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Study of the Transformation of Ecuador's Productive Structure, Technology, and GDP in Recent Years Using the IADOV Plithogenic Method

Pedro Gustavo Correa Mendoza [1], Albert Joao Nieto Pacheco [2], Shakila Devi G T [3], and Darvin Manuel Ramírez Guerra [4]

[1] Universidad de Guayaquil, Ecuador. pedro.corream@ug.edu.ec
[2] Universidad de Guayaquil, Ecuador. albert.nietop@ug.edu.ec
[3] Saveetha School of Engineering, Saveetha Institute of Medical And Technical Sciences Saveetha University, India. shakiladevigt.sse@saveetha.com
[4] Universidad San Ignacio de Loyola, Lima. Perú. darvin.ramirez@usil.pe

Abstract. This study investigates the transformation of Ecuador's productive structure, technological integration, and its impact on GDP over the last decade, using the novel Plithogenic IADOV method. This approach, based on neutrosophic logic, allows for the analysis of complex economic scenarios characterized by indeterminacy and contradiction, aspects often overlooked by traditional methods. Through questionnaires administered to 40 experts, the research evaluates five key dimensions: economic diversification, technological integration, GDP growth, public policy formulation, and economic resilience. Findings reveal progress in diversification and technological integration, albeit limited, with a persistent strong reliance on primary sectors and technological gaps, especially for SMEs. While there is political intent to foster transformation, its application and effectiveness are questioned, with an unequal distribution of GDP growth benefits observed. The study concludes by proposing feasible improvements such as fostering emerging sectors, SME digitalization, and the creation of macroeconomic stabilization funds.

Keywords: Neutrosophic Logic, Plithogenic IADOV Method, Economic Development, Ecuadorian Economic Policy, Economic Uncertainty, Sustainable Productive Transformation, Technological Gap, Economic Resilience Ecuador

1. Introduction

Productive diversification, technological changes, and technology's share of GDP is an international concern over time for developing nations like Ecuador, which are dependent upon natural resources for growth yet have no sustainable future. This dissertation utilizes the Plithogenic IADOV method to analyze the variables over ten years. The IADOV method is relatively new and attempts to quantify the uncertainty associated with such a complex economic phenomenon. This dissertation is important because the results can foster socioeconomic policymaking for inclusive, diversified, and resilient growth within the dynamically shifting global socioeconomic and increasingly digitized world. According to ECLAC, productive diversification is needed to ease Latin America, economic vulnerability[1].

Currently, Ecuador's productive structure is still based on primary sectors; for example, it is estimated that in 2024, 24% of GDP will come from trade and mining [2]. Digitalization of the country is present, yet not all technology measures have been adopted across the board; for example, small and medium enterprises find it challenging to convert entrepreneurial endeavors because high-level technology is not accessible. Therefore, the following question resonates: how did Ecuador's productive structure, technology, and GDP manifest through the contradictions and indeterminacies of the process? This question comes about because the answer is more than simply answering a question through historical reconstruction; instead, it presents complicated economics. Moreover, the situation is dire: developing nations endure inequitable patterns of economic growth, vulnerability to external shocks, and

a lack of productive diversification. Industries rely primarily on traditional means although tourism and technology sectors, in addition to more recent crypto and bitcoin creation, have generated interest; yet lack of decentralization and investment into sustainable security prevent these from becoming legitimized fields. Thus, this research would like to answer how reliable experts in the field believe transformation took place so that not only the positive aspects were recognized but also those areas of uncertainty that need immediate attention.

Wherein this has been done before to assess the productive matrix and GDP generated, such efforts are linear without consideration for economic indeterminacy [3,4]. Where authorities champion diversification endeavors and educated assessments, no effort was made to show the detected discrepancies between idealized policy and experimental assessment [5]. Therefore, this study helps the body of knowledge by taking a new approach through plithogenic logic, which assesses the degree to which something can be accepted, rejected, and indeterminate—creating a non-linear, multidimensional perspective on the Ecuadorian economy.

