

An econometric analysis of the Greek wine industry's performance determinants

International
Journal of Wine
Business
Research

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Received 28 November 2025

Revised 25 May 2026

14 August 2026

Accepted 16 August 2026

Abstract

Purpose – This study aims to investigate the key determinants of firm performance in the Greek wine sector. The analysis focuses on firms' balance sheet structure and operational characteristics, emphasizing liquidity conditions, debt composition, working capital management, investment activity and firm-specific attributes.

Design/methodology/approach – This study uses panel data from 67 Greek wineries (2013–2024) to analyze profitability via return on assets. The model incorporates internal determinants, including liquidity, debt structure (short/long-term), working capital, capital expenditure, size and age, applying a one-year lag to financing and investment variables to account for delayed impacts. Estimation is performed using pooled ordinary least squares and random effects models, supported by diagnostic tests to ensure robustness.

Findings – The analysis reveals that liquidity, debt (short- and long-term), efficient working capital management and investment activity all significantly boost firm performance. Notably, long-term debt shows a stronger positive impact on ROA than short-term debt, emphasizing the importance of strategic financing for long-term growth. Conversely, firm size is negatively correlated with performance, pointing toward diseconomies of scale or increased coordination costs in large operations. Profitability is driven primarily by financial metrics rather than the length of time a firm has been operating.

Originality/value – This research contributes to the literature on the Greek wine industry, presents empirical data on the factors that shape business performance and supports the design of effective strategies and policies.

Keywords Firm performance, Panel data, Wine industry, Wineries, Financial structure, Working capital management, Liquidity, Greece

Paper type Research paper



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International Journal of Wine
Business Research

Emerald Publishing Limited

1751-1062

DOI 10.1108/IJWBR-11-2025-0082

1. Introduction

The wine sector is one of the most important agri-food industries worldwide, combining agricultural production with processing, marketing, tourism and cultural heritage. In recent decades, it has undergone significant changes in consumption patterns and international trade ([Annunziata et al., 2018](#)), accompanied by technological modernization and an increasing emphasis on sustainability, environmental performance and product diversification ([Adam et al., 2026](#); [Galbreath, 2017](#); [Pliakoura et al., 2024a](#); [Pomarici and Vecchio, 2019](#)). These developments reflect a broader transition toward higher-value and more sustainable production systems.

The emergence of new wine-producing countries has further intensified global competition, with firms adopting product-oriented strategies aligned with evolving consumer preferences ([Castillo et al., 2016](#)). Although Europe remains dominant in production and exports, New World producers increasingly shape a dynamic and highly competitive global environment ([Anderson et al., 2017](#); [OIV, 2025](#)).

The global wine market is projected to reach US\$362.41bn in 2025 and US\$424.56bn by 2030, with an annual growth rate of 3.22% ([Statista, 2024](#)). Despite declining overall production volumes, demand for high-quality wines remains strong. Global wine production fell by 5% in 2024 relative to 2023 due to adverse climatic conditions, including droughts and irregular rainfall ([OIV, 2024](#)). At the same time, the COVID-19 pandemic accelerated digitalization, driving a sharp increase in online wine sales.

The global wine market is increasingly shifting from volume-oriented consumption toward higher-quality products. Consumers are increasingly interested in wines with clear local origins, produced through sustainable methods and characterized by a strong identity. Effective product positioning and branding therefore play an important role ([Pomarici and Vecchio, 2019](#)), while climate change, rising production costs and supply chain disruptions pose significant challenges that require firms to adapt their strategies to maintain resilience and competitiveness ([Piña-Rey et al., 2020](#); [OIV, 2025](#)). The evolution of the economic and environmental context further requires the adaptation and optimization of business practices to support competitive strategies ([Coulon-Leroy et al., 2012](#)).

Europe holds a dominant position in the global wine market, although it has recently lost ground to New World producers such as Chile, Australia, South Africa and Argentina. The European Union accounts for around 44% of the world's vineyard area and remains the global leader in wine production, with France, Italy and Spain as the main producers, followed by Germany, Portugal, Romania, Hungary, Austria and Greece ([Wine Institute, 2024](#)). The European wine model is largely based on family-run firms closely embedded in local socioeconomic structures ([Anderson and Pinilla, 2018](#)). The market is highly fragmented, and understanding the drivers of profitability is crucial for firms to adjust production and quality strategies, thereby enhancing sales and market share ([Anderson et al., 2017](#); [Weatherbee et al., 2019](#)). The declining number of wine firms alongside increasing industry concentration further highlights the need for strategic adaptation to changing market conditions ([Chatzitheodoridis et al., 2012](#); [Kalogiannidis et al., 2022](#)). Ensuring long-term profitability and competitiveness therefore remains a central objective for wine producers ([Flores, 2018](#); [Ferrer et al., 2023](#)).

