
Peru	18	9685	8377	19,6	86,5	13,5
	Rest	19893	17943	22,5	90,2	9,8
	Total	29577	26320	21,6	89,0	11,0
Colombia	8	2429	2276	4,2	93,7	6,3
	Rest	29030	24592	27,8	84,7	15,3
	Total	31458	26868	25,8	85,4	14,6

Note: (2)- Definition in equation A9; (3) see equation A8 and table B3; (4)=(2)/(1), see equation A10; (5)- see equation A4.
Source: authors' calculations based on GTAP

The share of these types of sectors is less than in the rest of the economy in almost all the sectors associated with NRIGs (see table 3). Only in the case of Brazil in sector 35 (Ferrousmetals) the share is greater than in the average global economy. In minerals sectors the intensity is typically greater than in the other commodities and close to the average of the economy (see the cases of Chile, Peru and Brazil). In the NRIG sectors the VAX ratio is typically high or the import contents of exports are low. This result is natural considering that this type of sectors are defined by the intensively use of domestic factors (natural resources).

Table 5
Share of domestic value added by economic infrastructure services (%)

Countries	Sectors	Services domestic value added content						VAS/VA
		I	II	III	IV	V	VI	
Argentina	3	0,2	1,1	2,7	2,0	1,5	7,0	14,5
	8	0,2	0,4	1,2	0,8	0,8	1,4	4,7
	20	0,4	0,6	9,4	5,5	1,9	4,9	22,8
	21	0,4	1,0	6,2	7,2	1,5	6,7	23,0
	Rest	0,8	1,0	5,8	8,0	2,1	9,8	27,5
	Total	0,7	1,0	5,7	7,5	2,0	9,0	25,9
Brazil	5	2,2	0,1	5,8	3,6	2,4	2,3	16,5
	8	2,7	0,1	5,6	3,6	2,4	2,3	16,8
	18	5,3	0,2	7,0	11,2	5,2	5,6	34,5
	20	3,5	0,1	8,2	5,0	2,8	4,0	23,7
	24	3,9	0,2	4,8	6,5	3,5	4,9	23,7
	26	4,2	0,2	9,7	7,6	4,1	6,1	31,9
	35	11,9	0,2	6,7	10,6	5,7	4,9	39,9
	Rest	5,3	0,5	8,9	10,2	5,4	13,4	43,6
	Total	5,2	0,4	8,2	9,4	4,9	10,5	38,6
Uruguay	19	1,5	1,4	4,2	3,3	6,3	1,9	18,5
	Rest	3,6	1,2	7,5	9,3	7,0	8,2	36,8
	Total	3,3	1,2	6,9	8,4	6,9	7,2	33,8
Chile	4	0,5	0,3	6,0	3,6	0,9	8,5	19,8
	18	5,6	0,3	2,8	3,9	0,9	13,6	27,1
	36	2,5	0,3	3,9	3,9	1,3	14,1	26,0
	Rest	2,3	0,5	7,0	10,8	3,3	16,5	40,5
	Total	3,2	0,3	4,7	6,1	1,8	14,5	30,6
Peru	18	2,5	0,3	1,0	2,4	3,7	9,7	19,6
	Rest	2,1	0,5	1,8	5,1	4,4	8,6	22,5
	Total	2,2	0,4	1,5	4,2	4,2	9,0	21,6
Colombia	8	0,4	0,1	1,0	0,6	1,2	0,8	4,2
	Rest	2,1	0,6	5,2	6,6	5,9	7,3	27,8
	Total	2,0	0,6	4,9	6,1	5,5	6,8	25,8

Source: authors' calculations using table B4.

Also is important to highlight that we are only measured the EIS (cost services in Arbaches,2015 terminology) because conventionally specific product services are embodied in the gross value of each commodity sector[11].

However there are three cases where the direct and indirect intensity in the use of imports is high: meat products (sector 20) in Argentina; ferrousmetals (sector 35) in Brazil; other minerals (sector 18) in Peru.

