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Global Value Chains and Their Challenge to the Sustainability of Exhaustible Resources in the Pacific Alliance

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In this paper, we identify which global value chain (GVC) made intensive use of minerals between 2005 and 2015. Input-output analysis instruments, complemented with network theory algorithms, are used for this purpose. We also describe, under the weak and strong sustainability approach, the mechanisms of resource rent capture and distribution used in the Pacific Alliance countries, as well as the creation of environmental laws, which governments have been forced to implement given the extractive boom of the 1990s and the first decade of this century.

Keywords: mining, global value chain (GVC), resource rent, environment and development

Introduction

The super-cycle of commodity prices in the first decade of the 2000s certainly favored the exports of mining and oil resource-rich countries. Among these countries are Chile, Colombia, Mexico, and Peru, who comprised the Pacific Alliance since 2011. These economies share the fact of having adopted a free trade policy that facilitates direct/indirect connection between international prices and extractive activities fluctuations. Thus, price boom and its corresponding boost on extractive activities, have two possible effects on these supplier economies: On the one hand, it poses challenges to the local regulatory capacity to guarantee future resources and environmental sustainability; and on the other hand, it allows reaching levels of economic growth at present that may have positive effects on the country's per capita income.

In order to distinguish which global industries have been the driving forces of extractive activities, the input-output tables published by the OECD (2018) with data from 36 economic industries for 64 countries, between 2005 and 2015, are used in this paper. Input-output analysis tools, complemented with centrality indices of the network theory (Borgatti & Everett, 2006), are used to identify which global value chain (GVC) makes intensive use of minerals. Although the concept of GVC has been created to understand the production process of goods, from design, inputs addition, until its transformation into a final good, this paper focuses on identifying the role that the Pacific Alliance countries play in the first links of the value chain, as their participation in the world production process is more representative at this point.

Likewise, in the context of the weak and strong sustainability approach (Dietz & Neumayer, 2007), we describe the construction of government regulatory tools, particularly, the mining royalty's collection and distribution scheme, the obligatory nature of environmental impact studies, and the incorporation of prior consultation in the Pacific Alliance countries.

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This paper is structured as follows: Introduction is followed by theoretical approaches about sustainable development and GVCs; description of the data and methods used; identification of the GVCs that make intensive use of minerals; identification of the instruments to capture and distribute resource rents developed in the countries evaluated; and finally, conclusions.

Sustainability in Natural Resources and GVCs

In terms of sustainability, the economic theory has developed a group of concepts that can be divided into two main branches: natural resources economics and environmental economics (Tietenberg & Lewis, 2018). This division started with the controversy regarding the extent to which it will be possible for science and technology to replace the natural ecosystem, or a part of it, on which economic activity is based (Daly, 1997; Dietz & Neumayer, 2007). Thus, weak sustainability is the approach that assumes economic growth will be sustainable over time if renewable resources are exploited according to their own reproduction rate; and, exhaustible natural resources are replaced little by little by man-made capital, to such a degree that the total capital stock of a society, natural and non-natural capital, remains constant, guaranteeing the sustainable continuity of production activities. This is the assumption on which most of the economic theory of natural resources are based, whose origins are found in the contributions of Hotelling (1931), Gordon (1954), Solow (1974), and Hartwick (1977), among others.

Otherwise, the strong sustainability approach assumes that there are nature's vital services, such as waste absorption, climate regulation, or the support of various forms of life, which are irreplaceable by some form of man-made capital. Thus, in order to extend the potential growth, it is critical to guarantee its maintenance. This is the starting point of the economic-environmental theory, based on the contributions of Georgescu-Roegen (1971), Pearce and Turner (1995), Daly and Farley (2004) among many others.

Although both approaches are still under development, resource management policies and environmental regulations currently applied are justified for both approaches; however, the weak sustainability approach has been "easier" to use thanks to the formal approach provided by the so-called Hartwick rule (1977). According to this rule, a society's constant and indefinite per capita consumption can be achieved if all resource rent coming from the extraction of a non-renewable resource is captured and transformed into different forms of manufactured capital. The concept has been further developed by the World Bank (The World Bank, 2011) including investment in education (added to the manufactured capital) and environmental degradation (which reduces natural capital), thus calculating the genuine savings that would be the balance between the assets that a country gains and loses annually, and which should be at least constant in time to maintain wealth. According to this approach, a country's wealth is estimated by the sum of all natural and non-natural assets it has at a given time, and which serves to generate a continuous income streams with which the satisfaction of population needs is guaranteed in an intergenerational way.

In the process of substituting natural capital for manufactured capital, there are three moments to highlight: estimation of resource rents; development of legal mechanisms for its capture by the government; and the evaluation of its transformation into manufactured capital through public spending. In this regard, some advances are discussed.

The World Bank defines the natural resource rent as the difference between the market price and the unit extraction cost, which includes the normal rate of return on capital. Each country's genuine savings and the wealth in form of assets have been estimated since 2006 using this concept. In its latest version (Lange, Wodon

& Carey, 2018), they find, for example, in 2014 natural capital reached 47% of the total wealth in low-income countries. However, in many of these states, especially in the sub-Saharan African countries, per capita wealth fell due to difficulties in transforming natural capital into manufactured capital.

Regarding the resource rent capture, it is found that the commodity consumption boom of the early 2000s has driven changes in tax legislation in several Latin American economies. These changes are evaluated by various institutions (FMI, 2012) and authors such as, Brosioand Jimenez (2012), Gómez, Jiménez, and Morán (2015), Viale (2015), among others, and in the following sections of this paper more precise references to these works will be made.

