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Working capital management and financial economic performance of manufacturing SMEs: A PanelMix statistical model

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Abstract
The present research aimed to determine the economic-financial performance and working capital for capital management of manufacturing SMEs in Zone 3 during the period 2017-2020. So, using a descriptive-explanatory approach, secondary data from the Superintendence of Companies were analyzed. In the first instance, an initial sample of 112 companies was considered; however, they did not meet the requirements to carry out this study. Therefore, under purely appropriate criteria, the sample was reduced to 92 companies. In addition, the study incorporated three control variables, which were the components of the ROE indicator, such as net margin, asset turnover, and financial leverage, essential to carry out the panel data methodology. Therefore, using SPSS software, frequency tables, measures of central tendency, and dispersion were generated, which made it possible to evaluate the behavior of the DuPont index and working capital during the aforementioned period. In addition, a panel data model was incorporated, where the results showed that the approach that best suited the conditions of this research was by fixed effects, demonstrating that the control variables were significant, except for the main variable contemplated as working capital, concluding that it does not have a major impact on the profitability of a company.

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1. Introduction

The manufacturing industry in Ecuador represents a fundamental pillar for the country's economic development, particularly in Zone 3, which includes the provinces of Tungurahua, Cotopaxi, Chimborazo, and Pastaza. This zone, located in the center of the country, integrates the Sierra region and part of the Amazon, bordering Pichincha, Napo, and Orellana to the north; Morona Santiago and Cañar to the south; Peru to the east; and Santo Domingo de los Tsáchilas, Los Ríos, and Bolívar to the west. Its territorial extension covers 30 cantons and 139 rural parishes. The climate varies between temperate in the highlands and humid in the Amazon, which facilitates various productive activities, especially in the manufacturing sector. According to the last census, the total population of these provinces exceeds 1.2 million inhabitants, with Tungurahua being the province with the highest concentration of manufacturing companies.

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In 2016, these provinces reported a production value of 11,878,565.03 USD, representing 7% of total national production. Tungurahua stood out for its contribution in the manufacturing sector with 15% and 13% in commerce, while Cotopaxi, Chimborazo, and Pastaza concentrated in agriculture, construction, and mining, respectively. These provinces concentrate a considerable number of SMEs engaged in manufacturing, agribusiness, and textiles, demonstrating their relevance in regional economic growth.

Globally, small and medium-sized enterprises identified as SMEs have been considered indispensable for the reason that they are responsible for promoting economic growth in many countries, even in periods of crisis, contributing significantly to the Gross Domestic Product [1]. According to [2], SMEs have accounted for approximately 90% of all enterprises, between 60 and 70% of employment, and 50% of the world's Gross Domestic Product. Thus, being fundamental within the different societies of the world, they have played an important role in boosting local and national economies, ensuring the economic livelihood of marginalized populations, such as the economically disadvantaged, women, youth, and other vulnerable groups.

In Ecuador, data from [3] has revealed a total of 843,745 registered companies have been revealed. Of this total, micro, small, and medium-sized companies represent approximately 99.5%, contributing 63% of total income generation. In terms of employment distribution, micro companies provide 39% of jobs, small companies 17% and medium-sized companies account for 14%. Likewise, in 2011, 27,646 SMEs were documented in Ecuador, of which 13,332 were classified as small and medium-sized enterprises. Of this subgroup, 4,661 were classified as medium-sized, representing 34.96%, while 8,671 were classified as small enterprises, corresponding to 65.04% [4].

Ecuador's industrial sector has played a key role in the country's economic framework, as it has driven innovation and fostered new avenues of development. Sales in this sector experienced a growth of 0.61% between 2013 and 2015, with a subsequent increase of 2.81% between 2014 and 2015, and an average participation of 22.75% in all economic sectors. However, this data has shown that the manufacturing industry's progress between 2007 and 2014 was lower than that of the overall economy, resulting in a marginal decline in its contribution to GDP, despite maintaining a constant level of 12% [5].

Ecuador's planning Zone 3 is located within the central region of the Sierra and the Amazon, and is bordered to the north by the provinces of Pichincha, Napo and Orellana; to the south by Morona Santiago and Cañar; to the east by Peru; and to the west by Santo Domingo de los Tsáchilas, Los Ríos, and Bolívar. This area covers four provinces: Cotopaxi, Chimborazo, Pastaza, and Tungurahua, comprising 30 cantons and 139 rural parishes.

In 2016, the provinces of Tungurahua, Cotopaxi, Chimborazo, and Pastaza reported a production value of 11,878,565.03 USD, representing 7% of the country's total production. Cotopaxi contributed 25% of its gross value added (GVA) from sectors such as agriculture, livestock, forestry, and fishing; Chimborazo accounted for 22% of construction; Pastaza generated 39% from mining and quarrying; while Tungurahua stood out with 15% from manufacturing and 13% from commerce. These provinces are home to a considerable number of SMEs engaged mainly in manufacturing, agribusiness, and textiles [6].

Therefore, the objective of this study is to determine the correlation between working capital and economic-financial performance of manufacturing SMEs in Zone 3 during the period 2017-2020, with the intention of identifying which working capital management affects their financial performance. Its purpose, therefore, is to understand how the competent management of current resources influences the liquidity and profitability of these companies, which impacts their stability and growth. This study aims to provide a broad perspective on the critical factors that influence the financial sustainability of SMEs, thus facilitating the formulation of strategies that will improve their management and promote their long-term progress.

For the purposes of this research, the paper is structured as follows: First, the historical background and literature review related to capital management in the economic-financial performance of Zone 3 in the aforementioned period are presented. Next, the methodology and results of the study are presented, at a descriptive level and using SPSS software, frequency tables, measures of central tendency and dispersion were generated, and at an

explanatory level a panel data model was incorporated, where the results showed that the approach that best suits the conditions of this research was by fixed effects, demonstrating that the control variables were significant, except for the main variable considered as working capital. Likewise, the discussion, conclusions, limitations of the study, future lines of research, and finally the bibliography are presented.

