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Structure of the production module, production factors and economic performance in Brazilian coffee growth

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Abstract
Coffee growing is an important activity for Brazilian agribusiness, and several production factors can reflect on economic and productive results. In this sense, the objective of this work was to evaluate, through Structural Equation Modeling, the interactions between property structure and effective operational costs with productivity, product value, and economic performance for coffee growing in Brazil. It was observed that the property structure positively influences productivity, but the hypotheses that they influence product value and economic performance were not validated. As for the effective operating costs, it was only possible to affirm a negative influence on financial performance. In this way, the study contributes to the formation of strategies among producers as well as providing theoretical support on the applicability of the structural equation modeling technique. Finally, it is suggested the use of new managerial indicators to measure economic performance, the evaluation of the impact of coffee beverage quality on costs and ownership structure, in addition to replicating the study for other crops such as oranges, apples, bananas, and papaya.

Keywords: coffee; agribusiness; structural equation modeling.

Estructura del módulo de producción, factores de producción y desempeño económico en el crecimiento del café brasileño

Resumen
El cultivo de café es una actividad importante para la agroindustria brasileña y existen varios factores de producción que pueden reflejarse en los resultados económicos y productivos. En este sentido, el objetivo de este trabajo fue evaluar, a través del Modelo de Ecuaciones Estructurales, las interacciones entre la estructura de propiedad y los costos operativos efectivos con la productividad, el valor del producto y el desempeño económico del cultivo de café en Brasil. Se observó que la estructura de propiedad influye positivamente en la productividad, pero no se validaron las hipótesis de que influyen en el valor del producto y el desempeño económico. En cuanto a los costos operativos efectivos, sólo se pudo afirmar una influencia negativa en el desempeño económico. De esta manera, el estudio contribuye a la formación de estrategias entre los productores, así como brindar sustento teórico sobre la aplicabilidad de la técnica de modelación de ecuaciones estructurales. Finalmente, se sugiere el uso de nuevos indicadores gerenciales para medir el desempeño económico, la evaluación del impacto de la calidad de la bebida de café en los costos y la estructura de propiedad, además de replicar el estudio para otros cultivos como naranja, manzana, plátano y papaya.

Palabras clave: café; agronegocios; modelos de ecuaciones estructurales.

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1 Introduction

Brazilian agribusiness is an essential pillar for the country's economic dynamics, ensuring the fulfillment of trade relations in different regions of the world [1]. In addition, the sector is an important source of employment and income generation for disadvantaged classes. According to [2], the Gross Domestic Product (GDP) of Agro grew by 24.31% in 2020, which increased the sector's share of the national GDP. Among the main products, the country has stood out in the production of some commodities such as corn, soybeans, coffee, and meats [3].

Coffee growing is one of the main activities of Brazilian agribusiness and, in this sense, the search for new perspectives of analysis that are capable of making the segment more efficient is characterized as a functional way of identifying production bottlenecks [4]. Coffee is one of the oldest, most popular, and most appreciated beverages around the world and has played an important role in consumer culture since the mid-16th century [4]. In addition, Brazil is the largest producer and largest exporter of coffee in the world [2,5]. In the last ten years, the Brazilian coffee crop grew by 41.6% in production volume, from 43.5 million bags in 2009 [6] to 61.6 million bags in 2020 [5], a 25% increase compared to the previous harvest according to Table 1. About 47.4 million bags come from arabica coffee (Coffea arabica) and 14.3 million bags from conilon coffee (Coffea canephora). The area destined for coffee growing (production and training) is around 2.2 million hectares [5].

Among the main producing states, Minas Gerais is the largest producer, responsible for approximately 33.5 million bags. It is noteworthy that in the state four regions are considered with their specificities, namely: Sul de Minas, Cerrado Mineiro, Zona da Mata Mineira, and Norte de Minas. Espírito Santo is the second largest producer, adding the production of arabica and conilon coffees, the state is responsible for the production of 13.6 million bags. When dealing only with conilon coffee, it becomes the largest producer in the national territory, with about 9.1 million bags [2,5].