Greece is one of the oldest countries in wine production. The 1960s marked the beginning of modernization, with large companies investing in the sector, leading to an increase in trade. The sector in Greece consists of a small number of large wineries and a much larger number of small and medium-sized wineries and agricultural cooperatives ([Kontogeorgos et al., 2014](#); [Mavrommati and Pliakoura, 2025b](#)). The large companies cover the entire territory, while the smaller companies mainly serve the local market. A small number of

small and medium-sized companies produce “limited production” wines with special characteristics. The wine sector is among the most dynamic sectors of the Greek agri-food economy, emphasizing quality improvement, exports and the strategic strengthening of its commercial identity (Anderson and Pinilla, 2018). The main advantage is the domestic varieties, which are observed as the largest percentage in both the mainland and island regions due to the climatic conditions prevailing in the Mediterranean region (Charters and Spielmann, 2014).

Large firms in the Greek wine sector are strongly export-oriented, with main destination markets including Germany, the USA, Italy, the UK, Cyprus and Canada (Euromonitor International, 2025; Wine Institute, 2024). The sector is characterized by high self-sufficiency, resulting in low import penetration. Wine production is geographically concentrated, with Attica accounting for 19.8% of output, followed by Peloponnese (16.0%) and Central Macedonia (11.1%), while South Aegean and East Macedonia and Thrace record the lowest shares (7.4%). Wine demand is influenced by price, disposable income, consumption habits, seasonality and tourism development. Over the past two decades, Greek wines have strengthened their international presence by emphasizing indigenous grape varieties, improving production standards and responding to growing global demand for distinctive, high-quality products.

According to the European Commission (2023), Greek wine production exhibits significant volatility, as evidenced by a 13.86% decline during the 2022–2023 period. This production instability is interpreted in the context of broader global developments, where wine markets are increasingly driven by value rather than volume. The observed fluctuations reflect long-standing structural challenges, including land fragmentation, inadequate irrigation systems and an aging workforce, which are further exacerbated by climate change. This pattern is consistent with wider trends observed in Southern Europe, where extreme weather conditions affect both yield levels and grape quality (OIV, 2024). Production instability does not necessarily contradict the growing global demand for high-quality wines but rather highlights the increasing complexity of maintaining competitiveness under changing environmental and economic conditions. These conditions increase uncertainty for wine producers and reinforce the importance of effective financial and operational management in sustaining profitability and competitiveness.

The Greek wine sector is a key pillar of regional economic development, especially in regions such as Macedonia, Peloponnese and Crete among others (Kontogeorgos *et al.*, 2017; Kalogiannidis *et al.*, 2024). In these regions, wine production is closely linked to rural employment, agrotourism and local identity. The sector in Greece has been characterized by dynamic renewal driven by the exploitation of indigenous grape varieties and the adoption of innovative winemaking techniques (Chatzitheodoridis and Kontogeorgos, 2020; Pliakoura *et al.*, 2024b). The wine industry contributes significantly to Greek tourism and Greek cultural promotion.

This study reviews the literature on wine business performance determinants. Analyzing panel data from 67 Greek wine-producing firms (2013–2024), it highlights how financial structure, liquidity, working capital and investment activity shape profitability, sustainability and competitiveness.

The study is organized as follows: Section 2 reviews the literature, while Section 3 details the methodology. Section 4 analyzes empirical results, followed by a discussion in Section 5. Finally, Section 6 concludes with the study’s findings and strategic implications.

2. Literature review

The wine industry is a key sector for many national economies, contributing significantly to employment and income (Karafolas, 2007; Neves *et al.*, 2022; Ruiz Estrada *et al.*, 2020;

Vlachos, 2017). As firms are central to value creation, managers focus on enhancing competitiveness and improving resource allocation to strengthen performance (Colbran *et al.*, 2019; Donzé and Katsumata, 2022; Mavrommati and Pliakoura, 2025b; Santini *et al.*, 2013). In Greece, the wine sector operates under intense competition, making an effective regulatory framework essential for supporting its growing international presence. At the same time, quality improvement and market expansion are driven by private investment and public policies promoting exports and sustainable production.