First of all, it should be noted that the origins of small enterprises date back to the 1950s, a period marked by the recovery efforts of European nations, the United States, and Japan after World War II [7]. However, during the 1960s and 1970s, the notion of medium-sized enterprises emerged, facilitated mainly by specialized agencies dedicated to promoting the sector, such as the United Nations Industrial Development Organization (UNIDO). Assuming in the same way that this development arose from the recognition of companies that exhibited the highest degree of technological dynamism, occupying a fundamental role within industrial development and emerging sectors such as services.

Thus, the merger between small and medium-sized companies gave way to the acronym SME, which has been used for a long time, especially by governments, development agencies and multilateral banks such as the World Bank, the Inter-American Development Bank (IDB), the United Nations Development Program (UNDP) and the International Labor Organization (ILO) [8]. Therefore, it is crucial to mention that the designation of SMEs was finally coined in the 1970s, during which the Organization for Economic Cooperation and Development (OECD) began to use the term to designate companies employing less than 500 people [9].

As for the socioeconomic panorama of Ecuador in the mid-twentieth century with respect to the creation of SMEs, it has brought with it an alternative import framework. In such a way, it has been possible to fully understand the environment in which these SMEs flourished and the impact of their origins on their contemporary operational modalities, giving way to a reflection on the historical trajectory of Ecuador from its creation as a republic to the present day. Thus, starting in the 1950s, the first SMEs emerged, characterized predominantly by a family structure, which were mainly engaged in sectors such as textiles and clothing, leather and footwear [10].

In the words of [11], the denomination of a company is articulated as that economic entity designed to generate goods and, in turn, obtain profits. Likewise, it is considered the main dynamic force within the economy of a nation, functioning as a distribution mechanism that has a direct impact on the personal conditions of its citizens. However, the creation of a company requires a thorough study of the necessary instruments that allow the execution of its proposed activity. Therefore, recognized authors such as [12], [13], [14] clarify the presence of three essential components.

This production factor has been considered over the years as a fundamental element. It is understood from a general perspective that land, together with natural resources, has proven to be indispensable for production; in other words, without them, a business entity would not be able to operate effectively [15]. Capital refers to all the assets or rights owned by the company and incorporated into its equity. Therefore, this term includes real estate such as farms, plots of land, buildings, and warehouses, as well as movable assets [16].The efficient operation of a company depends on the effort and commitment of individuals. Therefore, work is defined as the effort in which individuals contribute to the creation of goods or the provision of services within a market society, encompassing both physical and intellectual efforts [17].

One of the critical factors that determines the various classifications of companies according to their size is closely linked to both the geographic context and the economic circumstances prevailing in the nation in which they operate and carry out their operations. In this regard, Ecuador has adopted the definition provided by the Andean Community of Nations (CAN), systematically classifying companies according to their size and scale [18].

Microenterprise, this category of companies is characterized by its compact scale when classified according to size. Therefore, these types of establishments tend to represent ventures or businesses that often rely on the close relationships inherent in family dynamics for their operational success.

Table 1 . Microenterprise classification criteria

Type of company	Criteria	Quantity
Microenterprise	Number of collaborators	From 1 to 9 persons
	Gross annual sales value	Equal to or less than $100,000.00
	Assets	Up to $100,000.00

Smes: this type of organization encompasses both small and medium-sized enterprises, operating within the boundaries of national borders and engaging in activities that are not only economically important, showing commitment to innovation and creativity, with the foreknowledge that their operations do not extend to the industrial sector on a broader scale.

Table 2. Small business classification criteria

Type of company	Criteria	Quantity
Small	Number of collaborators	From 1 to 49 people
	Gross annual sales value	$100.001,00 a $1.000.000,00
	Assets	$100,001.00 up to $750,000.00

Table 3. Criteria for the classification of medium-sized enterprises

Type of company	Criteria	Quantity
Median	Number of collaborators	From 50 to 199 people
	Gross annual sales value	$1.000.000,0 a $5.000.000,00
	Assets	$750,001.00 to $3,999,000.00

Large company: refers to companies that have substantial influence and commercial power within the market and extend their operations beyond national borders to participate in international trade, contributing significantly to the global economy.

Table 4. Large company classification criteria

Type of company	Criteria	Quantity
Large company	Number of collaborators	More than 200 people
	Gross annual sales value	More than $5,000,000.00
	Assets	More than $4,000,000.00

Along the same lines, financial analysis has been conceived as a process that involves a thorough examination and an exhaustive synthesis of its various financial conditions, elements, properties, and distinctive characteristics, thus playing a crucial role in the financial health of an entity [19]. Therefore, it involves a retrospective study of the company, allowing not only to know the current state, but also to establish a comparison with a previous one in order to understand the scenarios in which the company has been maintained and thus be able to set objectives that allow it to be in an improved position than the previous one.

Thus, the manufacturing industry can be understood as that which encompasses the process of converting materials, substances, or components through physical or chemical processes to create new products. These types of converted components are generally derived from raw materials derived from activities such as agriculture, forestry, fishing, and mining [20].

Working capital indicators: It refers to the time required to recover cash from customers, stating that an organization's effectiveness depends on the management of accounts receivable [21]. In essence, if the entity facilitates the prompt collection of its receivables, it is unlikely to face liquidity problems related to operating expenses. Similarly, it states that a higher turnover rate means that credit sales are recovered quickly, implying

improved liquidity. Conversely, a decreased turnover rate suggests that the company is experiencing prolonged delays in the collection of its credit sales.

$$Accounts\ Receivable\ Turnover\ = \frac{Annual\ Credit\ Sales}{Average\ Accounts\ Receivable} \quad (1)$$

Reflects the average duration required to transform accounts receivable into liquid assets, specifically the period to collect cash subsequent to sales transactions. It is calculated using the following formula:

$$Average\ Collection\ Period\ = \frac{360}{Accounts\ Receivable\ Turnover} \quad (2)$$

