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Supply Chain Resilience in the Tobacco Industry in Honduras

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ABSTRACT

Purpose: The purpose of this article is to show the factors associated with the resilience of the supply chain in the tobacco industry and their influence on its performance.

Methodology: The methodology used was an exploratory, descriptive, correlational and explanatory type of study.

Findings: Through a path analysis, the integrated link between the theoretical model and the sample data was evaluated, and it was demonstrated how these data are anchored in the theoretical framework.

Originality/Value: The characterization of disruptions (positive or negative) in the performance of the supply chain, shows how they dynamically influence the ecosystem, the investments of the supply chain, interacting with each other and having effects to a greater or lesser extent; as is the case of the pandemic and the war between Russia and Ukraine in the Tobacco Industry and how it responds to such disruption, generating to what extent they affect these components and the strategies developed to address the risks.

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1. Introduction

Over the years there has been much disagreement about the conceptualization of supply chain risk and resilience, as well as their categorization and how best to organize the factors associated with these concepts [1]. A number of causes that make modern supply chains more vulnerable have also been identified. Melnyk et al. [2], state that the heart of the current supply chain management thinking is resilience. Within this order of ideas and despite multiple researches, no clear understanding has been provided to define a resilient supply chain.

This research presents an overview of the literature on supply chain risk and resilience, disruptions and the three-component approach that relates to disruptive events and supply chain performance; It also shows the methodology of the research, which contemplates the scope, the design used, defining the population and sample, and the collection of data to be analyzed, whose data are processed and evaluated in the results, showing the values obtained and whether the hypotheses raised in the research, which pertain to the tobacco industry in Honduras, are proven or rejected. In the final part, the conclusions and limitations of the study are presented, as well as the bibliographic source on which the theory is based.

2. Literature Review

In this section, the theoretical basis of the research is founded, a review of articles and other sources was carried out to study general concepts, theories and principles, and characteristics to carry out the analysis of the supply chain resilience trajectory in the tobacco industry and how it influences its performance; the supply chain, risk management, current disruptive events such as the Covid-19 pandemic and the war between Russia and Ukraine, among others, were considered.

2.1. Supply chain

In a global context, whose environment is changing and governed by uncertainty, and whose implications can be diverse both in their level of impact, frequency and origin (internal or external) [3], organizations focus their efforts on supply chain management; since these aim to achieve customer satisfaction by maximizing profitability through efficiency, this object bases its strategy on the planning, monitoring and control of the supply chain network that connects the business network with stakeholders (suppliers and intermediate customers) [4, 5].

Ballou [6], defines the supply chain as "a set of functional activities (transportation, inventory control, etc.) that are repeated many times along the flow channel, by which raw materials are converted into finished products and value is added for the consumer".

It is worth considering, on the other hand, that the supply chain is proposed as: "a network of connected and interdependent organizations that work together mutually and cooperatively to control, manage and improve the flow of materials and information from suppliers to end users" [7].

As globalization has opened new markets and competition has intensified, organizations have taken advantage of this fact by developing more complex global supply chains, with this expansion of supply chains to reduce production costs [8], in order to be competitive in the global market.

With this international market approach, it becomes necessary and almost mandatory to have a plan to manage risks, or measures that anticipate or address potential impacts to the organization, through risk

management the company identifies, analyzes/evaluates the magnitude, frequency and develops and implements plans to mitigate the effects of risks.

2.2. Supply chain risk management

For the authors Jüttner, Peck, & Martin [9] supply chain risk management (SCRM) is defined as "the identification of potential sources of risk and implementation of appropriate strategies through a coordinated approach among supply chain risk members to reduce supply chain vulnerability".

Within this framework, studies reveal that company management did not work on or give the required importance to risk management practices despite the fact that risk management aims at assessing the sources of risk in the supply chain and developing strategies to manage them [10]. According to Fiksel *et al.* [11], these practices are inefficient mainly because they are based on traditional risk management, i.e. risk identification and statistical information, and their failure lies in the fact that many of these risks are unpredictable and unknowable and statistical information may not exist.

