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EFFECTIVENESS OF STATE-DRIVEN PRODUCTIVE RECONVERSION: A CASE STUDY OF THE SHIFT ON PRODUCTION MATRIX IN ECUADOR.

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Summary: *Over the last century, Ecuadorian economy has been characterized as being a supplier in the international commodity markets besides an importer of value added goods and services. In consequence, it has been a long-term specialization process focused on this type of production. It is, therefore, easy to verify that these types of outputs have more developed supply chains, leaving aside the industrial production with highest complex technological links, such as the manufactures or services sectors, which are generally considered as natural drivers of changes on any productive structure. Therefore, key sectors took in count in the input-output matrix, are only the primary sectors which have low productivity levels. This dynamic has a direct impact on returns and leave the country extremely dependable of volatile markets.*

This paper has the aim of analysing productive structure of the Ecuadorian economy during the period 2000-2014. We calculated the industrial production comparing the GVA (Gross Value Added) on the basis of the Supply-Use Table, seeking thereby to identify improvements in the performance of the strategic sectors according to what is expected in production matrix change state-driven plan. Then, we determine, if any, increases in the supply chains, based on

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analysis of the technical coefficients, obtained from the Input-Output Matrices for the years 2007 and 2014. Using this framework, results suggest that in the case of the Ecuador, changes in inter-sectoral linkages are still weak. This despite the fact that is in force a system of policies to promote the process of productive reconversion, which apparently is not giving the outcomes expected by the Government.

Key Words: Productive Matrix, Added Value, Productive Transformation, Productive chains, Input-Output Matrix.

Classification JEL: B41, C67, C82, E01, E61.

1. -BACKGROUND

A first aspect to consider is that Ecuador has a production sector that has been sustained largely due to oil extraction. In the 70's the government incurred a large amount of public debt, mainly in order to create the infrastructure that allowed a massive oil drilling. Then, as with many countries, in the 80's that debt burden became difficult to sustain. This lead to believe that Ecuador suffer a Dutch Disease dynamic. However, according to Allergret et al. Al (2014), Although Ecuador is below the general average among countries with high reliance on oil in 2009, it still shows a high dependence on oil exports as a proportion of GDP. By 2014, this is about 50% (Allegret and Tahar Benkhodja, 2014). Now, according to Gelb (1998), quoted by Ismail, 2010, Ecuador would not have been able to increase its oil production, but rather to reduce productivity in sectors such as agriculture. So, we manage the hypothesis that oil booms, external indebtedness and other large foreign exchange inflows slow down the production of other tradable sectors.

A second factor to consider is that with the opening of Ecuadorian economy at the beginning of the 1990s, government intervention in production sectors declining. In this context, market economy emerges as the fundamental axis of the economic system.[4] With the change of paradigm, laws such as the Industrial Development Law never succeeded in achieving their

[4] The Government has been set far, ignoring that liberalization should be supported by development policies that increase the productivity, closing internal and external gaps, opening productive complementarity and cooperation channels, and in innovativeness with other economies. Everything to allow regional development with the creation of scientific parks, entrepreneurship centers, and risk capital founding.

intended goals, causing the weakening of public policies conducive to reactivate the national productive apparatus. In that sense, (Rodrik, 2007) sustain that, in Latin America, in those years, a lot of strategies related to the improvement of the national competitiveness, clusters confrontation, foreign investment attraction arose. These are inevitably linked to the creation of free trade zones, exportation promotion and innovation processes[5]. Thus, in a framework without industrial policy and integral innovativeness these strategies foster diversity and impulse new activities with higher additional value needed by large regional economic clusters.

In this context, and as a consequence of a combination of political instability, poor reforms and a misused public policy, at the end of the 90's decade, Ecuador presented, a low investment in science, technology, innovation and a precarious intellectual property culture[6]. (Carrasco, Beltrán, & Palacios, 2011). This added to a very low productivity on almost all sectors boosted dependency by Ecuadorian economy on increasingly unstable international markets.

