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# A MULTILAYER PERCEPTRON NETWORK–BASED ANALYSIS TO CONFIGURE SMES STRATEGIC ENTREPRENEURSHIP FOR SUSTAINABLE GROWTH

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***Abstract***

*This study analyzed the close interaction among organizational networking and financial mechanisms of growth and sustainable growth of SMEs operating in Albania. Data on 120 SMEs for 2017–2018 were analyzed using multivariate regressions and multilayer perceptron artificial neural networks. Initially, the data were analyzed using multivariate regression analyses to find the correlation between firms' growth measured by three different indicators: return on equity, return on assets and business size. In this approach, growth takes into consideration a firm's liquidity, its operational efficiency, and leverage indicators in addition to organizational characteristics. The results obtained during the initial phase were fed to the multilayer perceptron artificial neural networks model to evaluate SMEs growth and further their sustainable growth process by using the age of the firm, classified into start-up, grown, and matured stages. The model results showed that SMEs in the start-up stage assume a risk-taker approach toward sustainable growth. In the grown stage, they implement a market-timing strategy in selecting investments toward a sustainable growth perspective. Those in matured stage replicate the liberal managerial style of the SMEs in start-up stage, but employ a less aggressive strategy.*

***Keywords****: SMEs, strategic entrepreneurship, sustainable growth*

## 1. INTRODUCTION

This paper identified and evaluated the interaction among factors impacting small and medium-sized enterprise (SME) development toward a sustainable growth process. The existing literature shows that the growth process of SMEs is determined by the owner/manager personal and managerial approach (Baldwin, 1994; Frank & Goyal, 2009; Sarwoko & Frisdiantara, 2016; Neneh, 2020). In addition, the literature considers various approaches to SME development based on growth models, social psychology of business owners/managers, and financial performance issues, but no studies have considered the transition process from growth to a sustainable growth.

The presented approach considers SMEs as a heterogeneous group, taking into account their size, age, equity origins, organizational philosophy, and

business strategies. This study does not consider them as closed and separate systems, and does not neglect the significance of networking and organizational mechanisms in their promotion and sustainable growth. There is a lack of studies that consider the strong relationships existing between organizational characteristics and financial aspects of SMEs during the transition process from growth to a sustainable growth.

SMEs are a very relevant part of the economic prosperity of a country and are considered as the backbone of the economy. Thus, it is very important from a theoretical and practical point of view to undertaking a deeper analysis that will help understand the factors influencing their wellbeing. Such an analysis should determine the factors impacting SME growth and indicate how to create a smooth transition versus a sustainable growth process. Thus, it is of high priority to select and use efficient tools that will determine SMEs' situation, and, based on these findings, to define the correct path for sustainable growth.

The presented approach is based on SMEs' financial aspects in close interaction with their organizational philosophy. This research study initially addressed the SME growth market measured through return on assets (ROA), return on equity (ROE), and business size (BoS) (Lee & Tsang, 2001; Naranjo, 2004; García-Teruel & Martínez-Solano, 2010; Czarnitzki & Hottenrott, 2011). Furthermore, in this approach the growth takes into consideration firm's liquidity, its operational efficiency, and leverage indicators in addition to organizational characteristics (Table 1) by using multivariate regression analyses. Next, based on the results of multivariate regression analyses, a multilayer perceptron artificial neural network (MLP-ANN) model is designed and used to specify and evaluate the factors influencing SMEs sustainable growth, measured by firms' age, classified as start-up, grown, and matured. To test our approach, we considered the Albanian market. The 2018 Statistical Register of SMEs (SRS) data show that SMEs account for 99% of total businesses, 81% of total employment, and approximately 67% of business turnover.

The potential contributions of this paper to the existing literature are as follows. First, this study addresses SME growth and sustainable growth issues considering the close interaction among organizational networking and financial mechanisms. This is a novelty of this study. Second, a multilayer perceptron artificial neural network analysis maps sets of input data onto a set of appropriate SMEs output classified in three different growth stages. In the current literature, these models are used to measure only SMEs' performance and creditworthiness. Thus, this study provides a novel utility of these models. Third, this paper presents a valuable model that can be used by SMEs to organize internal information to define their sustainable growth strategies.

The rest of the paper is presented as follows. A literature review reviews existing studies on the subject. Section Methods shows the research context, data used for the analyses, and the scientific approach; section Discussion presents the results obtained by this study; and the last section, Conclusions, presents the findings of this study.

## 2. LITERATURE REVIEW

Growth of small and medium enterprises is difficult to achieve because of the complexity of the phenomenon according to extensive studies (Czarnitzki & Hottenrott, 2011; Michna, 2007, Abdelaziz, Alaya & Dey, 2018). Sarwoko & Frisdiantara (2016) defined SMEs' growth philosophy as a set of owner's/manager`s personal characteristics, or as their personal approach. The definition also includes the way in which strategic decisions are made; this could be referred to as a managerial approach. The growth measurement process uses indicators such as sales, profit, assets, equity, and their derivatives (Lee & Tsang, 2001; Naranjo, 2004; García-Teruel & Martínez-Solano, 2010; Czarnitzki & Hottenrott, 2011).