Table 1.
Coffee production in Brazil by region and federative units, in thousand bags.

Region/State	Production (thousand bags processed) 2020 harvest
North	2434.10
RO	2434.10
North East	4138.20
BA	4138.20
Midwest	398.90
MT	158.40
GO	240.50
Southeast	53573.70
MG	33460.20
ES	13609.00
RJ	346.00
SP	6158.50
South	937.60
PR	937.60
Others	145.90
Brazil	61628.40

Source: [1]. Note: Estimate in September/2020.

Table 2
Coffee exports in Brazil in 2020

	Arabica	Conilon	Soluble	Roasted	Total
Bags (60kg)	35,599,346	4,924,851	4,124,062	23,765	44,672,024
Exchange Revenue (US$)	4,721,725,831.35	382,863,725.77	539,896,102.20	7,647,076.25	5,652,132,735.57

Source: [3].

São Paulo occupies the third place with the production of 6.2 million bags of Arabica coffee. Then there is Bahia with the production of 4.1 million bags, 2.1 million of which are conilon coffee - the second largest producer of conilon. In the north of the country, the state of Rondônia is the third largest producer of conilon coffee, with around 2.4 million bags, and ranks fifth overall. In the south of the country, the sixth largest producer is Paraná, with the production of 937.6 thousand bags of Arabica coffee. According to the [8], the export volume in 2020 was 44,672,024 bags of 60 kg, according to Table 2, with foreign exchange revenue of US$ 5,652,132,735.57.

Coffee farming has economic and social importance, as it is an activity of great importance and contributes, on a large scale, to the generation of jobs, income, and is of fundamental importance for regional development due to its ability to move the economy in several sectors, from cultivation to processing and marketing of products derived from the field [5]. When it comes to aspects related to productivity, coffee farming has faced difficulties with the occurrence of undesirable climatic events in recent years and that may extend over the next few years if containment measures are not taken [9]. In this sense, long periods of drought associated with the occurrence of frosts have impacted coffee production in the main producing regions. In Brazil, coffee production is divided into two types, namely Arabica and Conilon coffee. The production of Arabica coffee extends to the regions of Minas Gerais, Espirito Santo, Paraná, São Paulo, and Bahia. Conilon production occurs mainly in the states of Rondônia, Bahia, and Espírito Santo [2,5].

Coffee production in Brazil is also influenced by effective operating costs which are linked to production stages ranging from field production, harvest and post-harvest, processing, marketing, and export [5,10]. These costs have a direct impact on the economic performance of the activity. Given this, the objective of this study was to evaluate, through Structural Equation Modeling, the interactions between property structure and effective operating costs with productivity, product value, and economic performance for coffee farming in Brazil.

In this context, it is worth noting that the economic performance of agricultural properties can be measured through the use of economic indicators that use production costs [11]. The identification of production costs of an agricultural company offers a range of possibilities of analysis, among them the analysis of profitability: an indispensable tool when looking to verify the efficiency of a productive activity [12,13].

The calculation of the income of agricultural enterprises, compared to the total costs of production, provides subsidies to observe the degree to which costs were recovered through the products obtained in the company, products that are marketed, stored, and/or consumed [14]. There are several purposes for which production cost data are used and for each of them, a specific script must be followed, both for calculation and analysis. Thus, the costs serve to verify how the resources used in a production process are being remunerated, making it possible to verify how the profitability of the activity in question is, compared to alternatives for the use of time and capital [15].

The concept of operational cost developed by the Institute of Agricultural Economics [16], is conceptualized as the expenses effectively disbursed by the farmer plus the depreciation of machines and specific improvements of the activity, incorporating other cost components, aiming to obtain the total cost of production and profitability analysis. To calculate the hourly cost of the machines, the concept of variable cost (repairs, fuel, consumables, and operator labor) and fixed cost (depreciation, insurance, garage, and interest on capital) was considered. The sum of these two components constitutes the total cost, per hour, of using the machines, considering the different characteristics of each machine [17].

