INTEGRATING FINANCIAL AND ORGANIZATIONAL DRIVERS IN SME DEBT DYNAMICS: INSIGHTS FROM RADIAL BASIS FUNCTION ANALYSIS

Ardita TODRI
Associate Professor, Finance and Accounting Department,
University of Elbasan "Aleksandër Xhuvani",
ardita.todri@gmail.com,
ORCID: https://orcid.org/0000-0002-3825-0780

Petraq PAPAJORGJI
Emeritus Professor, Moore Albania Shpk,
petraq@gmail.com,
ORCID: https://orcid.org/0000-0002-3833-5215

Abstract

This study applies Radial Basis Function (RBF) models to analyze the determinants of SME debt structures among 132 firms, integrating quantitative and qualitative variables. The RBF approach reveals that both financial performance and organizational behavior significantly influence leverage and debt accessibility. Non-performing borrowers exhibit higher leverage and lower operational efficiency, while performing firms demonstrate stronger liquidity and asset utilization. Equity origin and gender-based management differences shape debt behavior, with national firms favoring long-term domestic debt and female or mixed ownership maintaining higher security margins. RBF models identify key predictors of short-term debt—such as ROA, ROE, and asset turnover—and long-term debt, including profitability ratios, tangibility, equity structure, and firm size. Layer-specific correlations highlight the multidimensional interaction between firm characteristics and financing patterns. Overall, RBF analysis enhances understanding of SME debt dynamics, providing actionable insights for financial governance, risk management, and policy formulation.

Keywords: Financial ratios, organizational patterns, SMEs debt structure
JEL Classification: M2, M29, M49

Citation: Todri A. Papagiorgji P. 2025. “Integrating financial and organizational drivers in SME’s debt dynamics: insights from radial basis function analysis”, Sustainable Regional Development Scientific Journal, Vol II. (2), pp. 45-58

1. Introduction

Over the years, a substantial body of empirical research has investigated the determinants of firms' capital structures, identifying a range of factors that influence financing decisions. The most consistently cited factors in the literature include asset structure, non-debt tax shields (NDTS), firm size, profitability, growth opportunities, liquidity, cash flow, and industry characteristics. Each of these variables contributes differently to the debt-equity mix a firm employ, reflecting both theoretical expectations and empirical findings, which often present nuanced or contradictory results.

One of the earliest and most extensively studied determinants is the structure of a firm's assets, specifically the proportion of tangible versus intangible assets. Tangible assets, such as property, plant, and equipment, can serve as collateral in case of default, making them particularly relevant for lenders (Harc, 2015). Firms with higher levels of tangible assets are therefore generally expected to issue more debt, including both bank loans and other debt instruments. This rationale is supported by multiple studies, which argue that tangible assets reduce lenders' risk exposure and facilitate debt issuance. Michaelas et al. (1999) and Hall et al. (2000), for instance, confirmed a positive correlation between tangible assets and long-term debt (LTD). However, the relationship between tangible assets and short-term debt (STD) is less clear; some studies report a positive association, while others find a negative or statistically insignificant relationship. Overall, the evidence indicates that asset tangibility remains an important, though sometimes context-dependent, determinant of capital structure.

Non-debt tax shields (NDTS) are another critical factor affecting leverage (Mitra & Samanta 2022). NDTS refer to tax-deductible expenses other than interest, such as depreciation, provisions, and allowances for doubtful accounts. While debt offers the advantage of interest tax deductibility, the existence of significant NDTS can reduce a firm's incentive to issue debt. Empirical studies generally find a negative relationship between NDTS and long-term debt (Öhman & Yazdanfar, 2017) although results for short-term debt are less conclusive. Contradictory findings also exist, with some research suggesting positive correlations between NDTS and LTD (Rudiningtyas et al., 2023), alongside negative correlations with STD. These variations may reflect differences in sample composition, firm size, or industry.

Firm size is widely recognized as a robust predictor of leverage (Forte et al., 2013). Larger firms typically have better access to capital markets, lower external financing costs, and more diversified operations, which reduce bankruptcy risk. Empirical evidence generally shows a positive relationship between size and debt levels, particularly LTD, while smaller firms often rely more heavily on internal financing due to higher transaction costs and greater risk aversion (Chittenden et al., 1996). SMEs, for example, tend to exhibit a negative correlation between size and STD while showing a positive correlation with LTD. The reduced cost of external financing and the capacity to stabilize earnings through diversified operations further reinforce the propensity of larger firms to carry more debt. Conversely, smaller firms are usually more conservative, relying on self-financing and demonstrating aversion to external debt.

Profitability is often analyzed in relation to the pecking order theory, which posits that firms prioritize financing internally generated funds first, then debt, and finally equity as a last resort (Martinez et al., 2019). Empirical evidence shows that, particularly for SMEs, profitability tends to be negatively correlated with debt ratios. Profitable firms often prefer to finance investments internally rather than incur the costs and risks associated with external borrowing (Rashid, 2014). Managers of smaller firms, often also the owners, are typically more risk-averse, avoiding debt financing even when tax shields are available. These findings suggest that while debt can be beneficial, highly profitable firms may not exploit leverage due to internal funding preference (Brav, 2009).