In this context, many researches have shown that SMEs' liquidity management is their major challenge. This issue is complex because liquidity is managed day by day in order to meet business short-term obligations due to agency[1] and asymmetry[2] issues

[1] Agency problems in SMEs occur when managers are delegated by owners to act according their interests. This relation inherently creates conflicts of interest in respect of each individual benefit clue.

(Gopinath, 1995; Chittenden, Hall & Hutchinson, 1996; Chow & Fung, 2000; Berger & Udell, 2005; García-Teruel & Martínez-Solano, 2008; García-Teruel & Martínez-Solano, 2010). Good management of business short-term obligations may positively impact SMEs business growth. Nowadays, SMEs try to balance the liquidity management process with operational efficiency and leverage. Studies show a positive relationship between cash management, inventory (INV) turnover, trade credit practices, and profitability (Baños-Caballero, García-Teruel & Martínez-Solano, 2010; García-Teruel & Martínez-Solano, 2010). In addition, SMEs' efficiency and sustainability mainly depends on good working capital management (WCM) practices (Kubíčková & Souček, 2013; Hyz, Stavroulakis & Kalandonis, 2017; Abimbola & Kolawole, 2017). Studies have proven that there is a non-linear relationship between the variables examined by demonstrating that there is a non-monotonic relationship between working capital level and firm profitability (Czarnitzki & Hottenrott, 2011). The same studies make clear that the liquidity management strategy is a crucial element in the survival and further growth of SME businesses. Other studies (e.g., Michna, 2007; Marom, Lussier & Sonfield, 2019; Barwinski, Qiu, Aslam & Clauss, 2020) show that SME survival in a risky and competitive environment requires innovation, and that innovation requires new knowledge. Some studies (Chittenden, Hall & Hutchinson, 1996; Jordan, Lowe & Taylor, 1998; Hall, Hutchinson & Michaelas, 2000; Booth, Aivazian, Demirguc-Kunt & Maksimovic, 2001) used as performance measures the determinants of capital structure. Those studies explain that debt management practices serve as integral parts of financial strategies applied to SMEs. Financial strategies logically affect the ability of the SMEs to grow. Furthermore, small businesses carry different types of debt depending on the services or products delivered (Mazzarol, Reboud & Clark, 2015). Normally, to correctly manage business debts, it is crucial to appropriately estimate current debts, minimum payment schedules, and respective interest rates. The success or failure of a firm depends even on the ability to secure adequate funding, among other issues (Derelioğlu & Gürgen, 2011). Smith (2013) showed that the insolvency of many SMEs depends not only on the owner's underperformance, but also on the underperformance of other sectors of the business. Therefore, owners'/managers' poor debt management or lack of financial management is the main cause of financial problems in SMEs (Jindrichovska, 2013). Reasonably, a serious issue is the maintenance of an optimal capital structure ensuring guaranteed and sustainable growth. Many studies (e.g., Frank & Goyal, 2009; Salder, Gilman, Raby & Gkikas, 2020) have shown that some firm-specific factors that affect SMEs' capital structure and growth are firm size, profitability, tangibility, debt amount, growth, and volatility. Other factors that should be considered are industrial/environmental characteristics. The organizational characteristics and the managerial decision-making process also are known to have a decisive influence on SMEs growth. For example, managerial skill, the competence of leadership style, employee commitment, administrators' and owners' gender, and equity origin could affect SME growth (see Shrader, Mulford & Blackburn, 1989; Baldwin, 1994; Frank & Goyal, 2009; Neneh, 2020).

Kazanjian (1988) showed that sustainable SMEs growth occurs in different stages measured by life-cycle periods or the age of the firm (FA). The stages are (1) the business conception and development, (2) commercialization related to business start-up, (3) growth, and (4) stability.

In the growth stage, sales and market share are increased, and that requires that SMEs must consider organizational arrangements such as increasing human resources or equipment to deal with growth. The stability stage is characterized by profitability, internal control, and consolidation of a base for future growth.

In addition, an important aspect to consider is the integration of owners'/managers' behavioral, social, and psychological contexts in the firm growth philosophy. Studies such as Amit, MacCrimmon, and Oesch (1996) have found that both economic and psychological attributes are associated with businesses in the start-up stage to generate growth. How-

[2] An asymmetric information situation occurs when one of the parties involved in economic transaction possesses more information than the other (i.e., a buyer vs. a seller). Under these circumstances it can be deduced that almost all economic transactions involve information asymmetries.

ever, according to Blatt (1993), newly registered businesses do not seek immediate growth for their businesses. On the other hand, Orser, Hogarth-Scott, and Wright (1998a & 1998b) showed that the decisions to reach growth derive from a variety of motivations, including the owner's perception of growth and their values. The experience demonstrates that SMEs' growth it is impacted by business environment conditions. The business environment is a factor that also influences SMEs growth. Due to environmental conditions such as competitiveness and changing market dynamics, SMEs' growth is uncertain (Baum & Locke, 2001; Street & Cameron, 2007).

