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Debt financing as moderator in the relationship between intellectual capital and SMEs performance

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Abstract

Purpose – This study aims to analyze the moderating role of debt financing in the relationship between intellectual capital (IC) and small and medium enterprise (SME) performance in high-tech and low-tech industries.

Design/methodology/approach – This longitudinal study uses a balanced panel sample of 7,293 (3,563 high-tech and 3,730 low-tech) SMEs in Southwestern European countries from 2013 to 2020. The data are analyzed using a fixed-effect model as baseline estimation, and a generalized method of moments estimation is used for robustness checks.

Findings – The results show strong positive effects of human capital (HC) and structural capital (SC) and a weak effect of capital employed (CE), on the performance of high-tech SMEs. Debt financing is negatively and significantly associated with SME performance, and the moderating effect of debt financing is more significant in low-tech industries. Specifically, debt financing accentuates (attenuates) the positive effect of HC (SC and CE) on the performance of low-tech SMEs.

Practical implications – This study offers a valuable framework for managers and policymakers when considering the role of debt financing in the IC components – SME performance relationship in distinctive industrial environments.

Originality/value – This study provides new insights into the close and complex relationships between IC components, debt financing and SME performance.

Keywords Intellectual capital, Debt financing, SMEs performance, Technological intensity, Europe

Paper type Research paper

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1. Introduction

Research in accounting, finance and management recognizes the role of intellectual capital (IC) on small and medium enterprise (SME) performance (Xu and Li, 2019). According to the resource-based view (Barney, 1991; Martín-de-Castro *et al.*, 2011), IC ranks ahead of physical and financial capital and is increasingly attracting attention as a critical strategic asset because it is rare, valuable and difficult to imitate and transfer. Hence, IC is a source of competitive advantage and superior performance for firms (Barney, 1991). With the rise of knowledge-based economies, firms increasingly focus on investing in IC assets (Grant, 1996).

IC understood as a set of intangible resources and capabilities responsible for a firm's value-creation process, is highly debated among scholars, practitioners and consultants. While some studies define IC theoretically (e.g. Grant, 1996; Bontis, 1998), others have developed effective tools to measure IC-based performance (Stewart, 1998; Public, 2004) and examined IC efficiency–firm performance relationship, considering firm-specific characteristics, industries and regions (Tan *et al.*, 2007; Zeghal and Maaloul, 2010; Sardo and Serrasqueiro, 2018). Yet another literature stream (e.g. Martín-de-Castro *et al.*, 2011; Roos, 2017) examines how IC influences a firm's competitiveness and performance. While abundant literature shows a positive effect of IC on firm performance (Martín-de-Castro *et al.*, 2019), SMEs rarely measure or acknowledge IC due to a lack of substantial tangible and financial resources. However, IC counterbalances the small-size effect and the lack of economies of scale (Cohen *et al.*, 2014). Moreover, unlike large firms, which can access capital markets, SMEs rely heavily on bank financing, owing to their firm-specific characteristics and rarely disclosed business strategies (Bamiatzi *et al.*, 2017). Because of the bank's key role in firm-financing decisions and the disproportionately large share of SMEs in Southwestern Europe (European Commission, 2021), SMEs in this region are vulnerable to macroeconomic shocks and changes in bank-lending practices (Bamiatzi *et al.*, 2017). Furthermore, the interrelated mechanism of debt financing behind the IC–firm performance relationship remains underexplored (Frank and Goyal, 2009; D'Amato, 2021; Dalwai and Sewpersadh, 2021).

Debt financing is a key component of firms' capital structure and an essential source of financing for building IC (Dalwai and Sewpersadh, 2021). However, excessive debt financing can lead to financial distress, high agency costs and information asymmetry, especially given the risky nature of intangible assets (Jensen and Meckling, 1976; Frank and Goyal, 2009). Therefore, examining the IC–SME performance relationship in distinct industrial settings requires analyzing factors that moderate the relationship. Such an analytical viewpoint can help clarify what circumstances exert a strong or weak impact on this relationship and explain inconsistent findings in the literature in the context of high- versus low-tech industries. Relatedly, Tan *et al.* (2007) propose that the IC–firm performance relationship differs across industries. However, Zeghal and Maaloul (2010) examine this relationship across three groups of industries: high-tech, traditional and services, and find it to be positive regardless of industry classification. Meanwhile, we investigate whether and how debt financing plays different moderating roles in the IC–SME performance relationship in different industrial settings of technological intensity.

Our study contributes to the literature in three ways. First, it examines the moderating role of debt financing in the IC components–SME performance relationship in high- and low-tech industries. We argue that the research in IC remains fragmented and inconclusive. Therefore, it is important to determine the dominant factors and evolution of this stream of management research (Martín-de-Castro *et al.*, 2019). Moreover, previous studies have examined the association between IC, debt financing and SME performance in a limited and fragmented

manner, and they also lack a comprehensive conceptual framework. Hence, this study is novel in re-examining the IC components–SME performance relationship while considering the interaction effects of debt financing in a distinctive industrial environment.

Second, we provide new evidence from both theoretical and empirical perspectives on the IC components–SME performance relationship in high- and low-tech industries. The use of a large balanced panel sample of 7,293 SMEs in Southwestern European countries distinguishes our work from previous studies that have examined the direct effect of IC on SME performance (e.g. Kujansivu and Lönnqvist, 2007; Holienka *et al.*, 2016; Xu and Li, 2019), and of debt financing on SMEs performance (e.g. Abor, 2007; Weill, 2008; Yazdanfar and Öhman, 2015). It offers a conceptual framework for enriching current knowledge and provides novel insights on the IC components–SME performance link in a distinctive industrial environment. We conjecture that this relationship differs across industries because high-tech industries operate in a highly competitive environment. Moreover, firms in high-tech industries are knowledge-intensive, and their primary goal is to invest in IC. Hence, they may differ from low-tech industries in knowledge creation and asset specialization aimed at achieving a competitive edge (Nimtrakoon, 2015; Buenechea-Elberdin *et al.*, 2018; Xu and Li, 2019).