This is an approximation of the periodicity with which inventory is physically delivered within a fiscal year. According to [22], inventory is considered a form of investment for the purpose of obtaining a short-term return on the capital invested in terms of the acquisition of raw materials.

$$Inventory\ Turnover = \frac{Cost\ of\ sales}{Average\ inventories} \quad (3)$$

By using this indicator, the typical duration of stock turnover can be determined.

$$Average\ Inventory\ Replenishment\ Lead\ Time\ = \frac{360}{Inventory\ Turnover} \quad (4)$$

This index makes it possible to evaluate how many times the company manages to settle its liabilities within a specific accounting period. Consequently, this indicator determines the company's solvency in relation to its ability to meet its obligations within the stipulated period [23].

$$Accounts\ Payable\ Turnover\ = \frac{Cost\ of\ sales}{Accounts\ payable} \quad (5)$$

This indicator reveals the number of days required for the company to meet its financial obligations:

$$Average\ Payment\ Term\ = \frac{Accounts\ payable}{Cost\ of\ sales} * 360 \quad (6)$$

The period of time that elapses from the time the company acquires raw materials until the sale of finished products or services rendered is settled.

$$Cash\ cycle = Inventory\ period - Accounts\ payable\ period + Accounts\ receivable\ period \quad (7)$$

DuPont system indicators.- also known as profit margin, it serves as an indicator of the operating profit derived from each monetary unit used in sales, so a reduced margin means that the organization is incurring excessive costs [24].

$$Profit\ Margin = \left(\frac{Profit\ Margin}{Net\ Income}\right) \quad (8)$$

This indicator reflects the efficiency of assets in generating sales, specifically, the volume of sales produced per unit of currency invested. Where a lower figure may indicate high levels of investment or low sales volume, total asset turnover is therefore interpreted as the frequency with which assets are used annually to generate revenue.

$$Asset\ Turnover = \left(\frac{Sales}{Sales\ Total\ Assets}\right) \quad (9)$$

It is an indicator that illustrates the company's capacity to finance investments through external financing. Thus, an increase in financed capital correlates with an increase in financial costs, which in turn influences the profitability generated by the assets. Consequently, a higher ratio denotes a predominance of external financing as a source of resources.

$$Leverage\ multiplier = \left(\frac{Total\ Assets}{Equity\ at\ book\ value}\right) \quad (10)$$

2. Research method

The study population is conceived as that group of specific, restricted, and easily accessible individuals that will serve as the basis for selecting the sample and must meet established criteria, so that the results of the research can be applied with greater accuracy to the previously established population. According to [25], this term is not limited to human beings, but can also include organizations, objects, etc.

In this context, the main focus of the study was a specific demographic group composed of several small and medium-sized companies operating within the manufacturing sector located in Ecuador's planning zone 3, which is made up of four different provinces: Cotopaxi, Chimborazo, Pastaza, and Tungurahua. Therefore, the research used the most updated and relevant information accessible through the database found on the web platform of the information portal administered by the Superintendence of Companies, Securities, and Insurance, which led to the identification of a total of 616 companies that met the predetermined criteria described in the study.

Thus, after an evaluation of the initial population, this research did not require a sample, so all the figures obtained from the duly cleaned database involving all the small and medium-sized companies in zone 3 of Ecuador were used. From the manufacturing industry. Thus, a total of 112 were selected, and subsequently, a refined sample of 92 companies was used for a more specific analysis within the explanatory objective, where a panel data model was applied. So, it was effectively executed due to the fact that these entities maintained consistent and reliable data throughout the research period, specifically during the years between 2017 and 2020 [26].

A fundamental part of this study focused mainly on documentary research. In the first instance, the use of the "Scopus" database was of utmost importance, since it has allowed access to a wide range of academic articles, providing high coverage in various areas of knowledge, and facilitating the deepening of the study through research related to the variable involved [27]. Thus, another fundamental aspect of this database lies in the sophisticated tools of citation analysis and visual representations of knowledge networks, allowing for to improvement of the ability to monitor trends in economic and financial studies. In order that facilitate the identification of the most prominent authors and theoretical frameworks, offering a panoramic perspective of the discipline, and incorporating relevant research to reinforce and validate the conclusions of the study.

Consequently, the use of secondary sources within a study was advantageous because this importance was rooted in the comprehensive synthesis of primary data that enhances the accessibility of the initial information for analysis and interpretation purposes. According to [28], this type of source inherently relies on previously established data, including databases, scholarly articles, media, and various academic papers that have undergone rigorous scrutiny and evaluation. Therefore, it is worth mentioning that this study has relied primarily on secondary sources that have been extracted from the extensive database associated with the web portal of the Superintendence of Companies, Securities and Insurance, facilitating the analysis through the quantitative review of the financial indicators linked to the variables of the study for the aforementioned period [29].

Documentary analysis (DA), represented within this study a methodology that involved the systematization of quantitative data, allowing a solid triangulation of narrative documents that have been effectively integrated with a wide range of information sources [30]. On the other hand, [31] states that this methodological framework has been conceived throughout history as an intellectual foundation that supports the accumulation and improvement of knowledge, contributing significantly to the understanding of the evolution of human talent by providing a well-defined conceptual basis that allows for facilitating exploration.

Data analysis is a systematic approach to examine, refine, reshape, and model data in order to uncover valuable information, formulate conclusions, and facilitate informed decision-making. Thus, this process encompasses a variety of techniques and methodologies aimed at interpreting data that comes from a variety of sources and is presented in various formats, whether structured or unstructured [32]. The variables used for data analysis were: year, company name, province, type of company, size, working capital, net margin, asset turnover, financial leverage, DuPont.

With respect to the treatment of the information in this research, information was gathered through secondary sources, and based on the period in question, several tables and figures were used that are pertinent to the indicators of the variables under study in the manufacturing sector, information that came mainly from the portal of the Superintendence of Companies, Securities and Insurance.