SMEs growth is a function not only of the financial performance of the businesses (Cragg & King, 1989; Belcourt, Burke & Lee-Gosselin, 1991; Covin & Slevin, 1991; Epstein, 1993, Sarwoko, Surachman & Armanu, 2013). Another important element of SMEs' growth performance is the interrelationship between planning, market timing–oriented strategies, characteristics of owners/managers, and growth philosophy.

However, past research, focused on the co-integration of SMEs' organizational characteristics and financial performance, toward sustainable growth in corresponding stages has not specifically addressed this issue in a holistic manner. The novelty of the present research is its insight into SME growth in a multidisciplinary context. This study explores various elements of business growth, such as the gender psychology of business owners/managers, entrepreneurship strategy, and relevant financial aspects to ensure business continuity and sustainable growth.

## 3. METHODOLOGY

### 3.1 Research context

SMEs were classified as micro, small, and medium enterprises, taking into account the number of employees and annual turnover. Micro businesses have fewer than nine employees and annual turnover of less than €81,600; small businesses have 10–49 employees and annual turnover of less than €408,160; and medium-sized businesses have 50–249 employees and annual turnover of less than €2,040,800. The 2018 statistics show that local businesses constitute 96%, joint ventures (foreign and local businesses) account for approximately 1%, and foreign businesses represent approximately 3% of SMEs operating in the country. During 2018, women owned 25.7% of total active enterprises.

### 3.2 Data

This research study used a sample containing 120 SMEs data pertaining to 2017–2018 from the National Registration Centre (NRC) and the Credit Registry of the Bank of Albania (CRBA) databases. The selected SMEs reported and documented in detail their financial data in both databases. Most of the SMEs' organizational characteristics were retrieved from the National Registration Centre, and only the borrowers' status records were retrieved from the Credit Registry of the Bank of Albania. In addition, all financial indicators used in this analysis refer to National Registration Centre data (Table 1).

The organizational characteristics analyzed (Table 1) emphasize the development philosophy of the SMEs operating in the Albanian business environment [i.e., Administrator Gender (AG), Business Ownership, Equity Origin (EO), Ownership Gender (OG), and Borrowers' Status (BS)]. The financial indicators analyzed pertaining to liquidity (current assets, inventory turnover ratio (ITR), inventory, and short-term assets/debts], operational efficiency [gross profit margin (GPM), net profit margin (NPM), asset turnover (AT), and return on equity), and leverage [long-term debt (LTD), long-term debt/equity ratio (LTDER), total leverage ratio, and interest coverage ratio] evaluate the business capabilities linked to organizational characteristics which ensure SMEs' growth and further their sustainable growth.

### 3.3 Variables and analytic techniques

To examine the SMEs' growth and their sustainable growth, this study considered their organizational characteristics and financial aspects at 95% confidence level. This study used various growth indicators, such as ROE, ROA, BoS and FA. Several models, such as multivariate regression models and the artificial neural network based on a multilayer perceptron classification also was used. Except for ROE, all the variables

(ROA, BoS, and FA) used to examine the SMEs' growth and sustainable growth pertained to growth area. ROE was used as a growth measure because it is the operational efficiency indicator most in line with growth referring to SMEs size (Naranjo, 2004).

In the first phase of this research study, a test was designed to determine a direct relationship between organizational characteristics and financial indicators of growth (measured in terms of ROE, ROA, and BoS). Three different multivariate regressions which use ROE, ROA, and BoS were developed:

1. $ROEit = \alpha + \beta \times organizational\ characteristicsit + \gamma \times financial\ indicators_{it} + \varepsilon\ it$ (1)
2. $ROAit = \alpha + \beta \times organizational\ characteristicsit + \gamma \times financial\ indicators_{it} + \varepsilon it$ (2)
3. $BoSit = \alpha + \beta \times organizational\ characteristicsit + \gamma \times financial\ indicators_{it} + \varepsilon it$ (3)

In these regressions ROE, ROA, and BoS were considered as the dependent variables. Other variables, organizational and financial (Table 1), were considered as the explanatory variables.

In the second phase of this study, an artificial neural network based on a multilayer perceptron classification was designed and implemented analyzing the results obtained during the first phase. The MLP neural network used the age of the firm as the SME sustainable growth indicator. SME sustainable growth was classified in three different stages: start-up, pertaining to businesses with 0–5 years of activity; grown businesses, with 6–15 years of activity; and matured, with more than 15 years of activity. The age variable was used with a dual purpose; it captured the effects of SME growth, and it measured the expansion into different business development stages.

The MLP model was used to map sets of input data onto a set of appropriate output:

$$FA(start\text{-}up;grown;matured)it = f(W\{organizational\ characteristics;\ financial\ indicators\}it) \quad (4)$$

Such an approach enables modeling the influence of beliefs, efforts and the implemented business strategies (their correlated effects not directly measured in the first phase of this research) on SMEs sustainable growth. Their impact on SMEs sustainable growth was analyzed using the multilayer perceptron network results.

