Open Section

DOI: 10.25115/eea.v39i8.4500

Studies of Applied Economics / Estudios de Economía Aplicada

Volume 39-8, September 2021 // ISSN: 1133-3197

Assessment and Sectorial Projection of the Santiago de Cuba Province

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ABSTRACT

For Cuba to achieve the prosperous and sustainable economic development to which it aspires, the country needs to update its productive structure at macro and meso economic scales, adapting it to the current dynamics and requirements of international economic development. The present study aims to assess the development of the productive structure of the Santiago de Cuba province, measuring the relative importance and complementarity of its sectors and economic activities. Using econometric models, through the method of ordinary least squares (OLS), productive reserves were estimated and capital budgets were calculated for those activities with better opportunities of undertaking investment projects, in order to contribute to the decision making in the economic and social development strategy of the province and country until 2030.

Keywords: Productive structure; Econometric models; Productive linkages.

Classification JEL: C, C58, G31

Received: February 15, 2021
Accepted: March 11, 2021

Sección Abierta

DOI: 10.25115/eea.v39i8.4500

Studies of Applied Economics Estudios de Economía Aplicada

Volumen 39-8, Septiembre 2021 // ISSN: 1133-3197

Evaluación y Proyección Sectorial de la Provincia de Santiago de Cuba

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RESUMEN

Para que Cuba logre el desarrollo económico próspero y sostenible al que aspira, el país necesita actualizar su estructura productiva a escala macro y meso económica, adaptándola a la dinámica y requerimientos actuales del desarrollo económico internacional. El presente estudio tiene como objetivo evaluar la evolución de la estructura productiva de la provincia de Santiago de Cuba, midiendo la importancia relativa y la complementariedad de sus sectores y actividades económicas. Utilizando modelos econométricos, a través del método de mínimos cuadrados ordinarios (MCO), se estimaron las reservas productivas y se calcularon los presupuestos de capital para aquellas actividades con mejores oportunidades de emprender proyectos de inversión, con el fin de contribuir a la toma de decisiones en la estrategia de desarrollo económico y social de la provincia y el país hasta el año 2030.

Palabras clave: Estructura productive; Modelos econométricos; Encadenamientos productivos.

Clasificación JEL: C, C58, G31

Recibido: 15 de Enero de 2021
Aceptado: 11 de Marzo de 2021

1. Introduction

For Latin American countries in general and Cuba in particular, having a solid, diversified, articulated and complementary productive structure, in accordance with the highest international standards, represents a challenge for their governments. What is more, it requires a strategy for inclusion in the world economy.

The productive structure is defined by those sectors or activities on which the production of goods and services of a country depends (Mendoza, 2020; Junior, et al., 2020). In most countries in the geographical area of Latin America, the economic development model maintains the productive structure of the Primary Export Model. It is based on the export of basic raw materials and goods and services with low value added, and on the import of goods and services with higher value added and high prices (Primera, 2013; Bárcena, et al., 2015; Buitrago, 2016).

Information from the Statistical Yearbook of the Economic Commission for Latin America and the Caribbean (CEPAL in Spanish) shows that in 2018 the region of Latin America and the Caribbean experienced a 1.3% increase in the growth rate of the Gross Domestic Product (GDP), simultaneously revealing a significant imbalance in its Balance of Payments, with a deficit in the Balance of Goods and Services of -26 769.5 million dollars, which is consistent with the difficult economic situation of the region (CEPAL, 2019, pp. 32- 40).

Recent documents of CEPAL (2020a) show that the aforementioned regional situation has been aggravated by the current global crisis caused by the COVID-19 pandemic, which will have repercussions that already exceed the international economic crises of the 1930s, the post-war crisis of the last century and the real estate crisis of 2008 (CEPAL, 2020a).

In view of this problem, the same source projected a 90% contraction of the Gross Domestic Product (GDP) per capita of these countries by 2020 in an unprecedented synchronous process whereby the world GDP will be reduced by 5.2%. The drop will be 7.0% in developed economies and 1.6% in emerging economies, caused by a decrease in the volume of world trade in goods of between 13% and 32% (CEPAL, 2020a).

Based on estimates of the effects of current processes, an average decrease in GDP of 9.1% in 2020 is estimated for the countries of the region, with values of up to 9.4% in South America, 8.4% in Central America and Mexico, and 7.9% in the Caribbean. For Cuba, the same source predicted a decrease of 8.0% in GDP, while the Ministry of Economy and Planning of Cuba forecasts a decrease of 11.0% (CEPAL, 2020b).

With respect to the Economic and Social Development Strategy of the Cuban government, within the framework of the Economic and Social Development Plan of the country until 2030, General Objective No. 226-4 proposes:

"...to develop the country's productive fabric by generating backward linkages (development of suppliers) and forward linkages (value addition on the base product), fostering a dense and diversified productive structure and the strengthening of the internal integration of the economy" (De Cuba, 2020).

The same document establishes the increase of the maximum limit of financing for investments to be approved by the government from 20 to 50 million, which favors the implementation of investment projects in those territories where reserves of production capacities for goods and services are identified. In order to boost the productive structure and stimulate consumption and economic development, investment feasibility studies should be carried out in accordance with the development strategy of each territory (De Cuba, 2020)

In this context, the province of Santiago de Cuba is the sixth largest in the country, with a territorial extension of 6 156.44 km2. It hasa population of 1 049 256 inhabitants (Hab), of which 423 151 Hab are active workforce and 408 361 Hab are employed, maintaining an employment rate of 96.5%, which in 2018 generated a production of goods and services of 4 868.71 million pesos (mp).

This figure is recognized as one of the best in the country from both economic and social points of view (ONEI, 2019c).

In a preliminary study on the information available in the National Statistical Yearbook and information provided by the National Office of Statistics and Information (ONEI), as a result of collaboration between the National Office itself and the Universidad de Oriente, the following elements were identified as exerting an influence on the economic situation of the country and the province:

- The flexibility of the state's investment policy in terms of the approval of the foreign investment law and the decentralization of the approval of national investment amounts.

- High dependence on imports of goods and services in the main sectors and activities of the country.

- Disincentives for the productive and financial systems due to monetary and exchange rate duality until 2020 (Lorente, et al., 2020).[1]

- Predominance of exports of primary and secondary sector products of low complexity and low value added.

- Lack of complementarity between the production of goods and services of companies and sectors of the provincial and national economy.