A panel data set, often referred to as longitudinal, comprises a time series corresponding to each unit within a cross-sectional data set. They are also considered a type of information collected by observing numerous individuals. Thus, their main objective is to use variations among individuals and over time to obtain more precise estimates of the impact of the independent variables on the dependent variable. Consequently, this type of data helps to control for unobserved variables that differ between individuals but remain constant over time, which are classified as fixed effects, while taking into account observed variables that fluctuate over time, but not between individuals, called random effects.

Thus, [33] mentions the following advantages of panel data:

1. They cover the variability of subjects over time, which facilitates the incorporation of different variables for each individual.
2. They improve information richness, increase variability, decrease collinearity, increase degrees of freedom, and improve efficiency.
3. They are particularly suitable for analyzing the dynamics of evolution.
4. They make it possible to identify and quantify effects that go unnoticed when only cross-sectional or time series data are used.
5. They facilitate a more detailed analysis of intricate behavioral patterns, including economies of scale.
6. Mitigate potential biases that can occur when grouping individuals together

The general equation of the panel data model is presented below, which allows us to analyze variations both between individuals and over time:

$$y_{it} = a_{it} + b_1 x_{it} + b_2 x_{2it} + \ldots + b_k x_{kit} + U_{it} \quad (11)$$

i= 1,...,n and t = 1,...,T

Where:

- i indicates the individual or unit of study.
- t refers to the dimension in time
- a constitutes a vector of intercepts that can contain between 1 and n+1 parameters.
- b is a vector of$k$ parameters
- x_{it} represents the$i$ -th observation at the time$t$ for the explanatory variables X1, X2,..., Xk

The terminology "mixed" denotes the combination of two different types of effects:

They signify a uniform and universal influence in all case studies. Therefore, they are considered fixed when their value remains constant throughout the population, indicating homogeneity. Thus, they are linked to explanatory variables whose values have a specific informative meaning.

$$Yit = Xit\beta + \alpha i + \mu it \quad (12)$$

Where:

- Yit the dependent variable evaluated for an individual i at a specific time point.
- Xit regression matrix, characterized by its time-varying nature, with dimensions of 1xk.
- β, parameter matrix, defined by its k x1 dimensions.
- αi, individual effect that remains unobserved and invariable over time.

– μit, error term.

They indicate an influence that fluctuates between cases, thus modeling the inherent heterogeneity of the data, which facilitates the capture of variability that cannot be explained exclusively by fixed effects. Thus, they are associated with explanatory variables whose values indicate identifying units [33].

$$Yit = Xit\beta + \mu_i + \mu it \quad (13)$$

For $t = 1, ..., y \;\; i = 1, ..., .N$

For research purposes and using the STATA programming language has allowed the adjustment of panel data models. Thus, it is considered a powerful methodology that allows the study of complex phenomena by controlling for unobservable effects and the inclusion of both inter-unit and time variations. This robust tool is therefore ideally suited to perform this type of analysis. For example, its commands, including xtset, xtreg, and hausman, have simplified the implementation of fixed and random effects models, making it easier to draw conclusions based on longitudinal data [34].

To continue with panel data estimation, random effects models, which aim to explain the variations among units by incorporating a stochastic element, are used together with the fixed effects model that uses dummy variables to assign different fixed parameters, assuming independent and stable individual effects over time. Thus, the Hausman test is responsible for determining the adequacy of a fixed or random effects model and is often used to detect endogeneity. This methodology is used to assess the validity and reliability of various regression models. This test indicates whether there is a correlation between the model and the independent variables [35].

3. Results and discussion

In accordance with the research objectives, the first objective focused on performing a detailed analysis and description of the trends and behavior of working capital, together with the economic-financial performance indicator of manufacturing SMEs, which in this case is the DuPont index. Thus, to facilitate this analysis, the SPSS statistical software package was used to generate frequency tables and calculate several measures of central tendency, including the mean, median, and mode, as well as the identification of maximum and minimum values, variance, and skewness, which were crucial to understanding the distribution of the financial data. On the other hand, the second objective was accomplished by applying the econometric software STATA, which facilitated the execution of a panel data model adapted to the specific needs of the panel.

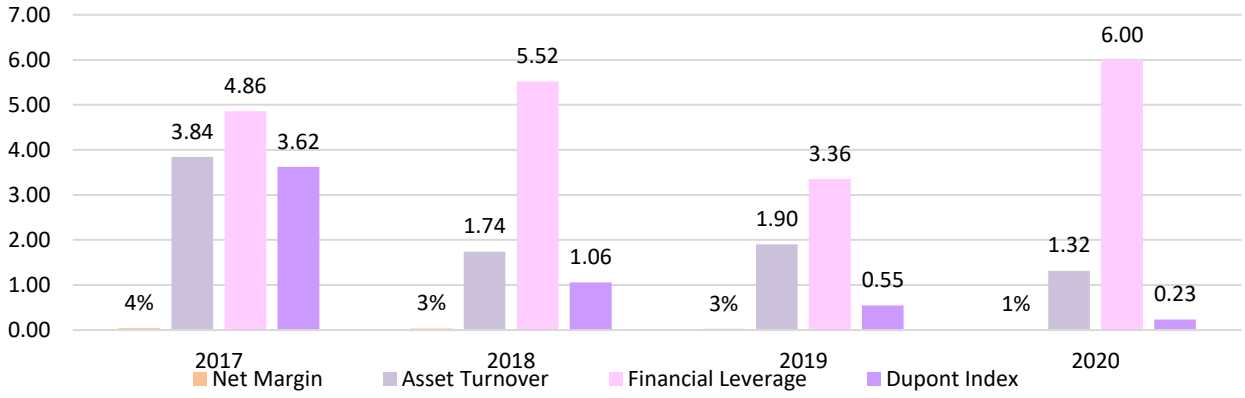

Figure 1. Behavior of the components of ROE of small and medium-sized enterprises in the period 2017-2020

Net margin fell from 4% in 2017 to 1% in 2020, reflecting lower profitability per dollar of sales. This is due to higher operating and financial expenses and lower capacity to pass costs to final prices, in line with the effect of oligopolistic structures in Ecuador [36]. In zone 3, industrial dependence shows high sensitivity to external fluctuations, affecting margins, especially in the textile and footwear sectors. In addition, protests in 2019 impacted supply chains and reduced domestic demand.