Regarding the use of resource rent captured to create manufactured capital, main publications evaluate the effectiveness of public spending on infrastructure from a tax efficiency perspective rather than under a framework for sustainability analysis. However, some works using the natural resource approach are those of Zarskyand Stanley (2013), who measure the impact of the Marlin mine (Guatemala) in the creation of productive infrastructure and local employment, under a weak sustainability approach; and also evaluate the risk arising from compliance with the environmental impact studies intended to maintain the ecosystem vital functions, under the strong sustainability approach. In both cases, unfavorable results have been found. From another point of view, Fuss, Chen, Jakob, Marxen, Rao, and Edenhofer (2016) estimate the infrastructure gap in water and sanitation, power, roads, and telecommunications over the world, and compare it with the resource rent published by the World Bank. They find, for example, that 10% of the resource rent could theoretically close the gap in access to water in almost all countries. However, resource-rich countries have weak institutional frameworks that prevent the government from capturing a greater percentage of resource rent. Likewise, under the weak sustainability approach, Landa (2017) finds that the increase of mining rent that subnational governments of Peru received, which by law must be invested only in infrastructure, is higher than the public expense of this item in education, health, and road network, due to institutional hurdles the country faces in its early process of regionalization.

Thus, at this point, we note that the need to transform resource rents into manufactured capital is not yet an idea anchored in the economic theory, nor is it a general guide to evaluate the public policies managing natural resources.

On the other hand, while these sustainability approaches have been built, the world economy and trade have undergone significant changes since the second half of the 20th century. The continuous process of intra- and inter-sectoral division of labor and its corresponding industrial linkages in developed economies have reached a new stage, moving up to the international level, thus achieving the diversification of production processes with greater speed, scale, depth, and extension (Elms & Low, 2013). One of the approaches used in the study of this new form of production is the GVC approach. A GVC is defined as a set of economic units that perform the activities necessary to create a product or service, from its conception to end-user sale. According to Gereffi and Lee (2016), the GVC approach is built to understand how value added is created and captured within various types of industries and focuses its evaluation on two features of modern industrial organization: governance and scaling. Governance studies how the leading company organizes its supply chain on a global scale, while scaling identifies the strategies used by companies or countries to improve their positions in higher value-adding activities (Gereffi & Lee, 2016).

Based on this approach, Baldwin and Lopez-Gonzales (2013) develop measures of trade in value-added to identify how their formation has changed through the links in the chain. These authors, on one side, and

Timmer, Erumban, Los, Stehrer, and Vries (2014) on the other, note that the developed economies (G7 countries) have become service providers mainly, moving manufacturing links to other countries (China, Mexico, and Poland, for example), thus promoting their industrialization. Likewise, Blyde (2014) affirms there is a possible fast industrialization in the case of those countries that facilitate the linkages of national industries in a GVC.

In this paper we identify the specific industries that have led the jump to transnational production in the GVCs and show how, through the global trade network, they have promoted the extraction of non-renewable natural resources in different supplier countries, thus posing challenges to the local regulatory capacity, in a context where the mechanisms to guarantee its sustainability are not yet established.

Data and Methods

Input-Output Analysis Tools

Data processed in this evaluation come from the international input-output tables for the years 2005 and 2015, published by the OECD (2018), which contain transactions among 36 economic industries in 64 countries. In this version, the OECD divides the extractive mining industry into energy mining, which corresponds to the extraction of hydrocarbons, and non-energy mining, which deals with the extraction of metal ores and quarry material.

We use the table of intermediate demand to calculate the Leontief's coefficients (Rasmussen, 1956) of goods with high concentration of minerals and oil, and measure the degree of linkages formed throughout the production process. The calculation of the Leontief's coefficients for an industry j is performed by Equation (1), where I is the identity matrix and A the technical coefficient matrix (input weight i in the gross value of production in industry j). The sum of the resulting coefficients measures the drag capacity of industry j towards the rest of the economy. In addition, results of these calculations are accompanied by centrality indexes of the network theory (which will be explained below) as they yield more real figures.

$$B_j = \sum_{i=1}^{n} [(I - A)^{-1}]_{i,j} \tag{1}$$

Network Analysis Tools

Just as the input-output tables are composed of a group of industries and their monetary links, in social network theory, a network is formed by a set of nodes and their respective ties. Although the technical coefficient and the Leontief coefficient measure the direct and indirect effects of one industry growth over the rest, due to their calculation, this method assumes that infinite numbers of successive impacts could happen in a country, which is not real. Therefore, the Leontief multiplier measures the potential effect, but not the real effect of an industry's final demand growth (Schuschny, 2005). In contrast, degree and closeness index offered by the network theory serve to determine more accurately the scope of one industry growth over the rest.

