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The impact of the level, type, and diversity of Top Management Teams' human capital on firm performance: An empirical analysis of Portugal, 2010 – 2023

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Abstract

Firms operate in increasingly complex environments shaped by globalization, digitalization, sustainability pressures, and intensifying competition, making strategic leadership a decisive factor for performance. Existing research on Top Management Teams (TMT) has mostly focused on CEOs or Boards of Directors, analyzing sociodemographic traits or static characteristics, often in small or sector-specific samples. However, little is known about how the evolution and combinations of the human capital of TMT members (encompassing top managers and executives), particularly their formal education and professional experience, shape firm-level outcomes across an entire economy.

To address this gap, this study examines the impact of TMT's human capital on firm performance in Portugal between 2010 and 2023, drawing on a unique, economy-wide matched panel from the *Quadros de Pessoal* (Personnel Records) and *Sistema de Contas Integradas das Empresas* (Integrated Business Accounts System) databases.

The final dataset covers 2.18 million firm-year observations from 363,308 firms, allowing for unprecedented scope and representativeness in TMT research. Using real gross value added per worker as the main performance measure and applying panel econometric techniques, the study develops original measures of educational and professional alignment, as well as curated diversity metrics, to capture nuanced dimensions of managerial human capital. The findings reveal that education and experience aligned with a firm's industry significantly enhance productivity, while curated heterogeneity in education levels contributes positively, but excessive dispersion in experience undermines performance. These results reconcile mixed evidence on diversity by distinguishing between breadth and dispersion, and show that managerial fit amplifies firm-specific value creation. The study contributes methodologically, conceptually, and empirically to the upper echelons and human capital literatures, moving beyond CEO-centric and financial-performance studies. Policy implications highlight the value of fostering industry-specific managerial skills, promoting mobility across adjacent sectors, and integrating managerial training with workforce development and R&D support, as levers to enhance productivity and competitiveness.

Keywords: Top Management Teams, Human Capital, Formal Education, Professional Experience, Firm Performance, Panel Data

Resumo

As empresas atuam em contextos cada vez mais complexos, moldados pela globalização, digitalização, pressões de sustentabilidade, e intensificação da concorrência, tornando a liderança estratégica um fator decisivo do desempenho. A literatura existente sobre as equipas de gestão de topo (TMT) centra-se, maioritariamente, nos Diretores Executivos (CEOs) ou Conselho de Administração, analisando características sociodemográficas ou atributos estáticos, frequentemente em amostras reduzidas ou específicas a certos setores. No entanto, pouco se sabe sobre como a evolução e as combinações do capital humano dos membros das TMT (incluindo gestores de topo e executivos), em particular a sua educação formal e experiência profissional, influenciam os resultados das empresas em toda a economia.

Para abordar esta lacuna, o presente estudo analisa o impacto do capital humano das TMT no desempenho das empresas em Portugal, entre 2010 e 2023, com base num painel único e abrangente à escala da economia, elaborado a partir das bases de dados Quadros de Pessoal e Sistema de Contas Integradas das Empresas.

O painel final abrange 2.18 milhões de observações empresa-ano referentes a 363,308 empresas, permitindo um alcance e representatividade sem precedentes na investigação sobre TMT. Utilizando o valor acrescentado bruto real, por trabalhador, como principal medida de desempenho, e aplicando técnicas econométricas para dados em painel, este estudo desenvolve medidas originais de alinhamento ao nível da educação formal e experiência profissional, bem como indicadores de diversidade para capturar as nuances das dimensões do capital humano. Os resultados revelam que a educação formal e a experiência profissional alinhados com o setor da atividade da empresa impactam positiva e significativamente a produtividade e, enquanto uma heterogeneidade cuidada nos níveis de escolaridade contribui positivamente, uma dispersão excessiva na experiência profissional compromete o desempenho. Estes resultados conciliam evidências mistas sobre a diversidade, ao distinguir entre amplitude e dispersão, e demonstram que '*managerial fit*' amplifica a criação de valor específico da empresa. O estudo contribui metodologicamente, conceptualmente, e empiricamente para a literatura sobre '*upper echelons*' e capital humano, indo para além dos estudos focados nos CEOs e no desempenho financeiro. As implicações ao nível de política destacam a importância de promover competências de gestão específicas ao setor, promover

a mobilidade entre setores adjacentes, e de integrar a formação em gestão com o desenvolvimento da força de trabalho e apoio à investigação e desenvolvimento, como alavancas para melhorar a produtividade e a competitividade.

Palavras-chave: Equipas de Gestão de Topo, Capital Humano, Educação Formal, Experiência Profissional, Desempenho da Empresa, Dados em Painel

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Abbreviations

AgT – Agency Theory

BoD – Board of Directors

CAE Rev.3 – Portuguese Classification of Economic Activities, Revision 3 (*Classificação Portuguesa de Atividades Económicas, Revisão 3*)

CEO – Chief Executive Officer

CFO – Chief Financial Officer

CIT/IRC – Corporate Income Tax (*Imposto sobre o Rendimento das Pessoas Coletivas*)

COO – Chief Operating Officer

CPP 2010 –Portuguese Classification of Occupations of 2010

CTO – Chief Technology Officer

EBIT – Earnings Before Interest and Taxes

FE – Panel Fixed Effects

GEP – Office for Strategy and Studies (*Gabinete de Estratégia e Planeamento*)

GVA – Gross Value Added

HCT – Human Capital Theory

HR – Human Resources

IES – Simplified Corporate Information (*Informação Empresarial Simplificada*)

INE – Statistics Portugal (*Instituto Nacional de Estatística*)

IPO – Initial Public Offering

NUTSII – Nomenclature of Territorial Units for Statistics II (*Nomenclatura das Unidades Territoriais para Fins Estatísticos*)

OLS – Ordinary Least Squares

POLS – Pooled Ordinary Least Squares

QP – Personnel Records database *(Quadros de Pessoal)*

R&D – Research and Development

RDT – Resource Dependence Theory

RE – Panel Random Effects

ROA – Return on Assets

ROE – Return on Equity

SCIE – Integrated Business Accounts System *(Sistema de Contas Integradas das Empresas)*

SMEs – Small and Medium-sized Enterprises

SNC – Accounting Standardisation System (*Sistema de Normalização Contabilística*)

STEM – Science, Technology, Engineering, and Mathematics

TMT – Top Management Teams

UET – Upper Echelons Theory

VIFs – Variance Inflation Factors

1. Introduction

Firms are facing increasing challenges due to globalization, digitalization, sustainability concerns, and heightening competition, which contribute to the complexity of their operations and management of the same (e.g., Karlilar *et al.*, 2023; Lei *et al.*, 2024).

The definition of a firm's strategy is mostly a responsibility of its Top Management Teams (TMT), which encompasses top managers and/or executives, such as Chief Executive Officers (CEOs), Chief Operating Officers (COOs), Chief Financial Officers (CFOs), and the Board of Directors (BoD). That said, TMT members' personal traits and characteristics tend to influence the strategic choices made, and the resulting outcomes (Jiang & Kim, 2022; Urquhart & Zhang, 2022; Kumar, 2023; Madyan *et al.*, 2023; Ullah *et al.*, 2024).

The extant literature has analysed various characteristics of firms' CEOs (e.g., Kallias *et al.*, 2023) and/or BoDs (e.g., Kramarić & Miletić, 2022; Yilmaz *et al.*, 2023), and their impact on several business dimensions, mainly on firms' financial performance (e.g., Adams & Baker, 2021; Haque *et al.*, 2022; Kramarić & Miletić, 2022; Choi *et al.*, 2023; Istipliler *et al.*, 2023). Among the variety of characteristics analysed, there has been a particular emphasis on sociodemographic perspectives, such as gender (e.g., Yilmaz *et al.*, 2023), cultural diversity (e.g., Adams & Baker, 2021), and academic background (e.g., Kramarić & Miletić, 2022; Urquhart & Zhang, 2022).

The depth with which these traits are studied varies. While some studies, such as Urquhart and Zhang (2022) and Salimi *et al.* (2024), examined the possession of an academic degree, others also considered the degree's field of study such as, for instance, engineering or law (e.g., Boubaker *et al.*, 2020; Schmid & Mitterreiter, 2021), and the quality of education, usually reflected by the university's reputation and/or ranking (e.g., Urquhart & Zhang, 2022; Kallias *et al.*, 2023).

Despite the relevant contributions of prior research, in most studies the authors did not consider the changes/evolution of top executives'/managers' characteristics over time; moreover, they do not take into account the impact that different combinations of the levels/dimensions of these characteristics (e.g., high educational level with lower tenure) have on firms' economic and/or financial performance. Jiang and Kim (2022) is one of the few studies that has analysed such combinations, but without considering their impact on

economic or financial performance, examining instead how different configurations of TMT's characteristics (education, tenure, age, career experience, and size) affect public firms' tax planning. In addition, studies tend to often focus on firms operating in a specific sector, such as manufacturing (e.g., Kramarić & Miletić, 2022; Xu & Li, 2023) and banking (e.g., Hazzaa *et al.*, 2024), or only consider listed firms (e.g., Davoine & Schmid, 2022; Madyan *et al.*, 2023).

In this context, the present study seeks to contribute to the literature by assessing how TMT members' human capital, focusing on their formal education (level and type) and professional experience (level and type), impacts the performance of firms operating in Portugal, for the 2010 – 2023 period.

For this purpose, and in contrast to the extant relevant literature, which encompasses, in general, small samples of firms, the present study involves a large number of observations by combining the Personnel Records (*Quadros de Pessoal*) (QP) database with the Integrated Business Accounts System (*Sistema de Contas Integradas das Empresas*) (SCIE) database. The former database (QP) includes, on average, around 290 thousand firms and three million workers per year, over a wide period (1986 – 2023), encompassing virtually all sectors of the economy, except those in the public sector. The latter database (SCIE) provides information about firms' economic and financial indicators based on annual data collected from firms' Simplified Corporate Information (*Informação Empresarial Simplificada*) (IES), Annexes A and R, for over 400 thousand non-financial firms operating in Portugal (exceeding one million when sole proprietorship firms are also considered), per year, since 2010.

This dissertation is structured as follows. After this introduction, Section 2 develops a comprehensive literature review of the main theories on which the study will be based, and details the study's two main variables (formal education and professional experience), addressing the expected effects and hypotheses to be tested. In Section 3, an overview of the study's methodology is presented, followed in Section 4 by the presentation and discussion of the empirical results. Finally, in Section 5, we conclude with the presentation of a brief overview of the main results, contributions to the literature, theoretical, managerial, and policy implications, as well as limitations and suggestions for future research.

2. Literature review

2.1. General description of the main theoretical approaches

The studies that focus on analysing the impact of TMT's characteristics (most notably, formal education and professional experience) on firms' performance resort to a variety of theories with distinct foundations and focuses, the most prominent being: Human Capital Theory; Resource Dependence Theory; Agency Theory, and Upper Echelons Theory.