The analysis of wine industry performance has adopted both quantitative and qualitative approaches. This study proposes a model for evaluating the performance of wine companies, as an alternative tool for analyzing profitability in the industry. The present study investigates the key factors that determine performance in the industry and explores how these factors shape the profitability and competitiveness of Greek wine companies (Behmiri *et al.*, 2019; Candeias and Dias, 2023; Dodds *et al.*, 2013; Karelakis *et al.*, 2008; Mavrommati and Pliakoura, 2025a). According to the industrial organization theory, firm performance, market performance and profitability are recognized as key dimensions of competitiveness and sectoral efficiency (Georgopoulos and Glaister, 2018; Goddard *et al.*, 2005; Karakitsiou *et al.*, 2004; Karakitsiou and Mavrommati, 2009; Neves *et al.*, 2022; Vieira *et al.*, 2019; Wittwer and Anderson, 2001).

Business performance is commonly measured using indicators such as return on assets (ROA), return on equity (ROE), Tobin's Q and sales growth (Siddiqui, 2015). Sales growth is often viewed as a key indicator due to its link with financial outcomes and long-term sustainability (Abor, 2005; Bava and Gromis di Trana, 2016; Brush *et al.*, 2000; Georgopoulos and Glaister, 2018; Lee *et al.*, 2020; Karakitsiou and Mavrommati, 2009; Neves and Branco, 2020; Soesetio *et al.*, 2023; Vrontis *et al.*, 2011). However, firm performance is more consistently assessed using profitability measures such as ROA and ROE. Given the focus of this study, the analysis emphasizes ROA as the primary performance indicator. ROA is widely regarded as a robust measure of managerial efficiency and resource utilization, as it captures firms' ability to generate profits from their asset base (Khan and Subhan, 2019; Lee *et al.*, 2016; Mavrommati and Papadopoulos, 2005; Simon Elorz and Castillo Valero, 2022), making it particularly suitable for intra-industry analysis. Firm performance depends on the ability to adapt to market structures and develop effective competitive strategies under changing economic conditions (Amadiou and Viviani, 2010; Amato and Amato, 2004; Colbran *et al.*, 2019; Faria *et al.*, 2020; Mavrommati *et al.*, 2021; Žiković *et al.*, 2025). Through systematic monitoring of key performance indicators such as profitability, efficiency and productivity, firms can strengthen their competitive position and support long-term sustainability.

Key determinants of firm performance include financing structure, reflected in the composition of short- and long-term debt, working capital intensity and cost structures, all of which directly influence profitability (Aytac *et al.*, 2020; Goddard *et al.*, 2005; Mavrommati *et al.*, 2021; Neves *et al.*, 2022; Nguyen Huynh, 2022; Vieira *et al.*, 2019; Voulgaris and Lemonakis, 2013). Efficient working capital management is particularly important in inventory-intensive industries, as poor management of short-term assets and liabilities increases financing costs and restricts operational flexibility. Seminal evidence by Deloof (2003) documents a negative relationship between the cash conversion cycle and profitability, while more recent studies highlight the role of working capital as a financial buffer enhancing resilience during periods of market instability (Fazzini and Russo, 2014; Legenzova *et al.*, 2025; Neves *et al.*, 2023; Siddiqui, 2015). Although debt financing can support performance by facilitating production and investment during growth phases,

excessive leverage increases financial vulnerability, particularly under adverse economic conditions or rising interest rates (Neves *et al.*, 2022; Vieira *et al.*, 2019).

In addition to financing structure and working capital management, investment activity constitutes a key determinant of firm performance, particularly in capital-intensive industries such as wine production. Capital expenditures reflect firms' strategic decisions to upgrade production capacity, improve quality and enhance operational efficiency. Although investment projects may initially exert pressure on financial results, their positive effects on productivity and profitability typically materialize over time, justifying the use of lagged investment indicators in empirical analyses (Amadiou and Viviani, 2010; Migliaccio and Tucci, 2019; Singh and Bagga, 2019).

Firm size and age are key determinants of firm performance, as they relate to economies of scale, organizational structure and market power. In profitability studies, size is typically proxied by total assets (Georgopoulos and Glaister, 2018; Nguyen Huynh, 2022; Vieira *et al.*, 2019; Voulgaris and Lemonakis, 2013). However, evidence from the wine industry indicates that the size–profitability relationship is not uniformly positive, as larger wineries may face coordination costs and reduced flexibility (Sellers and Alampi-Sottini, 2016; Žiković *et al.*, 2025). Firm age reflects accumulated experience but does not necessarily enhance performance without continuous adaptation and investment (Bava and Gromis di Trana, 2016; Faria *et al.*, 2020; Andonova and Ruíz-Pava, 2016).