Moreover, this need is only furthered by the present international situation. International technological globalization requires greater international competitiveness which signals that without adopting new advancements like artificial intelligence, Ecuador will fall further behind; yet, advancements must be properly licensed and disseminated first to avoid additional poverty gaps [6]. Furthermore, economic stability amidst international catastrophe shows that only a flexible, non-specialization productive structure will keep Ecuador a/b positive and sustainable [7]. Thus, this study legitimizes the foundation of such conclusions.

Therefore, this study serves as a theoretical and empirical contribution to a field where plithogenic logic is applied to the IADOV methodology and the evaluation of the complex system is extended through a means for policy generation to alleviate economic uncertainties. The results serve the policymakers as an agents of change for a fair and technologically sustained economy. This research intends to: a) evaluate the productive structure of Ecuador via technology and GDP from the IADOV Plithogenenic perspective; b) illuminate uncertainties and paradoxes that complicate the nation's economic trajectory; c) propose solutions to champion diversification benefits, technological adoption, and momentum stability via plithogenic solutions. This paper flows according to these intentions, concerning the investigated research question while satisfying the needs of the nation of study.

2. Preliminary

2.1. Plithogenic analysis

A methodology that focuses on including indeterminacy and contradiction in the evaluation of sets and systems. Plithogenic logic has the following characteristics :

1. Neutrosophic sets: These sets allow for quantification of the indeterminacy (I) through a third parameter, in addition to the true membership (T) and the false membership (F) [8] . The values of T, I, and F are independent and their total sum is between 0 and 3.
2. Membership functions: Within a universe of discourse U, a Neutrosophic Set (NS) is defined by three functions [9]: $u_A(x), r_A(x), v_A(x) : X \rightarrow \ ]0-, 1+[$; that satisfy the condition $0 \leq -\inf u_A(x) + \inf r_A(x) + \inf v_A(x) \leq \sup u_A(x) + \sup r_A(x) + \sup v_A(x) \leq 3+$for all are the truth, $x \in X$. $u_A(x), r_A(x), v_A(x)$indeterminacy and falsity membership functions of x in A, respectively, and their images are standard or non-standard subsets of $]0-, 1+[$.
3. Plithogeny[10,11]: Represents the creation and evolution of entities from dynamics and fusions of previous entities that may be contradictory, neutral, or non-contradictory. It seeks the unification and connection of theories and ideas in different scientific fields.

4. Plithogenic[10,11]: an extension of the classical, fuzzy, intuitionistic, and neutrosophic sets. A plithogenic set (P, a, V, d, c) :
   a) Where "P" is a set, "a" is an attribute (usually multidimensional), "V" is the range of values of the attribute, "d" is the degree of membership of the attribute value of each element x to the set P for some given criteria ($x \in P$), and "d" stands for " d_F", or " d_{IF} ", or " d_N", when it is a fuzzy degree of membership, an intuitionistic fuzzy membership or a neutrosophic degree of membership, respectively , of an element x to the plithogenic set P;
   b) "c" means " c_F", or " c_{IF}", or " c_N", when it is a fuzzy attribute-value contradiction degree function, intuitionistic fuzzy attribute-value contradiction function, or neutrosophic attribute-value contradiction function, respectively.
   c) The functions are defined according to the applications that the experts need to solve. $d(\cdot,\cdot)$ and $c(\cdot,\cdot)$ then, the following notation is used: $x(d(x,V))$ where $d(x,V) = \{d(x,v)$, for all $v \in V\}, \forall x \in P$. The attribute value contradiction function is calculated between each attribute value concerning the dominant attribute value (denoted by) in particular, and also for other attribute values v_D.
5. Plithogenic aggregation operators[12]: These include union (OR), intersection (AND), and other aggregation operators that combine attribute values based on t_{norm} and t_{conorm}. Linear and nonlinear aggregation operations can be created.
6. Contradiction and Aggregation Calculation[13]: The contradiction function c evaluates the contradiction between attribute values. Therefore, they influence how t_{norm} and $t_{conorm}$when applied to create aggregation operators.
7. If t_{norm} is applied to the value of the dominant attribute indicated by v_D, and the contradiction between $v_D$and $v_2$is $c(v_D, v_2)$, then it is applied to the attribute value $v_2$as follows:

$$[1 - c(v_D, v_2)] \cdot t_{norm}(v_D, v_2) + c(v_D, v_2) \cdot t_{conorm}(v_D, v_2), \quad (1)$$