With the arrive of Correa Administration (2007-2017) there is also a return of Keynesian public policies. This new change of mentality, were formalized on the National Plan for Good Living. This one pointed out that Good Living strengthens the production matrix change, since it encourages the creation of technological industries that are expected to boost employment, science promotion, and productivity. In addition, it seeks to prioritize and order public investment, thinking in the territories and in view of the eradication of poverty. Hence, to transform the product matrix is one of the most ambitious goals of Correa Government. If it's successful, it pretends to overcome the actual wealth generation model based on natural resources, replacing it by a self-declared democratic model, based on the knowledge and capabilities of the population, and high value-added products. (SENPLADES, 2013)

[5]Assumed as a technical acquisition.
[6] That is expressed by limited patents in the country.

2. LITERATURE REVIEW

Analysis of productive structure is a recurrent topic largely used in the economic policies and development strategy proposals in Latin America, both at a national and regional level. This tool is used by the IO model, with the goal of analysing the production variations and to forecast variables of interest. Also, it could be improved and extended using mathematical modelling which allows updating and projecting better technical coefficients. In that sense (Pino & Llanes, 1996) using advance mathematical tools determine that around 65% of the production in Chile is clustered in key activities which act as growth drivers, being the most important, paper and metal products fabrication, elaboration of preservatives, bakery and clothes manufacturing. The authors' conclusions lie in the need of focalisation in reactivating actions on those sectors.

Now, from the production chain, coefficient sensibility and productive specialization perspectives, it is possible to widen the analysis. In that sense (Sosa-Amigo, 2015) determined that oil, fossil fuels and lubricants branches present the largest elasticity coefficient in Chilean economy scope. On other side, to (Moraga et. Al, 1996), in the vast majority of the regions of Chile, relevant sectors with a higher gross production have also presented strong backward or forward value chains, meanwhile on industries with weaker value chains, low levels of middle consumption and an intensive use of labour are the rule. Furthermore, (Cárdenas, 2004) highlight the importance of group and cluster reinforcing "from the bone", that is, from the very internal structure of production in order to formulate successful development strategies.

Cárdenas indicates that as long as these groups maintain a healthy and strong interrelation, there will be a true development of the economy; so, it becomes a requirement for the success of national policies. Similar research on this subject along Latin America confirm these findings, for instance, (Chraki, 2016) using the focus detailed above, identifies key industries in the Mexican Economy. In this case, middle and capital goods. More specifically, for the Ecuadorian case., it's worth to mention to (Gachet, 2005) whom, following above mentioned authors, raises the multiplier effect of the transporting, construction, oil refining and meat industries, identifying as key industries oil refining, textiles, wood and meat.

Finally, and to complement, (United Nations, 2015) explains the Productive transformation policies necessarily should be focused on the cluster and value chain development as well as agglomerations, foreign investment, entrepreneurial background and capability development. In that sense, Productive Transformation policies imply an open dialogue between public and private sectors, to guarantee equity in urban planning subjects, cities design, governance and financing. Therefore, both Ecuador and Peru have established Economic development plans to guide their economy's transformation.

3. DATA AND METHODOLOGY

Departing from the Ecuador's IO matrix to 2013, sectorial multipliers are calculated in order to allow the analysis of impact levels in the sector of an economy that have variable production outputs. It is expected that these multipliers show the variation, by amount or percentage, on every component of the final demand, and how it affects the total output of the Economy. Then, it is possible to verify if the increase of the final production is higher than the amount or percentage of the increase of the final demand component.