2.1.1 Human Capital Theory

The Human Capital Theory (HCT) establishes that investments in human capital,[1] such as education, (on-the-job) training courses and medical care, increase knowledge, skills, and the health of individuals, positively impacting their future productivity, income and consumption. According to Becker (1993), regardless of the country considered, the reality is that individuals with more human capital can obtain above average/higher incomes, meaning that individuals with fewer opportunities to make such investments tend to be less productive and, because of that, receive, in general, lower wages over their life cycle (Davenport, 1999/2007).

That is to say, investments in human capital, in particular education and training, increase workers' productivity by enhancing existing and providing new knowledge/skills (Becker, 1993; Davenport, 1999/2007), ultimately impacting firms' aggregate productivity, innovation, economic and financial performance (Teixeira, 2002; Hatch & Dyer, 2004; Crook *et al.*, 2011).

2.1.2 Resource Dependence Theory

Moving forward from the individual perspective of HCT to a more collective view is the Resource Dependence Theory (RDT) (Pfeffer & Salancik, 1978/2003).

[1] Human capital is defined by Becker (1992) as the aspects that cannot be detached from individuals (contrary to what happens with financial and physical capital), such as, knowledge, skills, health or values, and in which one can invest on (e.g., through schooling).

RDT seeks to understand the behaviour of the firm by considering its environment, that is, considering "… every event in the world which has any effect on the activities or outcomes of the organization" (Pfeffer & Salancik, 1978/2003, p.12). Specifically, it focuses on the access to resources and intends to understand firms' decisions and actions, not by looking at their internal dimension and on an individual level, but by looking at the influence that firms' external environment has on such elements, in which BoD's composition is included. At a general level, RDT considers that firms, in their interactions with their external environment, create networks of interdependences, potentially leading to them being dependent on and/or constrained by their respective external environment in crucial elements for their operations, such as resources and information.

Applying this theoretical framework to the survival of firms, Pfeffer and Salancik (1978/2003) consider that "the key to organizational survival is the ability to acquire and maintain resources" (p. 2) and, since no firm can be completely self-sufficient, they have to rely on third parties for the supply of resources. The problem lies with the stability of such supply and the uncertainty that comes from such dependencies, which, later down the line, can place the firm in situations that, due to external changes, put their survival at risk. Additionally, such dependencies are also influenced by the power of those with whom firms have interdependencies with – for example, the power of a supplier will be greater if there are only a few suppliers of the product/service; but also, by the power of some integrating elements of the firm, due to their role in contributing to the control of uncertainty, external dependencies and, ultimately, the firm's survival (Pfeffer & Salancik, 1978/2003). In response, and to manage constraints arising from interdependencies, some strategic actions may emerge, most of which involve joint ventures, alliances, mergers and the composition of the BoD, or even the influence in public policy (Pfeffer & Salancik, 1978/2003).

2.1.3 Agency Theory

Building on the belief that relationships should be managed cleverly, the Agency Theory (AgT) moves the focus to an internal perspective, specifically to the relationships between principal and agents (Jensen & Meckling, 1976; Fama & Jensen, 1983). This theory is based on the notion that individuals have a maximising behaviour within organisations, in other words, they make decisions that better contribute to the maximisation of their own utility, influenced by the propriety rights defined in the agreement made between a firm's

management and owners (Jensen & Meckling, 1976; Fama & Jensen, 1983). Jensen and Meckling (1976) consider an agency relationship to be an agreement between the principal(s) and agent, where the first delegates a service to the latter, which involves the ceding of decisive power. The problem is that, if the agent is maximising his/her own utility, he/she will not be acting in the best interest of the principal, but in their own self-interest, thus creating a conflict of interests between the principal and the agent. There are some measures that can be put in place in order to minimise the chance of engaging in such behaviour, such as placing incentives, observe and control the behaviour of the agent (monitoring expenditures) and/or incur in bonding costs, in order to prevent the agent from acting in a way that jeopardizes the principal or to ensure that the latter is compensated if such behaviour is carried out (Jensen & Meckling, 1976; Fama & Jensen, 1983). These two costs together with what is named as residual loss (reduction in the principal's welfare due to the divergence between the agent's decisions and what would have been best to maximise the principal's welfare), make for what is commonly known as agency costs (Jensen & Meckling, 1976; Fama & Jensen, 1983).

This theory considers crucial the separation between ownership and control, i.e., between management and control of decisions (Miller, 2002), ensuring shareholders that these are taken in their best interest. Among the different mechanisms to guarantee this separation, the most common control system and important mechanism in firm-level internal governance is that of the BoD, which, while monitoring management's decisions, has the "power to hire, fire, and compensate the top-level decision managers and to ratify and monitor important decisions" (Fama & Jensen, 1983, p. 311). The separation between decision management and control at the top level of the organization is ensured by the fact that decision management does not have an influence on the BoD (Miller, 2002; Sikarwar, 2022).

The AgT is often applied in the context of analysing the characteristics/behaviours of BoD, and their respective impact on board or firms' performance, contributing to a better understanding of the characteristics that allow board members to better perform their monitoring role. For instance, Mesnik *et al.* (2023) analysed the impact on (non) family firms' performance of the presence of outside directors on the BoD, having concluded that, in the case of family firms, the presence of such directors contributes positively to firms' financial

performance, since it conveys to the capital market the message of transparency and of control over decisions.

2.1.4 Upper Echelons Theory

While the AgT is focused on the principal-agent relationship, emphasising the importance of objective alignment and mitigation of conflicts of interests, the Upper Echelons Theory (UET) is focused on the strategic dimension of the firm and, in specific, how top executives' characteristics impact strategic choices, having also the particularity of focusing on the characteristics of the entire TMT, and not on one single element that constitutes it (Hambrick & Mason, 1984; Li & Singal, 2019; Mun *et al.*, 2020; Nawaz, 2022; Bilal *et al.*, 2023).

The UET is based on a behavioural theory from Carnegie School that states that complex decisions, in which strategic decisions are included, are mostly a result not of the pursuit of economic benefit, but of behavioural factors. If that happens to be the case, the cognitive base (knowledge/assumptions of future events, knowledge of alternatives and respective consequences), beliefs and values (which are constantly in contact and changed by potential stimuli, from both within and external to the firm), will impact individuals' perception of a problem, influencing the analysis of the same and, ultimately, the choices made (Hambrick & Mason, 1984).

While (further) developing this theory, Hambrick and Mason (1984) focused on observable managerial characteristics, as a proxy for what they refer to as givens (meaning the cognitive base and values of an individual); to these psychological and observable characteristics, the authors gave the name of upper echelons characteristics, which reflect the external and internal situation of the organization. The combination of the situation and upper echelons characteristics will impact the strategic choices made and, ultimately, the combination of these three elements (situation, upper echelons characteristics and strategic choices) will determine firms' performance.

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In summary, all these theories, can be applied to this study to some extent. While HCT focuses on individuals' characteristics in terms of knowledge, skills and experience, RDT, on the other hand, is based on firms' relationships and the sources of the resources that are crucial for the firms' survival, among which, we can consider the resources provided by the workforce. This latter theory, together with the AgT (which states the different agency costs

incurred to ensure that agents are making decisions in the interest of principals, and not in their own interest) are usually applied when analysing board members' characteristics. This is due to the fact that, in both cases, it is highlighted the importance of the BoD to decrease firms' dependence on the external environment (RDT) and to control managements' decisions (AgT), implying BoD's advisory and monitoring role, respectively. Finally, the UET brings a more strategic view, being the only one among these theories to focus specifically on TMT, stating that their psychological and observable characteristics (influenced by the organization's situation) will impact the strategic choices made and, ultimately, the firm's performance.

2.2. Formal education

According to the Human Capital Theory (HCT) (Becker, 1962, 1993) it is expected that human capital investments, especially, formal education (often used as a proxy for individuals' cognitive abilities) will contribute to the accumulation of knowledge and skills, providing individuals with the necessary tools to make better decisions and face (new) challenges, positively impacting their productivity and, consequently, their firm's performance (Schmid & Mitterreiter, 2021; Bilal *et al.*, 2023; Kallias *et al.*, 2023; Xu & Li, 2023; Salimi *et al.*, 2024; Wu *et al.*, 2024).

The Resource Dependence Theory (RDT) (Pfeffer & Salancik, 1978/2003) and Agency Theory (AgT) (Jensen & Meckling, 1976; Fama & Jensen, 1983), mostly used in studies focused on the BoD, add that formal education will impact BoD members' ability to perform their advisory/resource provisioning and monitoring roles, respectively. The RDT states that BoDs equip firms with their own valuable and unique resources, with a primary benefit being the advice and council given; consequently, the BoD members' formal education will enhance their ability to guide management's decisions, impacting firm performance (Pfeffer & Salancik, 1978/2003; Coşkun & Öztürk, 2023; Hazzaa *et al.*, 2024; Hernández-Atienza *et al.*, 2024). The AgT (Jensen & Meckling, 1976; Fama & Jensen, 1983), on the other hand, states that, in order to perform their monitoring role and to better guarantee the alignment between management's decisions and firms' abilities, BoD members must have appropriate expertise to better evaluate and understand what the best courses of action are – formal education contributing to such (Hillman & Dalziel, 2003; Uyar *et al.*, 2021; Sikarwar, 2022; Hazzaa *et al.*, 2024; Hernández-Atienza *et al.*, 2024; Ullah *et al.*, 2024).

With a specific focus on TMT's strategic decisions, Upper Echelons Theory (UET) (Hambrick & Mason, 1984) suggests that TMT's perceptions and interpretations of the challenges faced, and consequent decisions made, will be impacted by TMT's psychological characteristics (personality traits, perceptions, cognitions, and values), proxied by their socio--demographic characteristics (which include, for instance, formal education, age and gender). Formal education can then shape TMT's perspectives, decision-making process and risk--taking behaviour, and, subsequently, impact firms' outcomes through the strategic choices made.

Overall, according to the previously mentioned theories, formal education is expected to positively contribute to firms' performance by equipping individuals with the knowledge and skills required to fulfil their tasks/roles, as well as to make better (strategic) decisions – see Figure 1 for a synthesis of these main theoretical approaches.