[17] treats Gross Margin (MB) as a margin about the effective operating cost (COE), that is, the result that remains after the producer pays the effective operating cost and about this same cost (in percentage) considering a certain unit sales price and the yield of the production system for the activity. For [12], the gross margin (MB) is constituted from the difference between total gross revenue and variable costs. The result will demonstrate whether the property under analysis is covering current production costs, without taking into account fixed and opportunity costs. The positive result will determine the survival of the activity, at least in the short term [12].

In a market system, the economic performance of agricultural properties depends mainly on the following factors: i) Structural characteristics of the production unit: combination and organization of production factors and edaphoclimatic characteristics; ii) Nature and degree of production intensification: technological level used in production; iii) Level of technical and managerial efficiency of production: rational use of agricultural techniques and use of managerial tools; and iv) Importance of expenses with obtaining means of production: expenses related to the use of means of production [18].

In addition, good performance management practices associated with coffee production can bring benefits to leverage results in the sector. According to [19] and [20], performance management comprises an important aspect for the strategic planning of organizations. In agribusiness, performance management can occur through performance monitoring mechanisms, for example, with the use of performance indicators [19]. Thus, there are quality, capacity, production, and financial indicators, among others, that can be incorporated into coffee production [19,21].

However, strategic planning is a key element for achieving good results in a given sector [20]. In coffee farming, this planning is present from the initial stages of planting, where producers measure costs, choose indicators, define short and long-term goals and objectives [22]. However, this requires the effort of a group of collaborators, which can initially impact operating costs, being often unfeasible for small producers [23].

In Brazil, about 80% of coffee production comes from areas cultivated by small producers [22,24]. This fact directly reflects on the generation of jobs, where there are more than 8 million people in paid activity. In this way, the possibility of acquiring credit and rural insurance by this class of producers has been an alternative to overcome the difficulties imposed by the economic scenario recently [22]. It is worth mentioning the value added by family production to the quality of the coffee produced since the cultivation of specialty coffees follows unique processes, different from large-scale and mechanized production [22].

Coffee, according to [7], represents the second most consumed beverage in Brazil, and this consumption has grown steadily in recent years. At the same time, the population's interest in coffees of certified origin has also grown, especially for types of coffee of organic origin [22,25]. The presence of certification is an important aspect of proving the attributes of the drink, especially for the lay public, but it prioritizes good eating habits [22].

Thus, the study seeks contributions regarding the unfolding of the financial structure for the coffee trade. In this way, producers based on this knowledge will have greater possibilities within the productive activity, to plan better according to the variables that most impact the economic performance of the activity. In addition, a theoretical contribution constitutes the formation of relevant material on the applicability of the structural equation modeling technique in coffee farming.

Therefore, the study was divided into an introductory section, with the presentation of relevant information that justify the study, followed by the hypothesis section and research model. Thus, the next section corresponded to the methodology, where the study was characterized, and the structural model was validated. Soon after, the results and discussions were presented, followed by the conclusion and section of acknowledgments and references.

2 Research hypothesis and model

2.1 Hypotheses

The study starts from the investigation of the production factors and property structure have a direct impact on the economic performance of the activity. In this sense, Table 3 presents the hypotheses that were tested to interpret the relationships between predictor variables.

The first hypothesis presented seeks to confirm the influence of disbursements with inputs on effective operating costs (COE) since expenses related to the purchase of correctives, fertilizers, and pesticides are components of the indicator [16].

The second hypothesis deals with the verification of the influence of the property structure (productive module), a construct that is composed of predictor variables such as “productive area”, “culture”, “type of production” and “crop

Table 3.
Research hypotheses.

H_1: Disbursements with inputs influence the property's effective operating costs (COE).
H_2: The structure of the productive module influences productivity.
H_3: The structure of the productive module influences the value of the product.
H_4: The structure of the productive module influences economic performance.
H_5: Effective operating costs (COE) influence productivity.
H_6: Effective operating costs (COE) influence the value of the product.
H_7: Effective operating costs (COE) influence financial performance.
H_8: Productivity influences financial performance.
H_9: Product value influences financial performance.