Asset turnover, which measures efficiency in the use of resources to generate sales, fell from 3.84 in 2017 to 1.32 in 2020. The economic slowdown following the 2016 earthquake reduced demand and limited asset utilization. Although efficiency remained stable, there was a sharp decline in 2020 attributed to the COVID-19 crisis. Financial leverage was volatile, reaching 5.52 in 2018 and stabilizing at 6% in 2020. This reflects greater reliance on indebtedness, in line with the pecking order theory or Pecking Order. The devaluation of oil and tax changes, such as the anticipated income tax, increased financial pressures, raising the risk of insolvency, especially in 2020.

The best year was 2017, with an ROE of 3.62, reflecting a balance between margins, asset turnover, and financial leverage. This performance coincided with the recovery after the 2016 earthquake and the oil slump in 2014. In addition, the government supported SMEs with financing, avoiding excessive indebtedness.

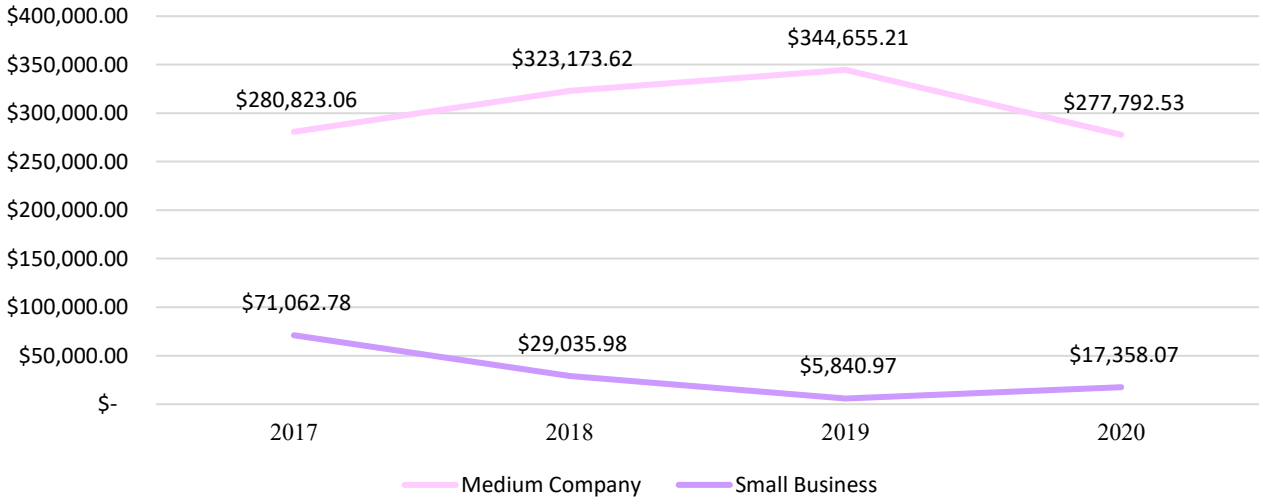

Figure 2. Behavior of working capital of small and medium-sized enterprises in the period 2017-2020

It represents, in the case of medium-sized companies, a working capital that experienced a progressive increase from $280,823.06 in 2017 to $344,655.21 in 2019, followed by a drop to $277,792.53 in 2020. This behavior is determined by macroeconomic variables, in particular the economic recession in Ecuador during the COVID-19 pandemic. According to Schumpeter's business cycle theory, this contraction may be linked to declining income and liquidity as a result of declining aggregate demand and disruptions in supply chains, particularly in the manufacturing sectors that predominate in Zone 3 [37].

On the other hand, small businesses exhibit more volatile and worrisome behavior, with working capital declining sharply from $71,062.78 in 2017 to $5,840.97 in 2019, before partially recovering to $17,358.07 in 2020. This pattern reflects structural fragility, which is consistent with financial constraint theory. Small firms encounter greater obstacles in obtaining credit due to their lower ability to provide collateral and the high perceived riskiness of financial institutions [38]. Thus, the drop in 2019 was clearly due to the fiscal adjustment policies implemented by the government of Lenín Moreno, which included reductions in public spending and the elimination of subsidies that negatively impacted consumption levels and business activity.

For this reason, in 2020, there was a slight recovery in the working capital of small businesses, possibly explained by the implementation of government programs to mitigate the effects of the pandemic, such as credits granted by BanEcuador and the relaxation of payment terms. However, the amount is still insufficient to facilitate efficient operational sustainability, revealing susceptibility to external shocks. This is why net working capital theory suggests that such a low figure may hinder the ability of small firms to meet their current obligations, thus limiting their operational continuity and growth prospects [39].

A panel data model was employed using STATA software. In this analysis, the dependent variable was the response of the model, represented by the Dupont index. On the other hand, the independent variable, which

acted as a predictor, was working capital. The main purpose of this model was to analyze whether there is a statistically significant relationship between the variables studied, in addition to evaluating the relevance of these relationships in the context of economic-financial performance. It is essential to mention that from the initial sample of 112 companies, 20 companies were eliminated under the criterion that they did not represent reliable or valid information, information that was directly provided by the Superintendence of Companies, Securities and Insurance, so that they gave way to a distortion within the analysis and hindered the interpretation of the results. In addition, for research purposes, control variables were used, which were the components of the ROE indicator, such as net margin, asset turnover, and financial leverage, serving to make the model more robust.