The multiplier is based on the Leontief inverse that assumes:

$$x = (I - A)^{-1}y \qquad (1)$$

where:

x: Sectorial Production

I: Identity matrix

A: Technical Coefficients Matrix (or inputs)

y: Final Demand

However, according to (Ghost, 2005), Leontief's proposal is only be valid for a short frame of time with an absolute lack of productive capacity. In that case, it leads to assume that if there is any change in the final demand, would not affect the different price relationships and supply should be unlimited, since it would be perfectly elastic. From this idea, Ghosh develop a new construct, called Distribution Matrix, which is obtained in horizontal form. Each element is

designated generically as bij and is calculated as bij = xij / xi, where x is the output of the ith branch. Therefore, each distribution matrix coefficient will show the proportion, in monetary terms, used by the branch of the ith row, which is allocated to each of the other branches or to the final demand. With this new way of posing the problem, primary inputs (labour or capital employed in the production of this jth branch) are the new exogenous variables instead of final demand, as in the case of the Technical Coefficients Matrix.[7]

In that sense, Ghosh Matrix is similar to Leontief's, since both are obtained from the Matrix Input Product. The difference with matrix A is that each row of the matrix is now divided by the gross output of each sector associated with that row. B is used to denote the matrix of direct input coefficients resulting from this operation. Hence, Ghosh Matrix is elaborated as: $G = (I - B)^{-1}$. The element g_{ij} is interpreted as a proxy value of the "total production value of the sector *j*, per input unit of the principal sector *i*". (Miller & Blair, 2009).

At the end, matrix of multipliers follows from: $L = (I - A)^{-1}$. Those can be categorized as type I and type II. A type I multiplier assumes that the row of wages and the household consumption column are exogenous to the model[8]. In this case, only direct and indirect effects derived from any change in the components of the final demand (household consumption, government expenditure, investment and exports) of any sector are considered (Miller & Blair, 2009). It should be noted that when calculate Leontief inverse, it includes the multiplier with the matrix of technical coefficients. Therefore, these coefficients indicate how an exogenous change in the demand of some sector of the economy impels a multiplier effect on the demand of other sectors. Thus, IO analysis focuses on measuring the extend of these effects and how they vary across industries or sectors. Consequently, multipliers assess the impact of a change in the final demand in some sector of the economy in terms of the total product, income and number of jobs created.

[7] In this way, the demand and supply models allow knowing how their changes affect the different production functions, due to is possible to work with two exogenous variables, giving the results of the tables. High flexibility.
[8] When using a type I multiplier it is said that the Open model is used in which the "households" sector of the matrix is excluded. On the contrary, type II multipliers are called a Closed Model (Miller & Blair, 2009)

Now, Total Requirements (direct and indirect) Matrix is the inverse of the matrix of A and is used to compute the impact of changes in any sector on the economy as a whole.[9] From this inverse matrix can be captured the chained effects that are caused by productive interaction between sectors.[10] (Arón Fuentes & Ruiz Durán, 2010). So, an element of the inverse of Leontief "represents the quantity of production that should be made by sector i to satisfy, Ceteris Paribus, a unit of net final demand for imports of the ith sector" (Schuschny, 2005). Thus, multipliers capture direct and indirect effects of increased demand. For instance, when an investment in the oil sector is made for one million dollars, the "direct effect" is that demand in the oil sector increases by one million dollars, but, in turn the oil sector has to buy different Inputs from others such as manufacturing, financial services, transportation and communications, and so on. Amounts spent on these other sectors to meet increased demand of one million, is called "indirect effect". Therefore, multipliers account the direct effect plus the indirect effect of an additional dollar increase in the final demand of a sector.

At this point, it is necessary to also recall some fundamentals: in addition to measuring the impact of a dollar spent in some sector of the economy, it is important to know how it is distributed across different sectors. In other words, if the sector j increases its output, this means that also increase the requirements (demands) from j to sectors whose products are used as inputs in the production of j.

Now, backward linkage measures the ability of a sector to encourage, or drag development processes on other sectors due it uses their inputs. On the other hand, an increase of production in sector j also means that additional quantities of product j are available to be used as inputs in other sectors for their own production, that is to say, they will increase sales of sector j for the those that use the output of j for its own production. This is known as forward linkage (push effect) and measures the ability of a sector to supply their product to others because they use inputs from it. (Miller & Blair, 2009).