In relation to the previous idea, vulnerability in the supply chain potentially increases the possibility of supply chain disruption [12, p. 166]. This author also emphasizes that although the need to periodically assess the risk profile of organizations is recognized, they focus their efforts more on regulatory and financial risk than on supply chain vulnerability [12, p. 190].

It is worth noting that Cranfield University (Cranfield School of Management) [13, p. 2] conducted a study for the UK government and defined supply chain vulnerability as: "an exposure to serious disruptions arising from risks within the supply chain as well as risks external to the supply chain".

Likewise, this study defines supply chain risk management as "the identification and management of risks within the supply chain and risks external to it through a coordinated approach among supply chain members to reduce the vulnerability of the supply chain as a whole" [13, p. 2].

That is why and it is thanks to this approach on the vulnerability of the supply chain, that according to Christopher [12, p. 194], we seek to determine where the greatest vulnerabilities are and what the probability of disruption is, considering:

$$\text{Supply chain risk} = \text{Disruption probability} \times \text{Impact}$$

Within this order of ideas, it is worth highlighting the importance of the role played by risks and the level of vulnerability to which they expose companies, directly or indirectly affecting business management in its decision making, which is why [12, Fig. 1] proposes a 7-step approach to risk management in the supply chain.

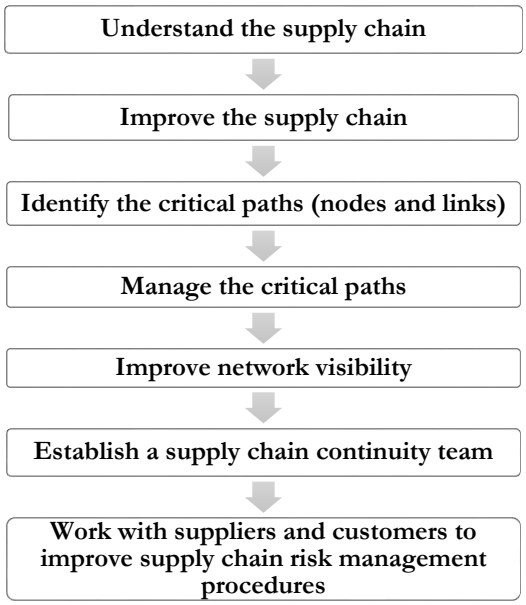

Fig. 1. The supply chain risk management process

2.3. Supply Chain Resilience

The role of the supply chain has been growing over time, so it is not surprising that it has always suffered from unforeseen events, such as accidents, machinery failures, etc., that threaten to destabilize its performance and compromise its operations and efficiency, These unforeseen events are increasingly greater as the chain has become more dispersed, adding risks with incidents such as strikes, globalized terrorism, wars, natural catastrophes, pandemics, and supplier default, among others, that may occur both at the business establishments and along their transit route; these increased risks and exposure to disruptions make the supply chain more vulnerable [14, 15, 16].

Due to the growth of globalization and innovation, the last decades have seen major changes in the supply chain, as it has become more global it has become more complex, due to the interconnectedness between suppliers and manufacturers, making it a more dependent relationship [17]. "This, in turn, resulted in supply chains that are efficient during environmentally stable business, but are highly vulnerable to risks and disruptions" [17].

In the last three years, events have occurred that have planned new threats to supply chain globalization models like never before [18]; the recent war in Ukraine and Russia and the coronavirus epidemic (COVID-19) have had a major impact on the global supply chain and have accelerated the focus on resilience for the industry [15].

According to the previous premise and the object of this research, the definition of supply chain resilience provided by Melnyk, Closs, Griffis, Zobel, & McDonald [2, p.36] will be adopted, expressing it as "the ability of a supply chain to withstand disruptions and recover operational capacity after they occur". The impact of supply chain disruptions has consequences that severely affect the financial, operational, and market performance of companies [4, 20].