Finally, unlike previous studies that primarily investigate the IC components–SME performance relationship based on a single theory like resource-based view (RBV) (e.g. Martín-de-Castro *et al.*, 2011; Xu and Li, 2019), we use multi-theoretical models not only based on RBV, but also pecking order theory and agency theory (Jensen and Meckling, 1976; Myers and Majluf, 1984) to shed light on the close and complex relationships among IC components, debt financing and SMEs performance in distinct industrial settings. IC promotes long-term competitiveness and enhanced performance (Barney, 1991). To improve performance, SMEs require a reliable source of financing to support IC assets. However, given the unique characteristics of IC assets, excessive debt financing may result in financial difficulty, high agency costs and information asymmetry (Jensen and Meckling, 1976). Hence, SMEs may prefer internal financing sources (Myers and Majluf, 1984).

The remainder of this paper is structured as follows. Section 2 presents a literature review. Section 3 discusses the methodological approach. Section 4 presents the empirical findings and the robustness check. Finally, Section 5 provides a conclusion and discusses policy implications.

2. Literature review and hypothesis development

Here, we frame our research under the RBV to clarify the role of IC on SME performance in high- and low-tech industries (Barney, 1991; Xu and Li, 2019). We also refer to pecking order theory (POT) (Myers and Majluf, 1984; Abor, 2007) and agency theory (AT) (Jensen and Meckling, 1976; Yazdanfar and Öhman, 2015) to discuss the effect of debt financing on SME performance and the moderating role of debt financing in the IC components–SME performance relationship in distinct industrial settings.

2.1 Intellectual capital and small and medium enterprise performance in distinct industrial settings

Abundant literature indicates a positive IC–firm performance relationship (Martín-de-Castro *et al.*, 2011; Sardo and Serrasqueiro, 2018; Xu and Li, 2019). Similarly, Nimtrakoon (2015) finds a significantly positive IC–firm performance relationship across South Asian countries. However, others have contradictory findings, which may be ascribed to industry or country peculiarities (Bontis, 1998; Zeghal and Maaloul, 2010; Nimtrakoon, 2015). In a similar vein,

Tan *et al.* (2007) analyzed IC–firm performance relationships across industries and found that the contribution of IC to firm performance differs by industry.

The extant literature provides numerous insights explaining the IC–SME performance relationship (St-Pierre and Audet, 2011; Xu and Li, 2019). For instance, Holienka *et al.* (2016) and Xu and Li (2019) find a positive and significant association between IC and SME performance, suggesting that investors place more value on firms with high IC efficiency. Xu and Li (2019), from RBV, highlight the independent, flexible and entrepreneurial character of SMEs compared with larger companies, which is intrinsically linked to SMEs' human capital (HC) and structural capital (SC) and their role in achieving sustained competitive advantage and superior firm performance. This helps SMEs overcome difficulties caused by the lack of other financial resources and economies of scale. However, other studies show that IC has no significant relationship with SME performance (Kujansivu and Lönnqvist, 2007; St-Pierre and Audet, 2011) and specifically highlight that physical capital and financial capital remain the primary drivers of SME performance because these firms more strongly emphasize capital employed (CE) than HC and SC.

In a more fine-grained analysis, this study explores the differentiated role played by IC assets (i.e. HC and SC) as well as CE on the performance of SMEs in different industrial settings. Studies show that the configuration and importance of IC assets for high- and low-tech firms differ substantially (Buenechea-Elberdin *et al.*, 2018; Xu and Li, 2019), playing a critical role for the former because of the intensive knowledge-based process of technological innovations (Subramanian and Youndt, 2005). Some industries rely heavily on IC, while others need financial or physical resources to perform better (Tan *et al.*, 2007; Zeghal and Maaloul, 2010). HC's creativity and commitment are key drivers of firm product innovation (Xu and Li, 2019), especially in high-tech and knowledge-based industrial settings. Subramanian and Youndt (2005) argue that firm innovation is closely tied to its IC management and ability to use and value its knowledge resources. In this vein, HC creativity is associated with radical innovations, while the organizational structural knowledge base is linked to incremental ones. In addition to HC, another component of IC is the SC, which is the technological know-how, routines and experiences required to successfully develop new products embedded in the firm's SC through IT procedures, routines and so on. IC is a critical determinant of firm competitiveness in a knowledge-based economy because it promotes adaptability, survival and success in continuously changing markets (Delgado-Verde *et al.*, 2016). Consistent with these studies, we propose:

H1. The positive effect of IC, specifically HC and SC, on firm performance is higher for SMEs operating in high-tech industries.

Meanwhile, CE comprises physical and financial capital, creating a firm's value-added IC efficiency (Public, 2004). High- and low-tech SMEs rely on physical and financial resources for superior performance. Therefore, managers should focus more on the effective use of physical and financial components to ensure high SME performance (Xu and Li, 2019). Previous studies argue that low-tech firms are more effective in developing value-added efficiency from their physical and financial resources than high-tech firms (e.g. Sardo and Serrasqueiro, 2018; Xu and Li, 2019). This is due to the knowledge-based economy; high-tech firms put more emphasis on the value-added generated by IC resources than CE. Hence, different industries require distinct assets and capabilities to operate and compete effectively. Thus, we propose:

H2. The positive effect of CE on firm performance is higher for SMEs operating in the low-tech industry.