Overall, this study examines these determinants to provide insights into profitability and competitive advantage in Greek wineries. Table 1 summarizes the relevant empirical evidence.

3. Data and methodology

This study examines the determinants of the profitability of 67 Greek wine companies for the period 2013–2024, covering 85% of the national market. By using a panel data econometric framework in Stata 17, the analysis captures unobserved heterogeneity and controls for time-invariant characteristics that cross-sectional data often overlook. This approach leverages the dual-dimensionality of the data set to yield more efficient estimates while mitigating the risk of omitted variable bias (Baltagi, 2008; Wooldridge, 2010). Return on assets (ROA) is used as the main performance indicator, while explanatory variables include liquidity, debt structure (short-term/long-term), working capital intensity, investments (CAPEX), size and age of the company, with some variables introduced with a one-year lag to capture temporal effects. The analysis is based on data from ICAP Hellas and includes the estimation of pooled OLS, fixed and random effects models, with the Hausman (1978) test confirming the suitability of the random effects model for drawing the final conclusions.

The following econometric model is used to estimate firm performance in the Greek wine industry.

$$\begin{aligned} \text{ROA}_{it} = & c_i + b_1 \text{CR}_{it} + b_2 \text{STDEBT}_{it-1} + b_3 \text{LTDEBT}_{it-1} + b_4 \text{CAP}_{it-1} + b_5 \text{CAPEX}_{it-1} \\ & + b_6 \text{LSIZE}_{it} + b_7 \text{AGE}_{it} + u_{it} \end{aligned}$$

where i refers to cross-sections and t refers to time periods, where u_{it} is an error term.

3.1 Description of variables and theoretical justification

The dependent variable is return on assets (ROA_{it}), defined as the ratio of net income to total assets. ROA measures how efficiently firms use their asset base to generate profits and is widely recognized as a robust indicator of corporate profitability. Given the study's focus on

Table 1. Comparative evidence on financial drivers of wine firms’ profitability

Study	Country / sector	Data and methodology	Key variables	Main findings	Gap / limitation
Aytac <i>et al.</i> (2020)	France / wine industry	Panel data; GMM	CCC, ROA, leverage	Working capital negatively affects profitability	No investment variables or broader financial structure analysis beyond working capital management
Fazzini and Russo (2014)	Italy / wine industry	Financial ratio analysis	Ownership structure, profitability	Investor-owned firms outperform cooperatives	No explicit working capital analysis or debt structure decomposition
Bava and Gromis di Trana (2016)	Italy (piedmont) / wine industry	Regression analysis	Exports, firm size, profitability	Exports and size positively affect profitability	No working capital, investment or dynamic specification
Sellers and Alampi-Sottini (2016)	Italy / wine industry	Parametric and non-parametric analysis	Firm size, productivity, profitability	Larger wineries perform better	No working capital or debt structure analysis
Migliaccio and Tucci (2019)	Italy / wine industry	Balance-sheet and ratio analysis	Assets, capital structure, performance	Financial structure shapes performance	Limited dynamic specification and no working capital management analysis
Silva Faria <i>et al.</i> (2020)	Portugal / wine industry	Panel data; FE, 2SLS, GMM	Firm characteristics, performance	Firm-specific factors drive performance	No explicit working capital or investment dynamics
Neves <i>et al.</i> (2022)	Portugal and Spain / wine industry	Panel data; systems GMM	ROA, sales growth, firm factors	Firm-level determinants are significant	Limited focus on working capital and no joint analysis of financial structure and investment dynamics
Candeias and Dias (2023)	Old world (Portugal) / wine industry	Panel data; ANN	CCC components, profitability	Non-linear WC-profitability relationship	No debt structure decomposition or investment variables
Žiković <i>et al.</i> (2025)	Europe (14 countries) / Wine industry	Dynamic panel models	Firm size, debt, investment	Investment boosts SME profitability	No integrated analysis of working capital, debt structure and investment dynamics
Current study	Greece / wine industry	Panel data (2013–2024); OLS, FE, RE	WC, debt structure, CAPEX, size, age	Integrated effects on profitability and resilience	—

Source(s): Authors’ own creation

firm performance, ROA and its determinants are emphasized, in line with extensive empirical literature on firm performance and sector-specific studies in agrifood and wine industries (Bottazzi *et al.*, 2008; Karelakis *et al.*, 2008; Aytac *et al.*, 2020).