Source: Authors (2022).

system". Hypotheses H2, H3, and H4 test whether the construct influences productivity, product value, and economic performance, respectively. The crop is divided into Arabica coffee or conilon coffee production and the cultivation system into irrigated or rainfed. Meanwhile, the type of production is categorized into i) manual, when mechanized activities are not carried out (use of self-propelled agricultural equipment); ii) semi-mechanized, when there is mechanized activity in carrying out the cultivation, but the harvest is manual; and iii) mechanized, when there are mechanized activities in driving and harvesting [26].

In addition, the influence of the COE is also tested by the hypotheses H5, H6, and H7, which are linked to productivity, product value, and economic performance, respectively. From these, it is sought to verify if the value related to the expenses interferes in an increase in productivity or the quality of the product (value). The relationship with performance (MB) is expected to be negative about economic performance, given that MB=Receita-COE. Hypotheses H8 and H9 aim to confirm the direct impact of productivity and product value with economic performance. Revenue is the product between productivity and the value of the product, so it is expected that both hypotheses will be accepted.

The proposed structural equation model to test these hypotheses was built with the help of SmartPLS3 software, shown in Fig. 1.

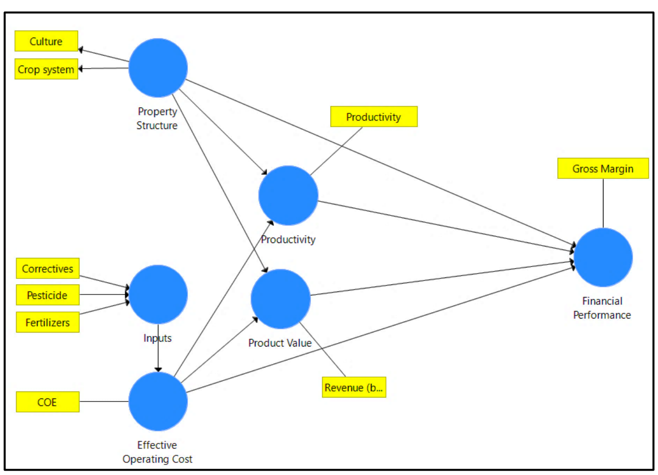

Figure 1. Proposed Structural Equation Model.
Source: Authors (2022)

2.2 *Structural equation modeling*

Structural equation modeling is a statistical method used to analyze multivariate data sets that use a combination of techniques and procedures [27,28]. According to [29] and [30], structural equation modeling can also be understood as an improved version of path analysis, which allows the investigation direct and indirect causality between variables. According to [31] and [32], the modeling of structural equations can help in the planning of organizational actions. The method involves the development of a structural model that represents the possible paths between the variables, the analysis and adjustment of the measurement model, and the model focuses on minimizing the difference between the covariance matrix and the observed variance [32,33].

In addition, this method allows several models to be tested, and different paths specified, so that the reality under study can be portrayed in more detail [28]. Although the measurement model can reproduce the possible paths and, therefore, allow the analysis of the interrelationship between the variables, it is necessary to verify the fit between the observation data and the hypothetical model [29,33,34]. According to [27] and [30], this verification can be performed through factor analysis. These authors also emphasized that there are two types of factor analysis: exploratory factor analysis, which links unobserved variables from which conclusions are drawn, with observable variables; and confirmatory factor analysis (CFA), which tests a set of variables based on theoretical or empirical observations and evidence and based on that, tests the model's fit against competitive factors.

[35] confirmed this view and the CFA has an important value in the data review and improvement process. Due to the nature of the data and the direct dependence of the distribution, the estimation of the structural model and the measurement model of structural equation modeling is very complicated to perform [28,36]. [37] point out this argument, emphasizing that this estimate analyzes the hypothetical structure of the sample data and then tests how well the observed data fits the measurement model. Also, according to the authors, the analysis is performed by comparing the variance-covariance matrix that represents the relationship between the variables and the estimated variance-covariance matrix of the best-fit model.