Table 5. Kolmogorov-Smirnov normality test

Normality test			
	Kolmogorov-Smirnov		
	Statistician	gl	Sig.
DuPont Index	0,198	368	0.000
Working Capital	0,047	368	0.000
Net Margin	0,197	368	0.000
Asset Turnover	0,089	368	0.000
Financial Leverage	0,122	368	0.000

A normality test of the variables relevant to the study was carried out, using the Kolmogorov-Smirnov test on a sample comprising more than 50 observations; therefore, the results suggest that the variables examined do not conform to a normal distribution, with significance values consistently lower than 0.05 in all cases. This behavior can be attributed to the nature of the variables, which are subject to external influences, such as economic policies and the structural heterogeneity of manufacturing SMEs, which present very diverse characteristics in terms of size, sector, and performance. Therefore, this test corroborates the non-normal distribution of the data, given that the sample size is relatively large, allowing the identification of small deviations from normality, which increases the sensitivity of the statistical tests [40].

Table 6. Spearman correlation

	lndupont	lncaptrab	lnmargenneto	lnrotactives	lnapalancfin
lndupont	1.0000				
lncaptrab	-0.0796	1.0000			
lnmargenneto	0.8116	0.0082	1.0000		
lonrotactives	0.3196	-0.3534	0.1103	1.0000	
lnapalancfin	0.0875	-0.0731	-0.1459	0.0644	1.0000

Within Spearman's correlational analysis, being a parametric technique, and maintaining a significance level of 5%, a strong and positive correlation was identified between the DuPont index and net margin, which was statistically significant at 0.8116. Thus, it suggests that the increase in net margin, a crucial indicator for sales profitability, is closely related to overall economic-financial performance, as represented by the DuPont index [41].

In contrast, working capital has very weak negative correlations with both the DuPont index and asset turnover, with a coefficient of -0.3534, suggesting a possible decrease in operating efficiency when high amounts of working capital are maintained. Thus, this trend may be attributed to over-investment in current assets or to inventory management strategies that reduce turnover rates.

On the other hand, there was a weak correlation between financial leverage and the variables pertaining to the study. This is justified, since the financing structure could exert a minor influence on the immediate fluctuations of working capital and operating efficiency.

Table 7. Variance inflation factor

Variable	VIF	1/VIF
Working Capital	1.09	0.913669
Net Margin	1.04	0.958570
Asset Turnover	1.09	0.916986
Financial Leverage	1.05	0.955707
Mean VIF	1.07	

The evaluation of multicollinearity among the independent variables of the model was carried out using the variance inflation factor (VIF) together with its inverse (1/VIF). Thus, the results presented in the table indicate that all variables present significantly low VIF values. Thus, these values remain below the critical threshold of 10, indicating the absence of multicollinearity problems in the model. Moreover, the inverse VIF values are close to unity for all variables, which reinforces the conclusion that there is no significant interdependence between them. Therefore, the independent variables provide differentiated information to the regression model, which ensures the robustness of the analysis and the credibility of the estimated coefficients.

Table 8. Breusch-Pagan test

Chi2(1) = 0.020
Prob > chi2 = 0.6516

To verify the validity of the homoscedasticity assumption within the model, the Breusch-Pagan test was performed under the null hypothesis that the model errors show constant variance. Thus, the results revealed a test statistic ofx^2 (1) = 0.20 with a corresponding p-value of 0.6516, which considerably exceeds the conventional significance threshold of 0.05; therefore, the null hypothesis is not rejected. Consequently, there is no evidence to support the occurrence of heteroscedasticity in the model residuals, indicating that the error variance remains constant.

Table 9. Wooldridge test

F (1, 91) = 0.019
Prob > F = 0.8909

The Wooldridge test was performed to evaluate the existence of possible time dependencies between observations within each panel unit. Thus, the resulting F-statistic was 0.019, with a p-value of 0.8909. Therefore, since the p-value significantly exceeds the conventional significance level of 0.05, the null hypothesis is not rejected. Thus, it is evident that there is insufficient evidence to support the assertion of the presence of autocorrelation; therefore, it follows that the residuals are not autocorrelated.

Table 10. Panel data model by fixed effects of medium-sized companies in the period 2017-2020

lndupont	Coef.	Z - value	P - value
lncaptrab	0.080	0.57	
lnmargenneto	1.550	17.70	0.000
lnrotactives	-0.203	-0.71	0.482
lnapalancfinan	0.137	0.82	0.416
_ cons	6.297	1.74	0.084
Rho		0.401	
Corr (u_i, Xb)		-0.287	
F (4,119)	86.12	Prob > F	0.000

Table 11 below shows the following conclusions derived from the medium-sized companies, so that, in general terms, the R-squared values show a within = 0.7432, between = 0.7310, and an overall = 0.7283, indicating that the model adequately elucidates the variations in economic-financial performance both within and between companies. Furthermore, the joint significance of the model Prob > F = 0.0000 reinforces the validity of the selected variables. A relevant aspect is the Rho value of 0.401, which means that 40.1% of the total variability

of corporate performance can be attributed to firm-specific differences that do not change over time. Research done by [42] expresses that this degree of heterogeneity fully validates the adoption of a fixed effects model, since it facilitates the capture and mitigation of these unobservable factors. On the other hand, the value of Corr(u_i, Xb) = -0.287 indicates a moderate negative correlation between the unobserved individual effects and the explanatory variables.

Thus, the results highlight that net margin exerts a significant and positive influence on business performance, as evidenced by a high coefficient of 1.550 and a statistical significance of P >| t | = 0.000. Furthermore, [43] confirms that as companies increase their net margin, their financial performance improves considerably, reflecting that net margin is a key indicator of operating efficiency.

On the other hand, variables such as asset turnover and financial leverage did not manifest a statistically significant impact within this model. Similarly, financial leverage was able to produce disparate effects depending on the level of debt incurred; while moderate indebtedness can foster growth, excessive leverage could pose significant financial risks.

As for working capital, although its coefficient was positive at 0.0805, it was also not significant, so this observation is consistent with previous research indicating that while effective working capital management is essential for operating liquidity, it does not always translate into direct improvements in financial performance [44].