The degree concept counts the number of direct links that a node p_k has with the rest of the nodes p_i forming a network of size n, calculated according to Equation (2). Thus, the larger an industry degree is, the better can transfer its growth to those who are directly connected to it, while the impact fades as indirect links are reached. The links represented by "a" can be the purchases made by an industry p_k to p_i (in degree) or its sales (out degree), in commercial values as in our case; or, in its binary form, a = 1 when it does exist or a = 0 when it does not exist (Borgatti & Everett, 2006). A standardized measure of the degree (indicator used in this investigation) is obtained by dividing the links of each node by the total number of possible links in a network (*n-1*).

$$C_D(p_k) = \frac{\sum_{i=1}^{n} a(p_i, p_k)}{n-1} \tag{2}$$

The closeness concept measures the number of jumps "*d*" that a node p_k needs to reach all network nodes p_i, according to Equation (3). In our context, it would show how fast (fewer number of jumps) or slow (greater number of jumps) would be the impact of an industry growth over its related sectors. This connection can occur through their purchases (In Closeness) or sales (Out Closeness) and it is normalized by dividing the jumps by the maximum number of direct links in a network (Freeman, 1979). Considering that in a more connected network there are fewer number of jumps, an inverse-count is used. Therefore, the higher the index is, the closer the nodes are.

$$C_C(p_k) = \left[\frac{\sum_{i=1}^{n} d(p_i, p_k)}{n-1}\right]^{-1} = \frac{n-1}{\sum_{i=1}^{n} d(p_i, p_k)} \tag{3}$$

In this paper, the Ucinet software was used to calculate these indexes, and then the Gephi software was used to make visible the strongest connections in the mineral and hydrocarbon trade network.

GVCs With Intensive Use of Minerals and Oil

In order to get an overview of the production segments in which mining resources participate worldwide, technical coefficients were calculated, classifying the data by industries. In the case of hydrocarbons, Figure 1 shows, on the one hand, a short chain that begins with extraction, goes through refining, and ends in the transportation industry. However, on the other hand, a more extensive chain is formed. This chain goes through refining, then chemical products manufacturing, plastics industry and ends up in vehicles manufacturing. In the case of the extraction of metal ores and quarry materials, the visible chain is formed by extraction; basic metals, manufacturing of metal products, machinery and equipment, and finally vehicles manufacturing. This figure also shows the main role of the construction industry which engages a wide variety of industrial goods; and the vehicles manufacturing industry, considered as the farthest sector of the entire chain that begins with extraction and receives a variety of processed inputs.

When we are evaluating the intermediate demand growth (purchase of inputs) of each sector, according to the horizontal axis in Figure 2, the agricultural industry stands out with 136%, but then followed by mineral extraction, mining services, and the manufacture of basic metals with figures above 100%. The Leontief's coefficient is calculated to identify where the impulse of such growth comes from. Figure 2 vertical axis shows that the manufacture of basic metals, vehicles, and electrical equipment are the industries that have shown the greatest theoretical drag capacity in the evaluated time.

Having identified that the fastest growing industries in the world economy are also linked to the value chain of minerals and oil, we will be seen below to which countries these sectors correspond. Based on the 50 countries-industries with the highest in degree, Figure 3 shows the respective value for the years 2005 (horizontal axis) and 2015 (vertical axis).

The industries belonging to China, the US, Japan, India, and Germany stand out as well as those that thanks to their purchasing capacity have produced the greatest movement in intermediate demand. In the same figure, the vertical distance with respect to the diagonal displays the magnitude of the in degree growth in the two years evaluated. Chinese sectors stand out almost exclusively, which shows that during this century China continues positioning in the segments of world production with high consumption of minerals and hydrocarbons.

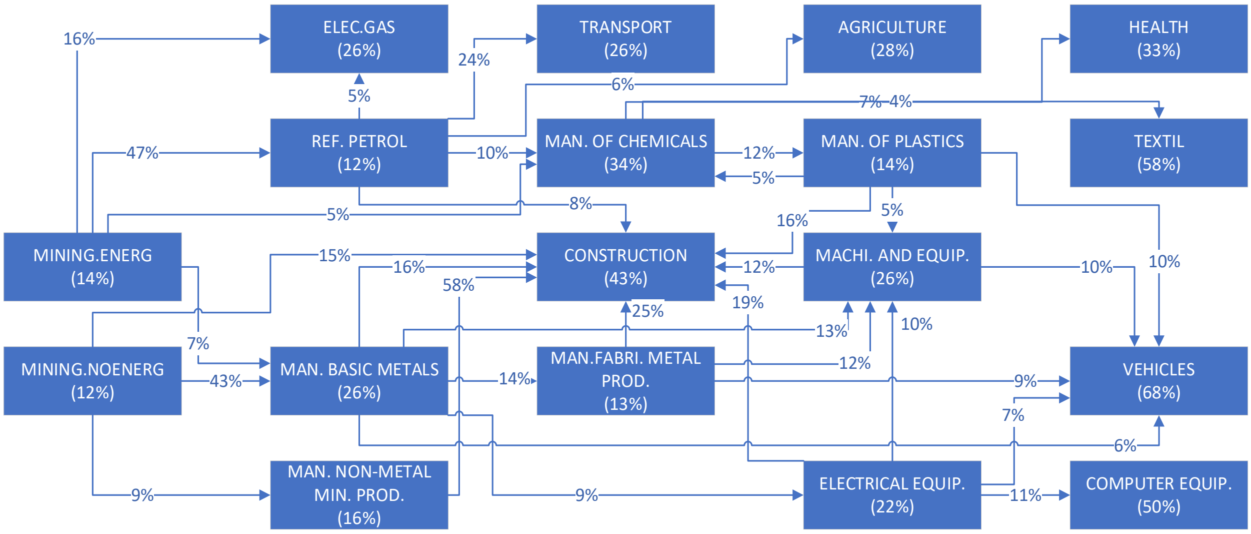


Figure 1. Segments of international production with intensive use of minerals and oil, year 2015. Note: Figures show the percentage of input sales from the industry in box to the linked industry. Sales between the same industries are shown in parentheses. Source: Inter-Country Input-Output Tables, 2018. Own elaboration.