As a result of these negative consequences, experts emphasize the need to design efficient and disruption-resistant supply chains [17]. Consequently, risk management capabilities significantly

improve competitive advantage [20]. Currently, risk management strategies mainly relate risk to the probability of occurrence of disruptions [4] and how disruptions impact the business [21].

However, the development of resilience in the supply chain translates as an effort in the face of unexpected and uncertain developments, which implies not being able to assess the probability of disruptions because they are random and with a lack of knowledge (epistemic) [22,11,23].

The resilience perspective [19] thus constitutes a conceptually distinct 'capability-driven' approach [22, 24, 25] where both supply chain characteristics [4], as well as the structure of the supply base [26, 27], are considered important. "A firm and a supply chain could structure its supply base to be more resilient in the face of plausible types of disruptive events" [28].

The authors Scholten & Schilder, in their article The role of collaboration in supply chain resilience [29], disclose as part of their key findings, how information sharing, collaborative communication, mutually created knowledge and joint relationship efforts, through increased visibility, speed and flexibility result in increased supply chain resilience; identifying the underlying mechanisms and interdependencies of these factors [29, Fig. 2].

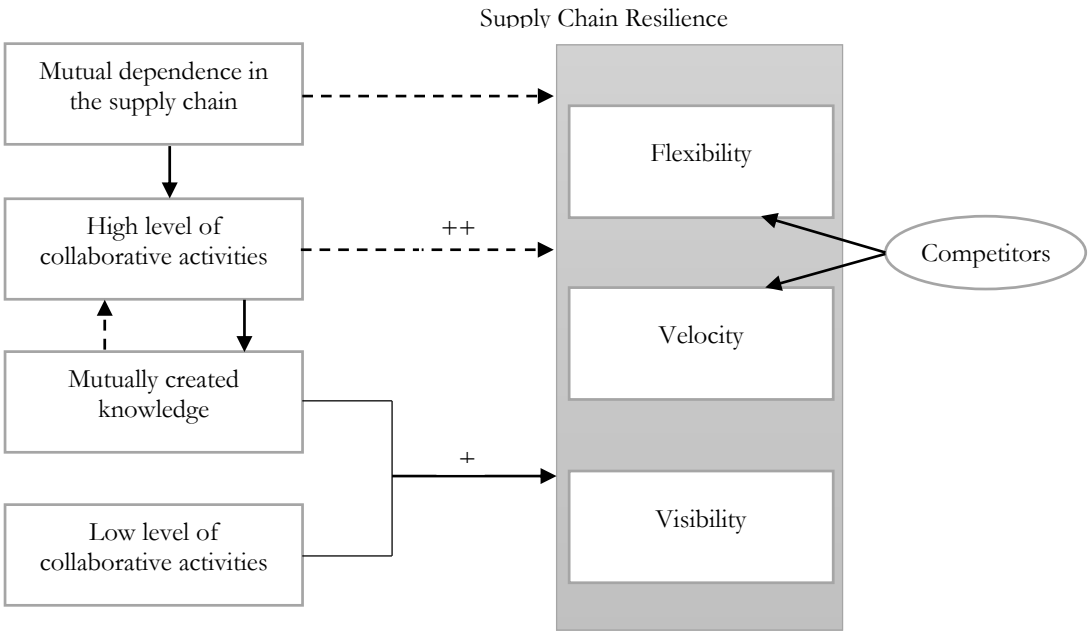

Fig. 2. The influence of collaboration on supply chain resilience

Despite the growing body of literature on the principles of supply chain resilience, there is limited empirical understanding of how companies can develop resilience in supply chains [30, 11, 31, 17].