8. Or according to the following symbology:

$$[1 - c(v_D, v_2)] \cdot (v_D \wedge_F v_2) + c(v_D, v_2) \cdot (v_D \vee_F v_2), \quad (2)$$

9. Similarly, if t_{conorm}applied to the value of the dominant attribute denoted by v_D, and the contradiction between $v_D$andv_2 is $c(v_D, v_2)$, then it is applied to the value of the attribute v_2:

$$[1 - c(v_D, v_2)] \cdot t_{conorm}(v_D, v_2) + c(v_D, v_2) \cdot t_{norm}(v_D, v_2), \quad (3)$$

10. Or, according to the following symbology:

$$[1 - c(v_D, v_2)] \cdot (v_D \vee_F v_2) + c(v_D, v_2) \cdot (v_D \wedge_F v_2), \quad (4)$$

11. Plithogenic intersection and union [14]: They are defined in such a way that one criterion is applied for membership and its opposite for non-membership, while for indeterminacy the average is taken.
12. plithogenic interception is defined as :

$$(a_1, a_2, a_3) \wedge_P (b_1, b_2, b_3) = \left(a_1 \wedge_F b_1, \frac{1}{2}[(a_2 \wedge_F b_2) + (a_2 \vee_F b_2)], a_3 \vee_F b_3\right) \quad (5)$$

13. plithogenic union is defined as :

$$(a_1, a_2, a_3) \vee_P (b_1, b_2, b_3) = \left(a_1 \vee_F b_1, \frac{1}{2}[(a_2 \wedge_F b_2) + (a_2 \vee_F b_2)], a_3 \wedge_F b_3\right), \quad (6)$$

14. Resolution and decision matrix: Formulas are used to calculate the median of the plithogenic numbers, allowing the construction of a single decision matrix for all specialists.

$$\text{median}_{i=1}^{m}\{PN_i\} = (\text{median}_{i=1}^{m}\{T(PN_i)\}, \text{median}_{i=1}^{m}\{I(PN_i)\}, \text{median}_{i=1}^{m}\{F(PN_i)\}), \quad (7)$$

Where the analyzed elements consist of plithogenic numbers, showing the components of truth, indeterminacy, and falsity. In other words, it means that the median of a set of plithogenic numbers is defined as the plithogenic number of the medians of its components $PN_i, T(PN_i), I(PN_i)$, and$F(PN_i)$

To compare neutrosophic numbers, we use the following score function S [15]:

$$S([T, I, F]) = \frac{2 + T - I - F}{3} \quad (8)$$

- For each row of the pairwise comparison matrix, calculate a weighted sum based on the sum of the product of each cell by the priority of each corresponding alternative or criterion (see Table 1).

Table 1: Linguistic expression to determine the level of importance of the factor on the variable.

Linguistics Expression	**Scale**	**plithogenic (T, I, F)**	**S**
Poor significance (PS)	0	(0,0,9,1)	0.03
Less significant (LS)	1	(0,2,0.8,0.8)	0.20
Low significance (LS)	2	(0.4,0.7,0.6)	0.37
Moderately significant (MS)	3	(0.5,0.5,0.5)	0.50
Significant (S)	4	(0.6,0.3,0.4)	0.63
Further significant (MS)	5	(0.8,0.2,0.2)	0.80
Very significant (VS)	6	(0.9,0,0.5)	0.95

Plithogenic IADOV

The Plithogenic IADOV[16, 17] technique is an assessment method that uses five questions, three multiple-choice and two open-ended, to measure respondent satisfaction. The peculiarity of this method lies in its "IADOV Logical Grid", which connects three of the questions in a way that is hidden from the participant to infer satisfaction through their interrelationships. By extending this technique to the plithogenic context and using a neutrosophic scale, the ability to measure indeterminate or inaccessible aspects with conventional methods is introduced. This makes it possible to address the complexity of respondents' perceptions. It requires an assessment

system adapted to the neutrosophic model to accurately capture expert opinions (see Table 2). This system and its neutrosophic equivalents are defined as the scoring function A.

