"We are What we Do." The Added Value of Exports from Colombia and Valle del Cauca 2016*

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Abstract

This paper presents the calculation of added value for exports from Colombia and Valle del Cauca in 2016 through the use of input-output matrixes. The findings show that the added value of Colombian exports, measured as a percentage of the total value of exports, was 86.5%. For Valle del Cauca, this indicator was 60.9%, reflecting a greater industrial and agro-industrial vocation that demands more inputs, both domestic and imported. The productive sector whose exports contributed the most added value to the economy of Valle del Cauca was food products. Among the main challenges, in terms of public policy and business development that stem from this study, are the consolidation of more integrated regional economies and the attraction of foreign direct investment in sectors that stimulate the production of intermediate goods.

Keywords: Productive chains; global value chains; input-output matrix; international trade.

"Somos lo que hacemos". El valor agregado de las exportaciones de Colombia y Valle del Cauca 2016

Resumen

Este documento presenta el cálculo del valor agregado para las exportaciones de Colombia y Valle del Cauca en 2016 mediante el uso de matrices de entrada y salida. Se encontró que el valor agregado de las exportaciones colombianas, medido como un porcentaje del total del valor de las exportaciones fue del 86.5%. Para el Valle del Cauca, este indicador fue del 60.9%, lo que refleja una mayor vocación industrial y agroindustrial que exige más insumos, tanto nacionales como importados. El sector productivo cuyas exportaciones aportaron el mayor valor agregado a la economía del Valle del Cauca fueron los productos alimenticios. Entre los principales desafíos, en términos de políticas públicas y desarrollo empresarial que se derivan de este estudio, se encuentran la consolidación de economías regionales más integradas y la atracción de inversión extranjera directa en sectores que estimulen la producción de bienes intermedios.

Palabras clave: cadena productiva; cadenas globales de valor; matriz de entrada y salida; comercio internacional.

"Somos o que fazemos". O valor agregado das exportações da Colômbia e Valle del Cauca 2016

Resumo

Este documento apresenta o cálculo do valor agregado para as exportações da Colômbia e Valle del Cauca en 2016 mediante o uso de matrizes de entrada e saída. Encontra-se o valor agregado das exportações colombianas, medido como uma percentagem do valor total das exportações foi de 86.5%. Para Valle del Cauca, este indicador foi de 60.9%, o que reflete uma maior vocação industrial e agroindustrial que exige mais insumos, tanto nacionais quanto importados. O setor produtivo cujas exportações aportaram i maior valor agregado à economia de Valle del Cauca foram os produtos alimentícios.

Entre os principais desafios, em termos de políticas públicas e desenvolvimento empresarial que se derivam deste estudo, encontram-se a consolidação de economias regionais mais integradas e a atração de investimento estrangeiro direto em setores que estimulam a produção de bens intermédios.

Palavras-chave: cadeia produtiva; cadeia de valor global; matriz de entrada y saída; comercio internacional.

Introduction

Since the analysis of economic relations between nations began, the causes, consequences, and patterns of international trade have been topics of special interest. Currently, there is general consensus on the importance of commercial activity for economic development of countries and their regions; nevertheless, diverse visions coexist on the degree and mechanisms through which it should be planned and regulated.

Recurrently, economic and political analysts call attention to trade balance figures, dynamism of export activity, and degree of integration of a country's or region's productive structures with international markets. In addition to trade in raw materials, inputs, final goods, new communication technologies, and greater connectivity have made the supplying of business and personal services an increasingly important feature in modern economies; thus, expanding the possibilities of integration between countries and remote regions.

Hence, commercial integration, flow of capital as foreign investment, and geographical fragmentation of production processes have led to the emergence and consolidation of multinational companies in the last two centuries, which are supplied from various countries and serve various markets made up of hundreds and even billions of consumers. This model has evolved and has been consolidated by the success of technology and service companies.

The process of economic integration has contributed exceptionally to the consolidation of the so-called phenomenon of globalization, which covers, in addition to international trade, higher levels of cultural, political, and ethnic integration between countries and regions.

From the point of view of economic integration, globalization has represented for companies not only the expansion of potential markets, but also greater possibilities to obtain the supply of raw materials, access to knowledge, technologies, capital, and land to carry out productive activities. The challenges that companies have had to overcome this new reality range from obvious logistics challenges of global operations to the need for cultural adaptation in new markets.

This paper presents a concise analysis of the main theoretical approaches on the importance of international trade for modern economies, emphasizing the concept of Global Value Chains (GVCs). It also includes an analysis of the export structure of Colombia and Valle del Cauca, a fundamental input for estimating the added value of exports.

Taking some theoretical and applied works as references that show how regional and national economies can benefit from their articulation into the global production and commercialization cycles, it is confirmed that the export structure of Valle del Cauca stands out in the national context due to its diversity and relatively higher level of technological intensity.

Based on official DANE[1] information on the Input-Output Matrix (IOM) and external sales, we estimated the added value of exports for Colombia and Valle del Cauca in 2016. Both the Colombia and Valle del Cauca IOM quantify the interdependence of various sectors, reflecting the existing productive linkages, as well as the added value of each sector. With this information, the Leontief Matrix was built, and then we measured through its technical coefficients the value of production associated to each one of the demand components for each sector, i.e., investment, intermediate consumption, and net exports.

The latter was achieved through a three-stage process. First, the multiplication of the Leontief Matrix and the Diagonalized Exports Matrix is performed. Subsequently, the vector of technical value-added coefficients for the Valle del Cauca economy is calculated, that is, the contribution of each sector to the generation of the total gross value of each of the productive sectors is identified. Finally, a new multiplication is done between the resulting matrix from the operation of the initial stage and the diagonalized value-added matrix, which generates the export added value associated with each productive sector.

The conclusions and policy recommendations derived from this work point to the implementation of an ambitious technological development agenda aimed at taking advantage of international markets to connect the national and Valle del Cauca production structures with more demanding markets. In this context, the main productive chains, regional clusters and technology-based startups are ideal to lead the process of integration with the GVCs through design, patentable inventions, assembly, production, brand management,

1 National Administrative Department of Statistics. (Spanish: Departamento Administrativo Nacional de Estadística).

and marketing of more sophisticated goods and services that have greater technological intensity in their processes.