Table 11. Small business fixed effects panel data model 2017-2020

lndupont	Coef.	Z - value	P - value
lncaptrab	-0.014	-0.13	0.896
lnmargenneto	1.462	23.73	0.000
lnrotactives	0.952	6.92	0.000
lnapalancfinan	0.433	2.27	0.025
_ cons	7.402	2.89	0.004
Rho		0.358	
Corr(u_i, Xb)		-0.163	
F (4,149)	163.70	Prob > F	0.000

Table 12, in terms of goodness of fit, the R-squared values are high, with a within-group R^2 reaching a value of 0.8146, indicating that the model explains 81.46% of the variability in financial performance measured by DuPont is explained by the variables included in the model within each company. On the other hand, theR^2 between groups is 0.7418, which shows that the model captures 74.18% of the variability between companies. Finally, the total R^2 of 0.7863 suggests that the model has an adequate overall ability to explain the relationships between the variables.

The Rho value of 0.3584 means that 35.84% of the overall variation in financial performance can be attributed to firm-specific individual differences, which is justified by this methodology. Likewise, the value of -0.1635 denotes a negative correlation between the unobserved effects and the explanatory variables. However, the F test, with Prob > F = 0.0000, thus corroborates that the chosen explanatory variables are, in fact, determinants of economic-financial performance.

Thus, a net margin emerges as one of the most prominent variables, with a p-value of less than 0.01, accompanied by a positive coefficient of 1.4623, implying that an increase in net profit correlates with an improvement in financial performance, as described by the DuPont model. Similarly, asset turnover has a positive and significant coefficient of 0.9522.

In turn, financial leverage presents a remarkable positive coefficient of 0.4332, which justifies that companies with a reduced financial burden or with lower risks linked to leverage tend to perform more favorably. This finding is consistent with static equilibrium theory, which postulates that an optimal level of debt maximizes financial performance by balancing the fiscal benefits of debt with the associated risks.

Ultimately, working capital presents an estimated coefficient of -0.0142, and lacks statistical significance, as evidenced by a p-value of 0.896, indicating that small companies present a tendency in which an excess of working capital, i.e., high levels of liquidity retained in current assets, generates opportunity costs by not investing in more profitable activities. Consequently, they emphasize the importance of maintaining an appropriate balance in the management of cash and liquid assets to avoid both shortages and surpluses.

Table 12. Panel data model by random effects of medium-sized companies in the period 2017-2020

lndupont	Coef.	z -	p - value
lncaptrab	-0.005	-0.05	0.959
lnmargenneto	1.441	22.74	0.000
lnrotactives	0.537	3.81	0.000
lnapalancfinan	0.357	3.26	0.001
_ cons	6.50	2.33	0.020
Rho		0.035	

Table 13 presents values for, where, in the first instance, an intra-group R^2 of 0.7270 is reflected, which implies that 72.70% of the variation in economic-financial performance can be explained by the variables in this study. In turn, a between-groupR^2 with a value of 0.8695 suggests that this model captures 86.95% of the between-firm variation. Finally, an overallR^2 of 0.7870 indicates that the model has the capacity to explain the relationships between variables and firms.

Thus, a Rho value of 0.035 is observed, representing that only 3.56% of the total variance is due to the differences of each company. Likewise, a Corr (u_i, Xb) = 0 is assumed, for the reason that the random effects model does not consider the correlation between the observed effects and explanatory variables.

Thus, a net margin with a coefficient of 1.441 is presented, highly significant $p < 0.01$, indicating that this variable is key within this research. Similarly, asset turnover has a positive coefficient of 0.5378, suggesting the use of economies of scale and efficient management of the available resources of medium-sized companies.

Financial leverage, on the other hand, has a coefficient of 0.3575, demonstrating that well-managed leverage can be effective for good performance. In contrast, the working capital variable is the only one with a negative coefficient of 0.005, which is not statistically significant, i.e., variations in working capital do not influence performance. This is due to the fact that the accessibility of external sources of financing is comparatively greater for medium-sized companies than for small companies, thus causing a decrease in their dependence on working capital as the main instrument of financial management [45].

Table 13. Small business random effects panel data model 2017-2020

lndupont	Coef.	Z - value	P - value
lncaptrab	-0.096	1.13	0.259
lnmargenneto	1.412	25.99	0.000
lnrotactives	0.967	8.61	0.000
lnapalancfinan	0.728	5.58	0.025
_ cons	3.778	1.90	0.058
Rho			0.153
Corr(u_i, Xb)			0

In the first instance, an R^2 within groups is observed, with 80.99%, suggesting that the model effectively captures the variations in terms of the performance of the variables pertaining to this research. Likewise, it has an inter-group R^2 of 73.38% and an overall R^2 of 79.94%, showing that the model achieves a robust equilibrium, addressing internal as well as external variations effectively. On the other hand, has a Rho of 0.1530, suggesting that this percentage of 15.38% is relatively low, which explains that most of the variability is explained by the variables involved in the model.

Thus, the main results showed that the net margin presents a coefficient of 1.412, highly significant, and asset turnover also shows a positive impact in terms of its coefficient of 0.9673, suggesting that good management of available resources can be successful in improving the performance of a company.

Financial leverage had a statistically significant positive coefficient of 0.7287, which is relevant for small companies, since they could use financial leverage as a strategy to alleviate liquidity constraints and enhance the growth of their activities. However, working capital, although presenting a positive coefficient of 0.0962, is not statistically significant with a p-value of 0.259, since, within this type of company, the efficient management of working capital depends more on operational aspects than on strategic decisions.

Table 14. Hausman's test

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	Faith	Re	Difference	Std. error
lncaptrab	-0.014	0.096	-1.110	0.067
lnmargenneto	1.462	1.412	0.049	0.029
lnrotactives	0.952	0.967	-0.015	0.079
lnapalancfinan	0.433	0.728	-0.295	0.138
chi2(4) = (b-B)'[(V_b-V_B) ^(-1)](b-B) = 10.20				
Prob>chi2 = 0.0372				

The Hausman test plays an essential role in assessing whether the discrepancies between the fixed effects (FE) and random effects (RE) estimators are systematic, which is a critical step in determining the most appropriate analytical method. In this case, the test result shows a chi-square value of 10.20, with a probability associated with a p-value of 0.0372 below the 0.05 significance level. This immediately leads to rejecting the null hypothesis that there are no systematic differences in the coefficients, indicating that the fixed effects model is the most appropriate for this analysis. Thus, this type of approach allows controlling for unobserved characteristics that remain constant over time, but vary from firm to firm, which is particularly relevant in this context, as firm-specific factors can significantly influence profitability.