Growth opportunities are another widely studied determinant, though the literature presents mixed findings. High-growth firms may issue more debt because they signal potential to creditors and can secure favorable credit terms (Lee, 2014) while other studies argue that growth is negatively related to debt since firms may prefer to fund expansion through retained earnings to avoid overinvestment or increase agency costs associated with debt. Some research indicates that investment in growth increases agency costs of debt, reducing the likelihood of external borrowing (Vanacker & Manigart, 2010). Overall, growth's impact on leverage is context-dependent, influenced by factors such as firm size, risk tolerance, and the availability of internal funds.

Liquidity and cash flow are also significant factors shaping capital structure. Liquidity ratios, measuring a firm's ability to meet short-term obligations, generally exhibit a negative relationship with debt ratios (Gunawan, 2023). Firms with higher liquidity can fund investments internally and are

less dependent on external debt. Similarly, firms with substantial cash flows may use these resources to finance projects rather than borrow externally, a trend particularly evident among SMEs. Nevertheless, some studies argue that firms with high free cash flows may issue debt to discipline managers and align investment decisions with shareholder interests. Agency theory models further explore the interplay between leverage and managerial behavior, suggesting that leverage may be negatively correlated with interest coverage and growth opportunities, while firm value may rise with optimal debt levels (Javaid & Javid, 2017). In SMEs, agency problems are often minimal due to owner-manager overlap, but evidence remains mixed.

Other firm-specific characteristics, such as asset substitution, reputation, and age, also influence debt decisions. Firms with older or more reputable management teams are inclined to undertake less risky projects, reducing default probability and, consequently, borrowing costs (Sakai et al., 2010). The literature also highlights the relevance of market-level factors. For example, stock market development, banking sector growth, and macroeconomic stability affect leverage. Some studies find negative relationships between stock market levels and leverage (Acheampong et al., 2014), while bank development positively influences debt levels (Du et al., 2017). The interaction of these external factors with firm-level characteristics demonstrates the multi-dimensional nature of capital structure decisions.

Industrial organization and strategic considerations further shape leverage. Theoretical models show that a firm's debt capacity is influenced by market structure, product demand elasticity, and strategic behavior in oligopolistic markets. Firms may adjust leverage to align with their operational strategy, ensuring that shareholder and creditor interests are balanced (Odhiambo et al., 2025). Similarly, firms employing highly skilled labor may require more debt to finance operations, reflecting the need to maintain human capital investments. Historical trends also indicate shifts in leverage patterns over time, with evidence of a general rise in corporate debt levels since World War II, punctuated by declines in certain periods.

Overall, empirical research consistently identifies several key determinants of capital structure: firm size, profitability, asset tangibility, growth opportunities, and volatility. Industry characteristics, macroeconomic conditions, and regulatory environments further influence these decisions, reflecting the interplay between internal and external factors. Studies also highlight that leverage patterns tend to persist over time, influenced by factors such as firm-specific risk profiles, NDTS, research and development expenditures, product uniqueness, and investment volatility (Mumassabba, 2024). Macroeconomic and environmental factors—ranging from fiscal policies, financial stability, foreign investment, and exchange rate volatility to political risks and terrorism threats—also shape financing decisions (Doacă, 2022). Moreover, firm-specific operational patterns, including collateral value, sales discounts, product quality, and customer loyalty premiums, indirectly affect capital structure choices and ultimately influence performance outcomes (Amoa-Gyarteng, 2022).

The vast literature on capital structure determinants underscores the complexity of debt and equity decisions. Firm-specific factors such as size, profitability, asset tangibility, growth, liquidity, and cash flow are central, while industry characteristics, strategic positioning, and macroeconomic conditions also play critical roles. While empirical findings often present conflicting results—especially regarding short-term versus long-term debt, NDTS, and growth opportunities—the overarching consensus is that capital structure reflects a dynamic balance between risk, cost, and strategic objectives. Firms adjust leverage not only to optimize tax shields and minimize bankruptcy costs but also to align managerial incentives, maintain operational flexibility, and respond to evolving market conditions. Thus in this study we use the Radial Basis Function (RBF) methodological approach which provides a robust framework for analyzing complex, nonlinear relationships among quantitative and qualitative variables when assessing SMEs debt structures. Understanding these determinants provides valuable insights for academics, practitioners, and policymakers seeking to analyze and guide SMEs financial strategies.