1. Conceptual Framework and Applied Studies

The importance of international trade on the economic development of countries has been widely analyzed by several generations of businesspersons, politicians, and economists. From the mercantilist perspective (sixteenth century to part of the seventeenth century), several theorists identified as a relevant aspect the understanding of the causes, consequences, and patterns of international trade. This current of thought established the economic objective of a nation to ensure a trade surplus, since the difference between the value of exports and imports was liquidated in precious metals, a balance that represented the increase of its wealth. For this reason, the main economies during the rise of colonialism promoted great commercial dynamics in the context of implementing drastic protectionist measures.[2]

Mercantilism considered international trade as a zero-sum game, that is to say, an activity in which the economic gain of one country came from the economic loss of another (Hill, 2015). For this reason, the main economies adopted policies to boost their exports of manufactured goods and raw materials independent of their productive efficiency, leading to the promotion of production in each country of everything that was technically possible, even if another producer in another country could do it with better quality or productivity standards.

Classic authors such as Adam Smith and David Ricardo offered a different perspective on mercantilism, arguing that international trade is an economic activity where all parties involved may benefit, provided they specialize in those activities in which, according to their level of relative productivity, they could have advantages versus their commercial partners.

2 Among the main exponents of mercantilism is Thomas Mun (Spiegel, 1991).

For Smith (1776), the wealth of nations depends on the abundance of inputs and low production costs associated to some sectors. Countries should, therefore, specialize in producing and exporting those raw materials and goods in which they have an *absolute advantage*, that is, it costs them less to produce, and they should import raw materials and goods from other countries where they are produced at a lower cost. Ricardo (1817) extended this concept and explained that a country should specialize in producing those goods in which it has a lower *opportunity cost* compared to other trading partners, e.g., those goods in which it has a *comparative advantage*, a condition determined by the relative productivity of the factors.

For Hechkscher (1919) and Ohlin (1933), the *comparative advantage* that a country may develop is associated to the way in which it takes advantage of its production factors (land, labor, and capital). Thus, a country's relative endowment of factors determines its exporting vocation; ergo, it specializes in the production and export of goods whose production processes are intensive in the use of factors that are relatively more abundant. For example, countries with naturally abundant arable land will have an export basket mainly made up of agricultural products, benefiting from international trade by being able to import capital-intensive goods.

Similarly, Helpman (1988) and Matsuyama (1992) emphasize that in the context of an open economy, countries tend to specialize in those sectors where they have comparative advantages derived from their endowed factors, regardless of their growth potential, so that their economic performance is higher than they would have in a closed economy context.

The so-called new international trade theory of Krugman (1991) highlights the importance of large-scale production of industrial and agricultural goods to meet a growing and diverse global demand. The fundamental elements of Krugman's approach emphasize that modern companies include in their strategic process the evaluation of several global location alternatives with the objective of producing at lower costs and serving larger markets. Therefore, the greater dynamism of international trade registered after Second World War has led to the consolidation of successful global business models characterized by the geographical fragmentation of financing, design, production, marketing, sales, distribution, and support processes.

The rise of these business models generated the concept of GVCs, which, as noted by Antràs and De Gortari (2017), have significantly transformed the international organization of production processes to the point that a modern commercial policy is based on identifying what are the objectives of a country or region in terms of achieving a certain role and degree of insertion in some of these chains.

The geographical fragmentation of production processes articulates several production units located in various countries in such a way that each one contributes its best capabilities to the process, reaching an efficient productive cycle as a whole. A conventional reference to explain how GVCs operate corresponds to the modern production process of an aircraft or a car, since the different inputs require parts and various engineering, marketing, and sales tasks are carried out in an articulated manner by different agents located in different parts of the world.

In addition to evaluating the relationship between international trade operations and the economic growth of countries, economic theory has also focused on identifying the influence of the export structure of a country or region on its level of development. Authors such as Bhagwati and Srinivasan (1979), Feder (1983), and Kohli and Singh (1989) emphasize that exports play an important role in the development of a country to the extent that they originate productive linkages and induce higher levels of productivity due to their exposure to international competition.

In this way, understanding structural aspects and commercial dynamics constitutes a fundamental input in the design of a successful economic policy. For Hausmann and Klinger (2006) and Hwang (2006), economic growth and structural change are closely related to the products exported by a country. Greenaway, Morgan, and Wright (1999) show evidence of the importance of the export structure in itself and to economic growth. Levin and Raut (1997) point out that a greater proportion of industrial products in the total exports stimulates the economic growth of a country.

In this context, Lederman and Maloney (2012) call attention to the importance of quantifying what is actually exported by a country, highlighting that modern commercial relationships correspond to the geographical distribution of tasks. The authors argue that:

> In the era of globalized production, [...] the multiple segments of the production process are carried out in different countries. It is possible that the findings regarding the different production technologies, and the different degrees of knowledge generation in the computer industry, for example, are not due to various production processes but to the fact that countries like Mexico are simply providing the last stage of the production process that, in fact, is not the one related to qualified work or generation of patents. Producing the last computer assembly stage may appear in the commercial statistics as export of high technology goods, but the reality is that the value added to this export is derived from unskilled labor that could perfectly be dedicated to assembling shoes (p.97).

Hence, China is a contemporary reference of the classic vision of international trade, since its competitive advantage in diverse sectors that are labor intensive, an abundant productive factor in this Asian country that is less expensive than in the main economies of the world, has allowed great dynamism in light manufacturing sectors. However, it must be established that the greater participation of a country in manufacturing goods represents greater generation of wealth and balance of the current account since the total balance of exports does not do so in an accurate manner. Thus, it is necessary to identify the added value generated from the productive tasks performed in the tradable sectors of a country or region before evaluating how these activities contribute to their economic development.