Scholten *et al.* [23] concludes that there is very little knowledge we have about what makes up: "supply chain resilience beyond generic high-level supply chain strategies;...and how supply chain resilience can be measured before the unexpected happens."

While "much of the literature is conceptual, theoretical and normative" [32], there are few or to be more precise no oriented studies on theory-based operationalization and empirical evaluation of supply chain and business resilience [17, 33, 32].

Therefore, it is necessary for resilience management to develop and implement new knowledge and analytical tools [34,35] in order to take risk management in supply chains to the "next level" [22].

2.3.1. COVID-19 Crisis and Its Impact on Supply Chains

With the pandemic, there have been a series of sudden events that result in the interruption of life in all areas: social, economic, commercial, and educational, among others, being the manufacturing industry one of the most affected.

It is worth noting that this situation has marked a turning point, especially in the supply chain, putting pressure on and testing the response capacity of companies.

This worldwide crisis affected the global manufacturing supply chain network, generating uncertainty in the supply and demand of products and through its disruptions in the supply of raw materials resulted in shortages of finished products [36].

This event, which has and continues to affect the entire world, has made us rethink not only the way we do business, but also life itself [37, 28]. In her dialogue with Alicke & Peters [39], Daphne Luchtenberg mentions that "Supply chain has become a fashionable concept nowadays, especially if we consider that five years ago it was almost unknown to the consumer".

In the last decade, the trend of managing a regional supply chain, where production could be closer to the market, became a reality thanks to COVID- 19 which accelerated this thinking [37], making this a relevant task, consequently in the last two years, it has been seen that companies have had difficulties in responding quickly to disruptions and returning stability and reliability to their operations [40]. "With borders closed and companies ordered by governments to temporarily shut down, many organizations were thrown into chaos" [41]. With this new reality paradigm that were entrenched are breaking down [15].

Many companies have chosen to redesign their supply chains in order to remain operational, assuming costs that were previously unacceptable [15], dealing with an "unprecedented task of balancing extreme demand and supply variations occurring at the same time" [41], forcing managers to develop strategies to address risks and have a resilient supply chain.

However, according to the above, what does resilience mean? According to the Spanish Royal Academy it is defined as the "capacity of a material, mechanism or system to recover its initial state when the disturbance to which it had been subjected has ceased", in this sense and before unfortunate events, supply chain management is called to anticipate and have the ability to "coordinate to anticipate and react quickly to a disruption" [39], this means that the greater the logistics capacity, the greater the resilience in the supply chain [16].

Cartier [42] in his publication refers that with the pandemic there have been changes in both the demand and supply of products and/or services, with priority being given to basic food, health and hygiene products; this drastic change in consumer preferences has had an impact on the demand for certain luxury products. Manufacturers have been the most affected, especially with the closing of borders, which has not only prevented them from supplying their international market, but has also forced them to seek alternative sources of supply locally, this impact has generated a rethinking of product redesign, business and strategies.

2.3.2. Impact on the global supply chain due to the Russia-Ukraine war.

An unprecedented event is the ongoing War between Russia and Ukraine, a situation that is negatively affecting some sectors of the global economy. "Energy costs, the stability of financial markets and the export of agricultural products are beginning to feel the consequences of the conflict" [43].

"The above despite the fact that such conflict has not led to the worst of its scenarios: a third world war" [44], however, it should be noted that this is a conflict that involves all countries and states in the world.

As is well known, "the Russian economy is one of the major producers of oil and gas. Therefore, the war negatively affects oil and gas production, generating upward pressure on the prices of these raw materials" [44]. In the global context, Russia's invasion of Ukraine is a fact that "will have an even greater impact on global supply chains, which are already stretched to the limit after the COVID 19 crisis" [45].

From a more general geopolitical perspective, some experts on the subject [46, 45, 47, 48] point out the consequences that the war between Russia and Ukraine has had and is having; as part of this study, those that directly affect the supply chain will be mentioned:

- Energy Crisis: Rising Cost of Fossil Fuels

  This worldwide crisis is not precisely due to the conflict between these countries; during 2021 the evolution of oil prices has been observed, due to all kinds of factors, but the current situation has worsened [45,48].