[9] Actually, the Leontief inverse is represented as the Inverted reciprocal of A. Meaning $(I-A)^{-1}$.
[10] The linkage effects are known as multiplier and are the total of increasing production rounds generated from the increase of a final demand unit. For instance, even the other increments (indirect effect) derived from the first round (direct effect).

So, by comparing the size of the backward and forward chains between sectors, we achieve a mechanism to identify "key" or "leading" sectors of the economy. The criteria are as follows; those sectors that are more interconnected are identified as the most important. Furthermore, sectors with quantitatively significant linkages generate significant externalities, so state intervention could be justified to give incentives to these sectors, since, by orienting the investment pattern to them, it could promote national growth.

In analytical terms, Backward linkages are obtained by dividing the product multipliers of sector j for the average product multiplier across all sectors of the economy. [11]:

$$b(t) = \frac{ni\prime L}{i\prime Li} \qquad (2)$$

If the ratio is greater than 1 it implies that the stimulus is higher than average, and therefore, we found a sector with dispersion power that drags to others, since it consumes inputs from them (Schuschny, 2005)[12]. Meanwhile, forward linkages are obtained by dividing the input multiplier of sector i for the average input multiplier between sectors of the economy[13]:

$$f(t) = \frac{ni\prime G}{i\prime Gi} \qquad (3)$$

Putting all together, and depending of the value of ratio, sectors will be distributed in 4 types:

[11] These values are normalized. *n* is the number of sectors, , i is a unit vector and *L* is the Leontief matrix that contains the product multipliers.
[12] Schuschny (2005), Chanery-Watanabe (1958), Rasmussen 1963 y Hirschman (1961) use the called sectorial chains as a method to analyze the effects of the changes in the final demand.
[13] The inputs multipliers are obtained through the Ghosh matrix that is derived from the IO matrix (Z). The difference with A matrix is that, each Z row is divided by the gross production of each sector associated to it. Therefore, the Ghosh matrix is created as: $G = (I - B)^{-1}$. The element g_{ij} is interpreted as a measure of the total value of the production of the sector *j* per principal input unit of the sector *i* (Miller & Blair, 2009).

Table No. 1.

Sectorial typology according to productive chaining.

		Forward chains	
		Low (<1)	**High (>1)**
Backward chains	**Low (<1)**	Island	Base
	High (>1)	Motor	Key

Source: Ecuador Central Bank. Methodology for to calculate the Input-Output Matrix.

Table No. 1 summarizes sectorial typology according to the kind of productive chaining. When forward and backward linkages are lower than 1, we can say that we found an Island Sector. They are not strongly connected to others with a low, middle consumption and demanding primary or imported inputs. Their production is oriented to satisfy the final demand. When backward linkage is higher than 1, but forward linkage is lower than 1, we can say that we found a Motor Sector. They are the ones with a little inputs demand. Its production is mainly used to supply intermediate goods to other sectors and, to a lesser extent, to final goods market.

If the backward chains are less than 1 but the forward chains are higher than the average generated by the economy to the sector we have found a Base Sector. It is so named because it depends on intersectoral demand. These economic sectors have a high intermediate uptake and their supply is mainly for final consumption. This kind of sector has big chances of drag and induction economic growth.

Finally, we have found a Key Sector if the backward and forward linkages are greater than 1 implying that they are strong demanders and suppliers of intermediate inputs, but that it also has forward chains. This suggests that their connections are important enough to generate growth in several sectors regardless of whether they are demanders or suppliers of their

products. In short, we are talking about sectors of mandatory passage of sectoral flows on the economy.

We cannot complete this methodological note without warning that when different methodological alternatives such as those presented above are used, it is necessary to pay attention to factors such as accuracy in calculation, efficiency of each method, the expertise on the technique and, of course, the availability of data.

4. RESULTS AND DISCUSSION

Results of the Shift on Production Matrix can be synthesized using two criteria: i) On one side, compliance levels of the goals presented in the National Plan for Good Living.; and ii) Changes in the production structure evidenced by the technical coefficients on the IO matrices.