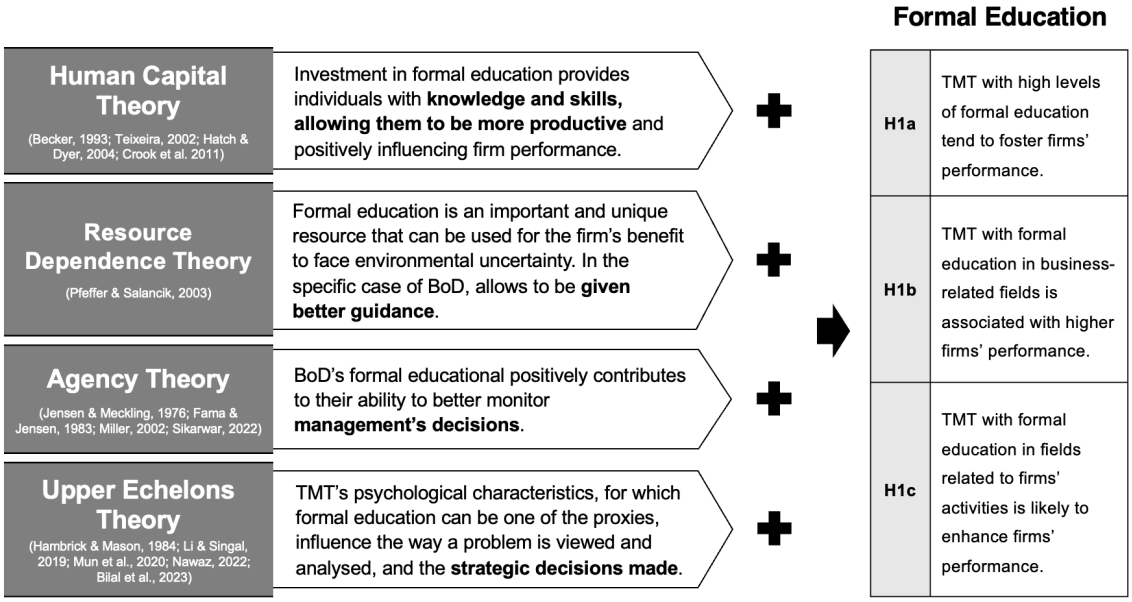


Figure 1: Theoretical framework and hypotheses to be tested on the impact of TMT's formal education on firms' performance

Source: Own elaboration.

Several empirical studies have concluded that TMT elements, in particular the BoDs and CEOs, having higher levels of education attainment contribute positively to firms' performance. For instance, Urquhart and Zhang (2022) concluded that CEOs with a PhD degree positively impacted firms' return on assets (ROA), the impact being even greater when the degree is from a top university. Likewise, Istipliler *et al.* (2023) concluded that CEOs successors possessing an academic degree are shielded from the biases that arise from having

experience in the family firm before the appointment,[2] allowing them to think critically and leading to unbiased decisions, at least in the first years,[3] positively contributing to family firms' profit margins after the succession. Moreover, Xu and Li (2023) concluded that BoDs' educational level has a positive relationship with research and development (R&D) intensity (emerging from BoD members' pro-innovation disposition), while Kallias *et al.* (2023) and Wu *et al.* (2024) demonstrated that CEOs and BoD members', respectively, having a PhD or MBA, positively impacted initial public offering (IPO) performance.[4]

However, other studies do not find evidence of any (significant) relationship between formal education and firms' performance. Hazzaa *et al.* (2024) concluded that there was no impact on Iraqi private banks' financial performance from its CEOs having a postgraduate education.[5] Likewise, Sidki *et al.* (2024) found that supervisory board members of German state-owned utility firms having a degree or PhD did not impact firms' financial performance. Urquhart and Zhang (2022), despite having found a significant positive impact on firms' performance from CEOs having a PhD degree, failed to encounter a statistically significant impact of CEOs holding a post and undergraduate degree, or MBA degree, on firms' financial performance. Similarly, Xu and Li (2023) concluded that boards' education level positively impacted R&D intensity, while the relationship between CEO's educational level and R&D intensity was statistically insignificant. Furthermore, it is important to note that there are some studies that also find a statistically significant and negative impact of the level of formal education on firm performance. Indeed, Dalziel *et al.* (2011) found that outside directors with doctoral degrees negatively impacted firms' innovation performance (measured by the firm's average R&D expenses).

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[2] The authors identify four main biases that can potentially harm firms' performance: attribution biases, story and organizational culture biases, confirmation and status quo biases, and lingering shadow biases.

[3] Notwithstanding, they found that the amount of time spent in the firm tends to increase the likelihood of such biases and the negative impact associated with them.

[4] Kallias *et al.* (2023) analysed its impact on the post-IPO success (higher evaluations being given to knowledge-intensive firms with CEOs with PhDs) and Wu *et al.* (2024) focused on its impact on the first day of transactions of an IPO, having concluded that BoD's formal education had a negative relationship with underpricing, meaning that it contributed to the decrease of the money left on the table by issuers, as well as to decrease the volatility and uncertainty after an IPO (the authors also concluded that boards with members holding PhDs are more important in research and development [R&D] firms, while for non-R&D firms, members with MBA degrees are more relevant).

[5] Hazzaa *et al.* (2024) explained that such could be potentially attributed to the specific nature of the banking sector.

Besides the level of formal education, some studies also analysed the impact of education quality, measured by the reputation of the school/university where the degree was obtained. Dalziel *et al.* (2011) and Urquhart and Zhang (2022) evidenced that CEOs with PhDs from an Ivy League university or from one of the top 100 universities worldwide (cf. the 2018 QS ranking), respectively, significantly and positively impacted firms' performance. In the same line, Madyan *et al.* (2023) argued that CEOs and CFOs with degrees from reputable universities are more likely to "take risks in managing their organizations" and "to choose long-term debt as a source of capital" (p. 15); the authors also showed that TMT's reputable university education was significantly and positively related to low-tech firms' debt-to-equity ratio, and high-tech firms' R&D investments decisions.[6]

The impact of CEOs and BoDs' field of education on firms' performance is examined by a relatively small number of studies. One of these few studies is that of Ullah *et al.* (2024), which analysed Chinese non-financial and listed firms, and concluded that CEOs having a postgraduate degree in science, engineering, research, or advanced studies contributed positively to firms' innovation (measured by R&D intensity). Distinctively, Kramarić and Miletić (2022) found no significant relationship between board members' financial education background and firms' performance, meaning that BoD members' having formal education in a specific field is not necessary condition to fulfil their roles – the authors suggested that it might be enough to have a university degree or equivalent skills to be able to comprehend the necessary information. In the same line, Sidki *et al.* (2024) concluded that supervisory board members' having a degree in business or technology did not impact firms' (financial) performance.

Having analysed the findings of empirical studies regarding formal education level, type (field of study) and quality, it is also important to take into account formal education's diversity. Several theoretical approaches address the issue of diversity and firms' performance, most notably the behavioural theory of the firm, similarity-attraction theory, and social categorization theory.

The behavioural theory of the firm (Cyert & March, 1963) suggests that firms define their goals and aspirations based on their competitors and their own prior experience. When firms

[6] This study also found that CEOs with an undergraduate degree and CFOs with postgraduate degree, both from a reputable university, have a significant relationship with firms' capital structure, and that CEOs are more influential in high-low growth and tech firms, while CFOs are more influential in low-growth firms.

underperform, they assess their strategy, looking for the sources of their underperformance and for possible (and often riskier) solutions and changes deemed necessary ("problemistic search"), being crucial, for the sake of a quick response/action-taking, to reach a consensus – these two aspects, search and consensus, will lead to the need to seek new perspectives (Jung *et al.*, 2023; Zhu *et al.*, 2023; Smulowitz *et al.*, 2025). The decisions will be more innovative when there is more comprehensive information available in the decision-making process (Miller & Triana, 2009; Li & He, 2023). With a diverse decision-making group, the risk for biased decisions (which can arise from having a homogeneous group) is diminished, making way to different perspectives and knowledge to be taken into account during the decision-making process, leading to innovative ideas and solutions (Miller & Triana, 2009; Li & He, 2023).

Conversely, the similarity-attraction theory and social categorization theory suggest a negative impact of diversity. The similarity-attraction theory (Byrne, 1961, 1971; Byrne *et al.*, 1966) establishes that common background, characteristics, and experiences are the basis for communication and understanding one another; therefore, individuals will resonate with others that have similar characteristics, in a way leading to (and possibly being used as a tool for) the grouping of individuals into categories. Consequently, the presence/inclusion of diverse members can affect the cooperation and interactions within a group and lead to negative behaviours towards those deemed different, discouraging the same from sharing their ideas and perspectives, and hindering the decision-making process (Li & He, 2023; Jiao *et al.*, 2024). For instance, Jiao *et al.* (2024) found evidence that entrepreneurial team resilience diversity impacted negatively team-member exchange.

Further supporting this is the social-categorization theory (Turner *et al.*, 1987), stating that individuals tend to self-categorise into in- and out-group based on the similarity of their objectives, incentives, and characteristics,[7] including their formal education and professional experience background. Individuals will favour and interact more comfortably with those that are part of their group, while being biased/discriminating against those that are not part of it, once again discouraging collaboration and the sharing of ideas and information between groups, and, consequently, impacting the decision-making process (Knapp *et al.*, 2011; Bogilović *et al.*, 2020; Li & He, 2023; Huang & Hao, 2024).

[7] If they are similar they are categorised as in-group, if not as out-group.

Granovetter's (1973) argument, present in his work "The strength of weak ties", is particularly relevant for the discussion on the relation between TMT education/professional experience diversity and firm performance. The author states that the strength of the ties between individuals is dependent on the amount of time, emotional intensity, intimacy and reciprocal services (the more similar individuals are, the stronger the ties between them will be); however, such strong ties can lead to fragmentation and the creation of "cliques". On the other hand, weak ties (i.e., more distinct individuals) are important for individuals' integration into communities, allowing a better diffusion of (a wide range of) information (i.e., individuals with weak ties between them will receive different information from one another) and to have mobility opportunities (e.g., job information is mainly passed on through weak ties), leading to social cohesion (contrary to what happens in the presence of strong ties). This notion can then be transposed to the current study, in the sense that having diverse networks (in which the observed/established ties are more likely to be weak ones), allows individuals to get in contact to a wide range of non-redundant information, which can be critical to firms' performance and success (Miller & Triana, 2009; Li & He, 2023).

All in all, diverse characteristics allow for individuals to have distinct networks and have different ideas and perspectives, creating cognitive conflicts, leading to creativity, identification of new opportunities and innovation, as well as affecting every step of the decision-making process (problem identification, solution development and selection), improving the quality of the solutions and decisions made (Bantel & Jackson, 1989; Milliken & Martins, 1996; Chi *et al.*, 2009; Li & He, 2023). On the other hand, diversity can also lead to a lack of unity/cohesiveness in a group, communication difficulties, conflicts, as well as complications in the decision-making process due to the multitude of opinions/perspectives, making it harder to reach a consensus, becoming important the presence of effective group discussions (Bantel & Jackson, 1989; Milliken & Martins, 1996; Li & He, 2023). However, Bantel and Jackson (1989) argue that, since TMT members are subject to prior specific recruitment and selection processes, firms' high levels of diversity are unlikely to severely harm TMT functioning and, consequently, endanger the decision-making process. These contrasting impacts (e.g., increased creativity/perspectives and potential conflicts/ communication issues) have led some authors to state that diversity can be seen as a double--edged sword (e.g., Milliken & Martins, 1996; Chi *et al.*, 2009; Li & He, 2023).