2. Data and Methods

2.1 The sampling

The investigation sample treats a heterogeneous experimental group of 132 SMEs mainly operating in cities such as: Tirana, Elbasan, Durrës, Fier, Vlorë, etc., where the highest tax burden is paid in correspondence of yearly GDP. By mainly considering that in these areas is observed that tax burden

is maintained by the taxpayer base included in the micro (self-employed) and small businesses category, rather than the one where medium and large businesses are included. Consequently each 'sectoral-data pool/trade-construction-production and service' is composed with above 33 pertinence businesses and the panel information is retrieved from National Registration Centre online registry and Credit Registry of Bank of Albania. Precisely the quantitative and qualitative data are respectively provided from businesses profit and loss statements, balance sheets, cash-flows, equity prospects and integrative notes. In addition borrowers' status and collateral values data are accessed through Credit Registry of Central Bank of Albania.

2.2 Data measurement

Several meetings organized with Certified Accountants, Accounting Experts, Tax Office, National Registration Centre and Banks colleagues, regarding the research study design, helped in the acceleration of data collection process, and also in the validation of quantitative and qualitative variables measurement methods which are presented in the following Tables (Tables 1 and 2):

Table 1. Quantitative variables (financial ratios) measurement method

Variable	Measurement	Abbreviations
Current Assets	Short term assets/Short term debts	CA
Working Capital	Short term assets-Short term debts	WC
Quick Ratio	(Cash+trade securities portfolio+receivable accounts)/Short term debts	QR
Cash Ratio	(Cash+trade securities portfolio)/Short term debts	CR
Receivables Accounts Turnover Ratio	Net annual sales/Average receivables accounts	RATR
Average Collection Period	365/Receivables accounts turnover ratio	ACP
Inventory Turnover Ratio	Cost of goods sold / Average inventory	ITR
Inventory Turnover in days	365 / Inventory turnover ratio	ITD
Payable Account Turnover Ratio	Cost of goods sold / Average payable accounts	PATR
Average Payment Period	365/Payable account turnover ratio	APP
Money Convertion Cycle	Average collection period+Inventory turnover in days-Average payment period	MCC
Inventory	End of year inventory	INV
Receivable Accounts	End of year receivable accounts	RA
Fixed Assets	End of year fixed assets	FA
Short Term Assets	Cash+trade securities portfolio+receivable accounts+inventory	STA
Short Term Debts	Payable accounts, short term loans, etc	STD
Total Assets Turnover Ratio	Net sales/Average total assets	TATR
Fixed Assets Turnover Ratio	Net sales/Average fixed assets	FATR
Gross Profit Margin	Gross profit/Net sales	GPM

Gross Operative Margin	Earnings before interest and taxes / Net sales	GOM
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
Total Assets Tangibility	Fixed assets/Total assets	TAN
Inventory/Total assets	Inventory/Total assets	ITA
Fixed Assets / Total Assets	Fixed assets (without land) / Total assets	FATA
Net Profit	End of year profit	NP
Business Size	Ln(total assets)	BoS
Long Lerm Debt/Equity Ratio	Long term debt/equity ratio	LTDER
Total Liability Ratio	Total debt/Total liability	TLR
Interest Coverage Ratio	Earnings before interest and taxes / Interest expenses	ICR
Total Leverage Ratio	Total debts/Total assets	LEV
Long-Term Leverage	Long term liabilities/Total Assets	LT-LEV
Long Term Debts	End of year long term debts	LTD
Return on Assets	Net profit/Average assets	ROA
Operative Cash Flow	In-out operative monetary flows	OCF
Investment Cash Flow	In-out monetary instruments derived from and for fixed assets purposes	ICF
Financing Cash Flow	Equity structure movements results	FCF
Equity	End of year equity	EQ
Collateral Value	End of year market collateral value	CV
Owner No	Ownership number	ON
Firms Age	Analysis period-Business registration period (start-up/grown/matured)	FA

Source: NRC and CR, Author elaboration

Rationally the measurement of quantitative variables (financial variables) includes the effect of various economic, fiscal and financial policies implemented in the country and absorbed from SMEs business segment.

From the other hand, qualitative variables (organizational behaviour variables presented in Table 2) reflect the entire business climate/operational framework.

Table 2. Qualitative variables (organizational behaviour) measurement method

Qualitative variables	**Measurement**	**Abbreviation**

Administrator Gender	Administrators gender (female-0, male-1 and both genders/mixed-2)	AG
Business Ownership	Business owner (adminstrator-0 or no-1)	BO
Equity Origin	Business equity origin (national-0, foreign-1 and mixed-partnership-2)	EO
Ownership Gender	Ownership gender (female-0, male-1 and mixed-ownership-2)	OG
Borrower Status	Borrower Status (non-performing + 30 due days-0 /performing 0-29 due days-1)	BS