Table 2: Expert evaluation system.

Term linguistic	**SVNN**	**Scale**
Clearly satisfied	(1,0,0)	0.50
Further satisfied that dissatisfied	(0.75,0.20,0.25)	0.40
Indefinite	I	0.25
Further dissatisfied that satisfied	(0.25,0.70,0.75)	0.15
Clearly dissatisfied	(0,0,1)	0.00
Contradictory	(1,0,1)	1.00

The term *I* in Neutrosophic is interpreted as a unit of indeterminacy [18]. Another component of the method is the IADOV Logic Table[19], which assigns numerical values to three closed questions applied to experts . If necessary, open questions can also be applied to the surveys. Among the questions used in this study are found :

1. Considering Ecuador's recent efforts, do you believe the transformation of the productive structure and the integration of technology are progressing adequately to positively impact the national GDP?
2. From your perspective, what are the most critical challenges or deficiencies in public policy formulation and implementation that hinder a more effective diversification of the economy and greater technological adoption in Ecuador?
3. Regarding the integration of technology in the Ecuadorian productive sectors, would you say the advances have been:
4. Could you describe specific examples or initiatives where changes in Ecuador's productive structure or technological integration have led to observable positive impacts on GDP, economic resilience, or the development of new competitive advantages?
5. Overall, how satisfied are you with the current trajectory and outcomes of Ecuador's economic transformation efforts concerning productive diversification, technological relevance, and more equitable GDP growth?

To calculate the Neutrosophic Plithogenic Global Satisfaction Index (NPGSI) of the respondents H_N^P, the aggregation operator was used, considering the evaluations of each element X to the plithogenic set P ; x ∈ Pd_F d_{IF} d_N. Thus, the NPGSI is obtained as the sum of the elements analyzed within the plithogenic subset ( ) S_i^P evaluated.

$$H_N^P\left(S_{1,}^P S_2^P, \ldots, S_n^P\right) = \sum_{i=1} \left[w_j\, , S_i^P\right] \tag{11}$$

where (w_i) is the weight assigned to the (i)-th respondent, and (S_i^P) is the neutrosophic plithogenic satisfaction score of that respondent with respect to set (P).

3. Case study

The Ecuadorian economy has undergone significant transformations in its productive structure over the last decade, influenced by factors such as economic diversification, the implementation of public policies aimed at changing the productive matrix, the incorporation of new technologies, and fluctuations in international commodity prices. This study uses the IADOV Plitogenic method, an advanced technique that incorporates neutrosophic logic, to evaluate these transformations from a perspective that considers the inherent uncertainty of complex economic processes.

The plithogenic approach allows for capturing the multidimensional relationships between the productive structure, technological incorporation, and GDP behavior, considering not only the binary aspects of growth or decline, but also the intermediate, contradictory, or indeterminate states that characterize Ecuador's economic reality.

Table 3. Linguistic expression to determine the level of importance of the factor on the variable

Expression Linguistics	Scale	Plitogenic Number (T, I, F)	S
Poor significance (PS)	0	(0,0,9,1)	0.03
Less significant (LS)	1	(0,2,0.8,0.8)	0.20
Low significance (LS)	2	(0.4,0.7,0.6)	0.37
Moderately significant (MS)	3	(0.5,0.5,0.5)	0.50
Significant (S)	4	(0.6,0.3,0.4)	0.63
Further significant (MS)	5	(0.8,0.2,0.2)	0.80
Very significant (VS)	6	(0.9,0,0.5)	0.95

The IADOV Plithogenic technique uses five questions (three multiple-choice and two open-ended) to measure experts' perceptions of Ecuador's economic transformation. The "IADOV Logical Grid" connects three questions in a way that is not obvious to participants, allowing participants to infer their level of satisfaction through their interrelationships.