1.1. Empirical Evidence

Determining the economic benefit associated with the articulation of the national productive apparatus with the GVCs requires identifying what type of products or activities are needed in these processes and quantifying the added value provided by the related companies in each stage.

Various estimates (international and national) have been done to calculate the added value associated with exports made by regions and countries. In the international context, the most recurrent example is electronic products' and other mobile device's manufacture in China, which exports them to the rest of the world. Dedrick, Kraemer, and Linden (2009) emphasize the high level of technological intensity required in this type of activities, carried out through geographically fragmented production processes and extensive value

chains. Chinese companies participate mainly in assembly activities, and not in design, engineering, logistics, and marketing, therefore, exports of these goods represent low levels of added value.

Koopman, Wang, and Wei (2008), to find out how much of what China exports is "made in China", estimated for 2002 the domestic added value in exports of high-tech manufacturing, such as computers (4.6%), telecommunications equipment (14.9%), and office equipment (19.1%). In contrast, Chinese exports of basic products such as coke, cement, and other mineral products exceed 80% of domestic added value, which is explained by the extractive or low technological intensity activities that are mainly carried out using local labor without high qualification and a non-tradable resource such as land. The domestic added value for total manufacturing exports in China was 53.9% in 2002.

Blyde (2014) carried out an analysis for Latin America, estimating the region's participation in global value chains. He concluded that, although the region is not outside of international integration, it has not taken advantage of the boom in geographical fragmentation of production processes because these countries concentrate their exports on basic raw materials and natural resource-intensive goods.

Fujii and Cervantes (2013) carried out for Mexico an estimate of the value added in manufacturing exports by sectors for 2003. The results highlight that, although Mexican external sales had extraordinary growth in the last decades, its contribution to national economic growth was weak: the domestic added value contained in total Mexican exports was 55% and for manufacturing exports 42%, in that same year.

Hernández (2012) developed an input-output model to study the composition of the added value of Colombian products in 2007. It highlights that the oil, chemical, plastics, electricity and gas, and transport and communications sectors have a great influence on the rest of the national economy's supply and demand. Hernández (2014) measured the degree of vertical specialization of Colombian exports determining that on average the imported added value component of exports was 9.6%. This study identified the decrease of vertical specialization as a consequence of the increase in production of basic products and the global recession, but not because of the linkages that have been created with the GVCs of greater productive complexity.

Argüello, García, and Valderrama (2013) highlight that Colombian exports correspond predominantly to intermediate inputs, especially of basic products such as oil and coal, while imports present an opposite pattern, concentrated on final products.

Gilles (2015) characterizes Colombian exports according to the generated and benefited[3] added value, resulting from an analysis of the input-output matrix and the exported value. It was identified that 79.4% of the value of Colombian exports in 2013 correspond to value added in the national territory, reflecting a low level of integration in GVCs and a low share of manufactured final products in total exports.

A review of the literature did not identify the existence of applied works which quantify the domestic added value of exports from the Colombian departments. Thus, the present research is a first approach to measuring the added value of Valle del Cauca exports through the regional IOM.[4] Also, Gilles (2015) updated to 2016 the work done for Colombia in 2013 with some variations in methodology.

In the case of Colombia, there are few studies that have been done to evaluate the articulation of the national economy to the GVCs or estimate the added value of its exports. Esguerra and Parra (2016) consider the low participation of Colombia in these chains as a symptom of low export performance. Based on the calculations of the United Nations Conference on Trade and Development (UNCTAD) for 2011, the authors constructed a total GVC participation index according to which Colombia ranked 46 out of 50 economies with a share of 37.9%.[5]

Additionally, this study breaks down the added value contained in Colombian exports between internal and external,[6] revealing that 53.2% of internal added value comes from the primary sector, 16.4% from the industrial sector, and 22.8% from the services sector,

3 Generated added value is that which the sector produces directly, and the benefited one is the added value it receives from exports made by other sectors.

4 Symmetrical Input-Output Matrix for Valle del Cauca 2005 at constant 2005 prices (Duque et al., 2013).

5 This calculation was done by products using TiVa Database. The economy in first place of the Index was Luxembourg with a share of 70.8%.

6 In the research, external is defined as backward participation to exports that generate added value with external inputs, which are exported. Internal is considered forward participation that refers to the fact that part of the internally generated added value is exported.

while the external added value in these same sectors was 1.3%, 2.9%, and 3.4%, respectively. This reflects a low level of articulation into the GVCs by the Colombian economy considering the use of local raw materials and inputs, low technological intensity, and reduced levels of transformation.

This is how the estimate of added value contained in Colombia and Valle del Cauca exports is relevant in guiding articulated efforts that seek greater competitiveness in international markets. The following section presents a descriptive analysis of the recent dynamics of foreign trade in Colombia and Valle del Cauca with the aim of understanding, in general, what the structure of the export basket is before estimating its added value.

2. Methodological Aspects for Estimating the Added Value of Exports

This research presents an estimate of the added value of exports based on the symmetric input-output matrix published by DANE for 2010[7] and the value of 2016 national exports classified by sector according to the System of National Accounts (SNA): IOM from 61 sectors in Colombia and IOM for 37 sectors in Valle del Cauca. This allows for an approximation to the generated added value by export sectors and the added value for the sectors that participate in the production processes of exporting sectors as exporters. In this second case, the benefited added value was reported.

It should be mentioned that there are few departmental IOM calculations available. In this paper, the calculation for Valle del Cauca is done with the available IOM for 2005.