In the first instance, the net margin shows a positive and stable correlation with profitability in both models, registering a value of 1.462 in the fixed effects and 1.412 in the random effects. Thus, these results confirm that a higher net margin allows companies to generate higher revenues per unit of sales, which improves profitability. On the other hand, asset turnover also exerts a favorable influence, although with insignificant variations between models, reflecting values of 0.9521894 in the fixed effects and 0.967253 in the random effects.

Finally, financial leverage presents notable differences between the models, with a coefficient of 0.433 in the fixed effects and 0.728 in the random effects. Similarly, working capital varies significantly between models, with a negative coefficient of 0.014 under the fixed effects approach and a positive coefficient of 0.096 under the random effects approach, suggesting that, when controlling for constant unobserved effects, an increase in capital per worker could be associated with a decrease in profitability, reflecting problems of inefficient capital allocation, such as overinvestment in assets that do not generate proportional income.

4. Conclusions

The results of this research reflected a significant reality for manufacturing SMEs in Ecuador, specifically in zone 3, which covers the provinces of Pastaza, Cotopaxi, Chimborazo, and Tungurahua. Thus, in both the national and Latin American context, the analysis of the economic-financial performance of this type of company has evolved progressively, which makes this research a valuable contribution that can serve as a reference for future studies.

Through the information analyzed, it was determined that manufacturing SMEs in Ecuador constitute a large part of the circulating economy in the country. However, the financial panorama of these companies reflected a

duality: while there are clear opportunities for growth, there is also a perceived limitation in their ability to maximize the use of available resources, which does not allow them to achieve sustainable profitability and guarantee long-term economic stability.

In order to fulfill the purpose of this research, the behavior of the key components of financial performance was analyzed through the DuPont model, which provided insight into how these companies manage their resources and face economic challenges. Thus, this approach not only made it possible to identify general performance patterns but also to accurately measure how financial and operational factors impact their sustainability and growth.

From an exhaustive analysis of the ROE components, it was evident that the net margin was the variable that influenced profitability, indicating a positive coefficient of 1.46 for small companies and 1.55 for medium-sized companies. This shows that the companies that achieved higher operating margins had a comparative advantage, thus generating profit for every dollar in sales. It is essential to exemplify as follows: while the average net margin of companies decreased from 4% in 2017 to 1% in 2020, evidencing that those companies whose margins did not decrease and even increased, did not suffer as much due to the pandemic crisis in 2020.

As for asset turnover was equally crucial, especially in small companies, indicating a coefficient of 0.95, so that it can be translated to mean that SMEs better optimized their productive resources, thereby increasing their income with fewer assets. However, the efficiency within asset utilization presented a downward trend, decreasing from an average turnover of 3.84 in 2017 to 1.32 in 2020, reflecting the incidence of factors such as economic recession and supply chain disruptions, especially in the course of the pandemic.

Financial leverage also showed a moderate positive effect, with coefficients of 0.43 in small companies and 0.35 in medium-sized companies, indicating that, if managed correctly, indebtedness can be a valuable tool for financing projects. However, risks linked to high levels of debt were detected, as in a 2020 case where leverage reached 311%, which could jeopardize the stability of the most fragile companies.

Working capital did not show a statistically significant relationship with economic-financial performance. So, although medium-sized companies showed higher capital averages of $277,792 in 2020 compared to $17,358 for small companies, this did not always reflect higher profitability. In fact, having excess current assets could generate opportunity costs, since, instead of remaining tied up, they could be used to make strategic investments.

Thus, in relation to the first specific objective, the descriptive statistical analysis made it possible to describe the behavior of working capital and economic-financial performance. Thus, the results revealed that manufacturing SMEs tend to operate with tight net margins, although some achieve high asset turnover, reflecting an operating structure based on efficiency. However, considerable financial leverage was observed, indicating a high dependence on external financing, highlighting the difficulties in generating high margins in a sector characterized by competitiveness and the need for constant innovation. In addition, the heterogeneity of the results is evidence of the diversity in management strategies and the conditions in which these companies operate.

As for the second specific objective, the relationships between working capital and economic-financial performance were evaluated using a panel data model, which revealed that, although working capital did not have a statistically significant relationship with financial performance, factors such as net margin, asset turnover, and financial leverage were determinants. Therefore, by means of the Hausman test, a fixed effects model was validated as the most appropriate, as it showed systematic differences in the estimators, allowing for to control of unobserved characteristics constant over time, but variable among companies, indicating that the net margin and asset turnover are determinants in profitability, showing an efficient management of resources. However, financial leverage presented variable impacts, and working capital showed possible inefficiencies in the allocation of resources, suggesting problems of investment in non-productive assets, so that it can be inferred that profitability does not depend on traditional working capital strategies, but on a management that optimizes financial and operating resources.

The research faced limitations related to the availability of financial data. Although it was planned to work with a random sample of manufacturing SMEs in Pastaza, Cotopaxi, Chimborazo, and Tungurahua, many companies did not have complete or updated financial information. As a result, the sample had to be significantly reduced, analyzing only those that met the requirements established in the methodology, thus limiting the scope of the analysis, but guaranteeing the validity and reliability of the results.

Declaration of competing interest

The authors declare that they have no known financial or non-financial competing interests in any material discussed in this paper.

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Author contribution

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Ethical approval statement

Ethical approval is not applicable to this research.

Informed consent

Informed consent for the publication of personal data in this article was not obtained because we worked with secondary source data, found on the Supercias website, which was detailed in the methodology.

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