## 4. RESULTS

### 4.1 Multivariate regression analyses

The first step of this analysis evaluated whether a direct relationship exists between SME growth measures and the independent variables examined (organizational characteristics and financial aspects) at 95% confidence level. The first model employed was a multivariate linear regression which used ROE as a SME growth measure. The same model was used for the second evaluation, which used ROA as the growth measure. The third model employed was a multivariate log-linear model in which the growth measure was a function of BoS (ln total assets).

The first model results (Table 2) confirm that the independent variables which influence ROE at the 95% confidence level are GPM, NPM, AT (operational efficiency area); LTDER (leverage area), and short-term debt (STD) (liquidity area). These variables can predict ROE volatility with approximately 99.6%. Note that the presence of multicollinearity issues are indicated by significant direct correlation between variables. Statistically this was confirmed from the variance inflation (VIF) value, which in every case was higher than 1. These results are the main reason why the organizational characteristics variables were excluded from examination in this multivariate linear regression analysis. In addition, results showed that the residuals of the model were negatively correlated. Thus, the model indicated heteroskedasticity issues, meaning that residuals were not normally distributed ($\pi = -2.12 \times 10^{-15}$; $\delta = 0.892$). Therefore, a different examination was performed to better explain ROE in terms of a SME growth measure.

The second multivariate linear regression model indicated that the variables that were statistically significant at 95% for ROA prediction are NPM (operational efficiency area), total leverage ratio (LEV) (leverage area), collateral value (CV) (growth area), OG mixed, and BS performing (organizational characteristics) (Table 2). These variables can predict only 57.1% of ROA volatility. The VIF value was higher than 1, which confirms the presence of multicollinearity issues between the examined variables. On the other hand, the residuals confirm a positive correlation (DW =1.781). Their distribution

was heteroskedastic ($\pi = -6.73 \times 10^{-16}$; $\delta = 0.893$). These numbers confirm that the relationship between the examined variables was not linear.

The third examination related to SMEs growth measure was performed using a multivariate log-linear model in which the dependent variable was BoS (ln total assets) (Table 2). In this case, the data showed that the variables that had a statistical significance at the 95% confidence level for BoS are AG mixed, EO foreign (organizational characteristics), INV (liquidity area), LTD (leverage area), and CV (growth area). However, they can predict only 56.7% of BoS volatility; thus the presence of multicollinearity issues in the model (VIF > 1) was confirmed. The residuals had a positive correlation (DW = 1.645), and their distribution was heteroskedastic ($\pi = -5.84 \times 10^{-16}$; $\delta = 0.763$), confirming that the relationship between the examined variables was not linear. The Pearson correlation also confirmed a weak correlation between the three variables examined as SMEs growth measures (ROE vs. ROA = 0.018; ROA vs. BoS = −0.116, and BoS vs. ROE = −0.143). There was a correlation between organizational characteristics, and a correlation between financial aspects of SMEs (Table 2). In addition, the data showed a correlation between organizational characteristics and financial aspects of SMEs. The multicollinearity, heteroskedasticity, and non-linearity issues between the variables and the model errors themselves from the multivariate regression models proved that these models are not adequate to measure SMEs' growth due to the complexity (Coenders & Saez, 2000). Thus, individual and correlated effects of the analyzed factors on the matter cannot be correctly evaluated. This means that this analysis should go deeper and use other tools to explain the complex relationships among elements of the study phase.

Thus, a more complex examination able to adequately evaluate all the variables' correlations and derived issues toward SME sustainable growth is needed. This study used the age of the firm as a variable to measure SMEs' sustainable growth during the three firm development stages (start-up, pertaining to businesses with 0–5 years of activity; grown businesses, with 6–15 years of activity, and matured, with more than 15 years of activity).

### 4.2 Multilayer perceptron networks analysis

Multilayer perceptron artificial neural networks are computational models able to model complex relationships between inputs/independent variables and outputs/dependent variables (Nabney, 2002). The multilayer perceptron classification used in this research classified the interaction between inputs (organizational characteristics and financial indicators) in three SME development stages: (1) start-up; (2) grown; and (3) matured. It calculated the ordinary and numerical variables outcomes and their observed nonlinearities easily by using a hidden layer with one unit and evaluated the direct relationship that existed between examined variables. The explanatory/input variables included in the MLP network analysis were ROE, ROA, and BoS (previously used as SME growth measures), in addition to all other variables previously mentioned pertaining to organizational characteristics and financial business areas.

In supervised learning, the MLP class of neural networks manages a set of training samples used to infer a classifier to predict a correct output value (Zhang, 2000). The MLP model confirmed that the overall percentage of incorrect predictions in the composition of testing and training sample was about 1.5%. This demonstrated that the model is statistically valid at the 95% confidence level.