According to [33], a structural model can contain formative and/or reflexive constructs. The formative constructs are formed by variables observed and, not necessarily, correlated. The reflexive constructs are formed by observed and correlated variables [32]. In this sense, the use of structural models allows the simultaneous estimation of interrelated dependence relationships, as well as the incorporation of measurement errors in the model estimation process [28,32].

3 Methodology

Data on coffee production costs in Brazil and Brazilian producing states used in this study were collected by the "Campo Futuro" project. This project is made up of several partner institutions, including the Confederation of Agriculture and Livestock of Brazil (CNA), the National Rural Learning Service (SENAR) and the Center for Intelligence in

Management and Markets (CIM) of the Federal University of Lavras (UFLA).

The methodology used for data collection was the Panel. This method consists of meetings with small, medium, and large producers, in which they provide information on labor, crop management, harvest and post-harvest, general expenses, financial values, crop area, inputs, productivity, machines, and equipment, cost interest and inventory [16,38,39].

This study used the basis of the factors that make up the effective operating cost (COE). According to [2], the COE comprises all costs effectively spent in an agricultural year, involving all cost components generated by the relationship between the technical coefficients (amount used) and their prices. As well as the characteristics of the productive modes that portray the productive area, productivity, the species of coffee cultivated, the type of production, the cultivation system, and the value obtained in the commercialization of the product. The time cut used was from 2017 to 2020, totaling 49 samples.

To analyze the financial viability of the different groups, the gross margin was used as an indicator of the financial performance of the milk activity, calculated by the equation: Gross Margin = Revenue (per hectare) – Effective operational cost (per hectare). The measurement of production factors is given by the indicators of costs with inputs (fertilizers, correctives, and pesticides) and effective operating costs.

The first methodological step was to organize the indicators in scales, being necessary to apply the logarithmic scale in base 10 for the indicators defined by unit of area (hectare). After transforming the data into ".txt", inserted the file into the software and mounted the model.

The next step was to verify the discriminant validity using the Heterotrace-Monotrace (HTMT) criterion, as shown in Table 4. Values above 0.90 indicate that discriminant validity is not present and only one construct presented a higher value (in bold).

The next step was to evaluate the reflective models, through the reliability of the indicator, internal consistency, convergent validity, and discriminant validity, as shown in Table 5. Higher external loads indicate how common the indicators are and values above 0.708 are recommended, as they indicate that the construct explains more than 50% of the variance of the indicator. Cronbach's alpha should assume values between 0.7 and 0.95 and composite reliability greater than 0.7. While the convergent validity (AVE) must be greater than 0.50 and with that, the reflexive constructs are validated, confirming the discriminant validity.

Table 4.
Discriminant validity analysis based on the HTMT criterion.

Variables	Operational costs	Property Structure	Productivity	Financial feedback	Product Value
Operational costs					
Property Structure	0.556				
Productivity	0.630	0.985			
Financial feedback	0.381	0.151	0.122		
Product Value	0.402	0.690	0.653	0.341	

Source: Authors (2022).

Table 5.
Validation of reflexive constructs.

Latent variable	Indicators	External loads	Cronbach's alpha	Composite reliability	BIRD	Discriminant validity?
Property structure	Culture	0.946	0.855	0.932	0.873	Yes
	Cultivation System	0.922				

Source: Authors (2022).

Table 6.
Validation of training constructs.

Construct	Indicator	External loads	T value	Value - p
inputs	Concealers	0.351	1,665	0.096
	defensive	0.192	0.561	0.575
	fertilizers	0.999	29,710	0.000*

Source: Prepared by the author (2021).

The evaluation of formative constructs takes place by checking the convergent validity of formative measurement models, evaluating the models in question of collinearity and the significance and relevance of formative indicators. Table 6 verifies the external loads of each indicator with statistical significance with p-value < 0.5. Only the indicator "Fertilizers" was relevant, but the others remained due to proof of participation of the construct in the literature.