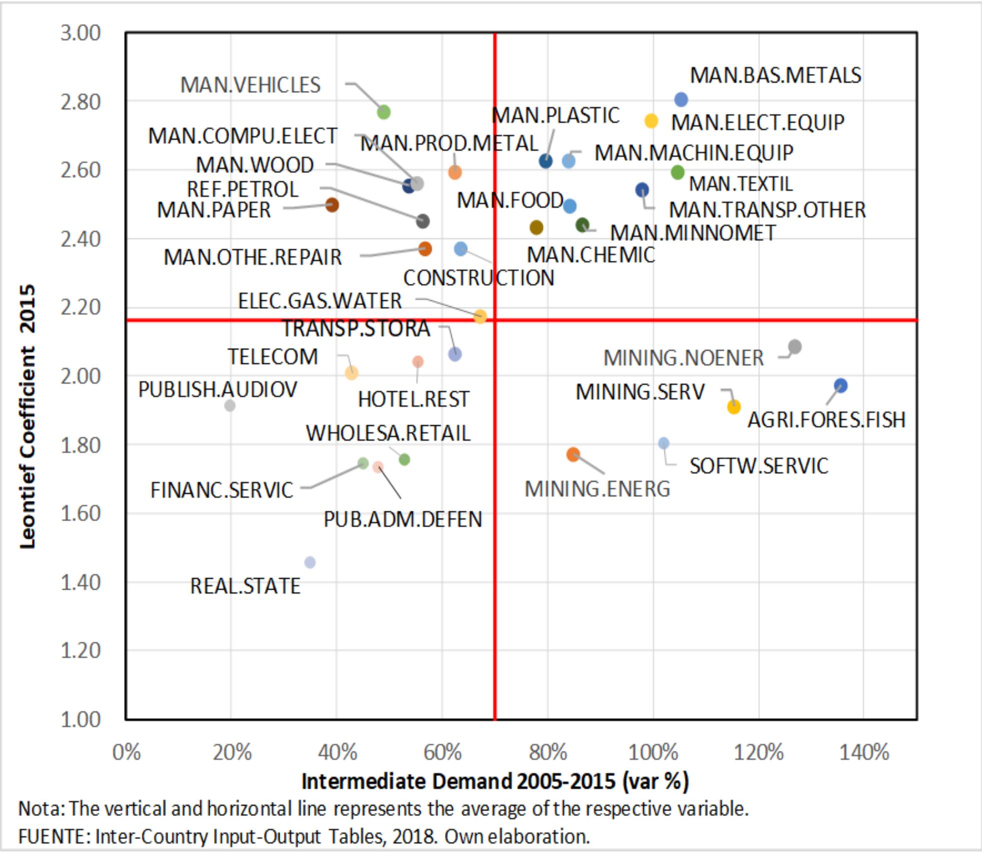
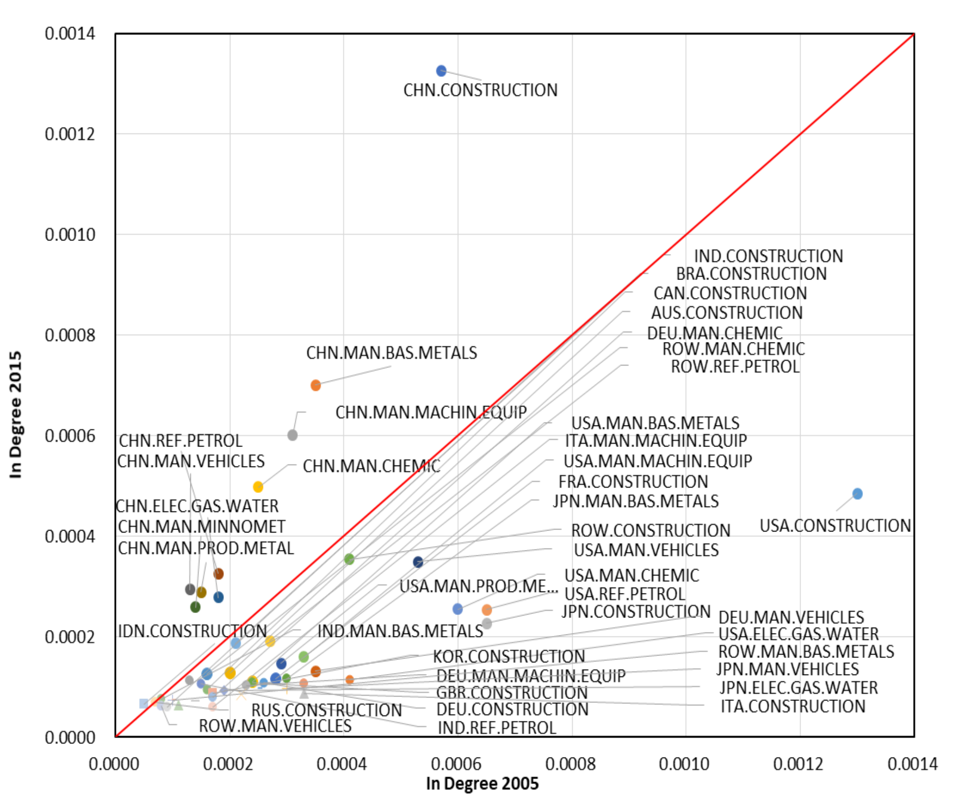


Figure 2. Intermediate demand (var %) 2005-2015 and Leontief coefficient by industries, year 2015.



FUENTE: Inter-Country Input-Output Tables, 2018. Own elaboration.

Figure 3. Input degree of industries with high mineral consumption, years 2005 and 2015.