For this study, an evaluation system was adapted to the neutrosophic model:

Table 4. Expert evaluation system

Term linguistic	SVNN	Scale
Clearly satisfied	(1,0,0)	0.50
Further satisfied that dissatisfied	(0.75,0.20,0.25)	0.40
Indefinite	I	0.25
Further dissatisfied that satisfied	(0.25,0.70,0.75)	0.15
Clearly dissatisfied	(0,0,1)	0.00
Contradictory	(1,0,1)	1.00

Questions used in the study include:

- Do you think the transformation of Ecuador's productive structure has had a positive impact on the country's GDP?

- Which economic sectors require greater attention to strengthen Ecuador's productive structure?
- What are the most significant advances in technological incorporation that you have observed in the productive sectors?
- Can you describe any specific experiences in which productive or technological transformation has had a measurable impact on GDP?
- Are you satisfied with the way the Ecuadorian economy has diversified in recent years?

To calculate the Neutrosophic Plithogenic Global Satisfaction Index (NPGSI), the aggregation operator was used, considering the evaluations of each element X to the plithogenic set P.

The research reveals the transformation of Ecuador's productive structure and its relationship with technology and GDP, using the IADOV Plithogenic method. A sample of 40 experts was used for the modeling, including economists, entrepreneurs, technologists, and government officials involved in the country's economic and productive policy.

The effective implementation of transformations in Ecuador's productive structure, despite significant advances in diversification and modernization, faces multiple challenges. Using a plithogenic approach with neutrosophic numbers, the disparity between productive transformation policies and their effective outcomes is assessed from a perspective that recognizes complexity and uncertainty. The main factors are identified below and quantified using the IADOV plithogenic method.

Plithogenic areas of satisfaction with respect to Ecuador's productive, technological, and GDP transformation

The following information was obtained from the challenges and criteria presented by the respondents:

- **Diversification of the productive structure (D1)** : $HD1\hat{}P = 0.38$This falls between the levels I and MSI. Therefore, respondents tend to be moderately satisfied with economic diversification, although they acknowledge its limitations.
  - $GS - (0{,}75, 0{,}20, 0{,}25)$: Although there are policies aimed at productive diversification, the economy still maintains a strong dependence on traditional sectors such as oil and agriculture.
  - $GS - (I)$: There is a high degree of uncertainty regarding the actual impact of diversification programs, with varying results across sectors and regions.
  - $GS - (1, 0, 1)$: There is evidence of a contradiction between the progress made in some innovative sectors and the decline or stagnation in other traditional sectors.

- **Technological incorporation in productive sectors** $(D2)$: $HD2\hat{}P = 0.25$is at level I (Undefined). Respondents show a high degree of uncertainty about the impact of technology on productivity.
  - $GS - (1, 0, 0)$: Advances in the digitalization of certain production and administrative processes are recognized.
  - $GS - (I)$The effectiveness of technology adoption varies significantly between large and small companies, creating productivity gaps.
  - $GS - (0{,}25, 0{,}70, 0{,}75)$: There are limitations in access to advanced technologies for most SMEs, which generates dissatisfaction.

- **GDP growth and distribution (D3)** : $HD3\hat{}P = 0.22$It is located between the MSI and I areas. Respondents show a tendency towards dissatisfaction with economic growth and its distribution.
  - $GS-(1,0,0)$: GDP has shown growth behavior in certain periods.
  - $GS-(I)$There is uncertainty about the sustainability of economic growth and its relationship with external factors.
  - $GS-(0{,}25,0{,}70,0{,}75)$: The perception of the distribution of the benefits of economic growth is largely negative.

- **Public policies for productive transformation** $(D4)$: $HD4\hat{}P = 0.42$are located between MSS and I. Respondents recognize progress in policy design but question their implementation.
  - $GS-(1,0,0)$: The design of policies aimed at changing the production matrix is valued.
  - $GS-(I)$: Coordination between different policies and levels of government presents uncertainties.
  - $GS-(1,0,1)$: Contradictions are evident between declared political objectives and the actual allocation of resources.