The independent variable CR_{it} (current ratio) is defined as the ratio of current assets to current liabilities and measures firms' short-term liquidity and ability to meet current obligations. A higher current ratio reflects stronger liquidity and lower financial distress risk (Vieira *et al.*, 2019; Neves and Branco, 2020). Empirical evidence consistently reports a positive relationship between liquidity and firm performance, as adequate liquidity enhances operational flexibility and reduces constraints (Goddard *et al.*, 2005; Voulgaris and Lemonakis, 2013). This relationship is particularly relevant for the wine industry, given its pronounced seasonality, inventory accumulation and storage requirements.

Short-term debt ($STDEBT_{it}$) is measured as the ratio of current liabilities to total assets and captures firms' reliance on short-term external financing. High short-term indebtedness may increase financial vulnerability through refinancing risk, interest rate fluctuations and liquidity pressure, potentially constraining profitability. At the same time, short-term debt can support working capital needs, inventory management and production cycles, particularly in seasonally exposed sectors such as wine production. Consequently, its impact on profitability is theoretically ambiguous and depends on firms' financial management practices and access to credit markets (Goddard *et al.*, 2005; Vieira *et al.*, 2019; Nguyen Huynh, 2022). To capture delayed financing effects, short-term debt is included with a one-period lag.

Long-term debt ($LTDEBT_{it}$), measured as the ratio of long-term liabilities to total assets, reflects firms' reliance on long-term financing. It is typically associated with strategic investments such as capacity expansion, modernization and technological upgrading. When used efficiently, it can enhance profitability by improving productivity and competitive positioning; however, excessive leverage increases financial risk and fixed obligations, potentially weakening performance under economic uncertainty. Accordingly, the relationship between long-term debt and profitability is context-dependent (Goddard *et al.*, 2005; Neves *et al.*, 2022). Given that its effects materialize over time, the variable is included with a one-period lag.

Working capital intensity (CAP_{it}) is measured as the ratio of working capital to total sales and captures the extent to which operating capital is committed to firms' core activities. This variable reflects the efficiency of working capital management rather than short-term solvency. Efficient working capital management is positively associated with profitability, as it supports smooth operations, reduces financing costs and facilitates sales growth (Aytac *et al.*, 2020; Chrysanthopoulou *et al.*, 2023; Habib and Kayani, 2023; Vieira *et al.*, 2019). Given the significance of inventory holding, aging processes and delayed revenue realization in the wine industry, CAP is introduced with a one-period lag to capture the effect of past working capital decisions on current performance.

Capital expenditures ($CAPEX_{it}$) proxy firms' investment activity and are measured as the annual change in tangible fixed assets plus depreciation, a standard accounting-based measure of productive investment. CAPEX captures strategic decisions related to capacity expansion, modernization and technological upgrading. From a theoretical perspective, investment activity is expected to enhance profitability through productivity gains, cost reductions or quality improvements, particularly in capital-intensive sectors such as wine production. However, investment returns typically materialize with a delay, while initial costs may temporarily burden performance. Accordingly, CAPEX is included with a one-period lag to examine whether past investment activity contributes to subsequent profitability (Amadiou and Viviani, 2010; Singh and Bagga, 2019).

Firm size ($LSIZE_{it}$), measured as the natural logarithm of total assets, is included as a control variable. Larger firms may benefit from economies of scale, stronger bargaining power and improved access to external financing (Ibhagui and Olokoyo, 2018; Georgopoulos and Glaister, 2018; Žiković *et al.*, 2025). However, increased size may also generate coordination costs, reduced flexibility and agency problems, implying a potentially nonlinear relationship between firm size and performance (Neves *et al.*, 2022; Ullah, 2020; Vieira *et al.*, 2019).

Finally, firm age (AGE_{it}) is included as an indicator of organizational maturity and accumulated experience. Older firms may benefit from learning-by-doing effects and established market presence but may also face constraints related to innovation capacity and adaptability. Accordingly, empirical evidence on the relationship between firm age and performance remains mixed and context-dependent (Coad *et al.*, 2013; Georgopoulos and Glaister, 2018; Rashid and Naeem, 2017).

4. Results

This section presents the panel data estimation results, ensuring the robustness and reliability of the empirical findings.