2.2 Debt financing and small and medium enterprise performance

The association between debt financing and SME performance has been the subject of theoretical and empirical studies (e.g. Abor, 2007; Weill, 2008; Yazdanfar and Öhman, 2015). Theoretically, the seminal work of Modigliani and Miller (1958) on debt financing (often referred to as capital structure) is based on the assumptions that capital structure decisions have no effect on the firm value given the perfect market competition with no taxes or transaction costs and that all essential information is freely available. This theory has been criticized for assuming rational economic behavior and perfect market conditions and having limited relevance to SMEs (Berger and Udell, 2006). SMEs may face high external financing costs because of information asymmetry issues such as adverse selection and moral hazards (Yazdanfar and Öhman, 2015). Moreover, SMEs operate in an opaque information environment, and financial institutions such as banks find it difficult to determine their repayment potential (Berger and Udell, 2006). However, Modigliani and Miller (1963) improved their earlier assumptions by assessing debt tax benefits against bankruptcy costs. Additionally, the AT (Jensen and Meckling, 1976; Abor, 2007) contends that financial stakeholders' opinions on risk frequently diverge, and posits that conflicts of interest and control rights exist among firms' diverse financial stakeholders. In this vein, SMEs are more likely to experience a conflict of interest between shareholders and creditors because of the lack of separation between management and ownership (Yazdanfar and Öhman, 2015). Moreover, SME owners and managers who seek independence and control rights rely less on external financing (Abor, 2007). Moreover, the POT suggests a specific order of preference when firms raise new capital (Myers and Majluf, 1984; Myers, 2001). This theory predicts a preferred sequence of firm financing sources due to adverse selection and information asymmetry problems. In this sense, firms prefer to finance their investments primarily with internally generated funds, followed by debt and, lastly, restoring to equity finance when internal funds are insufficient or lack an adequate source of debt financing (Myers and Majluf, 1984; Yazdanfar and Öhman, 2015).

Previous literature shows the negative effect of debt financing on SME performance. For instance, Abor (2007) analyzes Ghanaian and South African SMEs and reveals that debt financing is negatively associated with SME performance, suggesting that SMEs pursue aggressive debt policy because of high agency issues that lead to low performance. In a similar vein, Yazdanfar and Öhman (2015) examine a cross-industrial sample comprising 15,897 SMEs in Sweden from 2009 to 2012 and highlight a negative debt financing–SME performance relationship, suggesting that a high debt ratio increases SMEs' agency costs and enhances the chances of losing control rights over the firms. Consequently, SME owners and managers prefer internal sources of financing. Moreover, Weill (2008) investigates a large sample of SMEs in seven European countries and finds both positive and negative influences of debt financing on SME performance, concluding that the relationship varies by country.

Given that SMEs often suffer problems linked to asymmetric information, which involves agency costs associated with external sources of debt financing. Furthermore, excessive debt can result in high bankruptcy costs, negatively impacting SME performance. Consequently, extant literature hypothesizes a negative influence of debt financing on SME performance. Therefore, we propose that:

H3. The use of debt financing is negatively related to SMEs performance.

2.3 Intellectual capital, Debt financing and small and medium enterprise performance

Despite abundant literature, no study has revealed the effect of IC components on SME performance while considering the moderating role of debt financing. According to the

preceding discussion, IC and debt financing significantly influence SME performance. Hence, we argue that the moderating effect of debt financing can explain some inconsistent findings on the IC components–SME performance relationship (e.g. Kujansivu and Lönnqvist, 2007; St-Pierre and Audet, 2011; Xu and Li, 2019).

In this regard, Memon *et al.* (2020) argued that each IC element is substantial for the growth and survival of SMEs. However, SMEs' operational activities cannot run efficiently through intangible resources alone. SMEs need adequate financing to recognize new opportunities to improve their performance. For instance, Li *et al.* (2020) examine the relative role of IC and financial resources on SME performance and suggest that SMEs should emphasize both IC and financial resources to achieve high financial performance. However, owing to the intangible nature of IC, previous studies show a negative association between IC and debt financing (Harris and Raviv, 1991; Frank and Goyal, 2009), arguing that IC components are considered financially constrained assets because of their unique characteristics and uncertain investment returns. These factors prevent the efficient use of intangible assets; repossessing intangible assets is difficult in bankruptcy because of the lack of appropriate identification, valuation and separation.

As discussed above, extant research supports the POT and proposes a negative effect of debt financing on SMEs performance. Given the agency costs of debt and asymmetric information, the direction of the interrelated debt financing mechanism in the IC components–SME performance relationship is thus an empirical question. Therefore, we suggest that the interaction effects of debt financing in the IC components–SME performance relationship can be well pronounced. Hence, we propose:

H4. Debt financing significantly moderates the relationship between IC components and SME performance in high- and low-tech industries.

3. Methodology

3.1 Sample and data collection

We use a panel approach to examine a sample of nonfinancial SMEs in Southwestern European countries (i.e. Italy, Spain, France, Portugal and Malta) for 2013–2020. Specifically, we define SMEs following EU Commission Recommendation No. 2003/361/EC (European Commission, 2020) – as firms with a total number of fewer than 250 employees, annual revenue of below or equal to 50 million euros and/or a balance sheet total equal to or less than 43 million euros. Next, we classify high- and low-tech industries based on Eurostat NACE Rev. 2 to aggregate the manufacturing industry by technological intensity (Eurostat, 2014). To create two balanced groups in terms of the number of firms, we follow previous studies (e.g. Moncada-Paternò-Castello, 2016; Sardo and Serrasqueiro, 2018) and classify firms as high- or low-tech into two sub-samples based on the technology-intensity classification of industries. Industries in higher categories (i.e. medium-high or high technology, referred to as high-techs in our study) have a higher research and development (R&D) intensity.

On the other hand, industries in lower categories (medium-low or low-technology, referred to as low techs in our study) have a lower R&D intensity (Eurostat, 2014). Finally, we exclude SMEs in the process of liquidation or bankruptcy proceedings because, unlike large firms, SMEs are typically opaquer and provide less detailed accounting data in predicting bankruptcy risk (Kaya, 2022). Moreover, SMEs involved in bankruptcy proceedings often aim to reduce their debt burden, even if they are economically viable but unable to service their existing debt obligations (Rico *et al.*, 2021).