Following the approach of Kozikowski (1988) on the composition of Gross Production Value (GPV) from demand,[8] this equation is presented:[9]

7 Base 2005 at current prices. Latest IOM available.

8 The GPV from supply would be: $GPV_j = \sum_i IC_{ij} + S_j + (TT - SS)_j + MI_j + GOS_j$

9 The subscript *i* generally represents the rows and the subscript j the columns.

$$GPV_i = \sum_j IC_{ji} + FD_i \quad (1)$$

Equation (1) is the mathematical representation of the matrix structure of the system of national accounts that DANE publishes, the production being the sum of intermediate consumptions plus final demand. The concepts are defined as:

GPV_i = Gross Production Value of sector i

IC_{ij} = Sales of goods i, to the various sectors j so that they may be used as inputs in their production processes

FD_i = Final Demand for goods of sector i

The term is the Intermediate Consumption of the goods i done by sector of activity j, defined as:

$$IC_{ij} = a_{ij} GPV_j \quad (2)$$

Where the term a_{ij} is the technical coefficient or constant ratio of input i needed to produce the goods j. Also called the matrix of technical coefficients, which is obtained by dividing all the corresponding elements to the intermediate consumption quadrant IC_{ij} from the matrix among its corresponding GPV_j:

$$a_{ij} = \frac{IC_{ij}}{GPV_j}^{10} \quad (3)$$

In this way, equation (1) can be rewritten as:

$$GPV_i = a_{ij} GPV_j + FD_i \quad (4)$$

10 Similarly, the *AV* technical coefficient of each sector can be calculated by dividing it by its corresponding $GPV \frac{AV_j}{GPV_j}$; thus, all the technical coefficients for the components of the *AV* quadrant.

Naming X to GPV_j, D to FD_i and A to the square matrix of technical coefficients a_{ij}, equation (5) is obtained with its corresponding matrix dimensions:

$$X_{61x1} = A_{61x61}X_{61x1} + D_{61x1} \quad (5)$$

[11]

Clearing, the following is obtained:

$$X - AX = D \quad (6)$$

X is multiplied by the identity matrix, obtaining:

$$IX - AX = D \quad (7)$$

Factoring algebraically:

$$(I - A)X = D \quad (8)$$

To clear the X matrix in equation (8), the inverse matrix must be calculated $(I - A)^{-1}$, known as the Leontief Inverse Matrix (1936) or coefficient matrix for direct and indirect requirements per final unit of demand; hence, allowing the analysis of sectorial interdependence through the linkages among the various productive sectors.

Once the inverse is calculated, the following is obtained:

$$X = (I - A)^{-1}D \quad (9)$$

At this point, it is possible to disaggregate vector D of equation (9) into its domestic (d) and external (e) component.

Therefore, equation (9) can be expressed as:

$$X = (I - A)^{-1}(D_d + D_e) \quad (10)$$

11 The matrix and vector dimensions are given by the number of sectors available for the case of Colombia (61). For Valle del Cauca the matrix is reduced to 37 sectors.

Where:

D_d = *domestic demand (final consumption expenditure, gross capital formation and import adjustments)*

D_e = *external demand (exports)*

Naming $(I - A)^{-1}$ as M and applying matrix multiplication, equation (10) becomes:

$$X = MD_d + MD_e \quad (11)$$

From the supply side, each sector's *AV* is represented as a proportion of GPV. Thus, the technical coefficient of *AV* is calculated as explained in the reference of equation (3).

This vector of *AV* coefficients as a proportion of GPV will be called vector v of size 1x61, which multiplies the equation (11) in the following form:

$$vX = vMD_d + vMD_e \quad (12)$$

We know that $v = \frac{AV}{GPV}$ and $X = GVP$ and Therefore, equation (12) takes the following form:

$$AV = vMD_d + vMD_e \quad (13)$$

As expressed by Gilles (2015), equation (13) allows the separation of the domestic and foreign market effects, the latter providing information on the impact of exports in the generation of *AV*. In this way, an increase in exports of a certain sector will be reflected in the increase of demand for intermediate inputs.[12]

In turn, the first component of equation (13) may be affected by the technical coefficient of *AV* to identify those domestic productive sectors that benefit from the economy's

12 Unlike Gilles (2015), this document worked with the 61 sectors of the IOM (including services), although the only information available was on goods exports.

exports. This measure, as Gilles (2015) called it, is the *AV* in sector *i* associated with the total exports:

$$AV_iX_i = v_i \sum_j m_{ij} d_j^e \quad (14)$$

Similarly, the following equation allows analyzing the sectors that generate more domestic *AV* in the entire economy as a result of sector *j* exports:

$$AV_iX_j = d_j^e \sum_i v_i m_{ij} \quad (15)$$

Equations (14) and (15) calculate the exports added value (*AVX*) for Colombia and Valle del Cauca in 2016.

3. Added Value of Colombian Exports

The total current local currency value of Colombian exports in 2016 was $96.9 billion,[13] which were classified by sector (table 1). Applying the above methodology, the added value (AV) that these exports generated was calculated in each sector, AV_iX_j and *AV*, that each domestic sector received as a benefit of exports from other sectors of the economy AV_iX_i.

As a result, the AV of Colombian exports corresponded to 86.6% of the total exported in 2016. The sectors that most domestic AV contributed to the national total were crude oil, natural gas and uranium and thorium minerals, a sector that also had the highest figure for external sales. 97.3% of the total exported by this sector generated AV (AV_iX_j). This result is consistent considering that the productive processes related to these industries employ relatively few imported inputs.

The results also show the benefit received by some sectors of the economy that did not have foreign trade information related to services, but that benefited from the export of

13 Equivalent to USD 31,757 billion.

goods in the rest of the economy. This is the case of sectors such as services to companies except financial and real estate services (SNA 53).

For the chemicals and chemical products sector (SNA 28), its exports generate a higher AV than that generated by the exports of the rest of the sectors that use these products as inputs. In contrast, the exports of live animals, animal products and products from hunting (SCN 3) generate a lower AV than the one generated by other sectors that use these products as inputs (table 1).