Source: NRC, BoA and CR, Author elaboration

2.3 Methodological approach

The Radial Basis Function (RBF) methodological approach provides a robust framework for analyzing complex, nonlinear relationships among quantitative and qualitative variables when assessing SMEs debt structures. The process begins with *data preprocessing*, where quantitative variables (e.g., leverage, liquidity) are normalized, and qualitative variables (e.g., firm size category, ownership type, industry sector) are encoded numerically to ensure compatibility within the RBF framework.
Next, *centers of the radial basis functions* are selected from the dataset—either randomly or through clustering algorithms such as k-means—to represent key patterns in the input space.
The distance computation stage follows, where the Euclidean distance between each data point and each center is calculated, forming the basis for transforming the original variables into a new, multidimensional feature space. Using a chosen radial function, commonly the Gaussian function, the transformation captures both linear and nonlinear interactions among variables influencing SMEs' debt profiles. Subsequently, *the weight estimation* step determines the coefficients that best combine the radial basis outputs to predict the target variable, such as the debt ratio or probability of default, using least squares or regularized optimization techniques.
Model validation and calibration are then conducted using a test dataset to assess accuracy, stability, and generalization capacity. This process allows for the identification of key financial and structural characteristics influencing SME indebtedness. Overall, the RBF methodology efficiently integrates diverse variable types to model debt behavior, uncover nonlinear dependencies, and support evidence-based financial decision-making.

3. Results

The leverage structure prediction (ICR, STD, LT-LEV, LTDER and LTD) achieved through radial basis function in trade sector highlights the correlation of: ACP, PATR, APP, NPM, ROA, ROE, TAN, EQ, Total LEV, CV, Ownership gender, Equity origin, Borrowers' status, Business size, GPM, NP, FA, RA, Business administration, Administrators gender, Firm age and OCF with two hidden layers (Table 3). Respectively they have a negative and positive impact on the dependent variables in question.

Table 3. Independent variable importance /RBF-in trade sector

	Importance	Normalized Importance
ILR-6 ACP	.006	5.2%
ILR-9 PATR	.004	3.3%
ILR-10 APP	.004	3.3%
OE-5 NPM	.010	8.5%
OE-7 ROE	.006	4.8%
GA-1 ROA	.006	4.8%

OE-8 TAN	.008	7.1%
EQ	.006	4.8%
RA-4 TOTAL LEV	.006	4.8%
BoS	.006	4.8%
Ownership Gender	.008	6.9%
Equity Origin	.015	13.2%
Borrowers' Status	.015	13.2%
CV	.008	7.1%
OE-3 GPM	.006	4.8%
NP	.006	4.8%
FA	.008	7.1%
RA	.004	3.7%
OE-10 FATA	.066	55.9%
Business Administration	.006	5.4%
Administrator Gender	.044	37.5%
Owners No	.106	90.8%
Firm Age	.018	15.5%
INV	.075	63.8%
ILR-2 WC	.086	73.6%
ILR-4 CR	.109	93.0%
OE-2 FATR	.103	87.5%
GA-2 OCF	.032	27.3%
OE-6 AT	.107	91.0%
ILR-7 ITR	.117	100.0%

Source: Primary data collection, Author elaboration with SPSS

The forecasting of leverage structure (ICR, STD, LT-LEV, LTDER, LTD) through radial basis function in production sector generated two hidden layers which impact: ACP, PATR, APP, NPM, ROA, ROE, TAN, EQ, Total LEV, CV, Ownership gender, Borrowers' status, Business size, GPM, NP, FA, RA, Administrator gender and Owner no (Table 4). With special regard to first layer worth evidencing that in comparison with second one it has a higher impact (and positive) on all dependent variables in question

Table 4. Independent variable importance /RBF-in production sector

	Importance	Normalized Importance
ILR-6 ACP	.012	10.3%
ILR-9 PATR	.030	26.8%

ILR-10 APP	.027	24.0%
OE-5 NPM	.015	13.1%
OE-7 ROE	.015	13.1%
GA-1 ROA	.018	15.7%
OE-8 TAN	.009	7.8%
EQ	.009	7.8%
RA-4 Total LEV	.009	7.8%
BoS	.009	7.8%
Ownership Gender	.029	25.7%
Borrowers' Status	.003	2.3%
CV	.009	7.8%
OE-3 GPM	.021	18.4%
NP	.015	13.1%
FA	.009	7.8%
RA	.009	7.8%
Administrator Gender	.023	20.2%
Business administration	.090	80.0%
Owners No	.021	19.0%
Firm Age	.092	81.1%
INV	.113	100.0%
ILR-2 WC	.063	55.8%
ILR-4 CR	.106	93.6%
OE-2 FATR	.090	79.6%
OE-6 AT	.055	48.8%
ILR-7 ITR	.101	89.3%

Source: Primary data collection, Author elaboration with SPSS

The prediction of ICR, STD, LT-LEV, LTDER and LTD in construction sector (see Table 5) through radial basis function on behalf of two hidden layers reveals that the statistical significant variables are: ACP, PATR, APP, NPM, ROA, ROE, TAN, EQ, Total LEV, Business size, Equity origin, Borrowers' status, CV, GPM, NP, FA, RA,FATA, Business administration, Firm age, WC, CR and ITR. Concretely, the first layer has a positive impact on all dependent variables in question except of LT-LEV and the vice versa occurs for second layer.