Thus, our final sample includes panel data of 3,563 (48.86%) medium-high and high-technology SMEs (i.e. high-techs) and 3,730 (51.14%) medium-low and low-technology

SMEs (i.e. low-tech) operating in all economic sectors except finance and insurance. The data is collected from the *ORBIS* database of *Bureau Van Dijk (BVD)*. *ORBIS* represents the best data source for cross-country firm-level data. This database has increasingly been validated in the literature and has been widely used in recent studies on SME performance (e.g. Doan *et al*., 2020). Table 1 summarizes further details about the industrial composition of the sample.

3.2 Variables measurement and model specification

In line with the previous literature, we use an accounting-based measure of SME performance, such as return on assets (*ROA*), measured as net income over total assets (Abor, 2007; Sardo and Serrasqueiro, 2018; Xu and Li, 2019). Researchers used the value-added intellectual coefficient (*VAIC*) method to examine the impact of IC efficiency on SME performance. This method is essential to compute IC efficiency for management decision-making and allows for comparative analyses in a distinct industrial and country context (Meles *et al*., 2016). Therefore, consistent with recent studies (e.g. Sardo and Serrasqueiro, 2018; Xu and Li, 2019; Dalwai and Sewpersadh, 2021), we use VAIC as an indicator to measure IC efficiency. The following four steps are taken to quantify the VAIC model:

Step 1. Value-added (VA_{it}) is calculated as operating profit (*OP*) + employees' cost (*EC*) + depreciation and amortization cost (*DAC*) during the period "t":

$$VA = OP + EC + DAC$$

Step 2. Human capital efficiency (HCE_{it}) is measured as total wages and salaries cost divided by value-added (VA_{it}):

$$HCE = VA/HC$$

Step 3. Structural capital efficiency (SCE_{it}) is measured as value-added (VA_{it}) – human capital (HC_{it}) divided by value-added (VA_{it}) as the fraction accounted for by the SC:

Table 1. Sample composition

Industry	Frequency	%
Pharmaceuticals	95	1.30
Computer, electronics and optical	336	4.61
Chemical	574	7.87
Electrical and machinery equipment	2,216	30.39
Automotive	342	4.69
Medium-high and high technology subtotal	*3,563*	*48.86*
Coke and refined petroleum products	155	2.13
Rubber, plastic and metal products	245	3.36
Repair and installation of machinery and equipment	84	1.15
Food, beverages and tobacco	1,131	15.51
Textile	1,040	14.26
Wood, paper and printing	892	12.23
Furniture and other manufacturing	183	2.51
Medium-low and low technology subtotal	*3,730*	*51.14*
Total	*7,293*	*100*

Source: Authors' own creation

$$SCE = SC/VA$$

Step 4. Capital employed efficiency (CEE_{it}) is calculated as value-added (VA_{it}) divided by capital employed (CE_{it}) as the difference between total assets and intangible assets:

$$CEE = VA/CE$$

When VA measures an effective creation of IC, the extra value generated by the resources in terms of CE effectiveness may be characterized as the difference between total assets and intangible assets. Consequently, the VAIC model stresses identifying the relative contribution of IC and physical capital to a firm's value creation:

$$ICE = HCE + SCE, \text{ and } VAIC = ICE + CEE.$$

The moderating variable of debt financing (*DF*) is measured as the ratio of total debt to total assets (Li *et al.*, 2020). Consistent with previous literature, we control for several firm-specific variables, such as firm age (*FA*) measured as the natural log of the age. Firm size (*FS*) is measured as the natural log of total assets. Firm tangibility (*FT*) is the ratio of fixed assets to total assets (Harris and Raviv, 1991). Firm growth (*FG*) is measured as the annual percentage change in sales (D'Amato, 2021). Finally, firm liquidity (*FL*) is the ratio of current assets to current liabilities.

We examine the following econometric models to provide new empirical evidence on the role of debt financing in the IC components–SME performance relationship in high- and low-tech industries. First, we investigate the effects of firm-specific control variables on SME performance, as shown in model (1). Second, we analyze the effects of the IC efficiency components on SME performance in distinctive industrial settings, as shown in model (2). Finally, we investigate the impact of debt financing as an interaction term in the IC–SME performance relationship, as shown in model (3). We also run the Hausman test to determine the model that better explains fixed or random effect estimation. In Table 5, the Hausman test results indicate that the fixed-effect model (FEM) is appropriate for examining the association between the explanatory and dependent variables. Thus, the panel models are estimated using a fixed-effects model:

$$ROA_{i,t} = \alpha + \beta_1 FA_{i,t} + \beta_2 FS_{i,t} + \beta_3 FG_{i,t} + \beta_4 FT_{i,t} + \beta_4 FL_{i,t} + Country_{i,t} + Year_t + \mu_i + \varepsilon_{i,t} \quad (1)$$

$$ROA_{i,t} = \alpha + \beta_1 HCE_{i,t} + \beta_2 SCE_{i,t} + \beta_3 CEE_{i,t} + \beta_4 DF_{i,t} + \beta_5 FA_{i,t} + \beta_6 FS_{i,t} + \beta_7 FG_{i,t} + \beta_8 FT_{i,t} + \beta_9 FL_{i,t} + Country_{i,t} + Year_t + \mu_i + \varepsilon_{i,t} \quad (2)$$