  This rapid increase in the price of oil, gas and carbon dioxide emission allowances will continue to affect not only Europe but also the countries that Russia supplies. This increase in price and the interruptions of such an important supply have a great impact on very long value chains; it is important to emphasize that when there is a change in costs, a decrease or shortage of one of these elements of the productive value chain, the impact has a global effect [46, 45].

- Inflation

  The increase in the cost of raw materials and other products will generate a rise in inflation, which translates into low economic growth and is the result of the indirect impact of the war on Latin American countries [49]. This inflationary contagion has a domino effect, generating a rise in interest rates, as we know that too high rates slow down a country's economic growth [49].

  Garcia [49], states that this is a deceptive game because for some people the increase in commodities generates a short-term benefit, i.e. "In the end it is like the dog that eats its own tail and feels good", in other words, "you sell more commodities and you feel you are getting more money, but at the same time, those same commodities have to be used to manufacture or import other products at a higher price".

  In the case of Honduras in particular, it is a country that exports raw materials, but imports a large number of much more expensive products.

- Commercial communications affected:

  Due to the negative effect that the pandemic has had on global transportation, the impact of the war on transportation will be even greater, affecting commercialization [45]. "Sea routes and shipping areas are beginning to be restricted. We are already seeing the exclusion of airspace in Europe for

flights from Russia, and many countries are imitating this unilateral sanction of airspace exclusion" [46].

Among the most affected transportation methods are maritime, air and land. With the increase in oil, generated thanks to the conflict, it results in uncertainty and concern in maritime transport as "freight rates are already extremely high and could increase even more. This means changes in maritime routes, delays and increased maritime freight rates" [45].

2.4. Factors affecting the relationships between risk, disruption, resilience and supply chain performance

The authors Macdonald, Zobel, Melnyk, & Griffis [1] in their study indicate that they have identified factors that contribute to risk, as well as the impact of risk and the disruptions in performance that these can generate, as well as identifying those strategies and tactics used to achieve the development of supply chain resilience, these efforts can be used to provide support for the construction of a theory of risk and resilience.

Previously and in relation to this research, supply chain risk, resilience and performance (and the relationship between these three concepts) have been characterized into three main components [1]:

1. Supply chain crisis/shock: In this sense crisis/shock is adopted as a neutral term, in which the reasons that can cause supply chain disruption can be both positive and negative, the consequences of which ripple through the supply chain in a domino effect, thus the factors that contribute to these disruptions will eventually affect operational performance [1, 50, 51].
2. The supply chain ecosystem: this section studies "the main elements of the supply chain that influence how disruption passes from the source through the supply chain to the enterprise" [1]; and,
3. Resilience-related investments: refers, to organizational (policy) decision making to undertake investments in capabilities or activities to reduce the onset of disruption or increase system resilience [1].

2.5 Research hypothesis

H1: Supply chain crisis/shock affects supply chain performance.

H2: Disruptions (positive or negative) have a ripple effect on ecosystem and resilience-related investments.

H3: The ecosystem significantly affects the risk and resilience of the supply chain.

H4: Investments can generate impact on supply chain shocks.

H5: Supply chain performance is the result of the three components (Crisis, ecosystem and investments).

H6: Disruptive events, such as the Russia-Ukraine war and pandemic; and supply chain crisis vary in concert with the supply chain crisis.

3. Methodology

3.1 Scope

The scope of this research is exploratory, descriptive, correlational and explanatory; exploratory because it is a topic about which there is little knowledge and whose literature review shows few studies oriented to practice and seeks to guide the implementation of the theory of the evaluation of resilience in the supply chain, especially in the tobacco industry in Honduras; The study is descriptive because it seeks to describe the factors that significantly affect the performance of the supply chain, according to the evaluation of its resilience; correlational, because it seeks to know the relationship and/or the degree between the factors; and explanatory because it seeks to explain why resilience in the supply chain is important in performance and how the disruptions (positive/negative), the networks and the ability of a system to reduce the impact significantly affect the supply chain [52].