The growth of production in the aforementioned countries-industries has been possible thanks to the increase of minerals and oil world supply in the years evaluated, and the participation of the Pacific Alliance countries becomes, hence, visible. Although these countries are not among the main global suppliers of minerals and hydrocarbons, their position does not stop to be important as oil exporters, in the case of Mexico and Colombia, or as exporters of metal minerals, in the case of Chile and Peru.

Thanks to the implementation of policies to open up to world trade and foreign investment since the 1990’s, the corresponding extractive sectors have strengthened their participation in the first links of the evaluated world production segments, except for the Mexican oil sector, which has been suffering from a production crisis as a result of the depletion of its most important deposit. Consequently, hydrocarbons supply increased in monetary value between 2005 and 2015 by 169% in Peru, 115% in Colombia, 57% in Chile and dropped to 42% in Mexico. And, regarding the supply of metal minerals, the growth has reached 107% in Peru, followed by 71% in Colombia, 70% in Mexico, and 50% in Chile.

Gephi software has been used to make the forward linkages that start from the extractive sector of the Pacific Alliance visible. Through nodes and links, it shows the sales that leave from one country-industry to another. Results appear in Figure 4, and present Colombia, Mexico, and Peru’s oil extraction connecting with Spain, the US, and China’s oil refining, and then, each of these industries is responsible for supplying their own industries network. On the other hand, the extraction of metal ores from Chile, Mexico, and Peru is linked to the manufacture of China, the US, India, Japan, Canada, and Korea’s basic metals, a sector that plays a key role in each one of the economies, since it supplies several industries radially, those that go until the manufacture of automobiles, including also that industry in Germany. Finally, the size of the node representing China's basic metals manufacturing stands out, as it is proportional to its sales, and reflects the relative growth of this industry with respect to all others.

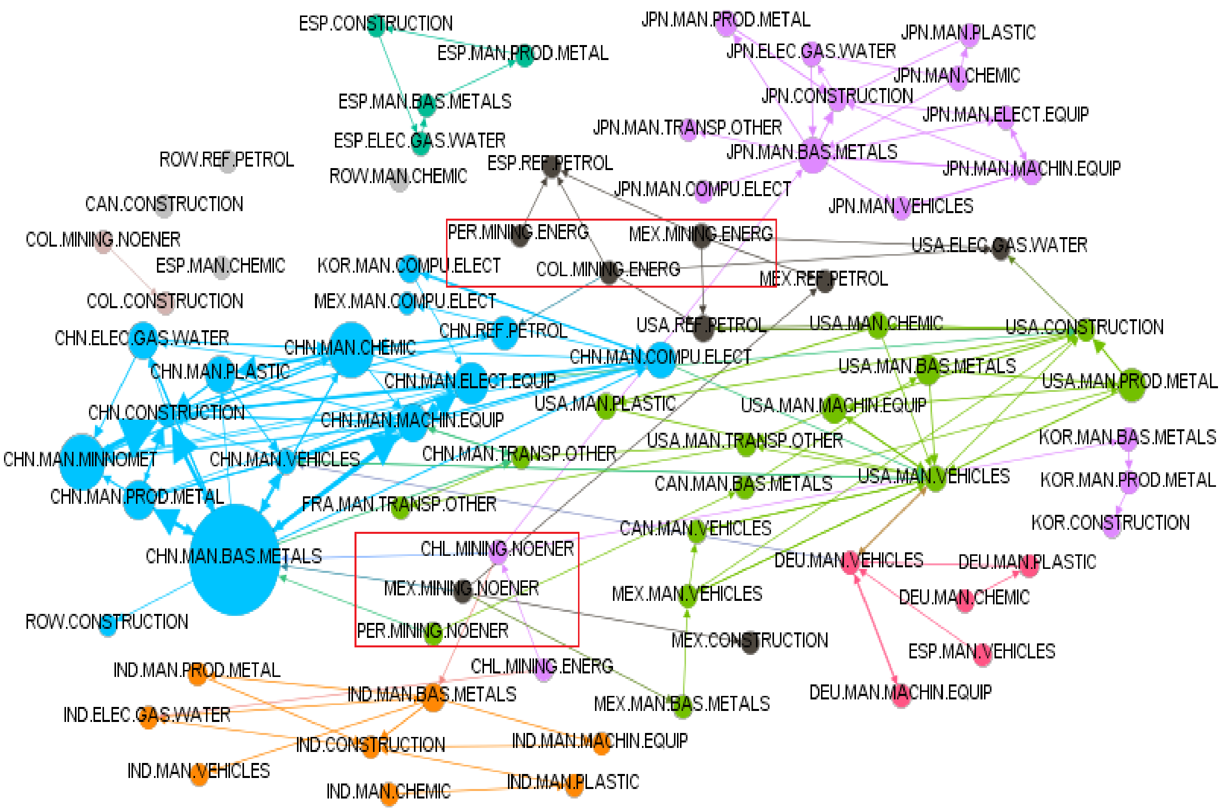
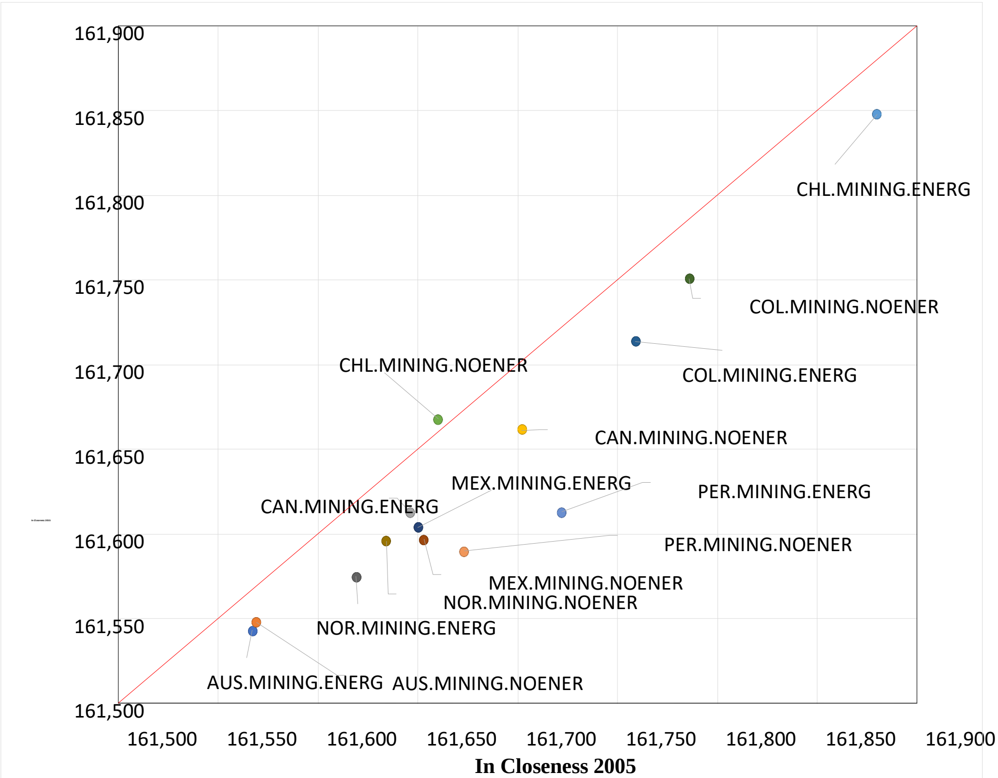