Table 1. Added Value for Colombia According to Generating Export Sector and Benefited Domestic Sector, and TX* of Goods (COP billions)

SNA	Products	AViX(j) generating export sector	AViX(j) benefited domestic sector	TX	AViX(j)TX
01	Coffee products	0	5,814	0	-
02	Other agricultural products	6,691	6,417	7,586	88.2%
03	Live animals, animal products and products from hunting	200	517	230	86.8%
04	Silviculture products, wood extraction and related activities	73	113	81	90.3%
05	Fishing products, aquaculture and related services	39	49	44	88.4%
06	Coal	12,492	10,190	13,328	93.7%
07	Crude oil, natural gas and uranium and thorium minerals	26,032	27,140	26,762	97.3%
08	Metallic minerals	107	1,218	118	90.7%
09	Non-metallic minerals	457	579	494	92.5%
10	Meat and fish	569	73	680	83.6%
11	Animal and vegetable oils and fats	806	360	1,109	72.7%
12	Dairy products	14	15	17	84.7%
13	Grain milling products, starch and its products	334	198	494	67.6%
14	Coffee and threshing products	7,489	918	8,159	91.8%
15	Sugar and jaggery	740	340	836	88.5%
16	Cocoa, chocolate and confectionery products	833	256	1,112	74.9%
17	Food products	351	134	480	73.1%
18	Beverages	50	47	61	81.6%
19	Tobacco products	17	8	20	82.8%
20	Natural textile fibers, yarns and threads; textile fiber fabrics, incl. plush	169	147	240	70.5%
21	Textile articles, except clothing	373	249	473	78.8%
22	Knitted and crocheted fabrics; clothing	1,107	549	1,437	77.0%

SNA	Products	AViX(j) generating export sector	AViX(j) benefited domestic sector	TX	AViX(j)TX
23	Tanning and leather preparation, leather and footwear products	405	195	544	74.5%
24	Wood, cork, straw and plaiting material products	52	80	60	85.4%
25	Paper products, cardboard and its products	608	357	846	71.9%
26	Editing, printing and similar articles	174	180	222	78.6%
27	Oil refining productus; nuclear fuel	6,482	4,372	6,971	93.0%
28	Chemical substances and products	5,817	3,491	8,389	69.3%
29	Rubber and plastic products	1,036	527	1,652	62.7%
30	Non-metallic mineral products	829	565	999	83.0%
31	Basic metallurgical products (except machinery and equipment)	5,801	2,768	7,275	79.7%
32	Machinery and equipment	924	506	1,368	67.5%
33	Other machinery and equipment	1,040	488	1,587	65.6%
34	Transportation equipment	564	96	1,850	30.5%
35	Furniture	174	91	219	79.2%
36	Other manufactured goods	331	185	417	79.3%
37	Waste and scrap	698	1,361	698	100.0%
38	Electrical energy	21	873	22	94.3%
39	Household gas	0	82	0	-
40	Water	0	68	0	-
41	Construction, building construction and repair and equipment with operator rental services	0	28	0	-
42	Construction, civil construction work and equipment with operator rental services	0	407	0	-
43	Commerce	0	2,114	0	-
44	Repair services for motor vehicles, personal and household goods	0	630	0	-
45	Accommodatios, food and beverage services	0	262	0	-
46	Land transportation services	0	1,902	0	-
47	Waterway transport services	0	17	0	-
48	Air transport services	0	54	0	-
49	Complementary and auxiliary transport services	0	470	0	-
50	Mail and telecommunication services	0	234	0	-
51	Financial intermediation, insurance and related services	0	1,356	0	-
52	Real estate and housing rental services	0	635	0	-
53	Services to companies except financial and estate services	0	3,827	0	-
54	Public administration and defense; management and control of social security system	0	0	0	-
55	Market teaching services	0	5	0	-

SNA	Products	AViX(j) generating export sector	AViX(j) benefited domestic sector	TX	AViX(j)TX
56	Non market teaching services	0	0	0	-
57	Market social and health services	0	0.8	0	-
58	Sewage and waste disposal services, sanitation and other environmental protection services	0	37	0	-
59	Market association and entertainment, cultural, sport services & other services	0	301	0	-
60	Non market association and entertainment, cultural, sport services & other services	0	0	0	-
61	Domestic services	0	0	0	-
TOTAL		**83,897**	**83,897**	**96,880**	**86.6%**

*Total exports

Source: Own calculations based on DANE.

The ten sectors that generated the highest AV as a total of their external sales (AV_iX_j) represented 59.3% of the exported value in 2016 and 65.1% of the total generated AV. In the waste and scrap sector (SNA 37), the total value exported in 2016 corresponded to 100% AV. In the case of the basic metallurgical products sector (SNA 31), it had considerable AV as a domestic sector that benefited from exports and other production sectors ($2,8 billion) and 79.7% of the total value of its exports corresponded to generated AV.

Some production sectors are widely benefited by the export activity of other sectors. Among these are the services sectors or the non-decaffeinated unroasted coffee sector that, despite not having exports, captured a high AV due to the external sales made by other sectors. In the specific case of non-decaffeinated unroasted coffee, its production requires mainly labor and few intermediate inputs; however, as an intermediate input, it is important for sectors with a high exporting vocation, such as coffee and threshing products.

For the most part, sectors with a high AV export products classified as natural resources or raw materials and intermediate consumption goods for industry,[14] reflecting a concentrated participation for Colombia with basic products such as mining, oil and its derivatives in the production processes of the GVCs.

14 Classification by Economic Use or Destination (CUODE in spanish).

The ten sectors that generate the most AV represented 88.2% of the total generated AV. Among the departments that most exported products from these sectors are Antioquia, Cesar, and Bogota. The main departments benefiting from the export activity in the higher added value sectors are Antioquia, Cesar and La Guajira.

When performing this analysis exclusively for the manufacturing sectors, Valle del Cauca ranks as the third department with the highest generated added value in its exports, as well as the third in terms of the benefited AV due to the export activity of the total national economy.

4. AV of Valle del Cauca Exports

Using the IOM tool adapted to Valle del Cauca[15] and the same methodology with which the analysis was done for Colombia, the AV of the department's 2016 exports was estimated. This regional matrix groups the 61 sectors of the SNA into 37, and details for each sector the generated AV as a result of exports, and the AV of domestic sectors benefited by the remaining exports. Valle del Cauca exported $5.8 billions in 2016[16] of which 60.9% was AV; the sector that generated the most AV and earned substantial profit was food products (table 2), a sector that includes the manufacturing of confectionery and coffee products, among others.