Results on the total value added generated by NRIG exports disaggregated by type of EIS are presented in Table 5 according to equation A**¡Error! No se encuentra el origen de la referencia.** of the Appendix A. In this case it is possible to identify an association between type of EIS service and the NRIG sector. We summarize results in table 6. For Argentina, an intensively use of trade services and transport services are verified in the chicken meat (20) and in vegetable oils (21) respectively. In Brazil minerals (sector 18) is associated with public services (I-electricity, gas and water), the beverage sector (26) in trade services (III), and finally in ferrousmetals (sector 35) the intensity link is with public services (I), transport (IV) and financial services (V). For Chile in minerals (18) the link is with public services (I). Finally in Peru also in minerals (18) the association is with other business services.

Table 6
Association between EIS and NRIG by country

Countries	Sectors	EIS VA contents intensity				
		I	III	IV	V	VI
Argentina	20		+			
	21			+		
Brazil	18	+				
	26		+			
	35	+		+	+	
Chile	18	+				
Peru	18					+

Source: authors' calculations using table 5.

4.2.2 EIS productivity and prices competitiveness of NRIG

Finally, we present the results of the Leontief price model. As mentioned before, we are interested on analysing the effects of a 10% increase in EIS productivity on the prices of

[11] This is a well know restriction to work with such a high level of aggregation of the IO analysis and only could be solved with more detail and deep product case studies.

NRIGs. This is modelled as a decrease in value added in services, as detailed in equation (A16) of the Appendix. In Table 7 we show the results of applying that productivity increase to each of the six different groups of EIS, together with a final simulation of a simultaneous 10% increase in all of them. Results should be interpreted as the price effect of that change on each of the selected NRIG and on the total production basket of the economy (using gross sectorial output as weights).

Table 7
Percent change on commodities' prices as a result of a 10% increase in Economic Infrastructure Services' productivity (%)

Country	Sector	Economic Infrastructure Services						
		I	II	III	IV	V	VI	All
Argentina	3	-0.05	-0.12	-0.32	-0.32	-0.21	-0.68	-1.70
	8	-0.02	-0.05	-0.15	-0.12	-0.10	-0.17	-0.60
	20	-0.07	-0.11	-0.83	-0.59	-0.24	-0.47	-2.30
	21	-0.09	-0.12	-0.63	-0.73	-0.22	-0.65	-2.44
	All	**-0.13**	**-0.39**	**-0.98**	**-0.78**	**-0.43**	**-0.80**	**-3.51**
Brazil	5	-0.25	-0.02	-0.59	-0.40	-0.27	-0.32	-1.86
	8	-0.29	-0.02	-0.58	-0.40	-0.27	-0.32	-1.88
	18	-0.54	-0.02	-0.70	-1.10	-0.54	-0.67	-3.56
	20	-0.37	-0.02	-0.82	-0.53	-0.30	-0.47	-2.50
	24	-0.41	-0.02	-0.50	-0.67	-0.38	-0.58	-2.55
	26	-0.44	-0.02	-0.95	-0.76	-0.43	-0.70	-3.31
	35	-1.11	-0.03	-0.67	-1.04	-0.57	-0.63	-4.05
	All	**-0.51**	**-0.34**	**-1.26**	**-1.12**	**-0.79**	**-1.14**	**-5.16**
Uruguay	19	-0.19	-0.13	-0.46	-0.37	-0.65	-0.25	-2.06
	All	**-0.42**	**-0.55**	**-1.21**	**-0.74**	**-0.86**	**-0.61**	**-4.37**
Chile	4	-0.12	-0.03	-0.61	-0.38	-0.12	-0.91	-2.16
	18	-0.64	-0.03	-0.32	-0.43	-0.16	-1.35	-2.93
	36	-0.34	-0.03	-0.42	-0.42	-0.21	-1.42	-2.85
	All	**-0.44**	**-0.43**	**-0.83**	**-0.91**	**-0.55**	**-1.88**	**-5.04**
Peru	18	-0.34	-0.04	-0.10	-0.24	-0.36	-0.96	-2.03
	All	**-0.34**	**-0.53**	**-0.22**	**-0.52**	**-0.50**	**-1.14**	**-3.25**
Colombia	8	-0.05	-0.01	-0.13	-0.09	-0.15	-0.12	-0.55
	All	**-0.30**	**-0.49**	**-1.08**	**-0.80**	**-0.80**	**-0.65**	**-4.12**

Source: authors' calculations based on GTAP

As a first comment on these results, it can be noticed that the average impact of services on the prices of the economy is reduced. Moreover, this is particularly true for the selected commodities, which feature below-of-the-average changes. In fact, these goods are generally in the low tale of the distribution of price impacts along the economy (minerals

being the exception). The group of services which produces the largest impacts on prices in the majority of countries is Trade services (III), followed by Transport (IV) and Other business services (VI).