$$\begin{aligned} ROA_{i,t} = {} & \alpha + \beta_1 HCE_{i,t} + \beta_2 SCE_{i,t} + \beta_3 CEE_{i,t} + \beta_4 DF_{i,t} \\ & + (\beta_1 HCE_{i,t} \times \beta_4 DF_{i,t}) + (\beta_2 SCE_{i,t} \times \beta_4 DF_{i,t}) \\ & + (\beta_3 CEE_{i,t} \times \beta_4 DF_{i,t}) + \beta_5 FA_{i,t} + \beta_6 FS_{i,t} + \beta_7 FG_{i,t} \\ & + \beta_8 FT_{i,t} + \beta_9 FL_{i,t} + Country_{i,t} + Year_t + \mu_i + \varepsilon_{i,t} \end{aligned} \quad (3)$$

where (α) is a constant. The parameters (β) are the explanatory variables; subscript (i) denotes individual firms; (t) refers to the time; (μ) *and* (ε) are error terms (residuals) and $ROA_{i,t}$ is an indicator of firm financial performance i in year t. IC is expressed as IC efficiency components [i.e. human capital efficiency (*HCE*), structural capital efficiency (*SCE*) and capital employed efficiency (*CEE*)] of firm i in year t. *DF* refers to the debt financing of firm i in year t. Control variables are firm-specific factors i in year t. All variables are defined in Table 2.

4. Empirical results and discussion

4.1 Descriptive statistics and correlation matrix

Table 3 reports the descriptive statistics based on sub-samples of the high- and low-tech industries. High-tech SMEs show, on average, higher performance than low-tech SMEs. Specifically, we see a higher mean ROA (0.04) in the high-tech group than in the low-tech group (ROA = 0.03). However, the low mean values of ROA in both industries imply that SMEs face difficulty achieving high performance. This is consistent with Xu and Li (2019), who report low financial performance in non high-tech SMEs compared with high-tech SMEs.

Nevertheless, high-tech SMEs show a higher mean value of growth opportunities (0.04) than low-tech SMEs (0.01). This indicates that intangible assets in high-tech firms outperform fixed tangible assets. This is because of the uniqueness and significant technological innovations in high-tech industries, as these firms often seize better growth opportunities through intangible assets and achieve higher expected returns, which is in line with D'Amato's (2021) findings. Contrary to our expectations, low-tech SMEs present values slightly above the mean values (HCE = 1.58, SCE = 0.30), compared with those of the high-tech industry (HCE = 1.49, SCE = 0.27). This indicates that SMEs in low-tech industries tend to create value from their IC resources more efficiently.

In addition, the mean of HCE in both industries (1.49, 1.58) is higher than the average combined value of CEE and SCE (0.65, 0.57) in the high- and low-tech industries, indicating that HCE creates more value for SMEs than SCE and CEE. Low-tech SMEs present a higher mean value of total debt than high-tech SMEs. Moreover, the two-sample *t*-test shows a significant difference between all variables used in this study.

Table 4 provides the Pearson correlation matrix, showing that HCE, SCE and CEE are positively and significantly associated with SME performance. However, debt financing is

Table 2. Definition of variables

Variables	Notations	Description
Human capital efficiency	*HCE*	Value added (VA) divided by total wages and salaries cost
Structural capital efficiency	*SCE*	VA minus human capital divided by VA
Capital employed efficiency	*CEE*	VA divided by total assets minus intangible assets
Debt financing	*DF*	Total debt to total assets
Firm age	*FA*	Natural log firm's age
Firm size	*FS*	Natural log of total assets
Firm growth	*FG*	Percentage change in annual sales
Firm tangibility	*FT*	Fixed assets to total assets
Firm liquidity	*FL*	Current assets divided by current liabilities
Return on assets	*ROA*	Net income divided by total assets

Notes: VA is calculated by operating profit + total employees' cost + depreciation + amortization
Source: Authors' own creation

Table 3. Descriptive statistics of sub-samples

	High-tech ($n = 3,563$)					Low-tech ($n = 3,730$)					Two-sample t-test
Variables	Obs.	Mean	SD	Min	Max	Obs	Mean	SD	Min	Max	(two-tailed)
ROA	28,504	0.04	0.06	−0.76	0.70	29,840	0.03	0.05	−0.63	0.79	22.42***
HCE	28,504	1.49	0.51	−4.09	7.94	29,840	1.58	0.63	−3.47	8.79	−18.24***
SCE	28,504	0.27	0.22	−3.27	3.74	29,840	0.30	0.24	−3.23	3.65	−15.03***
CEE	28,504	0.36	0.18	−0.95	2.86	29,840	0.29	0.15	−0.44	1.86	50.85***
DF	28,504	0.16	0.17	0.00	2.78	29,840	0.20	0.18	−0.24	0.90	−24.32***
FA	28,504	3.22	0.51	0.069	4.74	29,840	3.25	0.53	0.69	4.76	−5.63***
FS	28,504	15.48	0.69	12.23	17.57	29,840	15.62	0.60	14.51	17.56	−26.79***
FG	28,504	0.04	0.23	−0.99	2.71	29,840	0.01	0.17	−0.99	2.88	14.64***
FT	28,504	0.28	0.18	1.06	0.99	29,840	0.34	0.20	0.00	0.98	−35.79***
FL	28,504	1.65	1.41	0.00	18.18	29,840	1.54	1.47	0.03	18.03	9.45***

Notes: This table shows descriptive statistics of all variables used in the regression models. Obs, SD, Min and Max denote observations, standard deviation, minimum and maximum, respectively. We also report on the unpaired sample mean test (*T*-test). *** represents *p*-values = 0.01. Table 2 defines all variables
Source: Authors' own creation

negatively related to SME performance. We also use the variance inflation factor (VIF) for multicollinearity. Field (2013) stated that a VIF value exceeding 10 indicates a significant multicollinearity issue. In our case, coefficients are significant, and VIF values are low, indicating no multicollinearity issues.