- **Resilience to external shocks** $(D5)$: $HD5\hat{}P = 0.15$is classified in the MSI area (More dissatisfied than satisfied).
  - $GS-(1,0,0)$: Some institutional mechanisms are recognized to face crises.
  - $GS-(I)$:The effectiveness of countercyclical measures is uncertain and varies depending on the type of crisis.
  - $GS-(0{,}25,0{,}70,0{,}75)$:There is widespread dissatisfaction with the economy's ability to maintain growth in the face of external shocks.

This analysis by the Plitogenic IADOV highlights that while there has been progress in transforming Ecuador's productive structure, effective implementation faces a complex interaction between technological, institutional, and market factors. The plitogenic areas used illustrate the disparity between policies and their practical outcomes, emphasizing the need to address uncertainty to improve the effectiveness of economic transformations in Ecuador.

Another critical point is the perception of the interrelationship between productive structure, technology, and GDP, revealing a complex landscape characterized by variations in satisfaction and internal contradictions. Through the use of plithogenic areas, these perceptions can be quantified and analyzed, reflecting the diverse realities and challenges facing the Ecuadorian economy.

Table 5. Perception of the interrelationship between productive structure, technology, and GDP

Observation of respondents	Perceptions about the productive structure	Perceptions of Technological Incorporation	Perceptions of GDP behavior
(1,0,0)	There is recognition of progress in the diversification of certain economic sectors, especially in services, agribusiness, and light manufacturing.	-	It is acknowledged that GDP has shown recovery in specific periods, although with volatility associated with external factors.
(0.75,0.20,0.25)	-	The adoption of technologies in strategic sectors is valued but limited by barriers to accessing capital and knowledge.	-

Observation of respondents	Perceptions about the productive structure	Perceptions of Technological Incorporation	Perceptions of GDP behavior
(1,0,1)	A contradiction is perceived between the discourse of productive transformation and the persistence of extractivist models in economic practice.	Expectations about the transformative impact of technology clash with the reality of uneven and fragmented adoption across the productive fabric.	The benefits of economic growth show contradictions in terms of their territorial and sectoral distribution.

Plithogenic integration for productive and technological transformation in Ecuador

Based on plithogenic analysis in a neutrosophic environment, solutions are proposed to improve the transformation of the productive structure and its impact on Ecuadorian GDP. These solutions focus on addressing areas of great uncertainty and contradiction while reinforcing what has proven effective. The following plithogenic integration sequence is presented:

Table 6. Structure of the plithogenic set for the productive transformation of Ecuador

Plithogenic set	Subset	Attributes	Variables	Factors
Transformation productive and technological	V1: Diversification economic		Sectoral concentration index	Diversification policies
	Sectors emerging		Growth rate of new sectors	Incentives prosecutors
	Added value		Composition of GDP by sectors	Market access
	V2: Adoption technological		Digitization rate business	Policy technological
	Innovation and development		Investment in R&D as a % of GDP	Human capital qualified
	Productivity labor		Production by hour worked	Digital infrastructure
	V3: Growth economic		GDP growth rate	Fiscal policy
	Income distribution		Gini coefficient	Policy monetary
	Sustainability		Indicators environmental	Stability macroeconomic
	V4: Insertion international		Non -traditional exports	Agreements commercials
	Competitiveness		Global Competitiveness Index	Attracting investments
	Balance commercial		Balance commercial by sectors	Real exchange rate
	V5: Economic resilience		Vulnerability indicators	Institutional framework
	Ability countercyclical		Stabilization funds	Risk diversification
	Stability financial		System robustness financial	Reservations international

The structure of the plithogenic neutrosophic set allows for a neutral analysis of the situation of productive transformation in Ecuador. To establish the d_N structure and attribute values within the set,

neutrosophic values are assigned to each attribute based on the responses of the representative sample of respondents.