The theoretical approaches that explain the impact of TMT's diversity on firms' performance are summarised in Figure 2.

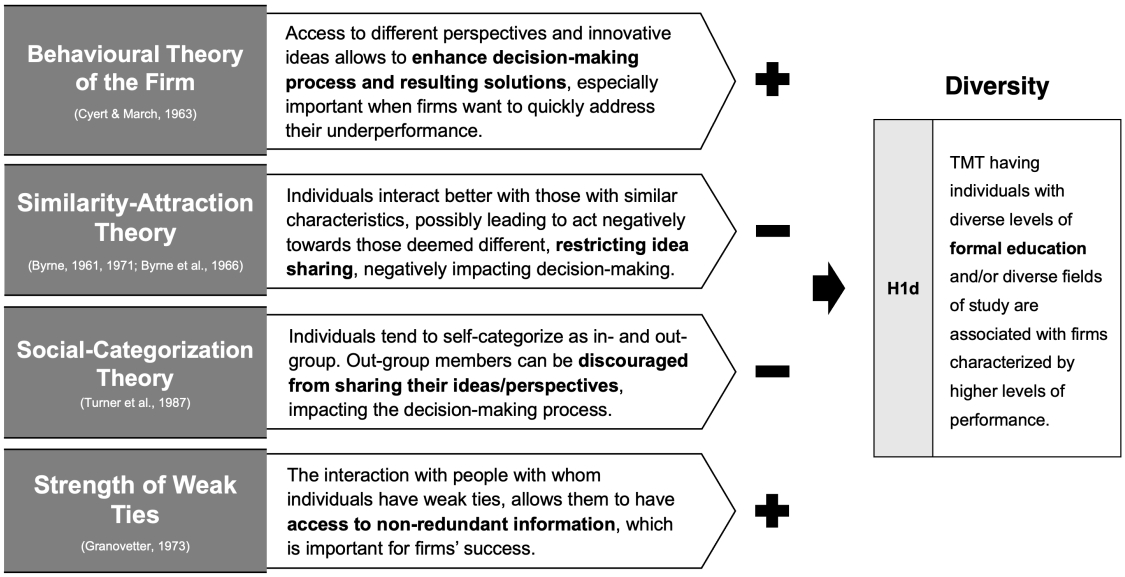


Figure 2: Theoretical framework and hypotheses to be tested on the impact of TMT's diversity of formal education on firms' performance

Source: Own elaboration.

Several studies find a positive impact of (formal education) diversity on firms' innovation and performance. Bantel and Jackson (1989) analysed the composition of TMT of 199 banks, concluding that the average level of education and educational background heterogeneity were positively related to innovation. Similarly, Li and He (2023) focused on the impact of BoD's cognitive and demographic characteristics diversity on Chinese listed firms' innovation. The authors concluded that cognitive diversity, in particular, educational background and expertise diversity, positively contributed to corporate innovation, while demographic diversity (as a whole) had no significant influence.

Hernández-Atienza *et al.* (2024) analysed how the diversity of characteristics of BoD's executive, non-executive and independent directors[8] impacted firm performance, concluding that executive directors' field of education diversity had a positive impact, while that of non-executive and independent directors was deemed insignificant. With the separation between the different types of directors, the study also aimed at assessing the explanatory pathway of

[8] Among the analysed characteristics, the authors assessed diversity in terms of depth (level of formal education diversity), for which the results were presented previously (negative impact on firm performance) and breath (field of study diversity); regarding this last one, due to limited available data, they were only able to analyse the diversity of financial expertise, not considering other fields.

the effect of board diversity – the authors stated that if the impact of diversity was more significant in executive directors (which have more of a strategic role) it would support the RDT, if more significant in non-executive directors (which have a more monitoring role) it would support the AgT, but if it was significant in independent directors (which fulfill both the strategic and monitoring roles) it would support both theories.[9] Accordingly, considering the previously mentioned results, Hernández-Atienza *et al.* (2024) validated the RDT.

Conversely, even though the primary focus of Chi *et al.* (2009) was testing the presence of a curvilinear relationship between organisational tenure diversity and team innovation, the authors found no evidence of the presence of a nonlinear relationship between educational level diversity (one of their study's control variables) and team innovation.

Taking into consideration the theoretical and empirical contributions detailed above, we hypothesise that:

H1a: TMT with high levels of formal education tend to foster firms' performance.

H1b: TMT with formal education in business-related fields is associated with higher firms' performance.

H1c: TMT with formal education in fields related to firms' activities is likely to enhance firms' performance.

H1d: TMT having individuals with diverse levels of formal education and/or diverse fields of study are associated with firms characterized by higher levels of performance.

[9] The logic behind this is that the Resource Dependence Theory (RDT) is more focused on BoD's advisory role, while the Agency Theory (AgT) is focused on more on BoD's monitoring role. According to the RDT, one of the ways to minimise firms' external dependencies involve the BoD, in the sense that, it provides firms with important resources (BoD resource provisioning role); in particular, BoD members' education and professional experience are seen as managerial and strategic resources, one of the primary benefits being the advice and counsel (advisory role) provided to firms. On the other hand, according to the AgT, one way of ensuring that decisions are made in the best interest of shareholders and that are in line with firms' capabilities and objectives, the BoD should monitor and control management's decisions (BoD's monitoring and controlling role), such ability being dependent on the BoD's human capital. So, Hernández-Atienza *et al.* (2024) state that, if the impact of diversity is more significant in executive directors means that the main pathway is the advisory/strategic role of the BoD, following the RDT perspective; if it is more significant in non-executive directors means that the main pathway is BoD's monitoring role, following the AgT perspective, and if it is more significant in independent directors means that the pathway is through both these roles, so supporting both theories.

2.3. Professional experience

Human Capital Theory (HCT) (Becker, 1962, 1993) establishes that the accumulation of expertise – mainly through professional experience/learning by doing –, in addition to that of knowledge and skills, will impact individuals' work skills and their ability to perform the tasks required in their job, positively impacting firms' performance (Schmid & Baldermann, 2021; Schmid & Mitterreiter, 2021; Bilal *et al.*, 2023; Kallias *et al.*, 2023; Xu & Li, 2023; Salimi *et al.*, 2024; Wu *et al.*, 2024).

Professional experience, according to the Resource Dependence Theory (RDT) (Pfeffer & Salancik, 1978/2003) and Agency Theory (AgT) (Jensen & Meckling, 1976; Fama & Jensen, 1983), can further enhance the BoD members' ability to perform their roles, shaping the way they govern/monitor, and the resources provided (Dalziel *et al.*, 2011). Pfeffer and Salancik (1978/2003) state that experience is essential to making decisions regarding the future, since firms base their decisions on past experiences, i.e., on previously taken actions and their respective consequences, to define future courses of actions and to establish their expectations regarding the impact these might have. In this sense, considering that prior experiences can shape decisions and recommendations made, experience can be seen as a key resource for firms (Hazzaa *et al.*, 2024). Similarly, the AgT (Jensen & Meckling, 1976; Fama & Jensen, 1983) highlights the importance of knowledge that cannot be transferred easily to other firms, in particular, suggesting that decision power should be given to agents that possess specific knowledge and across different organizational levels, leading to better decisions. With this in mind, professional experience can thus be seen as something unique to individuals, resulting from their professional journey, decisions made a long way, respective consequences, and lessons learned from such.

Additionally, according to Upper Echelons Theory (UET) (Hambrick & Mason, 1984; Hambrick, 2007), TMT's strategic decisions will be influenced by their perceptions and interpretations of the situation being faced, which in turn, are influenced by TMT's values, personality traits, as well as, by their experiences (in which, we are assuming, professional experience is included). In other words, TMT professional experience, together with their psychological characteristics, will affect firms' performance by impacting how they process information (delimiting the field of vision, perception, and understanding of the issues being dealt with) and the subsequent decisions made.

Overall, taking into consideration the previously mentioned theories, professional experience is expected to equip individuals with expertise and a foundation on which they can base their decisions on, potentially leading to better judgements and decision-making, positively contributing to firms' performance – see Figure 3 for a synthesis of the main mechanisms.

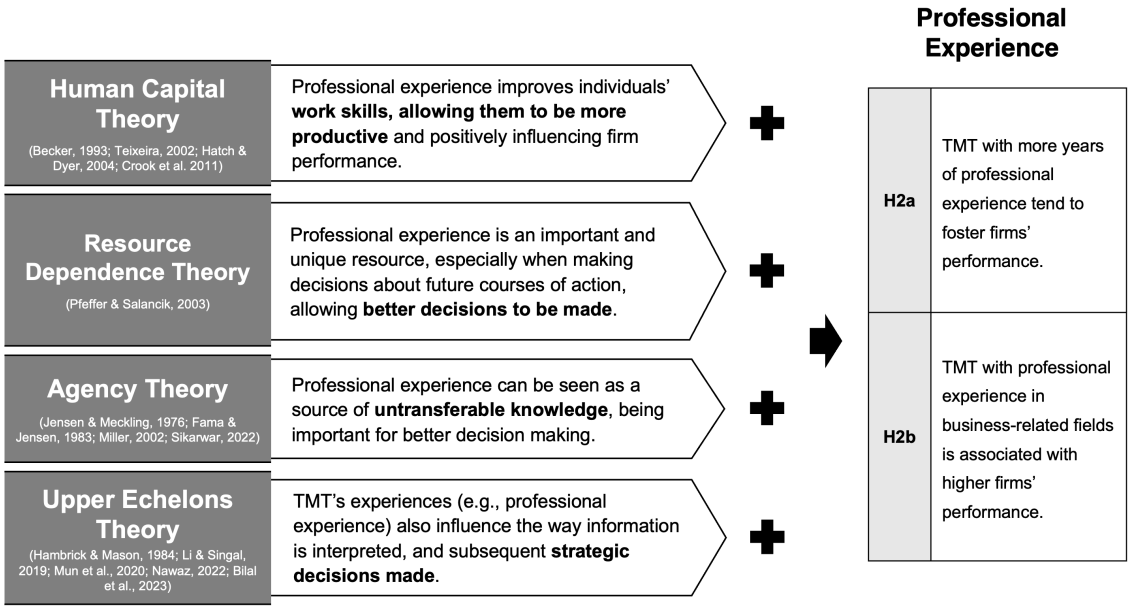


Figure 3: Theoretical framework and hypotheses to be tested on the impact of TMT's professional experience on firms' performance

Source: Own elaboration.

The conclusions of the empirical studies that focus on TMT members' professional experience are varied, with most types of professional experience having a statistically insignificant relationship with firm performance. However, there are studies, such as Dalziel *et al.* (2011) and Hazzaa *et al.* (2024), that do find a positive relationship between certain types of professional experience with firm performance.