Table 7 presents the assessment of the collinearity of the indicators through VIF values. Thus, VIF values above 5 indicate critical problems of collinearity between the indicators of formatively measured constructs. Ideally, VIF values should be close to 3 and below, which is what happened with the data indicated in Table 7.

4 Results and discussion

This study aimed to analyze the influences of production factors and the structure of the productive module on the economic efficiency of coffee farming in Brazil based on the Gross Margin obtained. Fig. 2 presents the result of the proposed Structural Equation Model. In this way, one can verify the strong path coefficients between property structure and productivity, between inputs and costs, between productivity and economic performance, and between product value and economic performance.

Table 7.
Collinearity Analysis.

Variables	VIF
COE	1,000
Concealers	1,117
Culture	2,265
defensive	1.056
fertilizers	1,176
gross margin	1,000
Productivity	1,000
Revenue (bag)	1,000
cultivation system	2,265

Source: Authors (2022).

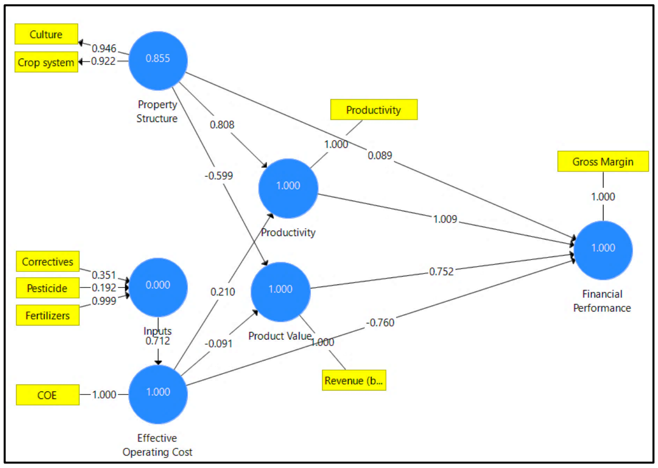

Figure 2. Result of the proposed Structural Equation Model.
Source: Authors (2022).

Still according to Fig. 2, it is possible to observe a predominance of formative constructs in the structural model. Thus, only the construct “Ownership structure” was considered reflexive, where its predictor variables present high correlation. According to [5] and [2], before carrying out a particular planting, issues related to the choice of cultivation and the cultivation system to be used are important to guarantee good productivity and preserve the quality of the crop. ground.

In the field of coffee farming, soil preparation is an important step in the process, since coffee productivity depends on the nutrients present in the soil in specific amounts [40]. Among the producing properties in Brazil, it is common to use strategies for this purpose, such as crop rotation based on the cultivation of corn, soybeans, and cotton, for example, and the later introduction of coffee [41]. In addition, the use of fertilizers is one of the concerns of producers, given the high cost of these elements for production. Thus, a viable alternative is the use of residues generated in production such as coffee husks, which have a high nutritional value for the soil, partially replacing the consumption of fertilizers [40].

Given this, the “Inputs” construct contemplates the predictive variables of fertilizers, correctives, and pesticides. These three elements, when present, guarantee good coffee productivity [41]. However, the excessive use of these can negatively impact both the quality of the product and the soil as well as the operational costs of production, generating an unsatisfactory economic performance of the activity [41]. Furthermore, this study investigates other forms of relationship between the constructs “Inputs”, “Productivity” and “Product Value”. Productivity in the structural model of Fig. 2 is a first-order construct, as is the value of the product. Productivity represents the amount of coffee bags produced per hectare, while the value of the product corresponds to the product's commercialization price, both are tested in the model based on the impact on “Economic performance”.

The relationship between the constructs “Ownership Structure”, “Productivity” and “Product Value” are also tested by the structural model. According to [42], there is a difference between the type of soil and the treatment performed in it for the choice of a particular cultivar. In this sense, coffee is characterized as a plant that adapts well to the tropical climate prevailing in Brazil. The relief is also an important aspect of the formation of coffee plantations. That said, the quality of the product is impacted and the variation in product prices can vary according to the processes carried out since planting.