Table 7. d_N values in the Plithogenic set

No.	Subset	Attribute	Attribute value d_N
1	Diversification economic	Sectors emerging	(0.7,0.3,0.3)
		Added value	(0.5,0.4,0.5)
2	Adoption technological	Innovation and development	(0.4,0.5,0.6)
		Productivity labor	(0.6,0.3,0.4)
3	Growth economic	GDP growth rate	(0.5,0.5,0.5)
		Income distribution	(0,3,0,6,0,7)
4	Insertion international	Non -traditional exports	(0.6,0.4,0.3)
		Competitiveness	(0.4,0.5,0.6)
5	Economic resilience	Ability countercyclical	(0,3,0,6,0,7)
		Stability financial	(0.6,0.3,0.4)

It can be observed that the multi-attribute neutrosophic plithogenic set with dimension 5 and cardinality 2x2x2x2x2 = 32 presents dominant values in the attributes va, vc , ve, vg , and vi for each subset. Based on each subset, the following priority strategies and actions are proposed:

1. **Strengthen diversification economic:**
   - ✓ Action: Implement sector-specific policies for the development of industries with competitive potential, particularly in agribusiness, technology services, and the circular economy.
   - ✓ Time: Medium deadline.
2. **Accelerate productive digital transformation** :
   - ✓ Action: Develop a national business digitalization program with an emphasis on SMEs, including preferential financing, technical training, and the creation of sector-specific collaborative platforms.
   - ✓ Term: Short to medium term.
3. **Improving the articulation between growth and distribution** :
   - ✓ Action: Implement policies that link productive incentives with commitments to improving wages and working conditions, along with territorial development programs focused on lagging regions.
   - ✓ Term: Medium deadline.
4. **Strengthen strategic international integration** :
   - ✓ Action: Develop an international promotion strategy focused on products with greater added value and technological content, accompanied by certification programs and compliance with international standards.
   - ✓ Term: Medium to long term.
5. **Develop economic resilience mechanisms** :
   - ✓ Action: Establish a macroeconomic stabilization fund fueled by extraordinary revenues during boom periods, complemented by explicit countercyclical policies for different crisis scenarios.
   - ✓ Time: Long term.

These solutions, prioritized through a plithogenic approach and quantified with neutrosophic numbers, seek to comprehensively and effectively address the challenges identified in Ecuador's productive and technological transformation and its impact on GDP.

Implementation of the plithogenic intersection

Neutrosophic plithogenic intersection involves the combination of two or more subsets and their attributes, each aspect of which is common to all. In the study, intersections are identified where there is an overlap of efforts, objectives, or outcomes:

- Innovation and development and non-traditional exports.
- Added value and income distribution.
- Emerging sectors and financial stability.

The degrees of contradiction between the values of each attribute within the intersection are defined. The results show the following:

- Subset $V2;V4$: $cN\ (\ vc, vg\ )\ =\ 0.40$
- Subset $V1;V3$: $cN\ (\ vb, vf\ )\ =\ 0.35$
- Subset $V1;V5$: $cN\ (\ va, vj\ )\ =\ 0.25$

Table 8. Plithogenic neutrosophic intersection between subsets

Intersection attributes	(a1, a2, a3) ∧ p(b1, b2, b3)	SN	Assessment
Innovation and development and non-traditional exports	(0.46,0.45,0.48)	0.51	It is located in a sublevel close to MS but with high indeterminacy.
Added value and income distribution	(0.38,0.50,0.61)	0.42	It is located in a sublevel with a tendency towards MSI and I.
Emerging sectors and financial stability	(0.64,0.30,0.37)	0.66	It is located in a sublevel close to S but with a component of indeterminacy.

Table 9: Plithogenic intersections in the productive transformation of Ecuador

Subsets	Intersection attributes	Plithogenic intersection	Cause of the intersection	Advantages	Cons	Benefits
Technological Adoption and International Insertion	Innovation and development and non-traditional exports	(0.46,0.45,0.48)	Innovation is essential to diversify and add value to exports	Improves the international positioning of Ecuadorian products	It requires considerable investments and sustained policies over time.	Reduces external vulnerability and generates more stable currencies
Economic Diversification and Economic Growth	Added value and income distribution	(0.38,0.50,0.61)	The increase in added value must translate into better income distribution.	Generates economic growth with greater social impact	There may be a disconnect between high value-added sectors and mass employment.	It contributes to reducing inequality and expanding the internal market

Economic Diversification and Economic Resilience	Emerging sectors and financial stability	(0.64,0.30,0.37)	systemic vulnerability	Create a more balanced and stable economic system	Emerging sectors can initially be volatile and unstable	Increases the response capacity to specific sectoral crises

The intersection between innovation and non-traditional exports indicates that the development of innovative capabilities can significantly improve the diversification and competitiveness of Ecuadorian exports. However, this relationship shows a high degree of indeterminacy, suggesting that the connection between innovative efforts and export performance is not automatic.