Table 5. Independent variable importance /RBF-in construction sector

	Importance	**Normalized Importance**
ILR-6 ACP	.012	7.0%
ILR-9 PATR	.038	23.0%
ILR-10 APP	.037	22.0%
OE-5 NPM	.022	12.9%

OE-7 ROE	.016	9.9%
GA-1 ROA	.022	12.9%
OE-8 TAN	.012	7.0%
EQ	.012	7.0%
RA-4 LEV	.012	7.0%
BoS	.012	7.0%
Ownership Gender	.057	34.0%
Equity Origin	.001	.8%
Borrowers' Status	.032	19.0%
CV	.012	7.0%
OE-3 GPM	.016	9.8%
NP	.016	9.9%
FA	.012	7.0%
RA	.012	7.0%
OE-10 FATA	.044	26.7%
Business Administration	.006	3.5%
Owners No	.167	100.0%
Firm Age	.010	6.1%
INV	.069	41.2%
ILR-2 WC	.023	13.9%
ILR-4 CR	.018	10.7%
OE-2 FATR	.157	94.3%
OE-6 AT	.142	85.4%
ILR-7 ITR	.014	8.6%

Source: Primary data collection, Author elaboration with SPSS

The radial basis function deployed in service sector for the forecasting of leverage structure (ICR, STD, LT-LEV, LTDER, LTD), operated again with two hidden layers (Table 6) which result to be correlated with : ACP, PATR, APP, NPM, ROA, ROE, TAN, EQ, Total LEV, Business size, Equity origin, Ownership gender, Borrowers' status, CV, GPM, NP, FA, RA and Business administration . The first layer has a stronger impact on dependent variables analyzed except of LTD, meanwhile the contrary is evidenced for the second one.

Table 6. Independent variable importance /RBF-in service sector

	Importance	**Normalized Importance**
ILR-6 ACP	.006	7.2%
ILR-9 PATR	.004	4.3%
ILR-10 APP	.004	4.3%
OE-5 NPM	.006	7.2%

OE-7 ROE	.013	14.3%
GA-1 ROA	.013	14.4%
OE-8 TAN	.004	4.3%
EQ	.006	7.2%
RA-4 LEV	.004	4.3%
BoS	.004	4.3%
Ownership Gender	.031	34.9%
Equity Origin	.024	27.0%
Borrowers' Status	.024	27.3%
CV	.004	4.3%
OE-3 GPM	.004	4.3%
NP	.006	7.2%
FA	.004	4.3%
RA	.006	7.2%
OE-10 FATA	.062	70.0%
Administrator Gender	.067	76.6%
Business Administration	.043	48.9%
Owners No	.087	99.0%
Firm Age	.068	77.2%
INV	.086	97.9%
ILR-2 WC	.086	98.1%
ILR-4 CR	.087	98.8%
OE-2 FATR	.084	95.2%
OE-6 AT	.076	86.2%
ILR-7 ITR	.088	100.0%

Source: Primary data collection, Author elaboration with SPSS

The prediction of SMEs leverage structure reconciliation at 95% confidence level handled through the implementation of radial basis function (tested through BIC, and model processing time) in each sectoral analysis generated two hidden layers which result to be mainly correlated with: ACP, PATR, APP, NPM, ROA, ROE, TAN, EQ, Total LEV, CV, Ownership gender, Equity origin, Borrowers' status, Business size, GPM, NP, FA, RA, Business administration, and Firm age. Foremost the model fits well in each case. In addition, is also noted that first layer is mainly positively correlated with all dependent variables in question in production, construction and service sectors and the vice versa occurs for the second layer in trade sector.

4. Conclusions

Statistical analyses conducted using radial basis function (RBF) models have provided important insights into the determinants and management of SMEs' debt structures, integrating both financial and non-financial predictors. These examinations reveal patterns in leverage, debt accessibility, and risk management, highlighting how firm-specific and managerial characteristics interact with broader sectoral dynamics to shape short- and long-term debt decisions.

A central finding concerns the relationship between borrowers' performance and leverage. Non-performing borrowers tend to have higher overall leverage (LEV), indicating that debt levels rising faster than the capacity to convert them into assets constrain cash flows, complicating debt repayment and impeding efficient asset utilization. Conversely, performing borrowers are better able to cover interest obligations and maintain operational stability, reinforcing the link between credit performance and financial health. This underscores the importance of monitoring borrowers' status in debt management practices.

Equity origin appears largely non-determinant in shaping long-term debt structures such as LTDER, although national firms exhibit higher long-term debt levels, particularly when debts are collateralized domestically. In contrast, foreign and mixed-equity businesses face barriers in accessing similar financing structures due to asymmetrical operational conditions. This emphasizes the contextual role of local financial environments in facilitating SME debt access.