3.2 Design

The design is non-experimental, since there was no alteration of the object of investigation, i.e. the analysis was performed in existing situations in the environment, without provocation [53]. The statistical data processing tool SPSS (Statistical Package for the Social Sciences) was used to carry out the analysis, as well as the use of a statistical technique of exploration and modeling [54] 'Path Analysis (PH)', this is a multivariate method that allows the evaluation of the fit of theoretical models where a set of dependence relationships between variables are proposed [55], these in turn according to Perez *et al.* [55, p. 52] allow "to verify the fit of causal models as well as to identify the direct and indirect contribution made by a set of independent variables to explain the variability of the dependent variables". AMOS26 was used for the path analysis.

3.3 Population and sample

The population was determined on the basis of a census of 25 identified companies engaged in the production, processing and export of tobacco in eastern Honduras.

Regarding the sample Kline [56] proposes the N:q rule, i.e. the ratio of cases per parameter, N being the number of cases and suggesting an N=20 and the number of parameters that require statistical estimates and which for the purposes of this research are 5, therefore:

$$N:q = 20:5 = 100$$

Based on the above, a minimum sample of 100 surveys was determined and 103 were processed.

3.4 Data Collection

Data collection was carried out through a survey developed and applied online through the Google Form tool, in a period from May to June 2022. A Likert-type measurement scale dimension 3 was applied, oriented to key personnel of the 25 companies identified, whose items are stipulated according to the components supported in the theoretical model.

4. Analysis of results

This section presents the statistical and trajectory analysis of 103 surveys applied.

Statistical analysis

Parametric and non-parametric tests were carried out in order to guarantee the reliability and validity of the measurement instrument, among them: Cronbach's Alpha, KMO and Bartlett and analysis of variance, for this analysis a significance level of 0.05 was considered.

In 1967 Nunnally [57] defined reliability "as the degree to which measures of constructs are repeatable and any random influence that might make the measures different from one measurement to another would be a source of measurement error", i.e. reliability reveals that there is a consistency of the construct measure; for the purposes of this research we used as a metric that provides evidence of reliability and that is based on internal consistency the 'Cronbach's Alpha coefficient'.

Table 1. Reliability statistics

Alfa de Cronbach
0.881

Table (1) shows a coefficient of 0.881, whose value is above 0.8 and almost at 0.9, indicating that the reliability of the instrument is adequate and consistent.

By means of validity, the items should appropriately reflect the trait to be measured [58]; an instrument can be reliable but not have validity, according to this and in order to determine the validity of the instrument, the Kaiser-Meyer Olkin adequacy test (KMO) was applied with the help of the SPSS program, with the objective of knowing the veracity with which the instrument is responding and if it responds to the variables of the research.

Table 2. KMO and Bartlett's test

Kaiser-Meyer-Olkin measure of sampling adequacy		0.791
Bartlett's test for sphericity	Approx. chi-square	292.394
	gl	10
	Sig.	0.001

Bartlett's test of sphericity indicates with a significance value of 0.001 a high degree of intercorrelation of the variables, thus rejecting the null hypothesis of uncorrelation between variables in the sample; it also has a KMO of 0.791, being within the parameters of acceptance of values ranging between 0.5 and 1, so it is established as an instrument is suitable for its application.

Analysis of Variance

For the present study, Friedman's nonparametric test was applied with the ANOVA table, using the analysis of variance to measure the normality of the instrument:

- H0 the average of the means of the items is equal, with a reliability of 95%.
- Ha In at least one variable the mean is different, with a reliability of 95%.