- Structural problems associated with high technological obsolescence and inefficiency in the companies of the strategic sectors of the national economy.

- Insufficient productive linkages between companies and strategic sectors.

The importance and relevance of this study lie precisely in these general problems. The present work is aimed at contributing to the development of Cuba's productive structure by measuring the relative importance and complementarity of its provincial economic sectors and activities in the national economy based on the performance of the indicators of the National Accounts System. In addition, this study evaluates Cuba's main productions and assesses potentialities to contribute to the fulfillment of the country's economic and social development strategy until 2030.

2. Theoretical Framework

A development model or pattern of accumulation according to Valenzuela (1990), and reiterated by Guillén (2008), is the part of the process of capital reproduction that characterizes the development of a country or region. In the countries of the "capitalist periphery", as is the case of Latin America, development models are defined by two basic elements of underdevelopment: "structural diversity", i.e., the relations that occur between "advanced" forms of production, with other "backward" ones; and the relations on which their linkage with the centers of the world economy are based (Prebisch, 2012; Buitrago, 2016).

The complexity, importance and performance of the productive structure and matrix are fundamentally determined by the technological, economic and social development achieved by the country, which allows transforming the economic fabric with relative self-sufficiency, which depends largely on the economic model of development adopted (Primera, 2013; Utkovski, et al., 2018; Quiñonez et al, 2020).

The development of a country is directly related to the productive structure of its economy. This ranges from the relative importance of the different productive branches to the institutional characteristics, including geographic and economic policy aspects (Primera, 2013; Utkovski, et al., 2018; Junior, et al., 2020; Mendoza, 2020).

Developing the productive structure in a country means identifying new forms of production, distribution and change in the productive and consumption patterns of the economy. In this sense,

[1] Deleted in Article 2 of Decree-Law 17, on the implementation of the monetary order process as of January 1, 2021. Exchange rate predicted by Lorente, et al., (2020).

governments should focus and prioritize their public policies on the creation of new industries, the promotion of high productivity and competitive, sustainable and diverse sectors that complement each other, with a territorial vision and economic inclusion, thus stimulating sustainable production chains (Ocampo, 2008; Primera, 2013; Utkovski, et al., 2018).

Need to modify the productive structure to promote development

The authors agree with Raúl Prebisch when he states that "...the countries considered as centers have developed a well-diversified and integrated productive structure to achieve growth..." Likewise, their technological progress expands in all activities, which contributes to the presence of a productive structure of great homogeneity and complementarity (Prebisch, 2012).

In contrast, in the countries of the "periphery", a consequence of the Primary Export Model, productive diversification is almost null, there is great technological heterogeneity, regional asymmetries; and specialization only exists in some activities (export sector), contributing to the fact that these countries possess a productive structure susceptible to being easily distorted (Prebisch, 2012; Buitrago, 2016).

In this sense, Prebisch (2012), Lencucha and Thow (2019) and Ocampo (2008) argued that in order to achieve development, it is necessary to program. Hence the importance of transforming the productive structure, with the active participation of the State as a guide, promoter and planner of development based on the application of public policies prioritized according to the proposed objectives.

Consequently, it can be anticipated that changes in the productive structure of a country's economy require the preferential development of some productive sectors over others, which implies a two-way movement of resources between the primary sectors and activities and the secondary and tertiary sectors.

This restructuring can be achieved in different ways. The first approach would be to study the share of the economic sectors in the Gross Domestic Product (GDP). The second involves linking change to the performance of certain factors, namely availability of labor, capital, the company factor and natural resources, in relation to Gross Value Added. The third way is based on the study of the productive structure, interpreting it according to the composition of demand, or of the sources and allocation of resources. Evaluating the results of any of these strategies, their performance dynamics and factors of change, could show the level of development of the productive structure.

Production linkages as drivers of the productive structure

Productive linkages are of vital importance to the performance of the productive structure as they are sequences of investment decisions that originate during the industrialization processes that characterize the economic development of a country or region. These decisions mobilize underutilized resources that have incremental effects on the efficiency and wealth accumulation of countries (Hirschman, 1998).

The theory of backward and forward linkages identifies when the production of a sector achieves the minimum threshold or minimum scale necessary to make investment in another sector that it supplies or processes appealing (Hirschman, 1998).

The economic importance of production linkages lies in the positive effects they have on the capacity to stimulate investment in pursuit of diversification, growth and productive strengthening of a country (Villamil and Hernández, 2016).

The economic sectors in the productive structure

An important concept in macroeconomics is the economic sector, which is a division of a country's economy on the basis of the economic area in which the population is employed for the production of goods and services.

In the economic sciences, three economic sectors are generally recognized by ordinal ranking: the primary sector, which includes agriculture, mining and other natural resource industries; the secondary sector, which encompasses manufacturing (fabrication), engineering and construction;

and the tertiary sector, for service industries. However, other sciences also consider a quaternary sector for intellectual activities linked to teaching and research and a fifth sector that comprises the governmental decision-making levels (Kenessey, 1987; Rosenberg, 2007; Mendoza, 2020; Junior, et al., 2020).

From another point of view, economic sectors can be classified based on directions of their productive chains (backward and forward) and the supply and demand levels of their productive processes and chains. According to Schuschny (2015) and Mendoza (2020), based on studies by Chenery and Watanabe in 1958, certain sectors have specific effects on others based on their productive chains, the value added they generate and the destination of their productions, which have the following characteristics:

Non-manufacturing sectors with intermediate destination

This sector includes some activities of the intermediate primary sector, such as mining and other extractive activities, which are characterized by a low demand for inputs. The destination of their production is rather to satisfy substantial amounts of demand from other sectors for intermediate use inputs with low value added, which is why they have high forward linkages and low backward linkages. These sectors predominate in the economic structure of a region or underdeveloped countries.

Non-manufacturing final destination sectors

These sectors include some primary and tertiary sector activities such as agriculture, mining and other extractive and service activities; they determine the economic structure of underdeveloped regions or countries. These sectors offer materials with low value added that satisfy the final demand and they buy significantly few inputs from the other sectors. They are isolated sectors which do not cause significant knock-on effects, nor are they particularly relevant in terms of the multiplier effect. Therefore, they have low productive linkages both backward and forward.