The descriptive (Table 2) statistics indicate heterogeneity among firms. ROA shows high variability, with a mean of 6.927 and a large standard deviation (31.871), reflecting significant fluctuations in profitability. STDEBT and LTDEBT have similar averages (0.314 and 0.301), suggesting a balanced debt structure, while the average CR (0.743) indicates possible liquidity constraints. CAP presents substantial dispersion and extreme values, pointing to outliers, whereas CAPEX remains low on average (0.051) but is highly skewed, indicating that few firms invest heavily. LSIZE shows low variability, implying homogeneous firm size, and AGE suggests relatively mature firms. Overall, most variables are positively skewed, indicating the presence of high-value outliers.

Table 3 presents the correlation matrix. ROA shows a moderately positive correlation with LTDEBT (0.491) and a weaker one with STDEBT (0.318), while CR is negatively correlated with debt (−0.258 and −0.144). CAP is positively correlated with ROA (0.469), while CAPEX has weaker relationships. Firm size (LSIZE) exhibits negative correlations, e.g. with CR (−0.281), while age (AGE) is strongly positively correlated with size (0.515), indicating that older firms are larger, justifying the use of robust estimation methods.

According to the results of the unit root test (ADF-Fisher) in Table 4, all variables under examination are stationary at the level, as the *p*-values are extremely low and fall below the 5% significance threshold ($p < 0.05$). Specifically, the ROA variable exhibits the highest test

Table 2. Descriptive statistics

Variables	Mean	Median	SD	Min.	Max.	Skewness	Kurtosis
ROA (<i>return on assets</i>)	6.927	1.141	31.871	−21.138	98.880	0.861	3.012
CR (<i>current ratio</i>)	0.743	0.681	0.592	0.126	9.185	0.710	2.815
STDEBT (<i>short-term debt</i>)	0.314	0.281	0.169	0.019	0.812	0.697	2.701
LTDEBT (<i>long-term debt</i>)	0.301	0.249	0.199	0.014	0.901	0.986	3.204
CAP (<i>working capital intensity</i>)	2.991	1.427	7.928	0.007	48.810	1.158	3.681
CAPEX (<i>capital expenditure</i>)	0.051	0.041	0.079	−0.219	0.399	1.607	4.072
LSIZE (<i>firm size</i>)	15.421	15.412	1.131	11.031	19.831	0.310	2.408
AGE (<i>firm age</i>)	27.135	24	9.012	9	51	0.424	−0.596

Source(s): Authors' own creation

Table 3. Correlation matrix

Variables	ROA	CR	STDEBT	LTDEBT	CAP	CAPEX	LSIZE	AGE
ROA	1.000							
CR	0.171	1.000						
STDEBT	0.318	-0.258	1.000					
LTDEBT	0.491	-0.144	0.342	1.000				
CAP	0.469	0.029	0.271	0.028	1.000			
CAPEX	0.139	0.095	0.396	0.284	0.114	1.000		
LSIZE	-0.171	-0.281	-0.217	-0.118	-0.195	-0.291	1.000	
AGE	0.097	-0.142	-0.121	-0.096	0.198	0.094	0.515	1.000

Table 4. Unit root test

Variables	ADF-Fisher (level)	<i>p</i> -value (level)	Order of integration
ROA	234.61	<0.01	I(0)
CR	38.32	0.007	I(0)
STDEBT	32.06	0.005	I(0)
LTDEBT	49.01	<0.01	I(0)
CAP	90.12	<0.01	I(0)
CAPEX	96.17	<0.01	I(0)
LSIZE	125.51	<0.01	I(0)
AGE	106.28	<0.01	I(0)

Source(s): Authors' own creation

statistic (234.61), while the remaining variables such as LSIZE (125.51), AGE (106.28), CAPEX (96.17) and CAP (90.12) follow with equally strong statistical results ($p < 0.01$). Even the variables with the lowest test values, such as CR (38.32) and STDEBT (32.06), remain statistically significant with p -values of 0.007 and 0.005, respectively, confirming that all series have an integration order of I(0) and that taking first differences is not required for further econometric analysis.

Table 5 reports the results of the Breusch–Pagan test for heteroskedasticity. The test fails to reject the null hypothesis of homoskedasticity ($\chi^2 = 4.521$, p -value = 0.718), indicating that the variance of the residuals is constant across observations. Nevertheless, to ensure robust inference, heteroskedasticity-robust standard errors are reported in all model estimations.