Table 2. Added Value of Valle del Cauca According to the Generating Export Sector and the Benefited Domestic Sector, and TX* of Goods (COP billion) – 2016

SNA	Products	AViX(j) generating export sector	AViX(j) benefited domestic sector	TX	AViX(j)TX
01	Non-decaffeinated unroasted coffee	0	59,031	0	-
02	Other agricultural products	47,589	202,742	75,538	63.0%
03	Live animals, animal products and products from hunting	1,359	6,151	2,172	62.6%
04	Silviculture products, wood extraction and related activities	5,968	8,072	6,249	95.5%
05	Fishing products, aquaculture and related services	37	207	38	96.1%

15 IOM 2005 (Duque et al., 2013).

16 Equivalent to USD 1,984 billion.

SNA	Products	AViX(j) generating export sector	AViX(j) benefited domestic sector	TX	AViX(j)TX
06	Mining products	54,554	44,294	86,992	62.7%
07	Meat and fish	11,694	5,315	23,209	50.4%
08	Dairy products	318	4,095	436	73.0%
09	Grain milling products, starch and its products	181,270	80,833	229,194	79.1
10	Sugar and jaggery	414,222	245,990	567,931	72.9%
11	Food products	924,952	517,458	1,337,453	69.2%
12	Beverages	1,234	1,191	1,893	65.2%
13	Textile, clothing, fabrics and leather	148,721	146,133	320,345	46.4%
14	Wood, cork, straw prods & tradable materials & furniture manufacturing	33,553	18,991	65,612	51.1%
15	Paper, cardboard and editing	259,387	180,779	361,927	71.7%
16	Chemicals, rubber and plastic	599,332	738,362	1,084,906	55.2%
17	Non-metallic mineral products	73,779	58,489	121,420	60.8%
18	Basic metallurgical products (except machinery and equipment)	369,797	298,167	785,047	47.1
19	Machinery and equipment and other electrical machinery	311,303	206,934	584,266	53.3%
20	Transportation equipment	2,325	7,810	5,698	40.8%
21	Other manufactured goods	79,903	54,840	125,585	63.6%
22	Electricity, gas, water and basic sanitation	0	97,003	0	-
23	Construction work, construction and building repair	0	5,010	0	-
24	Construction work, civil construction work	0	491	0	-
25	Commerce	0	216,462	0	-
26	Transportation services	0	110,529	0	-
27	Mail and telecommunications	0	16,096	0	-
28	Financial intermediation, insurance and related services	0	103,709	0	-
29	Real estate and housing rental services	0	11,083	0	-
30	Repair services for motor vehicles, personal and household goods	0	22,704	0	-
31	Accommodation, food and beverage services	0	1,943	0	-
32	Services to companies except financial and real estate services	0	48,556	0	-
33	Market teaching services	0	140	0	-
34	Market social and health services	0	0	0	-
35	Market and non market entertainment services	0	1,690	0	-
36	Government services	0	0	0	-
37	Domestic services	0	0	0	-
TOTAL		**3,521,297**	**3,521,297**	**5,785,910**	**60.9%**

*Total exports

Source: Own calculations based on DANE and Duque et al. (2013).

The ten main export sectors of Valle del Cauca in terms of higher generated AV accounted for 46.8% of the value exported in 2016 and 54.4% of the total generated AV. In the silviculture and wood extraction products sector, the majority of what was exported corresponded to AV (95.5%), that is, few local and imported inputs were required for its production. However, its contribution is marginal because the added value generated by this sector's exports does not even represent 1% of the value added of the total Valle del Cauca exports.

In the case of the grain milling products (79.1%), sugar and jaggery (72.9%) and food products (69.2%), high export values were recorded with a high AV component in 2016 (Figure 1).

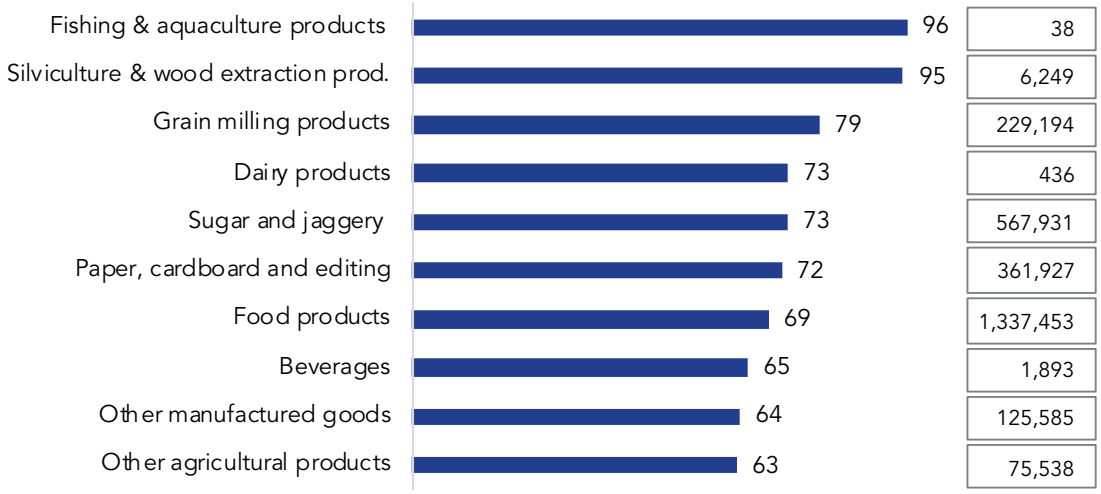

Figure 1. 10 main Valle del Cauca export sectors with the highest generated AV percentage (%) – 2016

Source: Own calculations based on DANE and Duque et al. (2013).

Chemicals, rubber and plastic; food products, and basic metallurgical products are among the ten sectors of the Valle del Cauca economy that benefited the most from the export dynamics of other sectors. The sugar and jaggery sector, for example, generated 72.9% of AV in the total exported and, as a fundamental input of other export sectors, it generates 43.3% of AV in the total exported. Therefore, sugar and jaggery as a beneficiary sector was the fourth most important one that produced inputs for Valle del Cauca exports.