4.2 Regression results

Table 5 presents the regression estimates of the direct effects of IC efficiency components and debt financing on the performance of high- and low-tech SMEs, and the moderating impact of debt financing on the IC efficiency components–SME performance relationship in high- and low-tech industries. Specifically, columns (1) and (4) present the regression estimates of firm-specific control variables on SME performance as stated in model (1). The FS and FG are negatively associated with SMEs performance in both industries. However, FS, FT and FL are positively and significantly associated with SME performance. Columns (2) and (5) of Table 5 exhibit the roles of HCE, SCE and CEE on SME performance, as shown in model (2). The coefficients of IC efficiency components are highly significant and positively related to SME performance irrespective of industry classification. This is in line with the empirical findings of Kujansivu and Lönnqvist (2007) and Xu and Li (2019), advocating that it is essential that SMEs invest in HCE, SCE and CEE to create IC efficiency to enhance performance and achieve competitive advantage in a knowledge-based economy. Moreover, our results support the RBV because IC is one of the most effective resources for creating value. Therefore, it is equally important for SMEs in both high- and low-tech industries to achieve high financial performance. Our results are consistent with studies that find positive and significant IC efficiency components–SME performance relationship (e.g. Holienka *et al*., 2016; Xu and Li, 2019).

Columns (2) and (5) of Table 5 also show the differentiated role of IC efficiency components in explaining SME performance in distinct industrial settings. We find that the positive effects of HCE and SCE on SME performance are higher in high-tech industries. Conversely, the positive effect of CEE is lower because low-tech SMEs tend to be more efficient in generating value-added efficiency from physical and financial capital. This is in line with the findings of Sardo and Serrasqueiro (2018), Buenechea-Elberdin *et al.* (2018)

Table 4. Correlation matrix of sub-sample

Variables	*ROA*	*HCE*	*SCE*	*CEE*	*DF*	*FA*	*FS*	*FG*	*FT*	*FL*
High-tech										
ROA	1									
HCE	0.708***	1								
SCE	0.619***	0.735***	1							
CEE	0.378***	0.018**	0.008	1						
DF	−0.289***	−0.183***	−0.122***	−0.054***	1					
FA	0.011	−0.021***	−0.026***	−0.077***	−0.087***	1				
FS	0.062***	0.269***	0.220***	−0.469***	−0.024***	0.114***	1			
FG	0.205***	0.161***	0.177***	0.099***	−0.016**	−0.065***	0.010	1		
FT	−0.149***	0.018	0.020***	−0.110***	0.290***	0.033***	0.137***	−0.036***	1	
FL	0.294***	0.284***	0.204***	−0.010	−0.360***	0.114***	0.076***	−0.059***	−0.187***	1
VIF		2.38	2.20	1.34	1.24	1.04	1.45	1.06	1.14	1.26
Low-tech										
ROA	1									
HCE	0.655***	1								
SCE	0.538***	0.680***	1							
CEE	0.446***	0.032***	0.0185**	1						
DF	−0.274***	−0.120***	−0.058***	−0.167***	1					
FA	−0.051***	−0.068***	−0.079***	−0.071***	−0.059***	1				
FS	0.045***	0.283***	0.217***	−0.361***	0.128***	0.154***	1			
FG	0.216***	0.178***	0.193***	0.123***	0.018	−0.083***	0.016**	1		
FT	−0.131***	0.036***	0.053***	−0.081***	0.233***	0.089***	0.255***	−0.019	1	
FL	0.269***	0.219***	0.138***	0.036***	−0.383***	0.106***	0.080***	−0.073***	−0.213***	1
VIF		2.04	1.89	1.21	1.26	1.07	1.42	1.08	1.17	1.30

Notes: VIF = variance inflation factor. Significance level: ***$p < 0.01$; **$p < 0.05$. Table 2 defines all variables
Source: Authors' own creation

Table 5. Baseline regression analysis

	Dependent variable: *ROA*					
	High-tech			Low-tech		
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Direct effects						
HCE		0.0654*** (0.0032)	0.0660*** (0.0034)		0.0440*** (0.0024)	0.0436*** (0.0023)
SCE		0.0436*** (0.0069)	0.0433*** (0.0071)		0.0180*** (0.0042)	0.0225*** (0.0045)
CEE		0.1924*** (0.0106)	0.1894*** (0.0103)		0.2721*** (0.0113)	0.2651*** (0.0109)
DF		−0.0253*** (0.0054)	−0.0228*** (0.0035)		−0.0238*** (0.0024)	−0.0288*** (0.0027)
Interaction effects						
HCE × *DF*			0.0115 (0.0170)			0.0168** (0.0084)
SCE × *DF*			−0.0036 (0.0340)			−0.0689*** (0.0181)
CEE × *DF*			−0.1095*** (0.0264)			−0.0836*** (0.0215)
Control variables						
FA	−0.0106* (0.0057)	0.0048 (0.0036)	0.0043 (0.0035)	−0.0052 (0.0048)	−0.0016 (0.0029)	−0.0015 (0.0029)
FS	0.0228*** (0.0028)	0.0288*** (0.0030)	0.0286*** (0.0029)	0.0163*** (0.0031)	0.0365*** (0.0028)	0.0352*** (0.0027)
FG	0.0444*** (0.0018)	0.0064*** (0.0009)	0.0065*** (0.0009)	0.0488*** (0.0024)	0.0059*** (0.0015)	0.0060*** (0.0015)
FT	−0.0888*** (0.0065)	−0.0451*** (0.0042)	−0.0438*** (0.0042)	−0.0763*** (0.0062)	−0.0324*** (0.0040)	−0.0314*** (0.0040)
FL	0.0022*** (0.0008)	0.0013*** (0.0005)	0.0014*** (0.0005)	0.0014** (0.0006)	0.0007** (0.0003)	0.0006* (0.0003)
Constant	−0.2671*** (0.0448)	−0.5871*** (0.0483)	0.0367*** (0.0009)	−0.1914*** (0.0489)	−0.6768*** (0.0439)	0.0342*** (0.0008)
Country and year fixed effects	Included	Included	Included	Included	Included	Included
Observations	28504	28504	28504	29840	29840	29840
Hausman test (chi2)	306.18***	902.63***	1045.32***	589.46***	1660.08***	1775.24***
R^2	0.120	0.654	0.656	0.099	0.628	0.633
Changes in R^2		0.534***	0.002***		0.529***	0.005***
F-statistic	108.763	369.656	369.231	98.051	456.179	409.707