For the Argentinean case, the impacts in sectors 3 (Cereals), 8 (Other crops) and 21 (Vegetable oils and fats) are low and are mainly explained by improvements in Trade and Other business services productivities. Sector 8 presents a very low reaction (to any service improvement), whereas sector 20 (Meat products) is affected by Trade and Transport services.

In Brazil we find the highest impacts on prices. For example, sectors 18 (Minerals), 26 (Beverage and tobacco) and 35 (Ferrous metals) are the most influenced, mainly by Transport, Trade and Other business services and also Financial services. Importantly, Minerals and Ferrous metals price' reactions to changes in Electricity, Gas and Water services productivity lie above the price impact of the latter on the whole economy prices. This is consistent with the fact that these NRIG are closely related to group I services, as mentioned in Table (6).

The same over-reaction is also found in the Mineral sector of both Chile and Peru, whereas the figures for Colombia are extremely low. In Uruguay the most important service group in terms of its impacts on NRIG competitiveness is Financial services, however the size of the impact is low.

Overall, we could present results of the association of services productivities and NRIG competitiveness by simply using Table (6) and changing its title. The main intuition is that commodities benefit from productivity changes of services according to the intensity in their respective production functions.

5. CONCLUSIONS

The initial motivation of the paper is that NRIGs are an important feature of South America trade pattern and South America is also a relevant supplier of this type of products in the world market (Vaillant, 2015). Policy makers in the region repeatedly sustain the need to search a path for the transformation of this pattern of specialization. The questions are: how do services can add value to the production and exports of NRIGs, and could the region benefit from the improvement of services to eventually become a net exporter of them? In the paper we give some new information that will be necessary to answer this question.

One of the characteristics of the actual era of globalization is the increase of the intensity in the use of specialized production services that participate as an intermediate input in many different activities and types of firms. The new technologies ability to penetrate in all kind of activities is one of the most important features of the changes to the production functions all over the world. This means servicification may be possible in many different activities and not only in dynamic manufacturing sectors. Our paper focuses on the identification of the phenomenon in the case of natural resources-intensive goods (NRIG) in South America.

Following Arbache (2015) we distinguish two types of services: specialized production services and cost services (mainly from economic infrastructure services). Two different methodologies are used to study the servification process in each type of services.

To identify the set of products and countries in which an increment in the use of specialized production services could be observed an indirect methodology is applied, based on trade data performance in a recent period (2000s). Food and raw materials is the first subset composed by 12 products that are identified with dynamic behaviour combined with relevance in world market. For minerals sectors, 8 products fulfil the stablished criteria. Six South American countries are exporter of this set of 20 products of NRIG.

Additionally, a review of recent literature about specialized production services in a set of NRIG is proposed. This showed that the big scale of regional markets in NRIG, the intensification of production combined with the acceleration of technical change together with the increase requirements in standardization and certification (both at the domestic

and international levels) are the environment where specialized production services (in particulars new KIBS) are developed. Sectors with strong RCA (NRIG) generate domestic interlinkages, which imply an incentive to develop new economic activities. These markets are huge at international level and they can create a representative demand in particular for the regional countries. Based on this critical mass, new competitive services activities could be developed which have the potential to be internationalized. This is like a combined Hirschman and Linder mechanism, as referred by Gonzalez, Meliciani y Savona (2015).

For the analysis of the impact of the second type of services (EIS) we used a conventional input-output methodology. The analysis is developed for the six South American exporters in twelve sectors (the 20 NRIG products map in 12 sectors, 9 food and raw materials and 3 minerals), which implies seventeen different bilateral matches country-sector. Three countries (Argentina, Colombia in Uruguay) are linked to food and raw materials sectors. Peru is associated only to mineral sectors. Finally, Brazil and Chile export products in both types of sectors.

We developed two types of indicators to approximate the relevance of EIS in NRIG. First, we measure the domestic value added contents (by sub type of EIS) in each combination country-NRIG sector exports. Naturally, in NRIG sectors the intensity of the use of EIS is lower than in the rest of the economy for all countries. However, the relevance of EIS is greater in minerals sectors and in some cases, it is close to the average of the economy.