Dalziel *et al.* (2011) concluded that outside directors having "functional experience in R&D areas (e.g. science and engineering)" (p. 1224) will positively impact firms' R&D expenditure. Similarly, Hazzaa *et al.* (2024) concluded that Iraqi private banks' financial performance was positively impacted by CEO's executive experience (measured as the number of executive roles, inside or outside the bank, held before their appointment). Moreover, the authors also state that "these findings are consistent with the recommendations of resource dependency theory, which states that experience is a vital and invaluable resource for a business" (Hazzaa *et al.*, 2024, p. 7), potentially resulting from their ability to make more accurate forecasts, better decisions and define better strategies.

On the other hand, several studies do not find evidence that certain types of professional experience significantly impact firm performance. Dalziel *et al.* (2011) found no evidence of a statistically significant relationship between inside directors' technical experience and R&D expenditure, contrary to the positive relationship found with outside directors. Likewise, Xu and Li (2023) also concluded that R&D intensity was not significantly impacted by CEOs having studied or worked abroad (overseas experience), nor by BoD's having past professional experience in marketing (marketing experience). Moreover, Sidki *et al.* (2024), in addition to analysing the impact of education level, also analysed supervisory board members' management (if they had previously worked in management positions, either in high or in middle level positions) and industry experience (if they had previously worked in the industry), having found that both had an insignificant relationship with German state-owned utility firms' financial performance.

However, Xu and Li (2023), in addition to the results mentioned above, also find that certain types of experience can negatively impact firms' performance – the authors concluded that the board members' government experience (having held an experience in the governmental sector), and CEO's production (having past experience in production; e.g., having worked as a frontline worker), and finance experience (having past experience in a finance related position) hindered R&D intensity of Chinese listed manufacturing firms.

Additionally, Dalziel *et al.* (2011) and Xu and Li (2023) also analysed an innovation-related dimension of professional experience. While Xu and Li (2023) concluded that CEOs' innovation experience (having held a position related to R&D or design) positively impacted R&D intensity, Dalziel *et al.* (2011) found that entrepreneurial finance experience (the authors exemplify with venture capitalists and investment bankers) of inside and outside directors had a statistically insignificant and negative impact, respectively, on American biotechnology and pharmaceutical firms' R&D expenses.

Finally, and based on the theories presented in the previous section, diversity can both positively contribute to firm performance or create additional challenges for the same (see Figure 4).

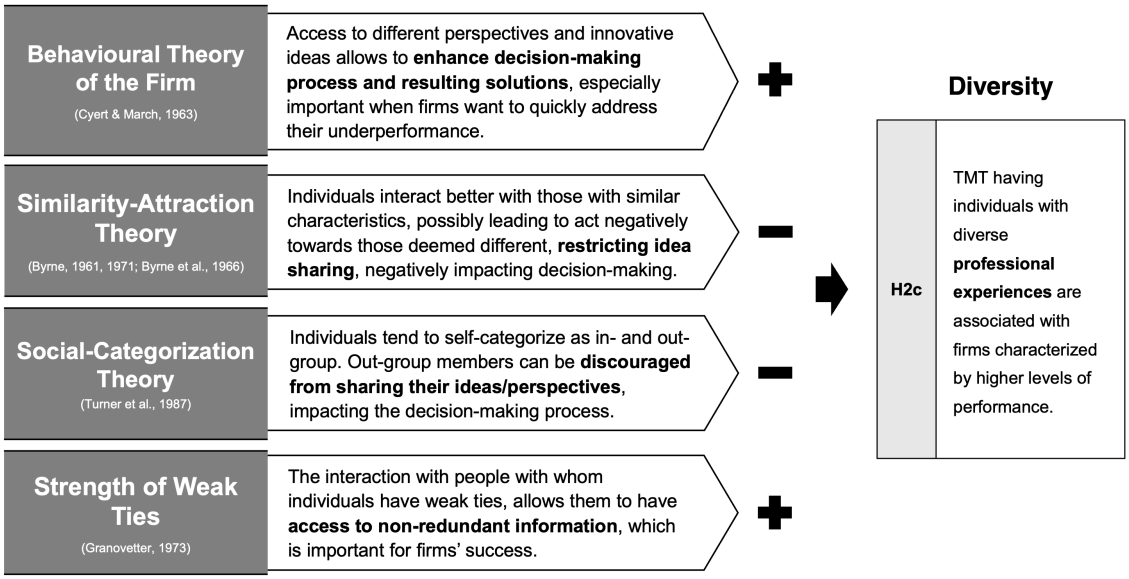


Figure 4: Theoretical framework and hypotheses to be tested on the impact of TMT's diversity of professional experience on firms' performance

Source: Own elaboration.

The above-mentioned dichotomy of the impact of TMT's diversity on firms' performance is reflected on the results of several empirical studies. For instance, Xu and Li (2023) having also considered in their analysis CEOs' professional experience diversity (total number of past experiences in different jobs/functions), found that it positively impacted R&D intensity. Furthermore, Geulen *et al.* (2024) concluded that there was an inverted U-shaped relationship between TMT's functional background heterogeneity (the authors considered all functional areas in which TMT's had previously worked in, including their current position) and large public American firms' survival. In other words, the probability of firms' bankruptcy increases with higher levels of TMT's functional background heterogeneity, but past a certain point, that relationship becomes negative, meaning that with the increase of TMT's functional background heterogeneity, the bankruptcy probability will decrease.

In addition, Krieweth *et al.* (2024), analysed 1698 alliances, for the 2005 – 2020 period, and confirmed that TMT's functional background diversity is positively associated with the occurrence of inter-firm coopetition, as well as with its competition intensity in inter-firm coopetition, and negatively associated with cooperation in inter-firm coopetition. Additionally, Zhang *et al.* (2023) concluded that TMT functional background diversity was positively related with firms' degree of greenwashing, this effect being strengthen by the technological innovation, from Chinese A-share listed firms.

Taking into consideration the theoretical and empirical contributions detailed above, we hypothesise that:

H2a: TMT with more years of professional experience tend to foster firms' performance.

H2b: TMT with professional experience in business-related fields is associated with higher firms' performance.

H2c: TMT having individuals with diverse professional experiences are associated with firms characterized by higher levels of performance.

2.4. Other determinants of firm performance

Besides TMT's human capital levels and diversity, there is a vast number of variables that are likely to influence firm performance. We organised these other determinants of firm performance into four main groups (see Table 1): (workforces') human capital endowments, corporate governance characteristics, strategic characteristics, and structural characteristics.

Regarding the first group, workforces' human capital endowments, extant empirical firm--level studies often consider employees' education attainment – measured as the percentage of highly educated employees (e.g., Danley & Eriksson, 2022; Braunerhjelm & Lappi, 2023) or as workers' average formal educational level (e.g., Aghazada & Ashyrov, 2022) – and formal training, usually presented as a dummy variable assessed by verifying if the firm provides formal training to its employees or not (e.g., Njinyah *et al.*, 2024). These characteristics tend to be positively related to firm performance, since they are expected to contribute positively to employees' productivity and innovation capacity through human capital development (e.g., Teixeira, 2002; Teixeira & Santos, 2016; Braunerhjelm & Lappi, 2023; Njinyah *et al.*, 2024; Baishya *et al.*, 2025).

Studies focused on firm performance also examine corporate governance characteristics, most commonly considering variables such as TMT size – measured as the number of members in TMT (e.g., Peng *et al.*, 2022). Having in mind the studies of Xie *et al.* (2022), TMT size it is expected to have a negative impact on firm performance, since it can difficult decision making, due to the increase on the amount of information to be processed and associated costs, but also due to the decrease of the contribution that each TMT member

makes, and the evidence of such effort, leading to weaker monitoring of results, reduction of members' motivation and, ultimately, firm performance; notwithstanding, in the study of Peng *et al.* (2022) this control variable has a positive impact on firm innovation.

The variables that studies usually rely on to reflect firms' strategic characteristics include firms' financial leverage (e.g.., Ahamed *et al.*, 2023; Bai & Mkrtchyan, 2023; Xu & Li, 2023; Wang *et al.*, 2025) and their R&D investment intensity (e.g., Kiss *et al.*, 2022). Allowing to assess firms' investment strategy and so, to evaluate firms' capital structure and investment strategy, financial leverage can be measured in several ways – as the ratio between firms' total liabilities and total assets (e.g., Uyar *et al.*, 2021; Kramarić & Miletić, 2022; Urquhart & Zhang, 2022; Kallias *et al.*, 2023; Yilmaz *et al.*, 2023; Hernández-Atienza *et al.*, 2024; Ullah *et al.*, 2024; Wu *et al.*, 2024) or divided by total equity (e.g.., Hazzaa *et al.*, 2024; Veeravel *et al.*, 2024). Also used to assess firms' financial and strategic priorities, firms' R&D investment intensity can be measured by the ratio between R&D expenses and total assets (e.g., Xu *et al.*, 2022; Ushie *et al.*, 2024) or divided by total operating revenue (e.g.., Wu & Nguyen, 2024) or by sales (e.g., Bonini *et al.*, 2022; Chen *et al.*, 2022; Zhang *et al.*, 2022), another possibility being the ratio between R&D employees' and total number of employees (e.g., Bataineh *et al.*, 2024).

While the first, leverage, mostly presents a negative effect on firm performance (Kramarić & Miletić, 2022; Urquhart & Zhang, 2022; Ullah *et al.,* 2024), since highly indebted firms may see their ability to perform their normal and innovative activities jeopardised (Ma *et al.*, 2024), R&D intensity usually presents a positive relationship with firm performance (e.g., Bataineh *et al.*, 2024;[10] Ushie *et al.*, 2024; Wu & Nguyen, 2024). This last variable contributes to firms' having a greater ability to access and absorb external knowledge and technology, and of its innovation output/outcomes, contributing to sustain competitive advantages and improve value creation, which positively impact firms' performance (Chen *et al.*, 2022; Banerjee & Deb, 2023; Bischoff *et al.*, 2023).

Regarding firms' structural characteristics, past studies have considered firm size – mostly measured by total assets (e.g., Adams & Baker, 2021; Uyar *et al.*, 2021; Baum *et al.*, 2022; Urquhart & Zhang, 2022; Mesnik *et al.*, 2023; Yilmaz *et al.*, 2023; Hazzaa *et al.*, 2024; Hernández-Atienza *et al.*, 2024), total number of employees (e.g., Xu & Li, 2023) or by sales (e.g., Goll & Rasheed, 2005) –, firm age (e.g., Dalziel *et al.*, 2011; Adams & Baker, 2021; Baum

[10] This study specifically exhibits a positive relationship between R&D intensity and firm innovation.

et al., 2022; Kramarić & Miletić, 2022; Kallias *et al.*, 2023; Geulen *et al.*, 2024; Hazzaa *et al.*, 2024; Hernández-Atienza *et al.*, 2024; Ullah *et al.*, 2024; Wu *et al.*, 2024), industry (e.g., Dalziel *et al.*, 2011; Ahamed *et al.*, 2023; Istipliler *et al.*, 2023; Kallias *et al.*, 2023; Geulen *et al.*, 2024), location – country (e.g., Ahamed *et al.*, 2023; Yilmaz *et al.*, 2023) or region (e.g., Baum *et al.*, 2022) –, foreign ownership – usually presented as a dummy variable that assesses if a firm has foreign ownership or not (e.g., Adams & Baker, 2021) or measured by the percentage of ownership held by foreign shareholders (e.g., Verma *et al.*, 2022) – and exporting intensity,[11] usually measured by the ratio between firms' exports and total sales (e.g., Bataineh *et al.*, 2024).