Manufacturing intermediate destination sectors

These sectors include some activities of the primary and secondary sectors, such as transformative manufacturing and other activities, which are predominant in the productive structure of a region or developing countries. They demand and offer large quantities of intermediate inputs and sell their production to other sectors. Although their production does not have such high value added, these sectors are an important part of the flow of the economic system and have high backward and forward linkages. Regarding the internal articulation of the productive structure, these are the most important sectors, as they are responsible for any increase in final demand.

Manufacturing final destination sectors

These sectors include manufacturing activities that offer final products with high value added and social service activities such as food, health and education. These are sectors that purchase substantial quantities of inputs from others and most of their production of goods and services is directed to final demand. They predominate in the economic structure of developed countries and have a significant influence on global economic growth as they are major drivers of activities. These sectors feature high backward and low forward linkages and belong to the last phase of the production process.

In short, the elements detailed above are essential when analyzing the productive structure in a context of evaluation and transformation. Therefore, the characteristics of the sectors, activities and representative companies, their relative importance, the destination of their productions and the predominant productive chains must all be considered.

The National Accounts to evaluate the performance of the productive structure

The System of National Accounts (SNA), also called National Accounts, is a branch of accounting at the macroeconomic scale that uses an orderly system of indicators to identify the transactions of

products, services and materials that determine the economic activity of a country or region (Junior, et al., 2020; Mendoza, 2020).

In this sense, in order to diagnose and evaluate the productive structure, it is widely agreed that the relative importance of sectors and activities in the economy must be calculated based on the performance of the following SNA indicators.

Gross Domestic Product (GDP). It represents the final result of the production activity of resident units. GDP corresponds to the production of goods and services of the economy including net taxes on production, once the intermediate consumption of goods and services required for the production process is deducted. In Cuba, 64.31% of the national GDP is composed of GVA from productive activity, while 35.49% belongs to budgetary activity (ONEI, 2019a).

Production of goods and services (PGS). It is an economic concept used to measure the total economic activity in the production of goods and services in a period. PGS, in general terms, represents the total value of sales of the companies' production, subtracting the value of intermediate goods (in process) used in production (Fuentes and Ruiz Durán, 2010).

Intermediate consumption (IC). Also known as intermediate demand, this constitutes intermediate goods or services used as factors of production of economic sectors, such as raw materials, fuel, professional services, among other items (Lencucha and Thow, 2019).

Gross Value Added (GVA). In macroeconomics, it is an indicator used to measure the new value created in an economic activity from the production of goods and services in an accounting period. It represents the difference between the total value of sales through the production of companies in a period and the value of intermediate goods used (Fuentes and Ruiz Durán, 2010; ONEI, 2019b).

Econometrics in sectoral investment planning

Econometric models (EM) have been successfully used to determine the influence of sectoral characteristics on SNA indicators, both for predictive and explanatory purposes., to plan or evaluate investment processes. For example, EM were utilized in the analysis of the determinants of private investment in Brazil in the short and long term (Ribeiro and Teixeira, 2001), while, most recently, the KLEMS Model and a Cobb-Douglas type function were applied to identify and evaluate the factors of Japan's investment in Mexico's electronics industry (Orobio, Guzmán, 2020).

As for other aspects, EM widely use analysis of covariance regression models (ANCOVA), which mix quantitative and qualitative variables (dummies), to incorporate different attribute "control" elements into the regression model. These should be expressed in terms of their presence or absence, which can be represented dichotomously (Gujarati and Porter, 2010).

The development model in Cuba. Characteristics

As in most underdeveloped countries, the economic model of development in Cuba generally features the characteristics of the Primary Export Model. On one hand, it is a supplier country to the international market of raw materials or semi-finished products with little value added and, on the other hand, it is an importer of goods and services with higher value added. This has contributed to increase its economic and financial vulnerability to variations in the prices of raw materials in the international market (Machado and Martinez, 2018).

According to the Observatory of Economic Complexity (OEC) in 2018, Cuba is the 84th economy in the world in terms of GDP per capita (current dollars), the 146th economy in exports, the 123rd in imports, and the 92nd economy in the Economic Complexity Index (ECI). In general terms, the country manufactures products with low complexity and little diversity, and the products it exports have minimal competitive advantages, which could explain the low levels of economic growth in recent years (OEC, 2017).

With regards to goods, Cuba's Balance of Payments in 2018 reveals a deficit in exports of -9 111.00 mp (ONEI, 2019a). Said goods are mainly made up of basic market products with little value added from the primary sector or the secondary sector. As for the amount of imports and their

composition, it is observed that out of a total of 11,484.00 mp imported in 2018, approximately 75.00% corresponded to fuels, food and manufacturing products (ONEI, 2019a).

One important aspect worth noting is the significant weight of services in Cuba's exports, which in 2018 amounted to 11,764.00 mp. This represents 81.09 % of the country's total exports, among which professional services account for a substantial portion (ONEI, 2019a).

In the domestic economy, a nationwide phenomenon caused by imbalances between supply and demand is manifested in an accelerated increase in the average general level of prices of basic goods and services for the population.(Martínez, 2020).

In order to achieve sustainable development, Cuba must make changes in its productive structure, for which it must change the specialization pattern of its productions, diversify the economy and generate greater value added to encourage productivity, competitiveness and complementarity of national production, with productive diversification and territorial development as the bases.

3. Materials And Methods

To evaluate the development of the sectors of the provincial productive structure, a combination of empirical methods will be used, which are supported by quantitative tools that include econometric models, expressions of economic and financial sciences and other heuristics. In addition, this study will also utilize qualitative analysis based on indicators of the System of National Accounts (SNA) of the country and the province to contribute to investment decision-making at the macro and meso-economic levels.

Initially, the economic activities of the province will be identified in the different sectors (primary, secondary and tertiary). Then the companies and entities will be classified, grouping them into the 21 different activities of the National Classification of Economic Activities (CNAE) elaborated by the National Office of Statistics and Information (ONEI) in 2020. To estimate the relative weight of sectors and activities in the provincial economy, a general econometric model will be estimated and used for explanatory and predictive purposes.

Objective of the econometric model: To project and/or explain some variables and attributes of the provincial productive structure.

Hypothesis of model

Based on information regarding the productive structure of the province, where quantitative and qualitative variables are related to: performance of SNA variables and indicators such as Production of Goods and Services (*PGS*), Intermediate Consumption (*IC*), Gross Value Added (*GVA*), Total Expenditures (*ET*) and the qualitative classification of companies, according to the destinations of the production of goods and services (intermediate or final), it is possible to explain the weight or economic importance of the companies and evaluate and project the behavior of these variables.