The receiver operating characteristic (ROC) curve analysis (Figure 1) proves that the analysis fairly classified the output in the start-up stages (ROC area = 0.694). The classification of output in the grown and matured stages was very good (ROC areas = 0.803 and 0.788, respectively). The same results were obtained using a lift chart (Figure 2). In approximately 50% of cumulative cases, most businesses were in the grown stage, 30% were in the matured stage, and the remaining 20% were classified in turns as start-up, grown, and matured. The MLP hidden layer activation function was a hyperbolic tangent, whereas the final activation function was the softmax function. The MLP statistics show that the SME organizational characteristics which had a normalized impact over 30% on SME sustainable development phases were AG (male), OG (male), OG (female), and BS performing. In addition, in terms of SME financial aspects, the variables with

a normalized impact over 30% on SME sustainable development stages were GPM, AT, and ROE in the operational efficiency area); LTDER, LTD, and LEV (leverage area); CA, ITR, short-term assets (STA), and INV (liquidity area); and ROA, BoS, and CV (growth area). All the variables considered in the analysis had a statistically significant impact on SME sustainable growth classification, as measured by the age of firm (FA).

## 5. DISCUSSION AND CONCLUSION

Regression analyses of SME growth using as dependent variables ROE, ROA and BoS do not produce valid outcomes. This is attributed to the existence of multicollinearity, heteroskedasticity, and non-linearity issues between the variables and the model errors. This is why ROE (an operational efficiency indicator) used as a SME growth measure is not affected by the organizational characteristics. In this case, only the financial aspects influence SMEs' growth. When ROA and BoS (growth area indicators) are used as SME growth measures, the organizational characteristics significantly impact them in addition to financial aspects.

It is a novelty of this study to approach the evaluation of SMEs sustainable growth operating in Albania using an MLP. The literature recommends using MLPs for SME performance and creditworthiness evaluation (Derelioğlu & Gürgen, 2011; Abdelaziz, Alaya & Dey, 2018). This study makes a novel contribution by using an MLP to evaluate SME growth and sustainable growth.

The MLP was used to accurately identify the factors (organizational characteristics and financial indicators) influencing SME sustainable growth stages. The MLP helped to identify factors impacting SME growth in a complex business environment (Table 3).

The MLP classifier showed that the SME organizational characteristics with a greater influence on the business philosophy of SMEs in the start-up stage were the administration gender (female/male); the business ownership, in cases in which it is divided from administration issues; equity origin (foreign and joint ventures); ownership gender (male and mixed cases); and the business classification in non-performing status (see variables' correlation signs in Table 3). Furthermore, the financial indicators which impacted the SMEs' growth in this stage were ITR, INV, STA, and STD (liquidity area); GPM and NPM (operational efficiency area); ICR, LEV and LTD (leverage area); and CV and ROA (growth area). The maintenance of all the previously mentioned financial indicators at high levels represents value added for the SMEs for sustainable growth in the start–up stage. The opposite also can be confirmed: maintaining financial indicators at low levels negatively affects SMEs' sustainable growth (Table 3).

From the organizational philosophy point of view, the analysis demonstrated that SMEs in the grown stage mainly were administrated by mixed genders, and the business owners were involved in the business administration process (Table 3). Data showed that female business ownership patterns in this stage are decisive. The correlation statistics were significantly negative in cases in which SMEs were in the grown stage and owned by females. Furthermore, the businesses in the grown stage repaid loans according to schedule. In terms of the financial aspects, grown businesses prefer to maintain low levels of CA (liquidity area), AT, and ROE (operational efficiency area), LTDER (leverage area), and BoS/assets growth (growth area). The increase of the remaining financial indicators, such as ITR, GPM, and NPM, is maintained to assure continuous progress.

This study found similarities between SMEs in the matured stage those in the start-up stage (Table 3). These businesses maintained lower levels of ITR, INV, STA, and STD (liquidity area); GPM and NPM (operational efficiency area); ICR, LEV, and LTD (leverage area); and CV and ROA (growth area) than did those in the start-up stage. Furthermore, in terms of organizational aspects, these businesses implemented strategies to expand their portfolio activity. Thus, their philosophy is open-minded toward administration issues, separation of each activity and the respective management duties, and foreign direct investments. Joint ventures bring additional experiences in the national market, even in the majority of cases in which the business owners are males. Another important element is that these businesses also may be classified as non-performing in terms of loan repayment schedules. This classifi-

cation is imposed by the banks, but nevertheless a business may perform well in its activities. The businesses borrowers' status from banks is evaluated considering their worst repayment schedule case. This means that as different loans are granted (pertaining to different activities undertaken from these businesses), bankers use the contamination evaluation rule to evaluate their entire loan performing status.

The business philosophy statistics showed that SMEs in the start-up stage face agency issues as the owners (male/mixed partnership cases) delegate to skilled managers (of female/male gender) the business management process. This is true mainly for foreign and joint ventures businesses. These businesses configure the daily activities as open organizations. Investing in a liberal management style and assuming a risk-taker approach vis-a-vis the financial aspects means that their business strategy for growth is aggressive. Furthermore, in this stage, SMEs explore as much as possible all the internal capabilities expressed in terms of knowledge toward innovation in order to survive in such a competitive business environment. Because of the competitive business environment, SMEs in the start-up stage try to maintain a balanced approach toward liquidity, operational efficiency, and leverage management, seeking a rapid growth process which can result in sustainable growth.