With the exception of two control variables, industry and region, whose impact can vary, the remaining control variables in this group – firm size, firm age, foreign ownership, and export intensity – tend to have a positive relationship with firm performance. Overall, the reasoning behind such expectations is that larger and more established firms benefit from competitive advantages, economies of scale, financial resources, management expertise and accumulated knowledge, when compared to recent market entrants (Adams & Baker, 2021; Peng *et al.*, 2022), while having foreign investors is expected to lead to a closer monitoring of the firms' activity, due to information asymmetry and distance from operations, positively impacting firm performance. Having a higher export intensity can lead to better opportunities commercially, as well as in technology and knowledge attainment, having a better capacity to take advantage of the same, having a more efficient innovative capability due to its needs to adapt and to have different strategies according to various markets (e.g., Bischoff *et al.*, 2023; Bataineh *et al.*, 2024), exporting firms tending to be more productive and to grow faster (e.g., Boikos *et al.*, 2023).

The positive effect of firm size is evidenced by studies such as Adams and Baker (2021) [on the return on equity (ROE) of British insurers firms], Uyar *et al.* (2021) [when measuring financial performance as ROA; however, when measuring it with Tobin's Q such impact became negative, the same impact also being observed in Urquhart and Zhang's (2022) study], and Xu and Li (2023) [when analysing firm innovation]. The positive relationship between firm age and firm performance is shown in the empirical results of Adams and Baker (2021) [when assessing firm solvency], Kramarić and Miletić (2022) and Kallias *et al.* (2023); however, Ullah *et al.* (2024), focused on firm innovation, did find a negative relationship.

[11] If it is an exporting firm.

Moreover, the positive impact of foreign ownership on firm performance is evidenced by Adams and Baker (2021) and Verma *et al.* (2022). Finally, Bataineh *et al.* (2024) finds a positive impact of export intensity on firm innovation.

Table 1: Other determinants of firm performance and their respective impact on firm performance

Group of variables	Variable	Description	Relation with performance	Studies
Workforces' Human Capital Endowments	Education Attainment	Workers' average formal educational level.	+	Teixeira (2002); Braunerhjelm and Lappi (2023); Njinyah *et al.* (2024); Baishya *et al.* (2025)
	Training	If the firm provides training to its employees.	+	
Corporate Governance Characteristics	TMT Size	Number of members in TMT.	–	Peng *et al.* (2022); Xie *et al.* (2022)
Firms' Strategic Characteristics	Leverage	Total Debt divided by total Assets (or by total Equity), to assess firms' investment strategy.	–	Kramarić and Miletić (2022); Urquhart and Zhang (2022); Wang *et al.* (2025)
	R&D Intensity	Ratio between R&D expenses and total assets/sales.	+	Bataineh *et al.* (2024); Ushie *et al.* (2024); Wu and Nguyen (2024)
Firms' Structural Characteristics	Firm Size	Number of employees, total assets or sales volume.	+	Uyar *et al.* (2021); Adams and Baker (2021); Xu and Li (2023)
	Firm Age	Number of years since the firms were founded.	+	Kramarić and Miletić (2022); Kallias *et al.* (2023); Adams and Baker (2021)
	Industry	The sector in which the firm operates.	+/ –	Dalziel *et al.* (2011); Ahamed *et al.* (2023); Istipliler *et al.* (2023); Kallias *et al.* (2023); Geulen *et al.* (2024)
	Region	Operations' main location.	+/ –	Baum *et al.* (2022)
	Foreign Ownership	If the firm has foreign share capital.	+	Adams and Baker (2021); Verma *et al.* (2022)
	Export Intensity	If the firm sells outside Portugal.	+	Bataineh *et al.* (2024)

Source: Own elaboration.

3. Methodology

3.1. Methodological approach

Each research methodology, which can be defined as qualitative, quantitative and/or as mixed, has its own goals/purposes, advantages, and limitations, with the choice between them being based on research aims, objectives, and questions.

Given the aim of this study – to analyse the cause-effect relationship between TMT's formal education/professional experience and firms' performance, involving large datasets of firms, and the following research question: do the level and field of TMT's formal education and professional experience contribute to firms' performance?, a more deductive approach and a quantitative research method is advisable. This aligns with the fact that we aspire to determine causal relationships through the statistical analysis of numerical data, resorting to large datasets and the development of numerical indicators (Verhoef & Casebeer, 1997; Basias & Pollalis, 2018; Adorjan, 2023; Kuehn & Rohlfing, 2024). This decision is also in line with the literature analysed, with the majority using quantitative methods, such as panel fixed effects (FE) model (e.g., Li & He, 2023; Zhang *et al.*, 2023; Hazzaa *et al.*, 2024; Hernández-Atienza *et al.*, 2024), panel random effects (RE) model (e.g., Xu & Li, 2023; Hazzaa *et al.*, 2024), pooled ordinary least squares (POLS) model (e.g., Xu & Li, 2023; Hazzaa *et al.*, 2024), hierarchical regression (e.g., Dalziel *et al.*, 2011; Krieweth *et al.*, 2024), ordinary least squares (OLS) regression (e.g., Kallias *et al.*, 2023; Ullah *et al.*, 2024; Wu *et al.*, 2024) and logistic regression (e.g., Geulen *et al.*, 2024).

3.2. Selection of the estimation method

Based on the study's research question, we have defined the following econometric specification:

$$y_{i,t} = \beta_1 + \beta_2\, EDU_{LEVEL_{i,t}} + \beta_3\, EDU_{TYPE\ i,t} + \beta_4\, EDU_DIV_{i,t} + \beta_5\, EXP_{LEVEL_{i,t}} + \beta_6\, EXP_{TYPE_{i,t}} + \beta_7\, EXP_DIV_{i,t} + \beta_8\, \mathbf{X}_{i,t} + \mu_{i,t}$$

Where:

y represents firms' (economic or financial) performance.

$\boldsymbol{EDU_{LEVEL}}$ represents TMT's formal educational level (average years of education or percentage of graduates).

$\boldsymbol{EDU_{TYPE}}$ represents TMT's formal educational type (field of study).

$\boldsymbol{EDU_DIV}$ represents TMT's diversity in terms of formal education.

$\boldsymbol{EXP_{LEVEL}}$ represents TMT's average years of experience.

$\boldsymbol{EXP_{TYPE}}$ represents TMT's professional experience type (industry).

$\boldsymbol{EXP_DIV}$ represents TMT's diversity in terms of professional experience.

$\boldsymbol{X}$ represents the vector containing the control variables.

$\boldsymbol{\mu}$ represents the error term.

$\boldsymbol{i}$ represents the firm and $\boldsymbol{t}$ represents time.

Following similar studies (e.g., Xu & Li, 2023; Zhang *et al.*, 2023; Hazzaa *et al.*, 2024; Hernández-Atienza *et al.*, 2024), we have chosen to conduct a panel data analysis, since this approach allows us to track different entities (in this case, firms) across time (Verbeek, 2017; Hsiao, 2022; Li *et al.*, 2024; Qu *et al.*, 2024).

According to Hsiao (2022), the advantages of using panel data lie in the fact that it improves the accuracy of estimations and outcome predictions, due to the use of large datasets, as well as helps to overcome challenges that arise from using cross-sectional or time series data individually.

The analysis of panel data is usually conducted through at least one of these three analytical models: FE (e.g., Zhang *et al.*, 2023; Hernández-Atienza *et al.*, 2024), RE (e.g., Xu & Li, 2023; Hazzaa *et al.*, 2024), and POLS model (e.g., Xu & Li, 2023; Hazzaa *et al.*, 2024). Comparing the first two models, FE aims to control for (time-invariant) unobserved heterogeneity and/or omitted variable bias by controlling for characteristics/variables that remain unchanged over time within individuals/units (Verbeek, 2017; Hill *et al.*, 2020; Henderson *et al.*, 2021; Hsiao, 2022; Xu & Li, 2023; Breuer & Dehaan, 2024). In other words, FE focuses on differences within individuals/groups, absorbing time-invariant characteristics through the control variables (Verbeek, 2017). On the other hand, RE, instead of disregarding such variations (within and between-entity variations), assumes that those are a result of random disturbances, i.e., relies on the assumption that the error term (unobserved individual-specific

characteristics and white noise error term) is uncorrelated with the explanatory variables included in the model (Verbeek, 2017; Hsiao, 2022; Li *et al.*, 2023), considering variations within and across groups.

The third model, Pooled Ordinary Least Squares (POLS), treats the panel as a single pooled dataset and estimates the coefficients using standard OLS, assuming that unobserved individual-specific effects are either absent or uncorrelated with the explanatory variables (Verbeek, 2017). When these conditions are held, POLS provides consistent estimates, but if unobserved heterogeneity exists and is correlated with the regressors, the estimator becomes biased and inconsistent. Given that the present study considers a large number of firms over time, where unobserved firm-specific characteristics are likely to be relevant, the use of POLS is not appropriate.

With this in mind, we have considered the FE model to be the most appropriate approach to apply in our study, due to the previous mentioned characteristics. This choice will be, later on, further supported econometrically by the results of the Hausman test (see Table 4, in Section 4.2.), which rejected the null hypothesis of no correlation between the variables and the error (associated with individual-specific effects), meaning that it is better to use the FE model over the RE one (Verbeek, 2017).

Finally, it is important to note that we chose not to use dynamic panel data methods since the main aim of the study does not focus on the lagged dynamics of the variables (i.e., the effect of the past on current behaviour), nor would the (somewhat) limited period of our analysis allow, or be suitable, for such estimation strategy (Verbeek, 2017).

3.3. Procedure of data collection and data sources

The study combines two independent micro databases, Personnel Records *(Quadros de Pessoal)* (QP) and Integrated Business Accounts System *(Sistema de Contas Integradas das Empresas)* (SCIE), for the period 2010 – 2023.

The period 2010 – 2023 was selected due to its rich structural and macroeconomic heterogeneity. It includes part of the global financial crisis, particularly the Portuguese Economic Adjustment Programme, the following recovery, and the COVID-19 pandemic, providing a unique opportunity to examine firm-level dynamics under varying economic

regimes. Furthermore, improvements in the harmonization and completeness of the QP and SCIE microdata, since 2010, ensure consistency and reliability for longitudinal analysis.