This work utilizes qualitative information related to the theoretical precepts of Schuschny (2015) and Mendoza (2020), based on studies by Chenery and Watanabe from 1958, for classifying sectors, activities and companies according to: destination of the production of goods and services (intermediate or final); greater or lesser generation of value added; predominant productive linkages (minor backward, minor forward, minor backward, major backward, major backward, major forward, major backward, major backward, minor forward); and generation of drag and multiplier effects between sectors and economic activities.

Objectives of model

- Estimate the relative weight or importance of the sectors in the productive structure of the province.
- Explain the possible existing imbalances between the sectors of the productive structure.
- Project the *PGS* values necessary to balance the imbalances identified.
- Calculate the necessary indicators to evaluate the capital budget and the best investment project.

Indexes and acronyms of variables

s–Types of sectors depending on their linkages, value added and destination of their production ; *s* = 1... *T* (1- NMDI, 2- NMDF, 3-MDI, 4-MDF), where,

NMDI: Non-manufacturing sector of goods and services of intermediate destination.

NMDF: Non-manufacturing sector of goods and services of final destination.

MDI: Intermediate destination goods manufacturing sector.

MDF: Final destination goods manufacturing sector.

k – Number of attributes to be estimated.

Dependent variables

Y_1, Y_2, Y_3 , Y_4 (*PGS, GVA, IC, ET*).

$$GVA=PGS - IC \quad (1)$$

$$PGS=GVA + IC \quad (2)$$

$$IC=PGS - GVA \quad (3)$$

It should be clarified that due to the dependency relationships of these variables, the *PGS* and *GVA* will be used interchangeably as dependent and independent variables and the *IC* will be considered as an independent variable in the model to be designed.

Practical analysis: Taking advantage of an open but planned economy, where the Cuban state is the main actor and investor, it is assumed that if in a productive structure, most companies are classified in the non-manufacturing or manufacturing sectors with production of goods and services of final destination (NMDF, MDF), then it is assumed that there are reserves of production capacities in those same sectors but with intermediate destination (NMDI, MDI). In addition, if the destination of a portion of the Production of Goods and Services (*PGS*) of the NMDF and MDF sectors is changed, it can be used as a source to develop the intermediate destination sectors, based on the following expressions.

$$PGSFI_i = PGSF_j \cdot INPGS \; ; \; \forall \, j \in (1,2, \dots n) \quad (4)$$

where,

n: Number of companies in the NMDI and MDI sectors that receive *PGS* from companies in the NMDF and MDF sectors.

m: Number of companies in the NMDF and MDF sector that transfer part of their *PGS* to companies in the NMDI and MDI sectors.

$PGSFI_i$: Value of the initial *PGS* considered as destination for each company *i* of intermediate destination (pesos).

$PGSF_j$: Value of the *PGS* considered as source to be invested for each final destination company *j* (pesos).

INPGS: Index of *PGS* willing to invest (0 < *INPGS* ≤ 1) to change the destination of companies' productions. It can be interpreted as the opportunity cost of changing the balance of the productive structure, consistent with the method of balance between sources and destinations.

Once the value (in pesos) of the *PGSFI* to be invested is known, it must then be redistributed equally among the companies receiving the investment, for which the relative weight of the *PGSI* of each company in the total *PGSI* must be determined.

$$PRPGSI_i = \frac{PGSI_i}{\sum_{i=1}^{n} PBSI_{\,i}} \; ; \; \forall \, i \in \; (1,2, \dots n), \quad (5)$$

where

$PRPGSI_i$: Weight or relative importance of the company *i*.

$PGSI_i$: Value of the initial PGS of company *i* (pesos).

Estimate the value of production to change its final destination. It is interpreted as the new value of the Production of goods and services or amount of the investment source (*ΔINV*).

Consider an increase in the PGSI by estimating a % decrease in the *IC*, resulting from technological improvements and good practices in the processes, which is only applicable to the new *PGSFIi* values to be used as sources in the new investment.

$$PGSICI_i = PGSFI_i \cdot INCI\ ;\ \forall\ i \in (1,2,\dots n) \tag{6}$$

where

INCI: Intermediate consumption increment index (IC) to be considered in the company (0 < INCI ≤ 1).

$$\Delta INV_i = PBSI_i + PBSICI_i + PRPBI_i \cdot \sum_{j=1}^{m} PBSFI_j\ ;\ \forall\ i \in (1,2,\dots n), \tag{7}$$

where

ΔINV: It is interpreted as the new value of *PGS* or amount of the new source of investment of the goods and services production sectors from the NMDF and MDF sectors..

To maintain the dependency relationships between the *GVA, PGS* and *IC* indicators, these values will be adjusted using expressions 1, 2, 3.

Independent variables

Qualitative variables associated with external sectoral components.

X_s - types of sectors of the economy depending on attributes: destination of their production of goods and services, predominant linkages, value added and representative multiplier and carry-over effects, exogenous dummy variables with dichotomous values (0-1).

$X_1; X_2; X_3; X_4$ – types of sectors of the economy (0-1 NMDI, 0-1 NMDF, 0-1 MDI, 0-1 MDF).

PGS; IC; ET – independent variables associated with SNA indicators depending on expressions 1, 2, 3.

Considering these variables, an ANCOVA-type econometric model is designed which mixes quantitative and qualitative variables.

General econometric model

$$\overline{Y_k} = B_0^{(k)} + \sum B_{PGS}^{(k)}\, PGS + \sum B_{IC}^{(k)}\, IC + \sum B_{ET}^{(k)}\, ET + \sum D_S^{(k)}\, X_s + \varepsilon \tag{8}$$

Parameters:

$B^{(k)}{}_0$ - Average value of the variable Y_k, when the independent variables are zero.

$B^{(k)}{}_{PGS,\ IC,\ ET}$ – Coefficients associated with each of the independent variables *PGS, IC, ET* represent the variation of variable Y_k per unit variation of each of these variables, with all other variables remaining constant.