Performing an analysis of the matrix from supply, the AV is composed of compensation to employees (S_j), taxes minus subsidies $(TX - SS)_j$, mixed income (MI_j)[17] and gross operating surplus (GOS_j). Hence, the technical coefficients of these components are calculated through the departmental IOM as shown below for total sectorial VBP:

$$s_j = \frac{S_j}{GPV_j};\ (tt - ss)_j = \frac{(TT-SS)_j}{GPV_j};\ gos_j = \frac{GOS_j}{GPV_j} \quad (16)$$

The results of the distribution of these three AV components for each Valle del Cauca productive sector led to an analysis of the impact of exports on each sector, both generator and beneficiary. In terms of generated AV, the export sectors that most stand out in the department due to higher concentration in wages were textiles, clothing, fabrics and leather, paper, cardboard and editing, and machinery and equipment, and other electrical machinery (table 3).

Table 3. Detail of Valle del Cauca exports AV by export generating sectors (COP billion) – 2016

SNA	Products	Salaries	TT-SS*	GOS*	AViX(i)*
01	Non-decaffeinated unroasted coffee	0	0	0	-
02	Other agricultural products	10,758	0	36,831	47,589
03	Live animals, animal products and products from hunting	214	0	1,145	1,359
04	Silviculture products, wood extraction and related activities	1,206	2	4,759	5,968
05	Fishing products, aquaculture and related services	1	3	33	37
06	Mining products	13,583	36	40935	54,554
07	Meat and fish	2,236	150	9,309	11,694
08	Dairy products	28	9	281	318
09	Grain milling products, starch and its products	42,319	2,939	136,012	181,270
10	Sugar and jaggery	92,025	8,022	314,174	414,222
11	Food products	179,742	20,447	724,763	924,952
12	Beverages	118	20	1,096	1,234
13	Textile, clothing, fabrics and leather	49,751	2,463	96,507	148,721
14	Wood, cork, straw prods & tradable materials & furniture manufacturing	8,268	743	24,542	33,553
15	Paper, cardboard and editing	86,126	6,083	167,178	259,387
16	Chemicals, rubber and plastic	131,782	10,944	456,606	599,332
17	Non-metallic mineral products	17,067	1,816	54,896	73,779
18	Basic metallurgical products (except machinery and equipment)	96,167	6,487	267,143	369,797
19	Machinery and equipment and other electrical machinery	88,291	12,305	210,707	311,303

17 Due to the availability of information, the Valle del Cauca IOM does not have detailed mixed income.

SNA	Products	Salaries	TT-SS*	GOS*	AViX(i)*
20	Transportation equipment	493	65	1,767	2,325
21	Other manufactured goods	21,628	1,094	57,181	79,903
22	Electricity, gas, water and basic sanitation	0	0	0	0
23	Construction work, construction and building repair	0	0	0	0
24	Construction work, civil construction work	0	0	0	0
25	Commerce	0	0	0	0
26	Transportation services	0	0	0	0
27	Mail and telecommunications	0	0	0	0
28	Financial intermediation, insurance and related services	0	0	0	0
29	Real estate and housing rental services	0	0	0	0
30	Repair services for motor vehicles, personal and household goods	0	0	0	0
31	Accommodation, food and beverage services	0	0	0	0
32	Services to companies except financial and real estate services	0	0	0	0
33	Market teaching services	0	0	0	0
34	Market social and health services	0	0	0	0
35	Market and non market entertainment services	0	0	0	0
36	Government services	0	0	0	0
37	Domestic services	0	0	0	0
TOTAL		**841,802**	**73,628**	**2,605,867**	**3,521,297**

*TT-SS = taxes minus subsidies, GOS= gross operating surplus and AViX = added value of exports

Source: Own calculations based on DANE and Duque et al. (2013).

The textiles, clothing and leather sector was the most labor-intensive in Valle del Cauca, 33.5% of the generated AV corresponds to employee remuneration, followed by paper, cardboard and editing (33.2%) and machinery and equipment and other electrical machinery (28.4%) (Figure 2). Exports from these three sectors account for 26.6% of the total AV generated in remuneration. Additionally, beverages (88.8%), fishing products, aquaculture and related services (88.6%), and dairy products (88.5%) are among the sectors that generate the most surplus for firms as a product of their exports.

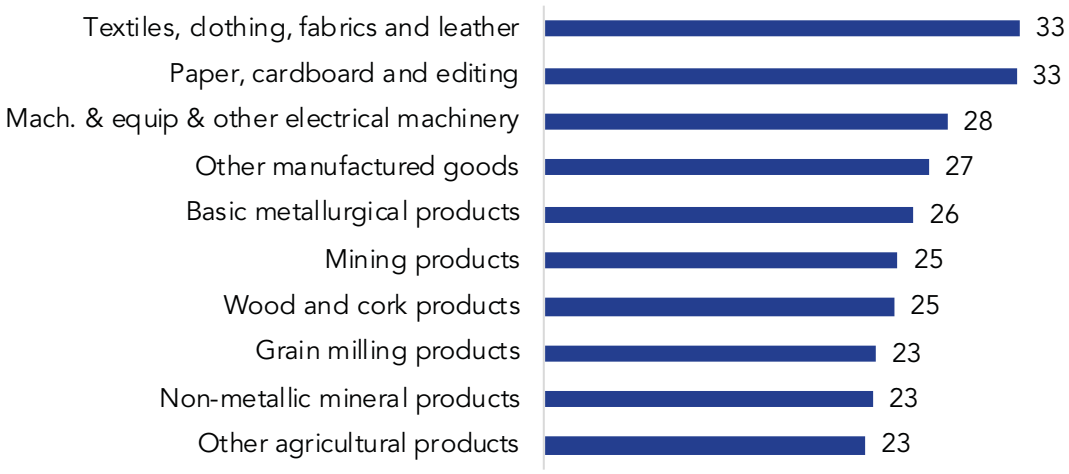

Figure 2. 10 generating sectors with the highest AV in salaries (%) in Valle del Cauca – 2016

Source: Own calculations based on DANE.