Figure 4. Participation of the Pacific Alliance in segments of world production with intensive use of minerals and hydrocarbons, year 2015. Data: OECD, 2018. Software used: Gephi 0.9.2. Own elaboration.

Besides, one way of evaluating to which extent mining extraction has a drag effect on supplier countries is by calculating its closeness index, as it has been done in Figure 5. In this case, the number of backward jumps a node which must make to reach the entire network which is being counted. Therefore, the higher the index is, the less connected the sector is, and it will not be able to transfer the impact of its growth so easily. In this figure, Australia, Canada, and Norway's mining sectors have been added as reference values for the Pacific Alliance. Although the level of connectivity has improved in almost all cases (figures in 2015 are below the diagonal), Australia and Norway's extractive industries reflect a greater production linkage, while the position of Colombia and Chile reflects the weakest linkages. Peru and Mexico's industries show a better position, although below the developed economies abovementioned.

Such weakness in the backward production linkages of the Pacific Alliance countries also appears when the extractive industry and its links with local suppliers are evaluated. This is demonstrated in the publications of Correa (2016) for Chile, Martínez and Delgado (2018) for Colombia, Pérez (2017) for México, and Barrantes, Cuenca, and Morel (2012) for Perú. The outcome is that the growth of global demand for minerals and oil does not expand backwards through market channels, and the government must create distribution mechanisms to relieve social tensions coming with the extractive activities.



FUENTE: Inter-Country Input-Output Tables, 2018. Own elaboration.

Figure 5. Closeness index of the energy and non-energy industries in the Pacific Alliance and other reference countries, years 2005 and 2015.

Environmental Instruments and Resource Rent Capture and Distribution in the Pacific Alliance

International trade and foreign investment openness policies applied in the Pacific Alliance let us evaluate the direct impact of the GVC production boom on their extractive industry, and their corresponding sustainability policies, without the complications that could arise from very closed economies.

Instruments for Weak Sustainability

In the process of transformation from natural capital into manufactured capital, the importance of mechanisms implemented by the government for capturing the resource rent stands out. In fact, this capture is made through all the taxes, duties, and contributions that extracting companies must pay, taxes coming not only from a direct tax regime, such as corporate, dividend, and in some cases, profit remittance taxes; but also those coming from an indirect tax regime, such as the value-added tax; and special tax imposed on the extractive industry. Table 1 shows a summary of the mechanisms used in the Pacific Alliance countries for capturing and distributing resource rents. Beyond the general corporate tax, regulation in these four countries includes specific taxes imposed on extractive activities. Given that in Chile, Colombia, and Mexico, the participation of government-owned companies as direct operators of wells and mines is important, their contribution to the national treasury is special. The most relevant case is the Pemex Mexican Company, which profited from the monopoly on oil extraction until 2015. In Peru, the corresponding government-owned company, Petroperu, has no extractive, only refining activities, simultaneously with transnational companies.