$D^{(k)}{}_s$ – Coefficients associated with exogenous variables X_s, related to the types of sectors, necessary to calculate the expected value of variable Y_k, from the following expression:

$$\overline{Y_k} = B_0 + D_s^{(k)};\ \forall\ s \in\ (1,2,\dots s) : D_s^{(k)} = 0, \tag{9}$$

where

$\overline{Y_k}$: Expected value of the variable Y_k in the presence of the attribute in the independent variable

X_s

To specify the general econometric model, the following data structure is considered:

Table 1 General data structure available for modeling the productive structure.

Y_k			i	PGS	IC	GVA	ET	X_1 (1,2,3,4)	X_2 (1,2,3,4)	X_3 (1,2,3,4)	X_4 (1,2,3,4)
1	2	3	1	PGS_1	IC_1	GVA_1	ET_1	$X_{1,1}$	$X_{1,2}$	$X_{1,3}$	$X_{1,4}$
Y_1	Y_2	Y_3	2	PGS_2	IC_2	GVA_2	ET_2	$X_{2,1}$	$X_{2,2}$	$X_{2,3}$	$X_{2,4}$
			3	PGS_3	IC_3	GVA_3	ET_3	$X_{3,1}$	$X_{3,2}$	$X_{3,3}$	$X_{3,4}$
			...	...	...	...	...	...	...	...	...
PGS	GVA	ET	n	PGS_n	IC_n	GVA_n	ET_n	$X_{n,1}$	$X_{n,2}$	$X_{n,3}$	$X_{n,4}$

Note: If any of the variables (*PGS*, *GVA*, *ET*) are considered as dependent (Y_k), then the remaining variables will be considered as independent.

Methodology to assess the development of the provincial productive structure

The methodology is based on three stages and ten steps: Stage I- Model application, estimation and sectoral evaluation; Stage II- Determine probable imbalances and identify reserves; Stage III- Calculate the capital budget.

Procedure for working with the econometric model

Stage I:

1) Using *GVA* as the dependent variable, estimate the relative importance of the sectors in the provincial economy, in terms of sectoral classification and other attributes.

2) Considering the *PGS* as the dependent variable, estimate the possible existing imbalances between the sectors of the productive structure.

Stage II:

3) Use expressions 4, 5, 6, 7 to balance the identified sectoral imbalances.

4) Calculate the expected values of *PGS* and *GVA* needed to balance the imbalances.

5) Using the model of expression 8 and the data once the imbalances are balanced,:

- Estimate a regression model for predictive purposes considering *ET* as the dependent variable and *PGS, GVA* and sector types (NMDI, NMDF, MDI, MDF) as independent variables..
- Develop a virtual case study to project a company in a strategic sector for the country's economy (De Cuba, 2020), substituting the expected values of *PGS* and *GVA* into the estimated regression equation.

Evaluate the effects of the most frequent internal and external risk factors in Cuba (Machado and Martinez, 2018), associated with the selected sector, which have an impact on the PGS, using the following expression:

$$NPGS = PGS \cdot (1 - RPGS) \tag{10}$$

where

NPGS: New value of the Production of Goods and Services (*PGS*) calculated according to risk.

RPGS: Risk coefficient associated with the *PGS* ($0 \leq RPGS \leq 1$).

6) Project probable scenarios, based on current risk factors classified as (High, Medium, Low), to determine the capital budget.

Considering the interpretation of *PGS* in microeconomics by Fuentes and Ruiz Durán (2010) and the expression:

$$PGS=PM \pm \Delta IPP, \tag{11}$$

where

PM: Mercantile Production (*MP*).

ΔIPP: It is the variation of Production in Process Inventories (*ΔIPP=0* is considered).

PGS is considered equal to *MP* and equal to Total Revenue (*TR*), i.e. *TR=PGS*.

7) Calculate the Total Benefits (*BT*) that will be considered as the Cash Flows (*CF*) for each period, necessary to determine the capital budget:

$$CF=BT= TR-ET \tag{12}$$

Stage III:

Procedure to evaluate the capital budget

The decision criteria for selecting the best scenario is based on the evaluation of the capital budget for each scenario. Thus, Step 2) is repeated to evaluate the econometric model in another scenario.

The dimensions of financial liquidity, profitability and risk to select the best project, using the following methods: Payback Period (*PR*); Net Present Value (*NPV*) and Internal Rate of Return (*IRR*), will be determined based on the following expressions:

8) Payback period (*PR*)

$$PR = \frac{\sum_{t=1}^{n} CF_t}{CF^*};\ \forall\ t \in (0,1,2,\dots p), \tag{13}$$

where

PR: The period of time that must elapse for the investment to pay for itself. It is interpreted as the period in years necessary for the accumulated Cash Flow to be cancelled. A project will be more liquid the lower the *PR* (Weston and Brigham, 1995).

p: Payback periods (years) calculated according to the time the investment is in operation.

CF_t*:* Discounted annual cash flows produced by the investment, based on the discounted cash flow technique.

CF^**:* Value of the cash flow where the initial investment cost or capital is cancelled out.

9) Calculate the Net Present Value (*NPV*).

$$NPV = \sum_{t=0}^{p} \frac{CF_t}{(1+K)^t} = 0;\ \forall\ t \in (0,1,2,\dots p), \tag{14}$$

where

NPV: Represents the total profit or absolute return at current prices of the investment project (Weston and Brigham, 1995).

K: Discount or discount rate that represents the minimum rate at which the capital is willing to be invested. In Cuba this is determined by the sector where the investment is planned (Almarales and Hierrezuelo, 2020).

The best project will be that in which $NPV \geq 0$, meaning the investment is generating cash in the proportion necessary to repay its debt and provide the required returns to shareholders; an $NPV < 0$ would rule out the project.

10) Calculate the Internal Rate of Return (*IRR*).

$$\sum_{t=0}^{p} \frac{CF_t}{(1+IRR)^t} = 0\ ;\ \forall\ t \in (0,1,2,\dots p), \tag{15}$$

where

The *IRR* is defined as that interest rate that cancels its initial cash flow (CF_0) or that discount rate (*K*) that equals the present value of the expected cash inflows with the present value of its expected costs. Among mutually exclusive projects, the best will be the one whose *IRR* is greater than the (K)

considered (Weston and Brigham, 1995; Almarales and Hierrezuelo, 2020).

When comparing investment projects to solve imbalances in the productive structure based on the criteria considered, the one selected will be that which best fulfills the decision rules of the liquidity, profitability and risk dimensions defined above.