Another approach is that one pursued by the grown SMEs, which seem to adapt the business needs to specific organizational arrangements. In this stage, the owners mainly are females directly involved in the business management process. The administration process is facilitated by trusting some specific issues to skilled managers, although the decision-making process remains centralized. These businesses continuously invest in assets and profitability growth, supported by long-term funding. This behavior is present specifically in the most profitable business areas, which correspond to market timing strategy. In this way, they achieve growth and further progress.

Matured SMEs instead prefer to foster growth continuously; thus, they continuously increase liquidity, operational efficiency, and leverage indicators by diversifying portfolio activities and trying at the same time to benefit as much as possible from the situational market circumstances. In general, they pursue an aggressive managerial business style. They centralize the decision-making process in separate business areas, in which skilled managers are responsible for growth. Their progress at this stage is safe, but the owners control the benchmarks for future growth strategies.

The presented model is a good example of how SMEs define better financial and internal organizational policies to reach their growth and sustainable growth goals.

This study also affirmed that female ownership in each business development stage, independently of invested equity origin, represents added value. In particular, partially/fully female-owned initiatives should be supported with dedicated training and facilitated with specific fiscal instruments, especially when SMEs are in the start-up stage and deal with innovation issues. However, it is widely accepted that the business evolution dynamicity should be monitored continuously to initially help businesses pass the potentially delicate stages. Furthermore, there is a need to support the growth of the entire national economy.

This study examined factors influencing growth and sustainable growth of SMEs in Albania, which are considered to be the backbone of the national economy. It enriches the existing literature in three different ways. First, the study addressed SME growth and sustainable growth issues considering the close interaction among organizational networking and financial mechanisms. This is a novelty of this study. Second, a multilayer perceptron artificial neural network analysis mapped sets of input data onto a set of appropriate SME output classified in three different growth stages. In the current literature these models are used to measure only SME performance and creditworthiness. Thus, this study provides a novel utility of these models.

Third, this paper presents to SMEs a valuable model that can be used to organize internal information to define their sustainable growth strategies.

Using a sample of 120 SMEs operating in the Albanian market, growth was measured through return on assets, return on equity, and business size.

In this approach, growth took into consideration a firm's liquidity, its operational efficiency, and leverage indicators in addition to organizational characteristics by using multivariate regression analyses. Based on the results of multivariate regression analyses, a multilayer perceptron artificial neural network model was designed and used to specify the factors influencing SME development stages, measured by firms' age, classified as start-up, pertaining to businesses with 0–5 years of activity; grown businesses, with 6–15 years of activity; and matured, with more than 15 years of activity.

The MLP-ANN model easily calculated the ordinary and numerical variables' outcomes and their observed nonlinearities using a hidden layer with one unit and evaluated the direct relationship between the examined variables. The explanatory/input variables included in the MLP network analysis were ROE, ROA, and BoS, previously used as SME growth measures, in addition to organizational and financial variables. The MLP data confirmed that the overall percentage of correct predictions in the composition of testing and training sample was about 98.5%. This demonstrates that the model is statistically valid. The empirical findings of this research confirmed that SMEs in the start-up stage assume a risk-taker approach toward sustainable growth. In the grown stage, they implement a market-timing strategy in selecting investments with a sustainable growth perspective. Businesses in the matured stage replicate the liberal managerial style of SMEs in the start-up stage, but employ a less aggressive strategy.

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This study also affirmed that female ownership in each business development stage, independently of invested equity origin, represents added value. In particular, partially/fully female-owned initiatives should be supported with dedicated training and facilitated with specific fiscal instruments, especially when SMEs are in the start-up stage and deal with innovation issues. However, it is widely accepted that the business evolution dynamicity should be monitored continuously in order to initially help businesses pass the potential delicate stages. Furthermore, there is a need to support the growth of the entire national economy.


## EXTENDED SUMMARY/IZVLEČEK

Avtorji so v prispevku analizirali tesno interakcijo med organizacijskim povezovanjem in finančnimi mehanizmi rasti ter trajnostne rasti malih do srednje velikih podjetji v Albaniji. Podatki o 120 malih in srednjih podjetjih za obdobje 2017–2018 so bili analizirani z uporabo multivariatnih regresij in modela nevronskih mrež, imenovanega večplastni perceptron. Sprva so bili podatki analizirani s pomočjo multivariatne regresijske analize. Namen slednje je bil potrditi korelacijo med rastjo podjetij, kar je bilo merjeno s tremi različnimi kazalniki: donosnost kapitala, donosnost sredstev in velikost podjetja. Pri oceni rasti podjetja se je v tem primeru poleg organizacijskih značilnosti upoštevala tudi likvidnost podjetja, njegova operativna učinkovitost in kazalniki vzvoda. Rezultati, pridobljeni v začetni fazi, so bili vključeni v model umetnih nevronskih mrež, s pomočjo katerega so avtorji želeli pridobiti oceno rasti malih do srednje velikih podjetji. Nadalje so avtorji želeli preveriti tudi njihovo trajnostno rast. Slednje je temelilo na starosti podjetja, ki je vključevala tri možnosti: zagonsko (start-up) obdobje, obdobje rasti in zrelo obdobje. Rezultati modela so pokazali, da mala in srednje velika podjetja v zagonskem obdobju sprejemanjo bolj tvegan pristop doseganja trajnostne rasti. Po drugi strani, podjetja v obdobju rasti vlagajo v trajnostno rast na podlagi trženske časovne strategije. Podjetja v fazi zrelosti uporabljajo bolj liberalni slog vodenja. Slednje je podobno strategiji malim in velikim podjetjem v začetni fazi vendar s to razliko, da je strategija podjetji v zreli fazi manj agresivna.