4.1 Level of Compliance of goals of the National Plan for Good Living 2013-2017 (Third Version)

National Plan for Good Living 2013-2017 actually has 12 objectives and 84 goals. Objective 10 is related to Shift of Production Matrix. Today, it is possible to summarize compliance of its overall goals as follows:

Table No. 2

Goal	Compliance
Goal 10.1: To increase the share of exports of products with high, medium, low and natural technological intensity to 50%.	**NO**
Goal 10.2: Reduce non-oil imports of primary and natural resource-based goods by 40.5%.	**NO**
Goal 10.3: Increase the share of manufacturing industry to 14.5% of real GDP.	**NO**
Goal 10.4: Achieve the 49.4% share of skilled labour in full employment.	**NO**
Goal 10.5: Reduce concentration of irrigated surface by 60 times.	**NO**

Goal 10.6: Reduce the intermediation of products of small and medium producers by 33%.	**YES**
Goal 10.7: Reversing the trend in the share of imports in the consumption of agricultural and meat foods to 5%.	**NO**
Goal 10.8: Increase tourism revenues to 64% on total services exports.	**YES**
Goal 10.9 Reduce the time needed to start a business to 12 days.	**NO**

Source: Information National System **Elaboration: The authors.**

Although indicators are not continuously updated, it is possible to verify some trends. Although the current plan has a fixed deadline for compliance, only the 22% of the planned goals have been accomplished, but it is expected that there are some that could be achieved in the third quarter of 2017.

4.2 Shift on Production Matrix from the Chain Analysis Perspective.

Results are presented on a national basis, for the period 2007-2014. They allow detection and analysis of the productive structure variations, by the identification of backward and forward productive chains, which help us to assess national productive structural variations and identify economic sectors that present higher impacts of the Shift on Production Matrix process.

Table No. 3

Economic Sectors in 2014 that shift their productive chains comparing to 2007.

No.	Sector	2007		2014		Change	Change state
		F(t)	B(t)	F(t)	B(t)		
1	Bananas, Coffee and Cocoa Cultivation.	0,9108	0,9106	1,1150	0,9057	From Island to Base	Good
33	Threads, treading and textile fabrication	1,0039	1,0011	0,9611	0,9823	From key to island	Bad
34	Clothing Fabrication	0,6309	1,0806	0,6609	0,9642	From motor to island	Bad

45	Common metals fabrication	1,0020	1,0300	1,0184	0,9174	From key to base	Bad
47	Machinery and equipment Fabrication	0,9441	1,0505	1,0166	1,0676	From motor to key	Good
50	Manufacturing industry	1,0012	1,0236	1,1707	0,9189	From key to base	Bad
56	Accommodation	0,6639	0,9905	0,6846	1,0114	From island to motor	Good
60	Communication and Information	1,0337	0,9090	0,9729	1,0170	From base to motor	Indifference
68	Entertainment, Recreation and other services.	0,8318	0,9933	0,8435	1,0050	From island to motor	Good

Source: Central Bank of the Ecuador **Elaboration:** The authors.

Data come are from the technical coefficients obtained of the IO matrices of 2007 and 2014 [14] about 69 economic sectors.

Table No.2 summarizes the Shift on Production Matrix results from of the IO perspective. From the 69 pooled industries, just in 9 is possible to observe some production pattern change: meaning that between 2007 and 2014, only 13% of the total industries presents a verifiable shift. Remaining industries keep up structural stability by showing no accountable changes on specialization since 2007. [15] By instance, inside agricultural sector, only "Bananas, Coffee and Cocoa Cultivation" stratum show any change in its productive structure. This behaviour lies in the fact that only in 7 years, this one move onwards from Island to Base category. This implies, in a sense, a positive change in the national economy, since it went from the absence of innovation on production to show great possibilities of drag and induction economic growth.