As for the data source, we will use the indicators of the System of National Accounts (SNA) by sectors and economic activities in the period 2013-2018 valued at current prices. This information is extracted from the data series of the Statistical Yearbooks of the country and the province of Santiago de Cuba published by the National Office of Statistics and Information (ONEI, 2019a, 2019b, 2019c).

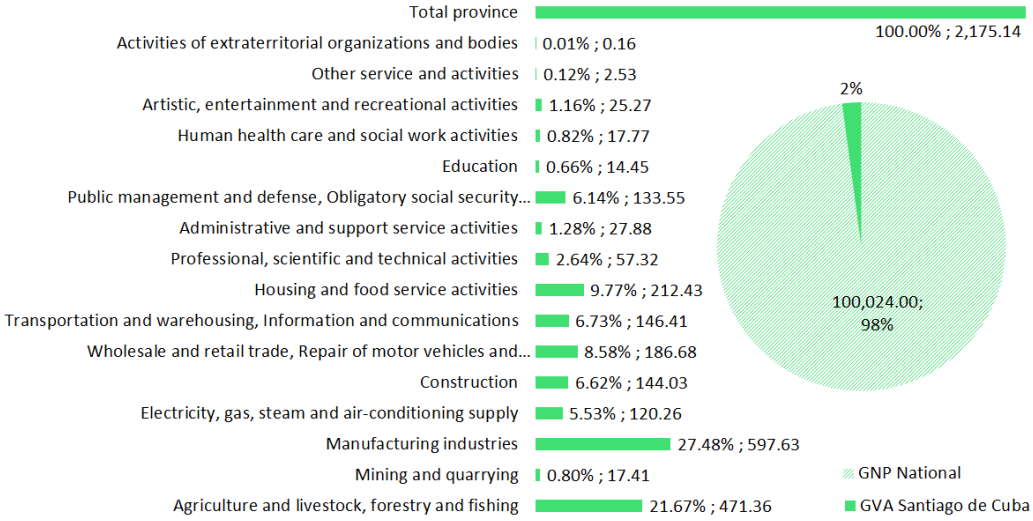
4. Results And Discussion

The study includes all 145 companies in the province of Santiago de Cuba engaged in business activity (113 companies; 78.00%) and budgeted activity (34 companies; 22%), where 12.33% of the business activity is classified in the Primary Sector; 32.19% in the Secondary Sector; 55.48% is located in the Tertiary Sector and 100% of the budgeted activity in the Tertiary Sector.

The greatest weight of the activities lies in Manufacturing industries (C) with (29.00; 20.00%); Agriculture, livestock, forestry and fishing (A) with (17; 12.00%); Accommodation and food service activities (I) with (14; 10.00%); Construction (F) with (12; 8.00%), while the remaining activities account for (29; 29.00%). It is worth noting the significant weight of the business sector and activities C and A in the province. As for budgeted activity, the fundamental weight is held by the entities of the Public Administration and Defense with (26; 18.00%).

An analysis of the relative importance of *GVA* and the relative weight in percentage (%) of this indicator in the *GDP* of the national economy is shown in Figure 1.

Figure 1 Relative importance of GVA by activities (%) and *GDP* in 2018, in Thousands of Pesos.



Sources: Based on SNA indicators (ONEI, 2019b, 2019c).

The graph figure 1 shows that the activities with the greatest importance are Manufacturing industries (C) and Agriculture, livestock, forestry and fishing (A), which contribute 27.23% and 21.67% to the *GVA*, respectively. The other activities of importance are Wholesale and retail trade, repair of vehicles (G) and Accommodation and food service activities (H), both belonging to the tertiary sector, contributing 18.35% of the provincial *GVA*.

The same graphs also shows that in 2018 the province's GDP represents only 2% of the national GDP, a trend that corroborates the low relative weight of the province's economy in the national economy, which may constitute reserves of capacities and productive linkages with greater drag and multiplier effects and the generation of *GVA*.

Stage I:

1) Using *GVA* as the dependent variable, estimate the relative importance of the sectors in the provincial economy based on the sectoral classification considering the destination of their productions and other attributes. Using the general econometric model of expression 8, the following model is specified for explanatory purposes:

$$\bar{Y}_k = B_0^{(k)} + \sum D_S^{(k)} X_s + \varepsilon$$

Using the Ordinary Least Squares (OLS) methods included in the regression functionalities of MiniTab® software, the following regression equation was estimated:

GVA = 21 543 003 – 10 357 320 *NMDI* + 5 289 742 *NMDF* – 9 356 298 *MDI*

Table 2 displays the results of the evaluation of the relative importance of the sectors in the productive structure, based on the expected value $\overline{GVA}$ in Pesos.

Table 2 Relative importance of sectors in the productive structure (%).

Types of sectors	**Expression**	$\overline{GVA}$ **(Pesos)**	**%**
Non-manufacturing intermediate destination (NMDI)	$B_0 + D_1$	11185683.00	15.59
Non-manufacturing final destination (NMDF)	$B_0 + D_2$	26832745.00	37.40
Manufacturer intermediate destination (MDI)	$B_0 + D_3$	12186705.00	16.99
Manufacturer final destination (MDF)	B_0	21543003.00	30.03
Total		**71748136.00**	**100.00**

Source: Prepared from coefficients B_0, D_s estimated from regression equation and expression 9.

By analyzing the D_s coefficients of the above regression equation, corresponding to the expected values of $\overline{GVA}$ and calculating the contribution of each sector, it is interpreted that the sectors formed by companies with final destination productions have a greater relative importance in the economic performance of the province.

2) Considering *PGS* as the dependent variable, estimate the possible imbalances between the sectors of the productive structure.

Using the model of expression 8, the following regression equation was estimated and the relative importance of each sector in the productive structure was calculated, as shown in Table 3.

PGS = 68 983 121 – 53 773 650 *NMDI* – 16 978 823 *NMDF* – 52 353 538 *MDI*

Table 3 Sectorial importance of the province in the productive structure (Pesos).

Types of sectors	**Expression**	$\overline{PGS}$ (Pesos)	**%**
NMDI	$B_0 + D_1$	15209471.00	9.95
NMDF	$B_0 + D_2$	52004298.00	34.03
MDI	$B_0 + D_3$	16629583.00	10.88
MDF	B_0	68983121.00	45.14
Total		**152826473.00**	**100.00**

Source: Based on the coefficients B_0, D_s estimated from regression equation and Expression 9.