The disaggregated results show an association between types of EIS services and NRIG sectors. For Argentina, an intensively use of trade services and transport services are verified in the chicken meat (20) and in vegetable oils (21) respectively. In Brazil minerals (sector 18) is associated with public services (I-electricity, gas and water), the beverage sector (26) in trade services (III), and finally in ferrousmetals (sector 35) the intensity link is with public services (I), transport (IV) and financial services (V). For Chile in minerals (18) the link is with public services (I). Finally in Peru also in minerals (18) the association is with other business services.

Finally, we present the results of the price model, which produces price effects on commodities following increases in EIS productivity. The general line of the association between EIS services and NRIG sectors is the same. However, we give evidence about the size of the effects considering how prices are affected by an increase in the productivity of transport services. The main impact is observed in the case of Brazil with

an increase in productivity of public services (I) imply a decrease in the price of ferrousmetals (35). The effect of transport service (IV) is relevant in the price of vegetable oil sector in Argentina, and a positive shock in productivity of other business services (VI) has a positive impact in competitiveness in metals (36) in Chile and minerals (18) in Perú.

New instruments in trade and industrial policy must be develop to promote the specialized products services in NRIG. It is necessary to know the nature of the process that generate this new comparative advantages. A deep understanding of the dynamic process of interaction between scale economics and the internationalization of this type of firm is required to reinforce this new structure of production. More cases studies must be done to know the mechanism of this development process. Finally, the results over EIS shows that the effect of Cost Services over commodities competitiveness is idiosyncratic of each country. This fact revealed a heterogeneous development of infrastructure among South American countries combined with different productive specialization pattern which imply different intensities in the use of the EIS.

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APPENDIX A- METHODOLOGICAL

In this section we briefly present the input-output model used in this document. It is important to clarify the use of notation and conventions beforehand. To begin with, upper case letters denote matrices, whereas lower case letters denote vectors; finally, letters with subscripts denote real numbers. There are n sectors in the economy. The (nx1) final demand vector is denoted by f; the use of domestic input *i* by industry *j* in monetary terms is denoted by z_{ij}; the direct coefficient matrix, of dimension n, is called A with elements a_{ij}; the corresponding Leontief inverse is L with elements l_{ij}. The import coefficient matrix is named A^m with elements m_{ij}, which express the share of foreign input *i* in terms of domestic sector *j*'s gross output. Finally, the gross output vector is x; and the value added vector is v. The standard representation of the input-output model is given by:

$$x = (I - A)^{-1} f = Lf. \tag{A1}$$

A1. Domestic value added contents of infrastructure service in NRIGs exports

Each time there is an export of a NRIG (in fact, of every good) this implies an increase in gross output and value added, not only in the sector from which the good comes from, but throughout all the economy via sectorial linkages. In this section we present the methodology to assess the magnitude of those effects as a way to weight their relative importance in the economy.

We start by considering the fact that final demand f can be decomposed into domestic (f^d) and the foreign final demand (e):

$$f = fd + e\,. \tag{A2}$$

According to Hummels et al. (2001) the imports content of total exports can be calculated as:

$$m^e = A^m L e. \tag{A3}$$

This is a vector of all the imports contents in global exports. If we sum over sectors and substract from exports we obtain the total domestic value added contents of exports

$$vdt^e = ie - im^e = \sum_s e_s - \sum_s m_s^e \tag{A4}$$

where i is a vector of ones. We can also express the import contents as a proportion of total exports,

$$sm^e = D(e)^{-1}A^m Le, \quad \text{(A4)}$$

where $D(\,)$ is the diagonal operator.