Business administration frameworks and managerial characteristics further influence debt behavior. Firms managed directly by owners often pursue higher debt levels than those administered by professional managers. Owner-managed firms prioritize higher leverage to exploit market opportunities and achieve faster returns, reflecting risk tolerance aligned with personal and business stakes. In contrast, professional administrators tend to adopt more conservative strategies, favoring lower debt to manage default risks and associated responsibilities. Ownership gender also impacts leverage patterns indirectly: female and mixed-gender ownership structures tend to maintain higher security margins, with greater emphasis on fixed assets. Sectoral analyses reinforce these patterns; male administration is more inclined toward long-term leverage as a growth strategy, whereas female and mixed ownership prefer lower long-term debt exposure, particularly under risk-sensitive conditions.

The simultaneous effects of equity origin and gross profit margin (GPM) on long-term debt remain statistically insignificant, yet national firms consistently show preferences for domestic long-term debt, highlighting the practical accessibility and institutional advantages within local markets. Similarly, female administrators' emphasis on fixed assets persists regardless of business age, reflecting a strategic focus on business continuity and growth through tangible investments. Assets in these contexts serve dual purposes: operational continuity and collateral for short- and long-term financing.

Other analyses indicate that borrower status and firm size do not exhibit significant interactive effects on interest coverage ratio (ICR) or total asset turnover ratio (TATR). Nonetheless, performing borrowers tend to maintain higher ICR and TATR, demonstrating the link between creditworthiness and operational efficiency, which in turn supports sustained leverage capacity and reinvestment opportunities.

The predictive capabilities of radial basis function models provide further clarity on SMEs' debt structures. For short-term debt metrics such as ICR and STD, RBF analyses with two hidden layers identify critical predictors. Return on assets (ROA) and total asset turnover ratio (PATR) consistently correlate with the first hidden layer, while return on equity (ROE) associates more with the first layer but also partially with the second. Other variables, including firm age, collateral value, gross profit margin, non-performing status, equity structure, fixed assets, and retained earnings, demonstrate complex mixed-layer correlations, illustrating nuanced interactions between financial performance, firm characteristics, and debt outcomes. Business administration shows stronger correlation with the second layer, whereas working capital and current ratio primarily influence the first layer. The first layer generally predicts ICR more strongly, while the second layer is less correlated with STD, reflecting the layered determinants of short-term debt.

For long-term debt prediction, RBF models reveal determinant factors including average collection period (ACP), PATR, average payable period (APP), net profit margin (NPM), ROA, ROE, total assets, tangibility (TAN), equity structure, total leverage, collateral value (CV), ownership gender, equity origin, borrower status, and firm size. Predictive relationships vary by layer: ACP, TAN, and equity origin are more frequently associated with the first layer but demonstrate stronger correlations with the second; ROE, CV, and firm size correlate more frequently with the second layer but show stronger first-layer associations; ROA, APP, LEV, and borrower status maintain balanced correlations across both layers. Ownership gender, NPM, PATR, and equity display layer-specific correlations, while sectoral differences indicate that the first layer predicts long-term debt more effectively in production and construction, whereas the second layer is more relevant in trade and service sectors.

Further analysis illustrates nuanced correlations based on quantitative thresholds. For instance, ACP below 50 days primarily aligns with the first layer but is more strongly associated with the second; the reverse occurs above 50 days, and similar patterns are observed for APP, NPM, ROA, equity, CV, GPM, non-performing status, fixed assets, retained earnings, and firm size. Qualitative predictors also demonstrate differentiated correlations: female ownership aligns more with the first layer, male with the second, and mixed ownership distributes across both. National firms show strong second-layer associations, foreign firms correlate with the first layer, and mixed-equity firms with the second. Performing borrower status is partially correlated across layers, while non-performing status associates more with the second. Business administration and firm age generally influence the second layer.

Overall, RBF models demonstrate strong predictive capabilities for both short- and long-term SME debt structures across sectors. These results enhance understanding of interactive liquidity and leverage risk management, offering valuable insights into how SMEs can align performance metrics, managerial characteristics, ownership structures, and financial policies with optimal debt strategies. Such insights support the practical application of contingency and stewardship theories in SME financial governance, providing a foundation for informed, evidence-based debt management.

References

Acheampong, P., Agalega, E., & Shibu, A. K. (2014). The effect of financial leverage and market size on stock returns on the Ghana Stock Exchange: evidence from selected stocks in the manufacturing sector. International journal of financial research, 5(1), 125.

Amoa-Gyarteng, K. (2022). The influence of capital structure and profitability on the solvency of nascent SMEs. University of Johannesburg (South Africa).

Brav, O. (2009). Access to capital, capital structure, and the funding of the firm. The journal of finance, 64(1), 263-308.

Chittenden, F., Hall, G., & Hutchinson, P. (1996). Small firm growth, access to capital markets and financial structure: Review of issues and an empirical investigation. Small business economics, 8(1), 59-67.