Among the sectors benefited, in terms of AV by exports from other sectors, chemicals, rubber, and plastic registered a greater gross operating surplus and higher salary remuneration in 2016 (table 4).

Table 4. Detail of AV for Valle del Cauca exports by benefited domestic sector (COP billion) – 2016

SNA	Products	Salaries	TT-SS*	GOS*	AViX(i)*
01	Non-decaffeinated unroasted coffee	11,506	1,300	46,224	59,031
02	Other agricultural products	44,230	3,060	155,451	202,742
03	Live animals, animal products and products from hunting	1,188	77	4,885	6,151
04	Silviculture products, wood extraction and related activities	1,836	68	6,168	8,072
05	Fishing products, aquaculture and related services	35	6	166	207
06	Mining products	11,034	86	33,175	44,294
07	Meat and fish	1,036	72	4,207	5,315
08	Dairy products	829	84	3,182	4,095
09	Grain milling products, starch and its products	18,754	1,328	60,751	80,833
10	Sugar and jaggery	54,313	4,793	186,883	245,990
11	Food products	100,863	11,395	405,200	517,458
12	Beverages	115	20	1,057	1,191
13	Textile, clothing, fabrics and leather	48,443	2,451	95,240	146,133
14	Wood, cork, straw prods & tradable materials & furniture manufacturing	4,687	422	13,882	18,991
15	Paper, cardboard and editing	57,247	4,224	119,308	180,779

SNA	Products	Salaries	TT-SS*	GOS*	AViX(i)*
16	Chemicals, rubber and plastic	166,309	14,360	557,693	738,362
17	Non-metallic mineral products	13,536	1,439	43,515	58,489
18	Basic metallurgical products (except machinery and equipment)	77,697	5,431	215,038	298,167
19	Machinery and equipment and other electrical machinery	58,489	8,093	140,351	206,934
20	Transportation equipment	1,837	186	5,786	7,810
21	Other manufactured goods	14,844	752	39,244	54,840
22	Electricity, gas, water and basic sanitation	23,697	2,075	71,231	97,003
23	Construction work, construction and building repair	1,217	114	3,680	5,010
24	Construction work, civil construction work	119	7	365	491
25	Commerce	51,731	4,889	159,842	216,462
26	Transportation services	26,601	2,346	81,581	110,529
27	Mail and telecommunications	3,912	359	11,826	16,096
28	Financial intermediation, insurance and related services	24,641	2,278	76,791	103,709
29	Real estate and housing rental services	2,757	248	8,078	11,083
30	Repair services for motor vehicles, personal and household goods	5,413	481	16,810	22,704
31	Accommodation, food and beverage services	470	43	1,429	1,943
32	Services to companies except financial and real estate services	11,981	1,104	35,470	48,556
33	Market teaching services	34	3	103	140
34	Market social and health services	0	0	0	0
35	Market and non market entertainment services	403	36	1,251	1,690
36	Government services	0	0	0	0
37	Domestic services	0	0	0	0
TOTAL		**841,802**	**73,628**	**2,605,867**	**3,521,297**

* TT-SS = taxes minus subsidies, GOS = gross operating surplus and AViX = added value of exports

Source: Own calculations based on DANE and Duque et al. (2013)

It should be noted that in the department's chemicals, rubber, and plastics sectors, there are several multinational companies such as Colgate, Johnson & Johnson, Baxter Laboratories, BSN medical, and Goodyear, among others, whose export activity has strengthened the business fabric of the region through the generation of local productive linkages.

5. Conclusions and Recommendations

Different theoretical approaches and empirical exercises have shown that foreign trade represents opportunities for the economic development of countries and their regions. Modern commercial policy must focus on leveraging the integration of the national and regional productive structure with the GVC, that is, on connecting the exportable supply of raw materials and intermediate inputs with business partners that use these products in high added value productive processes. This logic will drive the development of the regional and national production apparatus to produce raw materials and increasingly sophisticated and custom-designed intermediate goods; thus, promoting greater development and modernization in the production of these products.

The measurement of AV associated to the exports of a country or region identifies the sectors that have greater possibilities to generate wealth. The tradeoff should be noted in terms of the degree of technological intensity incorporated in the production process of an industry and its capacity to generate AV. In this way, basic activities such as mining and extraction of oil or coal have a high degree of added value, since, in terms of their gross production value, they incorporate a lower value of imported inputs and qualified labor than other productive sectors of greater technological intensity.

The added value of Colombian exports measured as a percentage of the total value of exports in 2016 was 86.5%. In the case of Valle del Cauca, this indicator was 60.9%, reflecting a greater industrial vocation, which requires imported inputs, and a relatively lower share of exports for the mining and energy sectors in the department's export portfolio. In 2016, the productive sector that contributed the most AV to the national total were crude oil, natural gas, and uranium and thorium minerals, while in the case of Valle del Cauca, the food products sector stood out.

The results of this research point out that economic policy measures aimed at reducing the price of imported raw materials, to the detriment of domestic production, do not necessarily imply a greater possibility of income generation and productive sophistication. To achieve these objectives through this approach, it is necessary that the adopted measures be

supported in the generated AV analysis, degree of technological intensity, productive complexity, and forward and backward linkages generated by the involved industries or sectors.

In this way, this paper shows that there is a high AV generation capacity from foreign trade operations. The available information suggests that one of the main challenges in terms of policy is the consolidation of more integrated regional production structures. Given its comparative and competitive advantages, the attraction of foreign investment can also continue to play a key role in raising the added value of the department's exports. Therefore, it is important to focus efforts on attracting companies that will make Valle and northern Cauca their export platform and that will manufacture goods that stimulate the production of inputs and intermediate goods in the region. In this way, the arrival of said investment will promote, through productive linkages, positive effects on income and employment.

Finally, there are opportunities for refining the methodologies and measurements presented in this work by incorporating greater break down of departmental accounts, as well as information on the export and import of services. To this end, it is also necessary to update the available information, and to structure and publish updated versions of the input-output matrices for the departments and regions.

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