Table 3. ANOVA with Friedman test

		Sum of squares	gl	Root mean square	Friedman's Chi-square	Sig
Inter subjects		81,592	102	,800		
Intra subjects	Berween elements	,668[a]	4	,167	6,949	,139
	Waste	38,932	408	,095		
	Total	39,600	412	,096		
Total		121,192	514	,236		

Overall average = 2,80

a. Concordance coefficient of W = ,006.

As shown in Table (3), the null hypothesis that the average of the means of the reagents is equal is not rejected, since the significance level of 0.139 is greater than 0.05, indicating that there is no significant difference in the mean concentrations.

Path analysis

The purpose of this analysis is to "evaluate the fit of the model, that is, the degree to which the proposed model represents the relationships between the variables under study" [55]; with this type of analysis it is possible to construct causal paths [54], to perform "a series of regressions to analyze the relationship between independent and dependent variables, which in turn can operate as independent variables of other variables included in the model" [55].

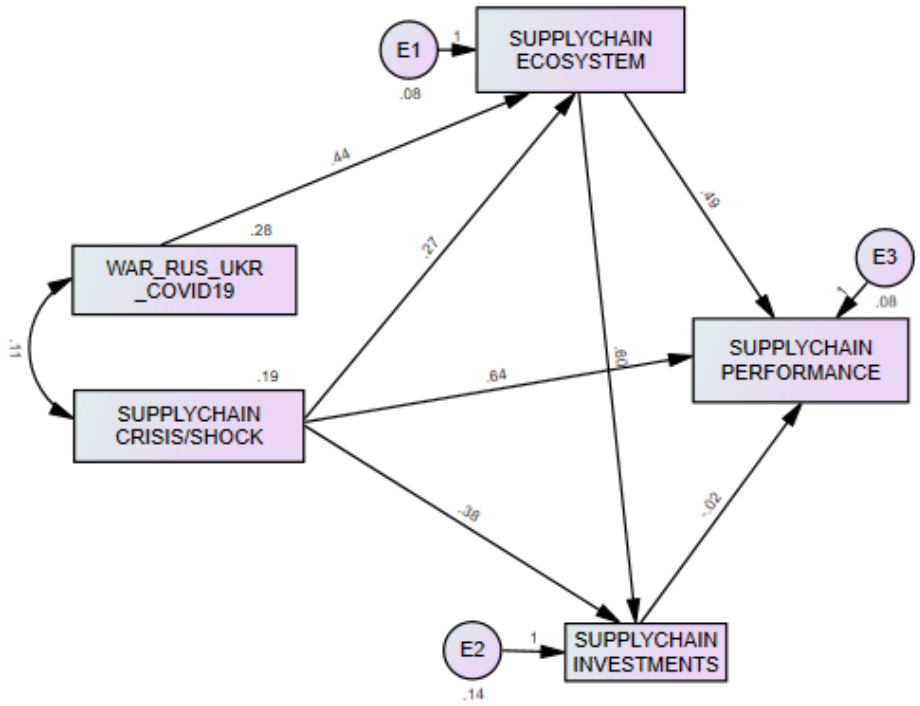

Fig. 3. Path analysis

Chi-square = 0.415; degrees of freedom = 2; probability level = 0.813

Note: As can be seen in Figure 3, a hypothesized model of the factors indicating in the supply chain capacity (resilience) and its impact on performance was performed, in which the covariation between the variables Supply Chain Crisis and Russia-Ukraine war is 0.11; Likewise, the relationship between the variables Supply chain performance (endogenous) with respect to Crisis is 0.64, ecosystem of ,48 and investments ,02; the exogenous variables called residuals and which are not measured directly, are represented by the letter E, and are the reflection of unspecified sources of variability in the dependent variables, whose values are 0.08, 0.08 and 0.14 respectively.

"The evaluation of the fit aims to determine whether the relationships between the variables in the estimated model adequately reflect the relationships observed in the data" [55].