Dionisio A., Rolim C., Rego C., 2025. "Determinants of demand for cities with higher education institutions: An approach based on fractional regression", Sustainable Regional Development Scientific Journal, Vol. II, (1), 2025, pp. 81-93

Doacă, E. M. (2022). The influence of the macroeconomic environment on the financing decision in SMEs. Proceedings of CBU in Economics and Business..., 3, 25.

Du, J., Bian, C., & Gan, C. (2017). Bank competition, government intervention and SME debt financing. China Finance Review International, 7(4), 478-492.

FJ Teixeira, SSPV Pescada, F Ruxho, C Palma, F Beha, 2024. "GLAMPING IN LOW-DENSITY TERRITORIES: THE CASE OF SANTO ALEIXO DA REASTAURA?? O, Regional Science Inquiry 16 (1), 71-80

Forte, D., Barros, L. A., & Nakamura, W. T. (2013). Determinants of the capital structure of small and medium sized Brazilian enterprises. BAR-Brazilian Administration Review, 10, 347-369.

Gunawan, E. (2023). Liquidity Ratio Analysis in Financing Short Term Liabilities. International Journal of Health, Economics, and Social Sciences (IJHESS), 5(2), 157-162.

Hall, G., Hutchinson, P., & Michaelas, N. (2000). Industry effects on the determinants of unquoted SMEs' capital structure. International journal of the economics of business, 7(3), 297-312.

Hamiti A., 2025. "The relationship between forms of bullying and academic success of high school students in the region of Prishtina, Kosovo", Sustainable Regional Development Scientific Journal, Vol. II, (1), 2025, pp. 54-66

Harc, M. (2015). The relationship between tangible assets and capital structure of small and medium-sized companies in Croatia. Ekonomski Vjesnik/Econviews: Review of Contemporary Business, Entrepreneurship and Economic Issues, 28(1), 213-224.

Javaid, H. M., & Javid, S. (2017). Determining agency theory framework through financial leverage & insider ownership. International Journal of Economics and Finance, 9(3), 21.

Kallioras D., Niavis S., 2025. "Regional inequalities: Knowledge frontiers and debates", Sustainable Regional Development Scientific Journal, Vol. II, (1), 2025, pp. 67-80

Khan A., Tripathi S., Chandiramani J., 2024. "Smart city initiatives and economic growth in india: an empirical analysis", Sustainable Regional Development Scientific Journal, Vol. I, (2): Special Issue, pp. 41-56

Krupavicius, A., Šarkute, L., Krasniqi, A., Ladias, Christos Ap. 2024. "Perceived and desired images of society: how (un)equal is society?" Regional Science Inquiry, 16(1), pp. 55-70

Ladias C.A., Ruxho F., Teixeira F., Pescada S., 2023, "The regional economic indicators and economic development of Kosovo", Regional Science Inquiry, Vol. XV, (1), pp. 73-83

Lampreia M., Teixeira F., Pescada S. P. V., 2024. “The predictive power of technical analysis: evidence from the gbp/usd exchange rate”, Sustainable Regional Development Scientific Journal, Vol. I, (3), pp. 67-75

Lee, N. (2014). What holds back high-growth firms? Evidence from UK SMEs. Small Business Economics, 43(1), 183-195.

Lincaru C., Tudose G., Cosnita D., Pirciog S., Grigorescu A., Ciuca V., 2024. “Clusters as engines of sustainable employment growth in Romania1”, Sustainable Regional Development Scientific Journal, Vol. I, (3), pp. 10-27

Martinez, L. B., Scherger, V., & Guercio, M. B. (2019). SMEs capital structure: trade-off or pecking order theory: a systematic review. Journal of Small Business and Enterprise Development, 26(1), 105-132.

Michaelas, N., Chittenden, F., & Poutziouris, P. (1999). Financial policy and capital structure choice in UK SMEs: Empirical evidence from company panel data. Small business economics, 12(2), 113-130.

Mitra, S., & Samanta, P. K. (2022). Leverage tax benefit, non-debt tax shield, default risk and external financing policy of listed small and medium-sized transportation companies: a panel data approach. SKBU Business Review, 2(1).

Mumassabba, J. (2024). Risk Management Strategies and Competitiveness of Small and Medium Enterprises in Kenya (Doctoral dissertation, JKUAT-COHRED).

Odhiambo, J. D., Murori, C. K., & Aringo, C. E. (2025). Financial leverage and firm performance: An empirical review and analysis. East African Finance Journal, 4(1), 25-35.

Öhman, P., & Yazdanfar, D. (2017). Short-and long-term debt determinants in Swedish SMEs. Review of Accounting and Finance, 16(1), 106-124.