However, what we want to know is the composition of domestic value added by sector of origin and linked with foreign demand (exports). So we need to use the vector of the ratio of domestic value added to gross output, defined as

$$v_s^r = \frac{v_s}{x_s} = \frac{x_s - \sum_j a_{js}x_s - \sum_j m_{js}x_s}{x_s} = 1 - \sum_j a_{js} - \sum_j m_{js} \quad \text{(A5)}$$

In matrix terms

$$v^r = (D(x))^{-1}v = i - A'i - M'i \quad \text{(A6)}$$

Then, the domestic value added contents in total exports (by sectors) is given by:

$$vd^e = D(v^r)Le \quad \text{(A7)}$$

In turn, we disaggregate this value added by each sector of the foreign demand (export vector). Then the domestic value added by sector in exports is:

$$VD^e = D(v^r)LD(e), \quad \text{(A8)}$$

where VD^e is a square matrix of dimension n, in each column we have the domestic value added generated in a specific sector as a result of exports of each sector (rows). Given the above, it holds that:

$$vd^e = VD^e i \quad \text{(A9)}$$

Also the total sum of domestic value added is $vdt^e = i'vd^e$ (see equation A4). The ratio between domestic value added contents and exports is:

$$vax = (D(e))^{-1}vd^e \quad \text{(A10)}$$

$$VAX = \big(D(e)\big)^{-1}VD^e \quad \text{(A11)}$$

Where: vax and VAX are the well-known value added to export ratios of the Global Value Chain literature (see for example, Johnson and Noguera, 2012). We assume that the domestic value added contents in imports is zero, so one minus the vax ratio is the import contents associated with total exports ($sm^e = (i - vax)$ see equation A4). This

could be also defined by sector and also expressed as a proportion of foreign demand (exports).

A2. Leontief price model

If we assume that it is not quantities but prices that adjust in the economic system, then the standard input-output model can be interpreted as a price model (Miller and Blair, 2009). Looking at sectors from a column perspective, we have that gross sectorial output can be decomposed into the use of intermediate inputs (both domestic and imported) and value added generated,

$$x_j = \sum_i z_{ij} + \sum_i m_{ij} + v_j. \tag{A12}$$

Next, dividing each side of the above equation by gross sectorial output, we have

$$1 = \sum_i a_{ij} + \sum_i am_{ij} + v_j^r \tag{A13}$$

where technical coefficients for domestic and imported intermediates now appear explicitly. The equation reflects the equality between the per-gross-output costs (right hand side) and the unit price (left hand side). Adopting matrix notation, these prices can be interpreted as a price index of the economy:

$$\mathbf{p}' = \mathbf{p}'(\mathbf{A} + \mathbf{A^m}) + \boldsymbol{v}^{\boldsymbol{r}\prime} \tag{A14}$$

$$\mathbf{p} = (\mathbf{A} + \mathbf{Am})'\mathbf{p} + \boldsymbol{v}^{\boldsymbol{r}} = (\mathbf{At})'\mathbf{p} + \boldsymbol{v}^{\boldsymbol{r}} \qquad \textbf{(A15)}$$

Where $\mathbf{p}'$ is a row vector of industry prices, $\mathbf{A}$ is the square matrix of domestic direct coefficients, $\mathbf{A^m}$ is the corresponding square matrix for imported intermediates, and $\mathbf{v'_c}$ is a 1xn vector of value added to gross output ratios. Solving for prices and transposing the result, the Leontief price model can then be expressed as:

$$\mathbf{p} = (\mathbf{I} - \mathbf{At}')^{-\mathbf{1}}\mathbf{v_c} \equiv \mathbf{L}'\mathbf{v_c} \tag{A16}$$

In this equation, $\mathbf{At}$ is the sum of matrices $\mathbf{A}$ and $\mathbf{A^m}$, whereas $\mathbf{L}'$is the transpose of the corresponding Leontief inverse. A given equation of this system writes:

$$p_i = \sum_j l_{ij}^t v_j = l_{i1}^t v_1 + \cdots + l_{ij}^t v_i + \cdots + l_{in}^t v_n. \quad \text{(A17)}$$

In other words, every change in sectorial value added will have effects all along the economy prices, according to the Leontief total effect coefficients, l_{ij}^t which denote the change in industry *i* price following an change in unit value added sector *j*.