The analysis of the multicollinearity test in Table 6 shows that there is no problem of linear dependence among the independent variables, as all centered VIF values are below the stricter threshold of 5. Specifically, the variables CR (1.25), CAPEX (1.29) and STDEBT (1.48) have the lowest values, indicating almost zero correlation with the others, while the

Table 5. Heteroscedasticity test

Test	Statistic (χ^2)	df	<i>p</i> -value
Breusch–Pagan	4.521	7	0.718

Source(s): Authors' own creation

Table 6. Multicollinearity test

Variables	Coefficient variance	Uncentered VIF	Centered VIF
C (constant)	0.821	235.11	NA
CR	0.021	3.312	1.25
STDEBT	0.051	6.812	1.48
LTDEBT	0.049	6.295	2.99
CAP	0.023	156.45	2.91
CAPEX	0.182	2.915	1.29
LSIZE	0.049	183.01	4.12
AGE	0.020	18.17	3.32

Source(s): Authors' own creation

variables LSIZE (4.12), AGE (3.32), LTDEBT (2.99) and CAP (2.91) exhibit slightly higher indices without, however, raising concerns about the reliability of the model's estimates. Although the uncentered VIF values are expectedly high due to scaling effects and the inclusion of a constant term (e.g. LSIZE 183.01 and CAP 156.45), the statistically critical centered VIF confirms the suitability of the variables for regression.

The following analysis reports the results of the econometric estimations. Model selection is based on a comparison between fixed and random effects estimators using the Hausman test. The test results ($\chi^2 = 9.271$, $p = 0.1831$) fail to reject the null hypothesis, indicating no systematic correlation between the regressors and unobserved individual effects. Accordingly, the random effects model is adopted for result interpretation.

According to the results in Table 7, the pooled OLS and random effects models demonstrate strong explanatory power with R^2 values of 0.75 and 0.72, respectively, while the overall statistical significance is indisputable [Prob(F) = 0.000]. The analysis shows that long-term debt (LTDEBT) is the strongest positive influencing factor with a coefficient of 0.389 in OLS and 0.334 in RE ($p < 0.01$), followed by working capital intensity (CAP) with coefficients of 0.321 and 0.271, respectively. A positive contribution is also recorded by the CR ratio (0.281 in OLS) and capital expenditure (CAPEX), which in the RE model show

Table 7. Pooled OLS regression/random effect model estimation of performance

Variables	OLS regression		Random effect model	
	Coefficient	P-value	Coefficient	P-value
C (constant)	1.84023	0.022**	2.01911	0.009***
CR	0.28160	0.004***	0.22145	0.018**
STDEBT _(t-1)	0.22114	0.001***	0.19114	0.004***
LTDEBT _(t-1)	0.38912	0.000***	0.33412	0.000***
CAP _(t-1)	0.32177	0.000***	0.27127	0.000***
CAPEX _(t-1)	0.32011	0.038**	0.29103	0.000***
LSIZE	-0.18018	0.008***	-0.16237	0.014**
AGE	0.09120	0.214	0.06221	0.499
Observations	804		804	
	R^2	0.75	R^2	0.72
	Prob (F-statistic)	0.000	Prob (F-statistic)	0.000

Note(s): *** and ** represent 1 and 5% significance level, respectively

Source(s): Authors' own creation

high significance ($p = 0.000$) with a coefficient of 0.291. Conversely, firm size (LSIZE) has a negative effect on performance with a coefficient of -0.180 (OLS) and -0.162 (RE), while age (AGE) remains statistically insignificant with high p -values (0.214 and 0.499), indicating that years of experience do not necessarily translate into improved performance.

5. Discussion

Empirical results demonstrate that liquidity, measured by the current ratio, is a primary driver of profitability. The positive and significant coefficient indicates that liquid wineries better manage short-term obligations and seasonal fluctuations, consistent with evidence that liquidity enhances operational flexibility and mitigates financial distress in capital-intensive sectors (Vieira *et al.*, 2019; Neves and Branco, 2020).

Both short-term and long-term debt exert a positive, statistically significant influence on profitability once their one-year lag is accounted for, indicating that external financing acts as a catalyst for performance only after it has been absorbed into the firm's operations rather than in the year it is raised. Short-term debt finances the intensive working capital needs and prolonged production cycles that define the wine industry, supporting prudent management of short-term liabilities as a driver of operational continuity (Goddard *et al.*, 2005; Vieira *et al.*, 2019). The lagged effect of long-term debt similarly shows that capital allocated to facility modernization and technological upgrading yields measurable returns only as these investments mature, strengthening medium-term competitiveness (Voulgaris and Lemonakis, 2013; Neves *et al.*, 2022).