Table1

Resource Rent Capture and Distribution in the Pacific Alliance

	Chile	Colombia	Mexico	Peru
Resource	Mining	Hydrocarbonsand mining	Hydrocarbonsand mining	Mining and hydrocarbons
Corporate tax	27%	25%	30%	29.5%
Special taxes on extractive activities		Taxes and dividends from Ecopetrol (State owned). Oil royalties. Fees for specific reasons. Extraction fees.	Pemex dividends (State owned). Hydrocarbon extraction fees (State owned). Oil base royalty and additional royalty (private).	Oil royalty with progressive rates. Gas royalty with progressive rates.
	Tax on CODELCO (state owned). Mining royalties with progressive rates. Mining extraction license.	Mining royalties with progressive rates. Fees for specific reasons Extraction fees.	Ordinary mining fees (quota per hectare). Special and extraordinary fees on mining (percentage).	Mining royalty with progressive rates. Mining fees. Special mining tax or special mining contribution with progressive rates.
Capture scheme	Central government	Central government	Central/federal government	Central government
Distribution scheme	From 1976 to 2018, the Copper Reserve Law allocates 10% of the exports value to the Armed Forces. In 2011, the Regional Investment and Restructuring Fund (RIRF) is created. One third of the fund goes to the producing regions and two thirds to the rest of the fund. Municipalities are required to make an application for the funds.	In 2012, the National Royalties Fund is created which serves to finance stabilization funds, extractive regions, pension savings, science and technology; regional development and compensation, among others. Regions are required to post their investment projects for funds.	1. Funds for national and federal budgets. Since 2014, the Mexican Petroleum Fund has been created. 2. Special funds for producing States.	In 2004, 50% of the corporate tax *(canon)* to the gas/oil/mineral extracting region. 100% of the royalties to the gas/oil/mineral extracting region. 75% of mining fees to extractive municipalities. 100% of the special mining tax or special mining contribution with progressive rates is retained by the central government.
Expenditure regulations	Money from the RIRF must be used in regional and municipal development projects.	Although without a defined parameter, the royalty fund is used for investment projects. Special fees are used to compensate environmental and even cultural impacts.	1. They are used for balancing budgets, hydrocarbon funds, science and technology expenses, and as a reserve fund. 2. Physical investmentwith a social, environmental, and urban development impact and infrastructure projects to compensate damages caused by extraction.	100% of the amount received by the municipalities should be allocated to infrastructure and scientific & technological research in universities.

Sources: Own elaboration based on EITI (2019), PWC (2019), and Viale(2015).

As for private extraction, royalties and extraction fees are currently charged in these four countries. In Chile and Peru, since 2010 and 2011, respectively, mining royalties are imposed with progressive tax rates which are charged based on operating profits. In Colombia, oil and mining royalties are progressive, but with respect to the total value produced. In Mexico, state-owned hydrocarbon companies pay extraction fees, while private companies pay royalties, in both cases, these are progressive amounts calculated according to market prices. In mining extraction, a base fee charged at a fixed rate on profits is paid.

In these four countries, the mechanism for collecting taxes is centralized, since it is based on the principle that natural resources are owned by the nation/state, which also determines how it is distributed.

In general, if we compare the tax revenues and non-tax revenues from the extractive industry—published on ICTD (2019)—with the resource rent published by the World Bank, the amount captured from the extractive sector in 2011 is a small part of the sum theoretically estimated, 23% for Chile; 39% for Colombia; 85% for Mexico; and 22% for Peru. The high percentage in Mexico is explained by PEMEX's control over the oil extraction industry and the contribution of an important percentage of its revenues to the budget of the Mexican government. Conclusions suggest that the amount captured is less than the sum that could be charged, which agrees with the findings by Fuss et al. (2016).

Although since the end of the last century the Pacific Alliance countries have implemented trade liberalization policies with tax strategies to promote foreign investment, the strong growth of global demand for minerals and oil during the first decade of this century changed the calculation method of the resource rent to be captured and its internal distribution. In Chile in 2011, the Regional Investment and Restructuring Fund (RIRF) was created, for the centralization of the obtained royalties; in Colombia in 2012, the Royalties National Fund was created with a similar purpose; and the Mexican Petroleum Fund was created in Mexico in 2014. Regarding the destination of such funds, in Chile, the money is used exclusively for investment projects; a third of the total amount is allocated to the extractive region and two thirds to the rest of the country. In Colombia and Mexico, such funds are not only used for investment project financing and for science and technology development, but they are also a source of income for the national and federal budget, without a specific spending destination.

In the case of Peru, royalty payment was introduced for the mining sector in 2004, and in 2011, two additional alternative taxes were introduced: a special contribution for those companies that had previously a tax stability agreements or, a special tax, for those who have not. Although the collection of all these contributions is centralized, there is no specific national fund created with this money. Furthermore, since 2004, 50% of the corporate tax is allocated to the producing regions under the concept of canon, and it is then distributed in established percentages to the extractive district. In the case of royalties, 100% is allocated to the extractive region. The destination of both contributions is exclusively for infrastructure and higher education investment. However, 100% of profits from contribution or mining special tax is retained by the central government and does not have a defined expenditure item.

In fact, the structure of collection and expenditure of what we called resource rent is more complicated than what has been described in this paper, since it deals with tax regulations that have been created throughout many years, one after another, in many cases as a complement to a previous regulation and not as a substitute. Although the creation of national funds and the following allocation of a percentage to the extractive region are predominant procedures, specialized literature on fiscal decentralization does not offer any specific criteria for estimating the percentage that should be distributed inside the country (Brosio & Jimenez, 2012). The transfer to the extractive region is 1/3 of the fund in Chile, in Peru it is 50% of corporation's tax, while Colombia and Mexico have no defined percentages. What is the appropriate amount?

Nevertheless, we see that Chile, Colombia, and Mexico choose to take advantage of the efficiency benefits of centralized resources when creating national funds, thanks to potential scale economies which happen when financing national scope projects. Peru, using its distributional mechanism, has chosen an equity criterion, as the use of distributed funds, although almost atomized, would reflect better the preferences of the extraction regions.

On the other hand, in terms of the possibilities to substitute natural capital for manufactured capital allowed by law, in Chile and Peru there is a more explicit obligation to use the captured money for infrastructure investment aimed to create benefits of long-term, while in Colombia and Mexico, they prefer to guarantee the national budget balance, in the short and long term.