[14] The IO matrixes used to the construction of table No. 2 were elaborated by the Economists Mercy Orellana and Dalia Argudo, researchers of the Regional Economy Research Group of the University of Cuenca, based on the Ecuadorian Central Bank information.
[15] To December.2014, 14 sectors were classified as a base, 25 as an island, 5 as key and 25 as motor.

On the other side, in the industrial sector, there are five strata that show changes. For instance, "Threads and textile manufactures" display a regression in the productive structure because it went from a key sector (with strongly demanders and suppliers of middle inputs) to an island sector (lowly linked to other sectors). In the same way, "Clothing Confection and Manufacturing" also presents a regression going from a motor (production mainly used to stock up other industries) to an island sector. The bottom line is that both sectors reduced sectoral interrelationships to the point of completely eliminating the productive chains.

On the other hand, the common metal fabrication and the manufacturing industries have a detrimental change: they moved from key sectors (strongly demander and supplier of average inputs), to a base sector. That means that before they generated chains back and forth, and now only forward chains. Only the machinery and equipment manufacturing sector has the opposite behaviour. It changes into a key sector departing from motor. The intuition behind this is that this stratum before was generating backwards productive chains only, and now it does back and forth.

Finally; in the services sector, "Accommodation and Entertainment, recreation and other service activities" became a motor sector (its production is principally used to stock up the other sector inputs) from island. That means that any improvement does not generate chains as strong with other sectors as to generate productive backward links. Thus, "Information and Communication" shows a regressive change in its productive structure since it became a base sector being previously a motor sector. The bottom line is that it previously generated forward chains, and now it does only backwards; Therefore, he reversed its production structure and chain value generation.

4.4 CONCLUSIONS AND DISCUSSION

The Correa Administration (2007-2017) has bet for a Shift of Production Matrix as one of the axes that articulates the implementation of productive development policies. This process attempts to overcome the primary export model by boosting and diversifying Ecuador's industrial production through strong government and profound Keynesian structural reforms.

This plan, by its very nature, is too ambitious in some cases. Firstly, it seeks the implementation of an industrial policy that creates a rupture in the structural adjustment and trade liberalization programs that, from the point of view of the Government, have undermined the industry and left the country without concrete policies of productive development. Second, it seeks to create a legal framework to reinforce and legitimize the process of Shift in the Production Matrix. Therefore, since the enactment of the 2008 Political Constitution, the Organic Production Code and the National Plan for Good Living, the Government is allowed to implement a comprehensive Country Planning System, to seek to achieve the proposed development objectives.

Now, after ten years from its issue, evidence shows that, instead of a large public investment, major advances are related only to the large industries, hydroelectric sector and the public education, based on the general context of human capital formation. Latest show some results on agroindustry chains such as the cocoa and in the metal-mechanic industries. This implies that, if this plan is to be successful, more policies are still needed to boost basic industries. Evidence suggests that although the stability of some industries has increased, the support system for them is inefficient since most of industries have not changed their production patterns.

Now, based on data from the IO matrix, it is observed that in only 9 of the 69 industries there is a change of production patterns. Which means that between 2007 and 2014, only a small fraction of total industries has positively changed. Consequently, there is still a large disconnection in the productive system, which suggests a very limited effectiveness of the government's plan to transform production. We can conclude this based on that: (i) the total chain is weak or non-existent in some cases, without direct and indirect chains between industries; (Ii) the process of linkage between local business suppliers is still very slow and (iii) the increase in the stock of raw materials for national and regional industries has improved but is still small in quantity.

Do these results imply that successful productive reconversion is not possible? Not necessarily, so far, the changes applied for this purpose, are of medium and long application, for example, in the case of the creation of an Innovation Ecosystem, the development of service chains and the underpinning of sectors Which require human capital. It is therefore expected that the results in these sectors can be appreciated in the long term. Then, it must be concluded that, despite the limited results, the Correa Administration has structured, at least, a planning framework that focuses on overcoming the primary export model. It is advisable to conduct periodic evaluations to quantify progress in future governments.

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