QP is an annual administrative dataset collected by the Portuguese Ministry of Labour, Solidarity and Social Security and managed by the Office for Strategy and Studies *(Gabinete de Estratégia e Planeamento)* (GEP). It provides detailed matched employer–employee information for all private-sector firms operating in mainland Portugal and autonomous regions (i.e., Azores and Madeira) with at least one paid employee (Statistics Portugal, 2025a). The dataset includes comprehensive data on individual workers (e.g., gender, age, education, occupation, wages, contract type), firms (e.g., sector, location, size), and job characteristics (e.g., working hours, seniority), making it a key source of information for labour market and organizational studies. Once a year, in November, firms are mandated to participate in the survey that serves as the basis for this database, with October as the month of reference, ensuring high coverage and reliability. This database covers annually, on average, around 290 thousand firms and three million workers (see Table A1, in the Appendix), though it can vary slightly by year due to economic cycles and reporting compliance.

SCIE is a comprehensive statistical database managed by Statistics Portugal *(Instituto Nacional de Estatística)* (INE) that consolidates accounting and structural information from non--financial and non-insurance firms operating in Portugal. Based primarily on the annual Simplified Business Information *(Informação Empresarial Simplificada)* (IES) submissions, SCIE provides harmonized data on firms' balance sheets, income statements, employment, and activity sectors. It enables detailed analysis of business demography, financial performance, and productivity at the firm level, being a key resource for economic research and policymaking, offering high coverage and consistency across time and industries. Typically, the coverage of SCIE exceeds 400 thousand firms per year,[12] considering only societies/ limited liability firms that are actively operating during the full period of analysis – i.e., that "present a business volume or main expenses (…) different than zero for firms and with a business volume different than zero for sole proprietorship enterprises" (Statistics Portugal, 2025b, p. 10) –, regardless of their number of employees.

Combining the QP and the SCIE offers a unique and powerful analytical foundation to examine the impact of the level, type, and diversity of Top Management Teams' (TMT)

[12] I.e., when taking into account sole proprietorship enterprises; otherwise, the number of observations/firms per year exceeds one million (see Table A1, in the Appendix).

human capital on firm performance, in Portugal, between 2010 and 2023. The QP provides rich, individual-level data on managers' demographic and educational characteristics, occupational roles, and employment trajectories, enabling precise identification and characterization of TMT composition. When linked with SCIE, which contains detailed firm--level financial and structural information, including profitability, productivity, and capital structure, we gain access to an integrated micro-level dataset that captures both the human and economic dimensions of organizational performance. This combination allows for an unprecedented level of analytical granularity, facilitating longitudinal, matched employer--employee analysis across a wide range of industries and firm sizes.

Compared to the existing empirical literature (e.g., Boubaker *et al.*, 2020; Kramarić & Miletić, 2022; Hazzaa *et al.*, 2024), which often relies on more aggregated, survey-based, or sector--specific data, this approach enables a comprehensive, population-level analysis with enhanced internal validity and reduced sample selection bias. Moreover, the integration of administrative data ensures greater accuracy and consistency over time, contributing to the scientific novelty of the study by bridging the gap between labour economics, strategic management, and corporate governance research in a national context rarely explored at this depth.

The integration of these two databases is done via firm-level identifiers (each firm is given a fictitious corporate tax identification number). After cleaning and ensuring consistency across sources (e.g., removing public entities, sole proprietorships, or firms not submitting complete financial statements), the matched dataset typically includes approximately 220-260 thousand firms, per year, with valid data in both QP and SCIE. Thus, the matched sample tends to be highly representative of the private, non-financial business sector employing wage earners in mainland Portugal.

When merging the QP and SCIE databases, using the firms' identifying code and year as key variables, it was observed that, even if most observations were matched, there still were unmatched observations from both the master database (QP) and the using database (SCIE). This is a reflection of coverage and methodological considerations: while QP considers all entities, singular or collective, with at least one paid employee, regardless of their economic and financial performance, the directly collected data (census) being referent to the month of October of the year in analysis, SCIE targets firms that are economically active throughout the year in analysis, regardless of the number of (paid) employees, being mainly based on

indirect sources such as IES (an information that firms are obliged to share and that reflects the firms' fiscal year results). Consequently, firms that are present in QP may not be present in SCIE, and vice versa, and the momentary image transmitted by the two databases may not be completely aligned.

Regarding the SCIE, we undertook a systematic 'cleaning' process to obtain meaningful and consistent data. Specifically, we eliminated observations related to (see Table A2, in the Appendix):

- Sole proprietorship enterprises (*empresas em nome individual*), totalling around 830 thousand firms per year, on average, which refer to a business that is owned and operated by a single individual, with no legal distinction between the owner and the business.
- Firms with assets (current and non-current), liabilities (current and non-current) and equity equal to zero, totalling around 1.4 thousand firms per year, on average, as well as those with no sales, income or assets, and with one employee (representing around 1.3 thousand firms per year, on average), since we considered that firms with these accounting characteristics were most probably inactive or with data errors.
- Firms located in Madeira, Azores, and overseas,[13] totalling around 14 thousand firms per year, on average.
- Firms belonging to the industries Portuguese Classification of Economic Activities, Revision 3 (*Classificação Portuguesa de Atividades Económicas, Revisão 3*) (CAE Rev.3) from Sections A and B (Divisions 01-09), corresponding to 'Agriculture; animal production; hunting; forestry; fishing' and 'Mining and quarrying', respectively, and from Sections O, T and U (Divisions 84, 97-99), encompassing, respectively 'Public administration and defence; compulsory social security', 'Activities of households as employers; undifferentiated production for own use', and 'Activities of extraterritorial organizations and bodies'. We excluded the firms of these sectors (which totalled approximately 15.8 thousand firms per year, on average) due to their distinct institutional characteristics, limited comparability, and irregular or incomplete representation in both SCIE and QP microdata. These sectors also operate under production and labour regimes that diverge significantly from those

[13] Corresponding to the codes 20, 30, and 90, respectively, of the Nomenclature of Territorial Units for Statistics II (*Nomenclatura das Unidades Territoriais para Fins Estatísticos*) (NUTSII).

observed in the business economy, thereby reducing the validity of firm-level productivity and employment comparisons.

Considering the total firms that were eliminated from SCIE (see Table A2, in the Appendix), we observe that they are mainly micro (99.5% of the total eliminated firms) or small (0.4%) firms that operated in 'Agriculture; animal production; hunting; forestry; fishing' (Section A, Divisions 01-03 of CAE Rev.3), 'Wholesale and retail trade; repair of motor vehicles and motorcycles' (Section G, Divisions 45-47 of CAE Rev.3) and 'Administrative and support service activities' (Section N, Divisions 77-82 of CAE Rev.3), corresponded to 12.9%, 15.0% and 18.3% of the total eliminated firms, respectively.

After cleaning SCIE database, we merged SCIE and QP, maintaining only the observations that were present in both databases.

Given that the focus of our study is to understand how the changes in TMT members' characteristics impact firm performance, we need to exclude from the merged database firms that do not have TMT in one or more years of our time span (2010 – 2023). That being said, the firms that were eliminated were mainly characterised as being micro and relatively new (operating for less than 3 years) (78.0% and 21.2% of the total eliminated, respectively), operating in 'Wholesale and retail trade; repair of motor vehicles and motorcycles' (Section G, Divisions 45-47 of CAE Rev.3) (25.2% of the total eliminated) and 'Manufacturing' (Section C, Divisions 10-33 of CAE Rev.3) (12.6% of the total eliminated), and located in the North of Portugal (38.9% of the total eliminated), followed by Lisbon and Vale do Tejo (30.0% of the total eliminated) (see Table A3, in the Appendix).

The final panel, with a total of 2,183,055 observations, encompasses 363,308 firms, being mostly made up by firms from the North (39.4% of the observations) and Lisbon and Vale do Tejo (27.7% of the observations), with most of them being micro firms (78.6% of the observations) and not older than 11 years (represent a cumulative percentage of 51.7% of the observations). In addition, they are mainly related to 'Wholesale and retail trade; repair of motor vehicles and motorcycles' (Section G, Divisions 45-47 of CAE Rev.3), 'Manufacturing' (Section C, Divisions 10-33 of CAE Rev.3) and 'Construction' (Section F, Divisions 41-43 of CAE Rev.3), representing, respectively, 29.1%, 14.5% and 12.9% of the observations (see Table A4, in Appendix).

3.4. Measures / Proxies for the relevant variables

Before presenting the variables used in this study, it is important to highlight that we identified has being part of firms' TMT those individuals whose occupation was categorized, under the Portuguese Classification of Occupations 2010 (*Classificação Portuguesa das Profissões 2010*) (CPP 2010), as one of the following codes: 112 (Managing Directors and Chief Executives), 12 (Administrative and Commercial Managers), 13 (Production and Specialized Services Managers), or 14 (Hospitality, Retail and Other Services Managers) (Alexandre *et al.*, 2021); and if not under any of these, those that were categorised as being the employer under the variable representative of employment status (code 1 of 'sitpro' in QP).

As observed in Table 2, the dependent variables of the present study revolve around two types of firm performance – economic performance, measured by gross value added (with market and factor prices) in absolute terms and per employee (i.e., viewed as a proxy for labour productivity) having created also the logarithmic form of these four variables (e.g., Ardito *et al.*, 2022; Masso & Vahter, 2023), and financial performance, measured by return on assets (ROA) or return on equity (ROE) (e.g., Kramarić & Miletić, 2022; Sidki *et al.*, 2024). Data was retrieved from SCIE database, the original values being initially adjusted using the GDP deflator.[14]

The core independent variables include TMT's formal education level (EDU_LEVEL) and field of study (EDU_TYPE), professional experience level (EXP_LEVEL) and industry/ sector of activity (EXP_TYPE); as well as TMT's formal education diversity (EDU_DIV) and professional experience diversity (EXP_DIV). The information for these measures was mainly retrieved from QP database.

Formal education and professional experience levels refer to the average years of schooling (EDU_LEVEL) [15] and average years of professional experience of its TMT members

[14] Values were converted to constant prices, having 2012 as the year of reference, with the following deflator: 0.93872 (2010), 0.97302 (2011), 1.00274 (2013), 0.99996 (2014), 1.00483 (2015), 1.01094 (2016), 1.02477 (2017), 1.03496 (2018), 1.03846 (2019), 1.03833 (2020), 1.05147 (2021), 1.13383 (2022), 1.18271 (2023). These deflators were based on Statistics Portugal (2025c).

[15] Since the educational level of individuals was originally reflected by the QP's categorical variable 'habil2', we associated to each category an average number of education years. The association used is presented in Table A5, in Appendix.

(EXP_LEVEL),[16] respectively, aggregated per firm. It was also created a second variable to assess TMT's formal education level, PERC_DIPLOMADO_TMT, that represents the percentage of TMT members that have a university degree (identified by having more than 15 years of average years of schooling, based on the individual's average years of schooling).