In a recent context, the use of certifications of origin and processes is a measure implemented for producers who produce coffees with a high standard of quality [2]. In addition, certification supports the role of consumer choice by attesting that the product was produced according to a set of specific processes in each region [43]. According to [43], Minas Gerais is one of the largest coffee producers in Brazil, and, above all, it has a denomination of origin certification, which means that this region has specialized and can produce a differentiated and excellent product as in Honduras and Colombia, for example.

The search for better results by coffee producers has been recurrent in Brazil in recent harvests, given the occurrence of undesirable climatic events such as long periods of drought and the occurrence of frosts that hampered the prosperity of production [44,45]. In addition, the global economic context has made it difficult to form good prices and an attractive margin for producers, with the high price of inputs and exchange rate issues with the devaluation of the real [2]. Thus, an alternative has been the commercialization of the product in the foreign market through standardization and increase in the quality of the product. Another alternative line contemplates the organic production of coffee that has grown among the preference of consumers in the country, and reducing costs for producers with inputs [41].

Table 8 presents the results obtained by the hypothesis test, and it can be affirmed that the hypotheses H1, H2, H7, H8, and H9 were accepted. It confirmed that inputs have a direct influence on the behavior of effective operating costs, that the ownership structure has a direct influence on productivity, that effective operating costs negatively influence economic performance, and that both productivity and product value positively influence performance economic.

The hypotheses H3, H4, H5, and H6 had no statistical significance at 0.05 and, therefore, were rejected. Thus, it is not possible to say that the property structure somehow influences the value of the product or economic performance. Likewise, it cannot be said that effective operating costs influence productivity or product value.

The hypothesis H1 was used as a test hypothesis for the model, following the Production Cost Theory, conceptualized as the sum of all resources (inputs) and operations (services) used in the production process of some productive activity [46]. However, the proposed structural model considers only fertilizers, correctives and pesticides as inputs. The result obtained in hypothesis 1 confirms the impact of these elements on the effective operational cost of production. According to [47], expenses with fertilizers were the main responsible for the variation in coffee production costs in Brazil in recent years.

Table 8.
Analysis of the structural model and hypothesis testing.

Hypotheses		T statistic	p-value	Expected signal	Signal found	Result
H1	Inputs → Effective Operating Costs	2,060	0.039**	+	+	Accepted
H2	Property Structure → Productivity	2,615	0.009**	+	+	Accepted
H3	Property Structure → Product Value	1.902	0.057	+	-	reject
H4	Ownership structure → Economic performance	0.118	0.906	+	+	reject
H5	Effective Operating Costs → Productivity	1,730	0.084	+	+	reject
H6	Effective Operating Costs → Product Value	0.178	0.859	+	-	reject
H7	Effective Operating Costs → Economic performance	2,089	0.037**	-	-	Accepted
H8	Productivity → Economic Performance	2.010	0.045**	+	+	Accepted
H9	Product Value → Economic Performance	2,460	0.014**	+	+	Accepted

Source: Authors (2022).

The hypothesis H2 confirmed that the structure of the property has a positive influence on productivity, being considered as components of the structure in the research in question, the species (Coffea arabica or Coffea canephora), and the production system (manual, semi-mechanized or mechanized). The botanical differences between the species predict that Coffea canephora has higher productivity and this fact is reflected in the study. In the work by [26] "the productivity of the coffee crop was not influenced by mechanized harvesting over the years, with the harvester passing once or twice in the crop. The increase in stem vibration promoted a greater amount of harvested grains, but defoliation increased proportionally to the increase in vibration. With two passes of the harvester, defoliation was greater than manual harvesting in all crops studied."