When analyzing the D_s coefficients of the previous regression equation and calculating the contribution of each sector to the economy of the province based on the expected value $\overline{PGS}$, a predominance of entities with final destination productions (NMDF, MDF) over those with intermediate destinations (NMDI, MDI) is evident, which is consistent with the previous result and signifies an imbalance between these sectors of the productive structure. In qualitative terms, this result shows the existence of low backward and forward productive linkages, lower drag and multiplier effects and the generation of lower value added.

Stage II:

3) Balance the identified sectoral imbalances.

Percentage changes will be estimated in the destination of the Production of Goods and Services (*PGS*) from the sectors with final destination (SDF) to those with intermediate destination (SDI), considering allocating 25% of the *PGS* from the SDF to the SDI. In addition, a 5% decrease in Intermediate Consumption (*IC*) will be considered in the new investments.

4) Calculate the expected values of *PGS* and *GVA*, necessary to balance the imbalances.

Using the general model of expression 8, and the assumed *PGS* and *IC* percentages, the regression equations to balance the imbalances were estimated, as shown in Table 4.

Table 4 Regression equations estimated to balance the imbalances.

Percentages		Y_k	Regression equation estimated from the econometric model
%INPGS	***%INCI***		
25.00	95.00	*PGS*	52 350 462 + 8 513 058 *NMDI* -11 273 686 *NMDF* + 75 900 381 *MDI*
25.00	95.00	*GVA*	16 348 727 + 30 641 122 *NMDI* – 7 860 046 *NMDF* + 6 474 573 *MDI*

Source: Based on the general model and SNA indicators for the province of Santiago de Cuba.

INPGS: Index of final *PGS* willing to invest (0 < *INPGS* ≤ 1), according to expression 4.

INCI: Intermediate Consumption Index (*IC*) to be considered (0 < *INCI* ≤ 1), according to expression 6.

Utilizing the above equations, the balance and relative importance of the sectors were established based on the expected value of $\overline{PGS}$ and $\overline{GVA}$, respectively, as shown in Table 5.

Table 5 Balance and relative importance (%) of the sectors in the productive structure (Pesos).

Sectors	Expression	Indicators			
		$\overline{PGS}$ (Pesos)	%	$\overline{GVA}$ (Pesos)	%
NMDI	$B_0 + D_1$	60863520.00	21.54	46989849.00	49.65
NMDF	$B_0 + D_2$	41076776.00	14.54	8488681.00	8.97
MDI	$B_0 + D_3$	128250843.00	45.39	22823300.00	24.11
MDF	B_0	52350462.00	18.53	16348727.00	17.27
Total		**282 541 601.00**	**100.00**	**94 650 557.00**	**100.00**

Source: Prepared using the B_0 and D_s coefficients of the previous models.

The above table shows a better balance or relative equilibrium between the sectors of production with intermediate destination and those with final destination, expressed in the expected values of ($\overline{PBS}$), which is corroborated by analyzing the distribution of the relative weight or importance of the sectors in the productive structure of the province based on the expected value of $\overline{GVA}$.

5) Based on the general model of expression 8 and considering average Total Expenses ($\overline{ET}$) as the dependent variable and *PGS, GVA* and the types of sectors (NMDI, NMDF, MDI, MDF) as independent variables, the regression equation was estimated for predictive purposes. The scenario analyses are shown in Table 6.

The estimated regression equation is used to make calculations for a hypothetical company in the intermediate destination manufacturing sector (IDM), specifically in food production, a strategic sector for the economy of the province and the country. In practical terms, another sector can be selected by varying the value of the qualitative variables NMDI, NMDF, MDI, MDF.

When analyzing the equation statistics in the table above, in the case of R^2 we can state that the independent variables explain the dependent variable to a high percentage. The t-values are less than the t-distribution (1.645) and their corresponding p-values are less than 5% of the pre-established significance level. Therefore, all variables are significant, i.e. they are linearly correlated with the dependent variable.

Table 6 Equation and regression results considering $\overline{ET}$ as a dependent variable (Y_k).

($\overline{Y}_k$)	Statistics		Regression equation estimated from the econometric model.
	R^2 (%)	D-W	
$\overline{ET}$	99.9	1.98581	– 111579 + 0.868 *PGS* – 0.%0269 *GVA* – 1189 970 *NMDI* + 104558 *NMDF* – 2112152 *MDI*

Predictors	Variables	Standard error	T=(*t*)	P=(*p*)
Constant	B_0	428452	-0.26	0.795
Production of goods and services	*PGS*	0.004129	-1.34	0.000
Gross value added	*GVA*	0.01564	-1.72	0.038
Non-manufacturing sector intermediate destination	*NMDI*	813926	-1.46	0.046
Non-manufacturing sector final destination	*NMDF*	458166	0.23	0.020
Manufacturing sector intermediate destination	*MDI*	892373	-2.37	0.019

Source: Based on the general model and estimated data from SNA indicators.

The parameters of the independent variables of the estimated regression equation *PGS* directly influence the $\overline{ET}$, while those of *GVA* have an inverse effect. There is an increase of 0.868 Pesos and a decrease of 0.0269 Pesos in response to a one-weight increase of these variables, provided the others remain constant. The constant expresses that the average Total Expenses ($\overline{ET}$) would decrease by 111 579.00 Pesos in the case that all the other independent variables take the value of zero. It is noteworthy that the $\overline{GT}$ of the companies of the non-manufacturing and manufacturing sectors of intermediate destination (NMDI and MDI) are lower by 3 525 280.00 Pesos than the companies of the same sectors of final destination (NMDF and MDF), where the $\overline{ET}$ is lower by 118 600.00 Pesos, with the *PGS* and the *GVA* remaining constant. The negative values of the NMDI and MDI coefficients explain the precarious existence of these sectors in the productive structure of the province.

The Durbin-Watson (D-W) test is satisfied for n=110; k=5; Sig. Level=0.05 ==> DWLow.=1.665; DW Hig.= 1.802 ==> D-W > 1.802.