In general, the boom in the world production of GVCs that make intensive use of minerals and oil has forced a strengthening of the resource rent capture and distribution mechanisms in the Pacific Alliance. However, such mechanisms do not ensure resource rent transformation into manufactured capital, which would not meet the basic principle of weak sustainability.

Instruments for Strong Sustainability

In these four countries, environmental management as a national policy has gone through a process of organizational development, since it starts as the responsibility of one office within a larger entity (in some cases the Ministry of Agriculture) and years later it achieves the status of ministry. The respective ministries of environmental management were created in 1993 in Colombia, in 2000 in Mexico, in 2008 in Peru, and in 2010 in Chile. Colombia was the first one who seeks to harmonize the defense of biodiversity housed in the forests covering 52% of its territory and the rights of the 84 existing indigenous ethnic groups, with their needs for oil extraction as the country's most important source of foreign currency.

In all four countries, one of the main regulatory tools is the environmental license required for extractive investments. Although environmental licenses already existed prior to the creation of the aforementioned ministries, the economic pressure for the extraction of resources since the 1990s and the resulting conflicts forced them to change from a mere administrative requirement (MINAM, 2016) to a rule that nowadays includes control mechanisms and economic sanctions.

It has been used in Colombia since 1993, and in 2009 sanctioning regulations for non-compliance were included. The Environmental Superintendence was created in Chile, in 2010 and is empowered to sanction and suspend extraction licenses. In Mexico, a legal mechanism regulating environmental impact assessment was approved in 2000, and added in 2002 the corresponding attorney's office with the ability to sanction. In the case of Peru, in 2001 the procedure of environmental impact assessments was standardized, which was before defined independently by each ministry, in 2008 powers were given to the regional authorities for their approval, and in 2010, auditing and sanctions are standardized.

The growth of GVCs that make intensive use of minerals has also intensified conflicts of environmental and social origin in the countries evaluated. If the risk of environmental conflict is already linked to the extractive activity, this problem is intensified by a social component, mostly as a result of the gap between labor and productive capacities prevailing in the area versus those capacities that are required by the extracting company. Then, both the absorption of local labor by the companyand the supply of local goods and services are very limited. Thus, there is no production linkage established, which do exist in integrated economies enabling the corresponding creation of market channels that facilitate income distribution, at least better than the one given in our study cases. The result is a potential social conflict, which is even more acute when it comes to indigenous peoples who, prior to the extractive boom, were already among the poorest population in the country.

In this context, prior consultation was incorporated in the legislation of the evaluated countries as a mechanism to allow indigenous or native population to be taken into account in any legislative or administrative measure that the government intends to approve and which affects them directly, putting into practice the regulations included in the ILO-convention 169, held in 1989. Thus, in 1993 in Colombia prior consultation was included in the legislation that organizes the Environmental Management System, and in 1998, it was implemented. It is worth mentioning that in 2015 a new requirement was added; companies were compelled to develop and execute a social management plan with programs and projects approved by the corresponding authority, a rule that is not found in the rest of the countries. In 2003 in Mexico, the law creating the National Commission for the Development of Indigenous Peoples where prior consultation is included was approved. In 2013, a protocol for its implementation was declared. In Chile, this mechanism is introduced in 2008 and regulated in 2013; while in Peru law was approved in 2011 and established in 2012 (Freire & Perez Serrano, 2016).

These rules show the creation of the government's regulatory tools, still weak in implementation, in the attempt to allow the use of natural resources in benefit for the entire nation, but ensuring the sustainability of the various environmental services towards the society as a whole, with emphasis on the most vulnerable populations, who lack their own defense mechanisms to encounter environment deterioration.

Conclusions

As minerals and oil are basic industrial inputs, they participate in several production segments comprising various GVCs. However, in the evaluated period, construction industry stands out for its largest purchase volume, and vehicle manufacturing industry stands out for its high level of linkage. Thanks to their drag capacity, both industries have gathered intermediate industries, such as the chemical industry, and metal manufacturing, among others, to consume the basic raw material, thus strengthening the extractive activity of various global suppliers.

Countries whose industries have exercised the role of largest direct buyers of minerals and oil have been China, Korea, USA, India, and Japan, while the Pacific Alliance countries are among the most important suppliers of such demand. Although foreign demand impulse should have favorable effects on the connected industries, the low level of linkage shown by the closeness index reveals that this demand benefits were not contagious enough to other industries, which reduces the distributional impact of growth through market channels. This low linkage occurs even the level of the industry located in the extraction area, creating, on the one hand, possibilities of growth in the country's aggregate accounts, but, on the other hand, with social tensions at a district level, as a part of the nearby population cannot benefit from extractive activities.

Therefore, the government is obliged to create instruments of resource rent capture and apply distribution mechanisms, replacing to a certain extent the market channels. Although the four countries evaluated receive royalties for mining and oil activities, in Chile, Colombia, and Mexico the creation of national funds predominates, in which the item of expenditure is not necessarily the productive investment, and the territorial destination is partly the extraction area. Only in the case of Peru, regulation requires the use of money in investments generating future income and with a specific territorial allocation. One effect of such policy in this country is an income inequality intensification in subnational budget at a territorial level and the investment atomization in provincial and district scale projects.

On the other hand, the extractive boom of the 1990s forces the government of the countries evaluated to add regulations that reduce environmental degradation as a purely administrative requirement first, but then sanctioning bodies were added, thus strengthening their application. Regarding the protection of the rights of the most vulnerable populations located in the extraction areas, although there has been a progress in establishing the corresponding rules, their real empowerment is still under construction.

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