Notes: Standard errors are in parentheses. Sig. level: ***$p < 0.01$; **$p < 0.05$; and *$p < 0.10$. Table 2 defines all variables
Source: Authors' own creation

and Xu and Li (2019), suggesting that high-tech SMEs are more likely than low-tech SMEs to invest in IC to achieve a competitive position, because the former are knowledge-intensive, and may differ from low-tech industries in terms of knowledge creation.

Meanwhile, the regression estimates of debt financing on SME performance in columns (2) and (5) show that the coefficients on debt financing are negative and significant at the 1% level across high- and low-tech industries. This result is consistent with the POT, which implies that SMEs prioritize their sources of financing in a hierarchical manner: use internal funds first (i.e. retained earnings) followed by external financing sources (Myers and Majluf, 1984). This is consistent with the findings of Abor (2007) and Yazdanfar and Öhman (2015), arguing that debt financing is likely to increase agency costs and enhance the chances of losing control rights over the firms. Therefore, a negative and significant association between debt financing and SME performance is demonstrated. In addition, columns (2) and (5) show that the direct effects of IC efficiency components and debt financing significantly increased the variance in SME performance in high- ($\Delta R^2 = 0.534, p < 0.001$) and low-tech ($\Delta R^2 = 0.529, p < 0.001$) industries.

Furthermore, columns (3) and (6) of Table 5 show the moderating effect of debt financing on the IC efficiency components–SME performance relationship for high- and low-tech industries as described in model (3). Specifically, column (3) shows that debt financing does not significantly moderate the relationships of HCE and SCE with SME performance for high-tech industries, suggesting that high-tech SMEs are less likely to disclose their business strategies. Moreover, column (6) reports that debt financing significantly and positively interacts with the HCE–SME performance relationship, indicating that debt financing has a disciplinary and monitoring role in managing value creation through HC efficiency via investments in projects that add value to the SMEs in low-tech industries. This is in line with AT, arguing the ability of debt holders to regulate and monitor managers' behavior, debt financing dispels investments that may have been misallocated, reduces agency costs, and therefore improves SME performance (Jensen and Meckling, 1976). However, debt financing negatively moderates the SCE–SME performance relationship.

Moreover, as shown in columns (3) and (6), debt financing negatively moderates the CEE–SMEs performance relationship in both high- and low-tech industries. This confirms the collateral role of asset tangibility, which limits SMEs' ability to acquire more debt as the borrowing cost is relatively high because of low collateral value, given that SMEs generally own a small proportion of fixed assets and therefore prefer internal financing sources, as POT suggests (Myers and Majluf, 1984; Yazdanfar and Öhman, 2015). Furthermore, knowledge-intensive assets in high-tech SMEs hinder their capacity to provide collateral to external lenders (Hall, 2002) (Table 5).

4.3 Robustness check

Endogeneity among variables is a common issue when investigating the relationships among IC, debt financing and SME performance. Therefore, as a robustness check, we refer to Roodman (2009) and follow a dynamic panel data technique that involves a two-step system generalized method of moments (GMM) approach with a one-year lag for instrumenting the lagged dependent variables to decrease the impact of any unobserved heterogeneity and endogeneity issues. This technique addresses endogeneity and reverses causation between variables through valid instruments. The GMM estimator can also improve fixed effect estimations by dealing with endogeneity and constructing instrumental variables from the data set. Hence, we reestimate models (1)–(3), and the results are reported in Table 6. Our results are consistent with the baseline regression estimates, suggesting that our findings are not influenced by endogeneity issues. In addition, we run several post-estimation tests to rule out probable autocorrelation and over-identification issues. The two-step system GMM is

Table 6. Two-step system GMM analysis

	Dependent variable: *ROA*					
	High-tech			Low-tech		
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
$ROA_{(t-1)}$	0.211*** (0.074)	0.494*** (0.153)	0.127*** (0.046)	0.570*** (0.084)	0.323*** (0.034)	0.131*** (0.048)
Direct effects						
HCE		0.198** (0.099)	0.083*** (0.029)		0.063*** (0.016)	0.050*** (0.008)
SCE		0.573* (0.343)	0.062* (0.037)		0.126* (0.068)	0.047*** (0.011)
CEE		0.238*** (0.071)	0.089*** (0.018)		0.260*** (0.089)	0.140*** (0.012)
DF		−0.020* (0.011)	−0.049 (0.056)		−0.030*** (0.004)	−0.033 (0.021)
Interaction effects						
HCE × *DF*			0.671 (0.548)			0.042*** (0.014)
SCE × *DF*			−0.780 (0.890)			−0.119*** (0.027)
CEE × *DF*			−1.755*** (0.524)			−0.568*** (0.204)
Control variables	Included	Included	Included	Included	Included	Included
Country and year fixed effects	Included	Included	Included	Included	Included	Included
Observations	24941	24941	24941	26110	26110	26110
AR(2)(p-value)	0.552	0.649	0.293	0.111	0.385	0.519
Hansen test (p-value)	0.201	0.600	0.494	0.447	0.677	0.699
F-value	24.958	104.156	344.772	335.786	465.949	197.591

Notes: Standard errors are in parentheses. Sig. level: ***$p < 0.01$; **$p < 0.05$; and *$p < 0.10$. Table 2 defines all variables
Source: Authors' own creation

valid only if the instruments are valid and there is no second-order autocorrelation. The acceptance of the null hypothesis of the second autocorrelation and the Hansen tests exhibit that our instruments are valid and fall under the recommended threshold (Roodman, 2009).