From the economic point of view, the previous evaluations show the opportunity for investment of resources from the final destination sectors to the intermediate destination sectors. They also make it possible to use the above regression equation for predictive purposes to estimate the value of the initial Total Expenses ($\overline{ET}_1$) in the case of a company in the food manufacturing sector (MDI). By substituting the values of: (PGS_1= $\overline{PGS}$ =128 250 843.00 Pesos; GVA_1= $\overline{GVA}$ = 22 823 300.00 Pesos; *NMDI*=0*; NMDF*=0*; MDI*=1) in the estimated regression equation, the value obtained is ET_1= 108 484 053.95 Pesos.

6) Three scenarios (High, Medium, Low) are projected based on consideration of the following risk factors: Recessionary effects of the COVID-19 pandemic; Adverse environmental phenomena; Low unit sales; High variable costs; Structural problems associated with high technological obsolescence and business inefficiencies, among other unfavorable effects. With the consensus of experts, the following risk levels by scenarios (*RPGS*) were estimated: Scenario I (0.15); Scenario II (0.10); Scenario III (0.05).

Using expression 11 and the *PGS* and *RPGS* values, the probable scenarios are projected to determine the capital budget.

7) Using expression 12, the Total Benefits (BT_1) or initial Cash Flows (CF_1) were calculated. These are necessary to determine the capital budget for each scenario considering risks (High, Medium, Low). Return to step 2) to assess another scenario.

The same variables were then estimated for each scenario, considering annual growth rates of 5% of the *PGS* levels and between scenarios, and 3% of the *ET*, in the following four years. The initial

Cash Flow (CF_0) necessary to undertake the investment process for each scenario was also estimated. A general summary of these results are shown in Table 7.

Table 7 Estimated values of *PGS* and *ET* under risk conditions by scenarios.

Indicators (Pesos)	**Scenario I (0.15)**	**Scenario II (0.10)**	**Scenario III (0.05)**
Estimated production of goods and services (PGS_1)	***109 013 216.55***	121 197 046.64	134 022 130.94
PGS_2	114 463 877.38	127 256 898.97	140 723 237.48
PGS_3	120 187 071.25	133 619 743.92	147 759 399.36
PGS_4	126 196 424.81	140 300 731.11	155 147 369.32
PGS_5	132 506 246.05	147 315 767.67	162 904 737.79
Total Expenses (ET_1)	***108 484 053.95***	105 229 532.33	101 975 010.71
ET_2	111 738 575.57	108 386 418.30	105 034 261.03
ET_3	115 090 732.84	111 638 010.85	108 185 288.87
ET_4	118 543 454.82	114 987 151.18	111 430 847.53
ET_5	122 099 758.47	118 436 765.71	114 773 772.96
Initial Capital or Cash Flow (CF_0)	(-8 332 456.00)	(-61 201 367.00)	(-91 965 432.00)
CF_1	529 162.60	15 967 514.30	32 047 120.22
CF_2	2 725 301.81	18 870 480.67	35 688 976.45
CF_3	***5 096 338.41***	21 981 733.06	39 574 110.49
CF_4	7 652 969.99	***25 313 579.93***	***43 716 521.79***
CF_5	10 406 487.58	28 879 001.96	48 130 964.83

Source: Calculated from estimated values using the regression equations and scenario risks.
Note: Since it is a company in the food manufacturing sector, to calculate the Net Present Value (*NPV*), the Discount Rate (K) considered is 13.4%, as proposed by Almarales and Hierrezuelo (2020).

Procedure to evaluate the capital budget.

Stage III:

8), 9) and 10) The results of the calculations of the liquidity, profitability and risk dimensions indicators (Payback Period (*PR*); Net Present Value (*NPV*) in Thousands Pesos (*TP*) and the Internal Rate of Return (*IRR*) in percentage (%) are shown in Table 8.

Table 8 Results of capital budget indicators by scenario.

Indicators	**Unit**	**Scenario I**	**Scenario II**	**Scenario III**
Payback Period (*PR*)	Year	3.14	3.24	3.82
Net Present Value (*NPV*)	TP	7 933.145	13 351.912	43 295.017
Internal Rate of Return (*IRR*)	%	36.00	21.17	30.00

Source: Prepared from the estimated capital budget calculations of the investment projects calculated for the different scenarios.

The table above shows that the estimated capital budget for the investment project associated with Scenario III is more feasible in terms of the dimensions of liquidity, profitability and risk, and its implementation will make it possible to balance the existing sectoral imbalances and take advantage of the reserves of productive capacities of goods and services of the province, estimated in the best scenario at a total value of 740 556 874.00 Pesos of production of goods and services, which could generate a total Gross Value Added of 131 788 230.00 Pesos [2].

[2] Capital budget results can be expressed in U.S. dollars using the recently approved exchange rate of (1.00 USD = 24.00 Pesos).

5. Conclusions

The study has corroborated the current difficult economic situation in Cuba, aggravated at present by the global crisis of the COVID-19 pandemic since March 2020. This has affected the performance of the national and provincial economies.

In the case of the province of Santiago de Cuba, its current productive structure has low relative importance with respect to the national economy, where the activities Manufacturing industries (C) and Agriculture, livestock, forestry and fishing (A) have the greatest importance in the province, although their contributions to the national economy are significantly low.

Using the econometric model designed, it is possible to explain the weight and importance of the economic sectors and evaluate and project the value of the dependent variables. This is consistent with the hypothesis proposed. From the economic point of view, it evidences the opportunities for investment of resources from the sectors of final destination to those of intermediate destination.

Imbalances are identified between the sectors of the economy, where the fundamental weight in terms of Gross Value Added (*GVA*) and Production of Goods and Services (*PGS*) is held by the activities of the secondary and primary sectors, represented mainly by non-manufacturing and manufacturing companies with production of goods and services of final destination. This does not stimulate the sustained prevalence of backward and forward productive linkages and, therefore, they generate lower drag and multiplier effects and contribute little *GVA*, meaning they have a weak dynamic effect on the provincial productive structure.

The state should outline public policies that attract national or foreign investment to the province, aimed at transforming the productive structure, focused on modernizing primary sector activities, together with a parallel process of technological improvements in the manufacturing and service sectors that will promote productive linkages in both directions to produce a dynamic effect on the economy, so as to take advantage of the comparative advantages of the provinces and transform them into competitive advantages of these territories.

The models utilized made it possible to level the sectoral imbalances of the productive structure of the province. Furthermore, the capital budgets calculated for the different scenarios made it possible to develop a case study for the strategic sector of food production, where the existence of production capacities of goods and services in the intermediate destination sectors is evidenced, which could be considered to decide future investment processes.

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