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## APPENDICES

### Appendix 1

*Table 1: Summary of research variables*

| | | Variable | Measurement | Abbrev |
|---|---|---|---|---|
| | **Organizational charateristics** | Administrator gGender | Administrator´s gender (female = 0, male = 1, and mixed genders = 2) | AG |
| | | Business ownership | Business owner (administrator = 0, no administrator = 1) | BO |
| | | Equity origin | Business equity origin (national = 0, foreign = 1, and joint ventures = 2) | EO |
| | | Ownership gender | Ownership gender (female = 0, male = 1, and mixed gender ownership = 2) | OG |
| | | Borrower status | Borrower status (non-performing + 30 due days = 0, performing 0–29 due days = 1) | BS |
| *Financial Indicators* | *Liquidity indicators* | Current assets | Short-term assets/Short-term debts | CA |
| | | Inventory turnover ratio | Cost of goods sold/Average inventory | ITR |
| | | Inventory | End of year inventory | INV |
| | | Short-term assets | Cash + trade securities portfolio + receivable accounts + inventory | STA |
| | | Short-term debts | Payable accounts, short-term loans | STD |
| | *Operational efficiency indicators* | Gross profit margin | Gross profit/Net sales | GPM |
| | | Net profit margin | Net profit/Net sales | NPM |
| | | Assets turnover | (Net profit + interest expenses)/Average equity | AT |
| | | Return on equity | Net profit/Average equity | ROE |
| | *Leverage indicators* | Long-term debt/equity ratio | Long-term debt/equity ratio | LTDER |
| | | Interest coverage ratio | Earnings before interest and taxes/Interest expenses | ICR |
| | | Total leverage ratio | Total debts/Total assets | LEV |
| | | Long-term debts | End-of-year long-term debts | LTD |
| | *Growth indicators* | Collateral value | End-of-year market collateral value | CV |
| | | Age of firm | Analysis period/business registration period (start-up (0–5 years0 = 0; growth (6–15 years) =1; maturity (>15 years) = 2) | FA |
| | | Return on assets | Net profit/Average assets | ROA |
| | | Business size | ln(total assets) | BoS |

*Source: NRC and CRBA data*

### Appendix 2

*Table 2: Summary of multivariate regressions models*

| Model no. | Significant variables at 95% | $R^2$ | Residuals correlation (1 – DW/2) | Heteroskedasticity ($\pi$; $\delta$) | Multicollinearity (VIF) |
|---|---|---|---|---|---|
| 1. ROE | GPM, NPM, AT, LTDER, STD | 0.996 | 2.719 | (−2.12 × 10−15; 0.892) | VIF > 1 |
| 2. ROA | NPM, LEV, CV, OG mixed, BS performing | 0.571 | 1.781 | (−6.73 × 10−16; 0.893) | VIF > 1 |
| 3. BoS | AG mixed, EO foreign, INV, CV, LTD | 0.567 | 1.645 | (−5.84 × 10−16; 0.763) | VIF > 1 |