APPENDIX B- STATISTICAL

Table B.1

Sectors of the input-output matrix

Sector	Title	Name
1	PDR	Paddy rice
2	WHT	Wheat
3	GRO	Cereal grainsnec
4	V_F	Vegetables, fruit, nuts
5	OSD	Oilseeds
6	C_B	Sugarcane, sugarbeet
7	PFB	Plant-basedfibers
8	OCR	Cropsnec
9	CTL	Bovine cattle, sheep and goats, horses
10	OAP	Animal productsnec
11	RMK	Rawmilk
12	WOL	Wool, silk-wormcocoons
13	FRS	Forestry
14	FSH	Fishing
15	COA	Coal
16	OIL	Oil
17	GAS	Gas
18	OMN	Mineralsnec
19	CMT	Bovinemeatproducts
20	OMT	Meatproductsnec
21	VOL	Vegetable oils and fats
22	MIL	Dairyproducts
23	PCR	Processed rice
24	SGR	Sugar
25	OFD	Foodproductsnec
26	B_T	Beverages and tobacco products
27	TEX	Textiles
28	WAP	Wearingapparel
29	LEA	Leatherproducts
30	LUM	Wood products
31	PPP	Paperproducts, publishing
32	P_C	Petroleum, coalproducts
33	CRP	Chemical, rubber, plasticproducts
34	NMM	Mineral productsnec
35	I_S	Ferrousmetals
36	NFM	Metalsnec
37	FMP	Metal products
38	MVH	Motor vehicles and parts
39	OTN	Transportequipmentnec
40	ELE	Electronicequipment
41	OME	Machinery and equipmentnec
42	OMF	Manufactures nec
43	ELY	Electricity
44	GDT	Gas manufacture, distribution
45	WTR	Water
46	CNS	Construction
47	TRD	Trade
48	OTP	Transportnec
49	WTP	Watertransport
50	ATP	Air transport
51	CMN	Communication

52	OFI	Financialservicesnec
53	ISR	Insurance
54	OBS	Business servicesnec
55	ROS	Recreational and otherservices
56	OSG	Public Administration, Defense, Education, Health
57	DWE	Dwellings

Source: GTAP.

Table B2

Economic infrastructure services

BIG SECTOR	SERVICES	SECTORS GTAP
I	Electricity, gas and water	43;44;45
II	Construction	46
III	Trade	47
IV	Transport and communications	48;49;50;51
V	Financial and insurance	52 and 53
VI	Other business services	54

Source: authors' calculations using table A1.

Table B3

Countries and sectors direct requirements of services/gross output by big sectors (2007)

Countries	Sectors	Direct domestic services requirements/gross output						Services as intermediate inputs	Domestic Intermediate use
		I	II	III	IV	V	VI		
Argentina	3	0,00	0,01	0,02	0,01	0,01	0,07	0,12	0,39
	8	0,00	0,01	0,01	0,00	0,01	0,01	0,04	0,18
	20	0,00	0,00	0,05	0,03	0,00	0,01	0,10	0,78
	21	0,00	0,00	0,06	0,09	0,00	0,01	0,17	0,88
Brazil	5	0,01	0,00	0,04	0,02	0,01	0,00	0,10	0,39
	8	0,02	0,00	0,04	0,02	0,01	0,00	0,10	0,40
	18	0,05	0,00	0,05	0,13	0,04	0,03	0,29	0,53
	20	0,02	0,00	0,05	0,04	0,01	0,02	0,14	0,74
	24	0,03	0,00	0,02	0,06	0,02	0,03	0,17	0,69
	26	0,02	0,00	0,07	0,06	0,02	0,03	0,21	0,75
	35	0,10	0,00	0,03	0,08	0,03	0,01	0,26	0,63
Uruguay	19	0,00	0,00	0,01	0,04	0,03	0,01	0,09	0,79
Chile	4	0,00	0,00	0,10	0,04	0,01	0,07	0,22	0,29
	18	0,08	0,00	0,03	0,04	0,00	0,11	0,27	0,46
	36	0,01	0,00	0,04	0,03	0,01	0,08	0,16	0,56
Peru	18	0,00	0,00	0,02	0,03	0,03	0,07	0,15	0,49
Colombia	8	0,00	0,00	0,01	0,00	0,01	0,00	0,03	0,14

Source: authors' calculations using GTAP input output matrices.