Working capital intensity has a strong positive effect on profitability, underlining the importance of efficient allocation of operating capital over merely maintaining high liquidity. In a sector marked by long production cycles and delayed revenue realization, effective working capital management supports smoother operations and lower financing costs, consistent with wine-specific evidence on the central role of working capital efficiency (Aytac *et al.*, 2020; Candeias and Dias, 2023; Habib and Kayani, 2023).

Investment activity is likewise positively associated with profitability, but only with a lag: investment costs initially burden financial results, and their benefits in quality control, efficiency and technological advancement emerge only as the investments mature. This reinforces prior findings on investment dynamics in the wine and agri-food sectors (Amadiue and Viviani, 2010; Neves *et al.*, 2022).

In contrast, firm size is negatively and significantly related to profitability, suggesting diseconomies of scale: larger wineries may face higher coordination costs and reduced flexibility that outweigh scale advantages in specialized, quality-oriented markets (Sellers and Alampi-Sottini, 2016; Žiković *et al.*, 2025). Firm age has no significant effect, implying that accumulated experience does not by itself guarantee higher performance without continuous adaptation and investment, consistent with mixed evidence on the age–performance relationship (Andonova and Ruíz-Pava, 2016; Coad *et al.*, 2013).

Taken together, these results point to a temporal rather than static logic of profitability: financing and investment decisions taken in one period translate into performance outcomes only once absorbed into the firm's operating structure, so that profitability is shaped less by the financial position observed in any single year than by the cumulative trajectory of prior financing and investment choices. This explicit temporal structuring, modeling short-term debt, long-term debt and investment activity with a one-year lag, moves the analysis beyond a static, cross-sectional reading of financial structure. Framed this way, the findings speak less to “what makes a winery profitable” and more to “how financing and investment decisions unfold into performance over time,” a dynamic perspective that is comparatively underexplored in the wine-sector literature and reinforces the study's contribution beyond a conventional determinants analysis.

6. Conclusions and strategic implications

This research extends prior determinants-based accounts of firm performance by showing that, in the Greek wine sector, profitability follows the temporal sequencing of financing and investment decisions rather than firm scale, maturity or capital availability *per se*. Two findings depart from conventional expectations and move the analysis beyond the intuitive claim that “well-managed firms perform better”: first, firm size is negatively associated with profitability, indicating that scale is not, by itself, a source of competitive advantage in this capital-intensive, quality-driven industry, and that coordination costs can offset the benefits typically associated with growth; second, firm age exerts no significant effect, suggesting that accumulated market presence does not substitute for active, adaptive financial management. Taken together, these results reposition financial planning not as a generic best practice but as a firm-specific, time-dependent capability that must be exercised deliberately rather than assumed to accrue automatically with size or longevity.

From a managerial standpoint, the sequential nature of the results carries a clear implication: performance is not the product of isolated financial decisions but of disciplined, forward-looking financial planning that anticipates the delayed materialization of financing and investment outcomes. Managers should treat investment not as a default lever for growth but as a strategic instrument to be activated selectively and cautiously, calibrated to the firm’s capacity to absorb and integrate new capital before its effects on profitability emerge. This implies a shift from “growing big” to “growing smart,” where resource optimization, rather than mere asset expansion, drives profitability. In practice, this requires managers to prioritize dynamic working capital management, optimizing the inventory-to-cash conversion cycle to mitigate the liquidity risks inherent in wine’s long production timelines; to sequence capital expenditure deliberately, channeling it toward targeted quality investments, such as precision viticulture and cold-chain logistics, only once financing structures are sound enough to sustain the lag between outlay and return; and to maintain financial flexibility through a balanced mix of short-term credit for seasonal needs and long-term, low-interest financing for modernization, ensuring debt service remains manageable even during periods of market volatility.

From a policy perspective, the analysis suggests that providing “cheap money” is insufficient; instead, initiative must transition toward fostering investment efficiency and structure resilience. Policy makers should prioritize financial literacy programs that train winery owners in advanced cost-accounting, enabling a granular understanding of production margins per variety. Furthermore, there should be a strategic shift to modernization grants over flat subsidies, using matching-grant schemes to reward investments in export-oriented infrastructure and digital traceability. Finally, the introduction of streamlined export financing, specifically specialized instruments designed to bridge the gap caused by long international payment delays, is essential to protect small producers from financial distress and ensure their long-term economic viability.

While the study uses a robust panel data framework, it is a steppingstone. Future research should examine how innovation (e.g. organic certification) and export branding directly impact the financial ratios observed in this study. Expanding this to a cross-country analysis would reveal whether the Greek sector is constrained or is following global efficiency trends.

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