5. Conclusion

This study explores whether debt financing plays a critical moderating role in the IC components–SME performance relationship in distinct industrial environments. Using a FEM to examine longitudinal panel data of 7,293 Southwestern European SMEs in high- and low-tech industries from 2013 to 2020, our results are threefold. First, we show that the positive effects of HCE and SCE on SME performance is higher for high- than low-tech industries. However, the positive effect of CEE on SME performance is higher for low-tech industries. According to Delgado-Verde *et al.* (2016), human capital (HC), which includes employees' ideas, talent, creativity, abilities and individual creativity and skill, is the first stage of the overall innovation process responsible for SME competitive success in high-tech developments. Similarly, the institutionalized knowledge, technologies and organizational routines encapsulated in the concept of SCE are key drivers reinforcing the firm's HC in developing continuous and radical innovations as the basis for the competitiveness and performance of high-techs.

Second, our findings align with previous research, indicating that the costs associated with borrowing are detrimental to SMEs performance. Our results support the POT, suggesting that SMEs prefer to use their internal funds, such as retained earnings, rather than seeking external financing. This preference stems from the fact that SMEs operate in an opaque information environment, the under-collateralization and lack of financial skills, further making it challenging for financial institutions like banks to accurately assess SMEs ability to meet debt obligations (Myers and Majluf, 1984; Berger and Udell, 2006). Thus, our results confirm that debt financing is negatively associated with SMEs performance.

Finally, our findings show one of the most intriguing insights of our empirical research, confirming the expected role of debt financing in building and using IC (Dalwai and Sewpersadh, 2021). Debt financing has a differentiated moderating role in explaining the relationship between IC efficiency components and SME performance across industries. Specifically, debt financing has similar and differentiated moderating roles depending on SME's technological profiles. This way, debt financing attenuates the positive role of CEE on firm performance in both high- and low-tech SMEs. Nevertheless, our empirical results show significant and divergent moderating roles of debt financing on the relationships between IC and the firm performance of low-tech SMEs. More concretely, debt financing attenuates the positive effect of SCE on firm performance of low-tech SMEs. According to AT, higher levels of debt financing can lead to higher agency costs and financial distress, leading to decreased use and development of SC assets due to the risky and financially constrained nature of intangible assets (Dalwai and Sewpersadh, 2021; Frank and Goyal, 2009).

Nevertheless, debt financing accentuates the positive impact of HCE on the performance of low-tech SMEs due to the relatively reduced levels of agency costs of HC, which are embodied in the company's employees, which permits human capital endowment flexibility. This way, HCE repositioning would be relatively not difficult in the case of bankruptcy. As a robustness check, we use system GMM estimation to rule out possible endogeneity issues and obtain results consistent with our baseline regression.

5.1 Theoretical implications

Theoretically, our study builds on existing literature about the connection between IC and SMEs performance in distinct industrial settings. We provide new empirical evidence on *whether* each IC efficiency component differently impacts SME performance and *how* debt financing

influences IC efficiency components and SME relationships. Unlike previous studies that primarily focus on the direct impact of IC on SME performance in a single country or industry (e.g. Holienka *et al.*, 2016; Li *et al.*, 2020), and suggest that the impact of IC on SMEs performance relationship is direct and inherently positive, our findings show that the firm's financing decisions, especially the use of debt financing, could challenge this intuition. To address this research gap, our study highlights the differential moderating effect of debt financing on the IC–SMEs performance relationship concerning industry classifications.

Moreover, our findings validate the relevance of multi-theoretical frameworks in explaining IC, debt financing and SME performance relationships, suggesting that the overall IC efficiency components are significant for all measures of SMEs performance. Specifically, our findings draw the inference that physical capital (CEE) continues to play a significant role in boosting and increasing the SME's performance for low-tech industries. Whereas the stronger positive effect of HCE and SCE in high-tech industries indicates that high-tech SMEs mainly focus on gaining value from investing in the enhancement of knowledge, skills of the employees and technological know-how (Delgado-Verde *et al.*, 2016).

In addition, the negative interaction effect of IC and debt financing on SME performance indicates that excessive debt is likely to reduce profitability, which may make SME owners and managers hesitant to invest in necessary IC resources unless they bring more equity into their firms. To address information asymmetry and moral hazard between SMEs and financial institutions, such as banks, SME owners and managers should prioritize high-level principles on SMEs financing (OECD, 2022). These principles can strengthen SMEs access to traditional bank financing while also promoting nonbank financing, thereby overall improving SMEs relationships with financial institutions in the business environment.

5.2 Practical implications

Practically, our study reinvigorates the importance of regulating and improving IC disclosure in enhancing SMEs debt servicing capacity. Our findings are valuable for investors and shareholders, to critically evaluate the distinctive role of IC efficiency components in SMEs around different technological levels, thus help magnifying investment decisions in IC to achieve higher SMEs performance. For policymakers and regulators, our study stresses the need to address how high agency costs and information asymmetry associated with debt financing may restrict SMEs' ability to invest IC resources. In this regard, our study suggests that efforts should be made to foster debt financing instruments for SMEs by implementing transparency measures in financial markets. This could encourage greater investor participation and improve SMEs borrowing capacity, leading to more efficient IC resource allocation.

5.3 Limitations

This study has some limitations that open avenues for future research. Specifically, the study's sample is limited to nonfinancial high- and low-tech SMEs in Southwestern European countries; hence, generalizability is limited. Therefore, it would be beneficial to investigate the role of debt financing in the IC–SME performance relationship in emerging economies with distinct socioeconomic factors. Moreover, future studies can consider an alternative measure of IC and market-based financial performance indicators, which can effectively provide further novel insights.

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