Table B4

Economic infrastructure services domestic value added contents by selected set of NRIG in South America (millions of dollars, 2007)

Countries	Commodity	Exports	Services domestic value added content						VA contents of selected services	Total VA contents
			I	II	III	IV	V	VI		
Argentina	3	2706	5	24	61	45	34	158	327	2253
	8	432	1	2	5	3	3	6	19	403
	20	488	2	2	33	20	7	17	81	355
	21	10716	34	83	542	628	128	579	1995	8688
	Rest	49612	290	391	2178	3000	797	3687	10341	37552
	Total	63953	332	501	2819	3695	969	4446	12763	49250
Brazil	5	6889	142	7	369	228	154	146	1048	6334
	8	5844	147	6	302	194	129	123	902	5378
	18	19804	949	32	1254	1995	927	999	6157	17829
	20	7090	233	9	546	335	185	265	1573	6645
	24	5013	182	8	220	299	162	228	1099	4631
	26	1610	62	3	142	111	60	90	469	1471
	35	8491	830	15	467	737	395	340	2784	6980
	Rest	121470	5294	513	8965	10236	5391	13481	43880	100689
	Total	176209	7840	592	12266	14135	7404	15673	57910	149957
Uruguay	19	901	11	10	33	25	48	14	143	771
	Rest	5772	143	47	297	371	277	327	1461	3970
	Total	6673	155	57	329	396	325	341	1604	4741
Chile	4	3014	14	7	163	96	25	231	535	2698
	18	17285	791	36	402	552	129	1917	3827	14113
	36	24820	486	62	763	770	256	2765	5103	19611
	Rest	23980	389	78	1190	1827	559	2794	6837	16899
	Total	69098	1681	183	2518	3245	969	7707	16302	53321
Peru	18	9685	206	28	81	200	314	816	1644	8377
	Rest	19893	378	89	314	911	795	1549	4036	17943
	Total	29577	584	117	396	1111	1109	2365	5680	26320
Colombia	8	2429	8	1	24	15	28	19	95	2276
	Rest	29030	519	151	1280	1630	1463	1795	6838	24592
	Total	31458	528	152	1304	1644	1491	1814	6933	26868

Source: authors' calculations using GTAP input output matrices.

Table B5

Share of each economic infrastructure service in total domestic value added of services (%)

Countries	Sectors	Services domestic value added content in NRIG exports						Intermediate use of Services
		I	II	III	IV	V	VI	
Argentina	3	1,6	7,3	18,7	13,8	10,4	48,2	100,0
	8	3,2	8,1	25,3	16,4	17,3	29,7	100,0
	20	1,9	2,8	41,3	24,2	8,3	21,4	100,0
	21	1,7	4,2	27,2	31,5	6,4	29,0	100,0
	Rest	2,8	3,8	21,1	29,0	7,7	35,6	100,0
	Total	2,6	3,9	22,1	29,0	7,6	34,8	100,0
Brazil	5	13,6	0,7	35,2	21,8	14,7	13,9	100,0
	8	16,3	0,7	33,5	21,5	14,3	13,7	100,0
	18	15,4	0,5	20,4	32,4	15,1	16,2	100,0
	20	14,8	0,6	34,7	21,3	11,8	16,8	100,0
	24	16,5	0,7	20,0	27,2	14,8	20,7	100,0
	26	13,3	0,6	30,3	23,7	12,8	19,3	100,0
	35	29,8	0,5	16,8	26,5	14,2	12,2	100,0
	Rest	12,1	1,2	20,4	23,3	12,3	30,7	100,0
	Total	13,5	1,0	21,2	24,4	12,8	27,1	100,0
Uruguay	19	8,0	7,4	22,9	17,7	34,0	10,0	100,0
	Rest	9,8	3,2	20,3	25,4	18,9	22,4	100,0
	Total	9,6	3,6	20,5	24,7	20,3	21,3	100,0
Chile	4	2,6	1,4	30,5	17,9	4,6	43,1	100,0
	18	20,7	0,9	10,5	14,4	3,4	50,1	100,0
	36	9,5	1,2	14,9	15,1	5,0	54,2	100,0
	Rest	5,7	1,1	17,4	26,7	8,2	40,9	100,0
	Total	10,3	1,1	15,4	19,9	5,9	47,3	100,0
Peru	18	12,5	1,7	4,9	12,2	19,1	49,6	100,0
	Rest	9,4	2,2	7,8	22,6	19,7	38,4	100,0
	Total	10,3	2,1	7,0	19,6	19,5	41,6	100,0
Colombia	8	9,0	1,2	25,1	15,5	29,6	19,6	100,0
	Rest	7,6	2,2	18,7	23,8	21,4	26,3	100,0
	Total	7,6	2,2	18,8	23,7	21,5	26,2	100,0

Source: authors' calculations using table B4.