Regarding value added and income distribution, the intersection suggests a problematic relationship with a tendency toward dissatisfaction, reflecting that the increase in value added is not effectively translating into distributive improvements, which requires specific policies to strengthen this link.

Finally, the intersection between emerging sectors and financial stability shows a more positive relationship, indicating that the development of new productive sectors contributes to the stability of the economic system, although with a certain degree of uncertainty that reflects the complexity of this relationship.

Analysis of the relationship between the variables studied

The plithogenic analysis of Ecuador's productive transformation, technology, and GDP reveals complex and multidimensional relationships that can be summarized in the following conclusions:

1. **Relationship between productive diversification and GDP** : There is a positive but highly indeterminate relationship between diversification efforts and economic growth. Emerging sectors show potential to boost the economy, but their relative weight is still insufficient to decisively transform the structure of GDP. Dependence on traditional sectors (especially oil) continues to determine macroeconomic fluctuations.
2. **Impact of technology on productivity** : The incorporation of technology shows a contradictory relationship with productivity. While there are successful cases of productivity improvements through digitalization and automation, these benefits have not been widespread across the business community. The technological gaps between large companies and SMEs, and between high- and low-productivity sectors, tend to widen, creating an uneven modernization landscape.
3. **Sustainability of economic growth** : The analysis reveals a high degree of uncertainty regarding the sustainability of the growth model. Periods of GDP expansion have often depended on temporary factors (commodity prices , remittances, debt) rather than profound structural transformations, which compromises their continued sustainability.
4. **Distribution of the benefits of growth** : A significant contradiction is identified between economic growth and distribution. Periods of GDP expansion have not generated proportional improvements in distributional indicators, revealing disconnects between dynamic sectors and quality job creation.
5. **Resilience to external shocks: The Ecuadorian economy remains highly vulnerable to external shocks, with limited** countercyclical response capacity. While dollarization has provided monetary stability, it restricts the economic policy instruments available to address crises, increasing the importance of productive diversification as a resilience mechanism.

4. Conclusion

This research engaged with the notion that Ecuador's productive transformation, technology integration, and GDP generation since 2003 was relatively effective but effective with a lot of natural and social uncertainty and induced uncertainties. The Plutogenic IADOV condition to assess such phenomenon found low levels of sectoral economic diversification, sectorally heterogeneous technology integration, and induced increases in GDP based on world resource prices. Furthermore, policies are well-intended but poorly applied; good intentions of economic stability exist, but they are vulnerable to exogenous economic shocks. The findings are also of practical applicability. The feasible improvements of fostering emerging sectors, digitization of SMEs, and a stabilization fund for macroeconomic expenditures are reality checks for any legislature's ability to implement to create a diversified and equitable economy. Such feasible improvements lay a foundation to reduce natural resource dependence yet increase natural resources' competitive advantages on the world stage for equitable growth.

In terms of contributions, the current research applies plithogenic logic to economics for the first time. It facilitates the quantification of successes, failures, and uncertainties that traditional economics overlooks and thus extends economic research with a holistic way of approaching a non-binary, multicausative reality. This application is not limited to Ecuador. The current research is limited in scope. Although 40 experts were sampled across various demographics, it did not capture all sentiments of all occurrences of the economic agents. In addition, without access to country-specific sector data, results could not be applied to specific dynamics. Such limitations suggest that these findings should not be too extensively generalized to other years or other countries. Future research should start with a quantitative approach, ideally econometric analyses, to validate findings from this qualitative study. Additionally, narrower approaches, such as tourism or agricultural-based sectors, should be sampled with a wider net including citizen feedback. Such research will not only help a greater understanding of economic transformations but also better substantiate legitimacy for sustainable development efforts in Ecuador.

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