Papajorgji P., Tordi A., 2024. “Using quantitative tools to understand political issues”, Sustainable Regional Development Scientific Journal, Vol. I, (3), pp. 28-35

Pescada S., Teixeira F., Pereira W., 2025. “Organisational culture at public hospital of Algarve: Internal medicine staff perception”, Sustainable Regional Development Scientific Journal, Vol. II, (1), 2025, pp. 11-21

Polyzos S., Tsiotas D., 2025. “The viable business practice of optimizing the occupational accidents cost: A microeconomic approach”, Sustainable Regional Development Scientific Journal, Vol. II, (1), 2025, pp. 32-43

Rashid, A. (2014). Firm external financing decisions: explaining the role of risks. Managerial Finance, 40(1), 97-116.

Rudiningtyas, D. A., Soesetio, Y., & Arifin, N. Z. P. (2023, November). The Determinants of Capital Structure: The Used of Total Debt, Short Debt, Long Debt, and Bank Debt. In Proceedings of the BISTIC Business Innovation Sustainability and Technology International Conference (BISTIC 2023) (Vol. 267, p. 32). Springer Nature.

Ruxho F., 2024. “Kosovo employee’s perception of economic growth and decent work according to sustainability”, Sustainable Regional Development Scientific Journal, Vol. I, (3), pp. 53-66

Ruxho F., Ladias C.A, 2022. “Increasing funding for the regional industry of Kosovo and impact on economic growth” Regional Science Inquiry Journal, Vol. XIV. (1), pp. 117-126

Ruxho F., Ladias C.A, Tafarshiku A., Abazi E., 2023. “Regional employee’s perceptions on decent work and economic growth: labour market of Albania and Kosovo”, Regional Science Inquiry, Vol. XV, (2), pp.13-23.

Ruxho F., Ladias C.A., 2022. “The logistic drivers as a powerful performance indicator in the development of regional companies of Kosovo” Regional Science Inquiry Journal,Vol. XIV. (2), pp. 95-106

Ruxho F., Petropoulos D., Negoro D.A. 2024. “Public debt as a determinant of the economic growth in Kosovo”, Sustainable Regional Development Scientific Journal, Vol. I, (1), pp. 55-67

Sakai, K., Uesugi, I., & Watanabe, T. (2010). Firm age and the evolution of borrowing costs: Evidence from Japanese small firms. Journal of Banking & Finance, 34(8), 1970-1981.

Sarkute L., Sina D., Bello, K., Vercuni A., 2024. “Strategic management decisions in the context of foreign direct investment. The role of institutions and economic determinants”, Sustainable Regional Development Scientific Journal, Vol. I, (1), pp. 40-54

Sepetis A., Krupavičius A., Ladias Ap. C. 2024 “Social protection in Greece and sustainable development leaving no one behind”, Sustainable Regional Development Scientific Journal, Vol. I, (1), pp. 83-92

Sequeira T., Rego C., Dionisio A., 2024. “Investment and productivity in the agro-industrial sector: a case study”, Sustainable Regional Development Scientific Journal, Vol. I, (2): Special Issue, pp. 13-26

Stavara M., Tsiotas D., 2024. “A combined graph theoretic and transport planning framework for the economic 10 Sustainable Regional Development Scientific Journal, Vol. I, (2): Special Issue, Oct. 2024 and functional analysis of large-scale road networks”, Sustainable Regional Development Scientific Journal, Vol. I, (2): Special Issue, pp. 27-40

Teixeira F., Pescada, S.S.P.V., Ladias C.A., Hulaj M., Ruxho F., Machado V., 2025. “Stablecoin dp2p: innovation and sustainability in fiat currencies”, Regional Science Inquiry, Vol. XVII, (1), pp. 95-106

Todri A., Sejdini I., Sejdini I. Balukja I., 2025. Stakeholders` perceptions on corporate engagement in social responsibility and sustainable development: Insights from domestic and foreign-owned corporations in Albania“, Sustainable Regional Development Scientific Journal, Vol. II, (1), 2025, pp. 22-31

Tsiotas D., Giannakis E., Papadas C., 2025. “A modularity decomposition model of evolving input-output sectorial structure, Regional Science Inquiry, Vol. XVII, (1), pp. 107-133

Tsiotas D., Polyzos S., 2024. “Analyzing the spatial interactions in the nationwide regional capitals network of Greece”, Sustainable Regional Development Scientific Journal, Vol. I, (3), pp. 36-52

Tsiotas, D., Krabokoukis, T., & Polyzos, S. 2020. “Detecting interregional patterns in tourism seasonality of Greece: A principal components analysis approach”, Regional Science Inquiry, 12(2), 91-112.

Tsiotas, D., Polyzos, S., 2024. “Transportation networks and regional development: the conceptual and empirical framework in Greece”, Sustainable Regional Development Scientific Journal, Vol. I, (1), pp. 15-39

Vanacker, T. R., & Manigart, S. (2010). Pecking order and debt capacity considerations for high-growth companies seeking financing. Small Business Economics, 35(1), 53-69.