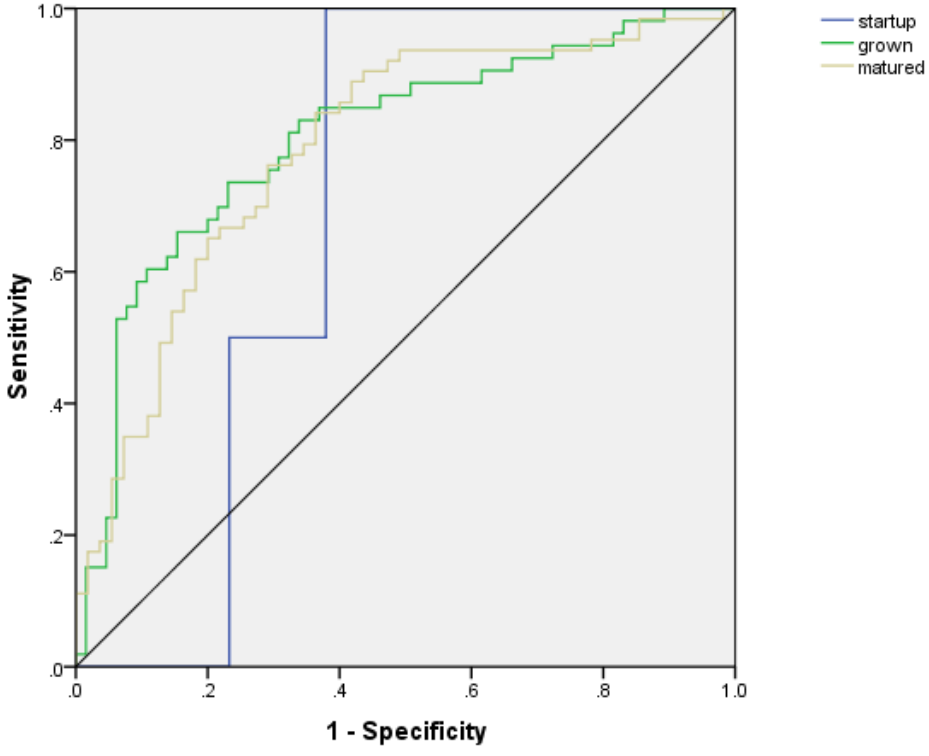
## Appendix 3

*Table 3: MLP model parameter estimates*

| | Input variables | Values | Input variables | Values | Input variables | Values |
|---|---|---|---|---|---|---|
| Input Layer | CA | −0.701 | CV | 0.741 | EO foreign | 0.162 |
| | ITR | 0.859 | STA | 0.375 | EO mixed | 0.262 |
| | GPM | 0.573 | STD | 0.065 | OG female | −0.861 |
| | NPM | 0.113 | LTD | 0.645 | OG male | 1.027 |
| | AT | −0.404 | AG female | 0.237 | OG mixed | 0.197 |
| | LTDER | −0.539 | AG male | 0.683 | BS non-perfoming | 0.926 |
| | ICR | 0.232 | AG mixed | −0.109 | BS perfoming | −1.187 |
| | LEV | 0.318 | BO administrator | −0.054 | ROE | −0.157 |
| | BoS | −0.415 | BO non administrator | 0.201 | ROA | 0.536 |
| | INV | 0.675 | EO national | −0.693 | | |
| | Age of firm: start-up | Age of firm: grown | Age of firm: matured | | | |
| Output Layer | 0.705 | −1.236 | 0.108 | | | |

## Appendix 4

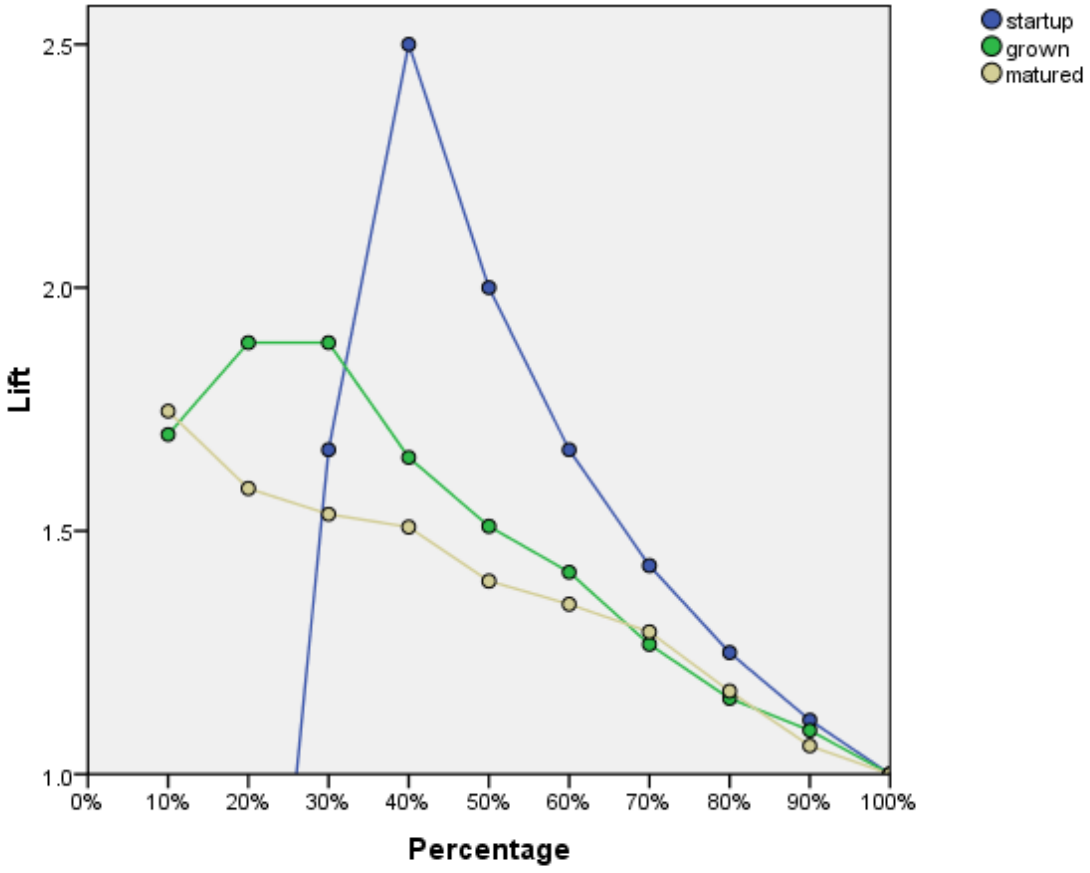
*Figure 1: ROC analysis.*




Dependent Variable: Firmage

**Appendix 5**

*Figure 2: Lift chart results.*




Dependent Variable: Firmage