Table (4) shows the maximum likelihood (ML) parameter estimation.

Table 4. Goodness-of-fit index

Adjustment index	Expected	Retrieved
Chi-Square x2 (CMIN)	> 0.05	0.415
Discrepancy between χ2 and degrees of freedom;(CMIN/DF)	< 3	0.208
Goodness of fit index (GFI)	0.90 - 1	0.998
Adjusted goodness-of-fit index (AGFI)	≥ .95	0.988
Root mean square root residual (RMR)	Next to 0	0.002
Normalized fit index (NFI)	0.90 - 1	0.999
Root mean square error of approximation (RMSEA)	< 0.08 (0.08 (preferably, less than .05)	0.001
LO 90		0.001
HI 90		0.120
Comparative Fit Index (CFI)	0.90 - 1	1.000

According to the above and with a chi-square of 0.415 greater than 0.05, it is determined that the observed variables are statistically significant, i.e. that the theoretical model and the sample data fit acceptably. The CMIN/DF less than 3 indicates an acceptable fit [59]. The Goodness of Fit Index (GFI) shows an excellent model fit [60]; and an adjusted Goodness of Fit Index (AGFI) of 0.988 indicates a near perfect fit. The root mean square residual (RMR) represents an almost perfect fit since its value of 0.002 is close to 0.000. Regarding the interpretation of the comparisons based on the results of the model fit, the normalized fit index (NFI) value of 0.999 shows a near perfect fit because of its closeness to 1; the comparative fit index (CFI) of 1.00 represents according to Hu & Bentler a perfect fit [61]. The root mean square error of approximation (RMSEA) of 0.001 is less than 0.05 are considered excellent [62].

Table 5. Hypothesis testing

HYPOTHESIS	**OBSERVATION**	
H1: Supply chain crisis/shock affects supply chain performance.	0.765	Not rejected
H2: Disruptions (positive or negative) have a ripple effect on ecosystem and resilience-related investments.	0.227	Not rejected
H3: The ecosystem significantly affects the risk and resilience of the supply chain.	0.109	Not rejected
H4: Investments can generate impact on supply chain shocks.	0.227	Not rejected
H5: Supply chain performance is the result of the three components (Crisis, ecosystem and investments).	0.552	Not rejected
H6: Disruptive events, such as the Russia-Ukraine war and pandemic; and supply chain crisis vary in concert with the supply chain crisis.	0.320	Not rejected

Given the path analysis and according to a correlation higher than 0.05, in each of the hypotheses raised, none of them is rejected. Given the above, it is possible to interpret how the factors significantly affect the performance of the supply chain and how it responds to disruptions in the supply chain.

5. Conclusions

According to the results obtained in the parametric and non-parametric tests, it can be concluded that the model of the instrument is reliable and valid, which indicates not only the correlation of the variables but also the veracity of the responses.

By conducting a path analysis, we framed how supply chain shocks influence the supply chain, how resilient they are and how the proposed approach to practice can be the starting point for supply chain resilience analysis for other items.

According to the literature review, the relationship between supply chain disruptions and the resulting system performance can be appreciated; within this framework of ideas it can be observed that the development of a dynamic resilience is influenced by the relationship of the supply chain ecosystem and the investments that the organization makes directly and indirectly.

The basic elements (factors) that provide the basis for resilience-based theory building and that together present a view of resilience are those used in this research.

6. Limitations

The limitations of this study include the lack of:

- *Quantitative studies on supply chain resilience.*
- *Previous qualitative and quantitative studies related to the tobacco industry in Honduras.*
- *Reliable information on the tobacco industry in Honduras, since there is no official source of statistical data and information on tobacco companies.*
- *Access to information, due to the confidentiality of the companies and therefore difficult access to personnel and important documents.*
- *Evidence and measurement of data on disruptive events in the supply chain.*

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