In the hypothesis H3 the property structure was expected to influence the value of the product since Coffea arabica has a higher market value and this factor could be inconsistent with the result. As described by [48] "the price The higher sales price of Arabica coffee can be justified because it is used to produce specialty coffees, or gourmet coffees, it is a differentiated bean that generates more added value and requires greater attention in its cultivation. Conilon coffee is used for blends, that is, blends and for soluble coffee, so it tends to have a lower selling price". In addition, the structure of the property is associated with the quality of the product, since higher-standard coffees require unconventional production processes [48,49]. However, this study, by rejecting this hypothesis, provokes reflections on low-standard productions, where small producers find themselves financially unable to make investments that raise the quality and value of the product. According to the [50], the availability of rural credit is a decisive issue for small producers to remain in coffee farming.

In the hypothesis H4 it was expected that, reflecting the higher valuation of the product proposed in H3, the ownership structure would have a positive impact on economic performance but was also rejected. Again, the study went in a different direction than expected, inferring that the cultivation system and culture do not influence economic performance. However, if the scenario of small producers is considered, the situation is reversed, since there is a lack of resources to have satisfactory impacts on the economic performance of the property [50]. According to [48], the economic performance of a property does not depend solely on the production structure, but on a combination of factors such as productivity, market value, production costs, experience of producers, among others. In hypothesis H5, higher effective operating costs suggest a more developed technological package applied to the activity, more inputs, skilled labor, and more efficient services, which would have an impact on productivity. If we consider in terms of efficiency, unit costs tend to decrease as productivity increases, the results of the work by [18] indicate that the average operating cost of arabica coffee was R$265.00 per bag of coffee produced, being reduced to R$210.00 when potential yields are reached, which justifies the rejection of the hypothesis.

The hypothesis H6 it was an exploratory hypothesis that sought to determine whether the costs could reflect on the price of the product, whether for better quality or added value. However, the hypothesis was rejected. The search for improvements in the quality of the product incurs higher operational costs, however, this does not provide guarantees of good coffee prices for the producer. This is because prices depend on external economic and environmental conditions such as crises, climate in the region, among others [45,47].

The hypothesis H7 it was a hypothesis that sought to understand whether there is an influence of the COE on economic performance, which was confirmed since performance is measured by subtracting the revenue obtained by the COE. However, it is worth mentioning that satisfactory economic performance requires the combination of good product prices and low operating costs. Thus, hypothesis 7 reaffirms the contribution of the COE to economic performance. According to [45], operating costs are related to the processes adopted by producers on their properties, since making wrong decisions can compromise crop productivity and increase costs.

Hypothesis H8 it was a hypothesis accepted as expected since productivity is directly related to total revenue and thus to economic performance, as well as H9, which measures a higher value of the product, influences a better economic performance. Both hypotheses influence economic performance as a common aspect. But for this to occur, investments must be leveraged in the coffee activity to reach new levels of performance. Given this, the creation of rural credit and insurance programs is justified to provide the necessary support to producers from different social classes and, consequently, the growth of the sector [48, 50].

5 Conclusions

Regarding the general objective of the research, the study between the property structure construct and the effective operating costs influencing economic performance found relevant results. In general, the study revealed that the higher the technological level of the property and the species used, there are positive influences on productivity levels, however it was not possible to observe this relationship in performance. It was also not possible to verify the influence of any construct on the formation of the value of the product, maintaining the specific market relationship for each region.

The study brought important managerial level contributions on the cost structure in coffee production. In this sense, based on this knowledge of the interrelationship of variables, producers will be able to better plan their field operations to increase crop productivity. In addition, the theoretical contributions were associated with the study method (Structural Equation Modeling), to encourage new studies in the area and promote the knowledge of the methodology by scholars.

As for the limitations of the work, data from a period from 2017 to 2020 was used, which can be expanded to older dates and annual updates to investigate changes in behavior. Another point is to increase the number of models or samples that were used to compose the database.

Finally, the study considered proposals for future research agendas. In this scope, a suggestion is to use other management indicators to measure economic performance in addition to the Gross Margin. To test the impact of coffee beverage quality under the influence of costs and ownership structures on economic performance. Another suggestion is to extend the present study to other crops, such as oranges, apples, bananas, and papayas.

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