The type of formal education (EDU_TYPE) and professional experience (EXP_TYPE) relate, respectively, to the degree/course and industry/sector of activity that the TMT member has and has worked in.

Regarding TMT's formal education field, we began to aggregate the different categories of the variable 'habil' from the QP database into a single variable that represents the individual's field of study (see Table A6, in Appendix), followed by the creation of several variables that calculated the percentage of TMT's members that had a specific field of study (e.g., percentage of TMT members that have a degree, regardless of its level, in Arts or in Health). When constructing the estimation models, we used as main proxies for TMT's type of formal education the percentage of TMT with a degree in a Science, Technology, Engineering, and Mathematics (STEM) field (e.g., Schmid & Mitterreiter, 2021; Ullah *et al.*, 2024) and with a degree in Business (e.g., Schmid & Mitterreiter, 2021; Sidki *et al.*, 2024); from these two variables, we created two additional binary variables that assumed value 1 when the above mentioned percentages were higher than 0, in other words, they assume value 1 when at least one member of the TMT has a STEM (TEM_STEM) or a Business (TEM_BUSINESS) degree, respectively.

In order to analyse hypothesis H1c 'TMT with formal education in fields related to firms' activities is likely to enhance firms' performance', we created the binary variable TMT_EDU_IND, that assumes value 1 when at least one TMT member has formal education in a field of study associated with the firm's main activity. To make such identification/matching, we created an association key to connect fields of study and industries (see Table A7, in Appendix). We created an additional two alternative variables: PERC_TMT_EDU_IND, which represents the percentage of TMT members with formal education in a field of study associated with firms' industry, and, MAJ_TMT_EDU_IND, a

[16] Since there was no variable that reflected the total number of years an individual has been professionally active, we measured this variable by deducting to the individual's age the average number of years of education, minus 6 years (which represent the period in which school is not mandatory (e.g., kindergarten), up to the first year of primary school and that are not taken into account in our association of average years of education).

binary variable which identifies when the majority of the members of the TMT have formal education in a field of study associated with the industry.

Respecting TMT's professional experience, we created two variables, the first (TMT_ SAME_INDUSTRY_EXP) is a binary variable that assumed value 1 when at least one members of the TMT had past professional experience in the same industry as the one of the firm he/she was working on (in a given year), and assumed value 0 if otherwise; as an alternative, we also created the variable TOTAL_INDUSTRY_EXPERIENCE, that represented the total number of different industries TMT's members had experience in, as a whole.[17] Similarly to what we did with TMT_EDU_IND (creating additional variables with the percentage of members and identifying when the majority of TMT members satisfied the criteria), we created an additional two variables for TMT_SAME_INDUSTRY_EXP – PERC_TMT_SAME_INDUSTRY_EXP and MAJ_TMT_SAME_INDUSTRY_EXP – the first representing the percentage of TMT members with past professional experience in the same industry as of the current firm he/she is working on, and the second, a binary variable, that assumed value 1 when the majority of TMT members had past professional experience in the same industry as the one of the firm he/she was working on (in a given year).

Given the different alternative variables created for identifying TMT's formal education level (AVG_EDU_YEARS_TMT and PERC_DIPLOMADO_TMT); formal education type [field of study] (PERC_STEM_TMT, PERC_BUSIN_TMT, TEM_STEM, TEM_ BUSINESS, TMT_EDU_IND, PERC_TMT_EDU_IND and MAJ_TMT_EDU_IND) and professional experience type [industry] (TMT_SAME_INDUSTRY_EXP, TOTAL_ INDUSTRY_EXPERIENCE, PERC_TMT_SAME_ INDUSTRY_EXP and MAJ_TMT_ SAME_INDUSTRY_EXP), we created different models considering these different options, and later we present the results that arose from these different models, constituting in this way a robustness analysis.[18]

QP also provided the information needed to assess the diversity of TMT's formal education and professional experience (both in terms of level and type – field and industry). When analysing the diversity of the average years of formal education and experience of a firm's TMT members, since both variables are measured in years, we resorted to the standard-

[17] These two options result from the difficulty to create a single variable that fully represents all the different industries the TMT members have experience in.
[18] In Table 2, we identify, for the core independent variables, the models in which they are used.

-deviation of EDU_LEVEL and EXP_LEVEL. Regarding the diversity of TMT members' field of study and industry, we applied two indices that assess categorical heterogeneity, the Blau index (mathematically equivalent to the Gini-Simpson index) and the Shannon index, respectively. The reason behind for the use of these two indices arises from the fact that EDU_TYPE is associated to the QP's variable 'habil' (academic qualifications), which corresponds to the highest degree obtained by individuals; as such, each person only has an associated field of study (i.e., one person cannot have more than one field of study). The same does not apply to when we identified the industries in which TMT members' have prior experience in (i.e., one person can have more than one industry in which they have experience).

The control independent variables include (see Table 2):

1) employees' human capital, encompassing (e.g., Braunerhjelm & Lappi, 2023; Njinyah *et al.*, 2024; Baishya *et al.*, 2025) the average years of formal education attained by employee's (i.e., of employees not identified of being part of the TMT) (AVG_EDU_YEARS_ WORKERS), and investment in employee training (TRAIN_EMP), represented by a binary variable that assumed value 1 if firms provide training to their workers (i.e., when they have training expenses) and 0 if not;

2) firms' corporate governance characteristics, namely the TMT size (TMT_SIZE), measured by the total number of individuals in the TMT (e.g., Peng *et al.*, 2022; Xie *et al.*, 2022);

3) firms' strategic characteristics, which include leverage, measured by total debt divided by total equity (LEV) (e.g., Kramarić & Miletić, 2022; Wang *et al.*, 2025), and R&D intensity (RD_INT), a binary variable which assumed value one if firms have expenses with R&D (e.g., Bataineh *et al.*, 2024; Wu & Nguyen, 2024); and

4) firms' structural characteristics, which comprise firm size (SIZE), reflected by the categorical variable of size by number of employees,[19] firm age (AGE), i.e., number of years since the firms' foundation (e.g., Kramarić & Miletić, 2022; Kallias *et al.*, 2023), industry (IND)[20] in which the firm operates (e.g., Ahamed *et al.*, 2023; Kallias *et al.*, 2023; Geulen *et al.*, 2024), region (REG),[21] location where the firm operates by NUTS II (e.g., Baum *et al.*,

[19] See Table A8, in the Appendix.
[20] See Table A9 and A10, in the Appendix. The first presents the codes of CAE Rev.3, while the second presents the key used to create this variable (i.e., used to transform CAE Rev.3, into overall industries).
[21] See Table A11, in the Appendix.

2022), foreign ownership (MAJ_FOR_OWN) a binary variable with value one if the foreign capital share is over 50% of the total capital, and export intensity (EXP_INT), measured by the percentage of sales outside Portugal over total sales (e.g., Bataineh *et al.*, 2024).

Table 2: Main variables description and data sources

Variable Name			Description	Source
Dependent variable	Firm performance	Economic	Gross value added at market prices ((log_)GVA_MP).	SCIE
			Gross value added at factor prices ((log_)GVA_FP).	
			Gross value added at market prices per employee (i.e., divided by total number of employees) ((log_)GVA_MP_EMPL).	
			Gross value added at factor prices per employee ((log_)GVA_FP_EMPL).	
		Financial	Net results over total assets (ROA_NR).	SCIE
			Earnings before interest and taxes over total assets [EBIT] (ROA_EBIT).	
			Net results over total equity (ROE).	SCIE
Core independent variables				
Formal Education	Level (EDU_LEVEL) TMT members' formal education level (e.g., high school, bachelor's, master's, doctorate).		Aggregated average education years by firm (AVG_EDU_YEARS_TMT). *Used in models 1, 3 to 10.*	QP
			Percentage of TMT members with at least a bachelor's degree (PERC_DIPLOMADO_TMT). *Used in model 2.*	
	Field of Study (EDU_TYPE) TMT members' scientific field of study.		Percentage of TMT members with a degree in a STEM field (PERC_STEM_TMT). *Used in models 1, 2 and 6 to 10.*	QP
			Percentage of TMT members with a degree in a business field (PERC_BUSIN_TMT). *Used in model 3.*	
			Identifies if there is at least one TMT member with a degree in a STEM field (TEM_STEM) [binary variable]. *Used in model 4.*	
			Identifies if there is at least one TMT member with a degree in a business field (TEM_BUSINESS) [binary variable]. *Used in model 5.*	
			Identifies when at least one member of the TMT has formal education in a field of study associated with firms industry (TMT_EDU_IND) [binary variable]. *Used in models 1 to 8.*	
			Percentage of TMT members with formal education in a field of study associated with firms industry (PERC_TMT_EDU_IND). *Used in model 10.*	
			Identifies when the majority of TMT members have formal education in a field of study associated with firms industry (MAJ_TMT_EDU_IND) [binary variable]. *Used in model 9.*	

Variable Name		Description	Source
	Diversity (EDU_DIV) Different academic backgrounds among members of TMT (level and type).	Standard-deviation of the EDU_YEARS_TMT variables (DIV_EDU_YEARS_TMT), representing diversity of education level. *Used in models 1 to 10.*	QP
		Diversity index regarding the TMT's different fields of study (DIV_EDU_FIELD_TMT), representing the diversity of the education field. *Used in models 1 to 10.*	
Professional Experience	Level (EXP_LEVEL)	Number of years since the beginning of the TMT members' professional career, measured by subtracting the TMT member's age from the years of their average education and from another six years (AVG_EXPERIENCE_TMT). *Used in models 1 to 10.*	QP
	Industry (EXP_TYPE) Industries in which TMT members have past experience.	Identifies when at least one member of the TMT has experience in the same industry as the firm it works in (TMT_SAME_INDUSTRY_EXP) [binary variable]. *Used in models 1 to 5, and 9 to 10.*	QP /SCIE
		Represents the total number of industries that TMT, as a whole, has experience in (TOTAL_ INDUSTRY_EXPERIENCE). *Used in model 6.*	
		Percentage of TMT members with experience in the same industry as the firm it works in (PERC_TMT_SAME_INDUSTRY_EXP). *Used in model 7.*	
		Identifies when the majority of TMT members have experience in the same industry as the firm it works in (MAJ_TMT_SAME_INDUSTRY_EXP) [binary variable]. *Used in model 8.*	
	Diversity (EXP_DIV) Different professional experience backgrounds among members of TMT (level and type).	Standard-deviation of the EXP_YEARS_TMT variables (DIV_EXP_YEARS_TMT), representing diversity of experience level. *Used in models 1 to 10.*	QP /SCIE
		Diversity index of the different industries where TMT members have experience in (DIV_EXP_INDUSTRY_TMT), representing the diversity of experience field/industry. *Used in models 1 to 10.*	
Other independent / control variables (X) – *Used in models 1 to 10.*			
Workforce's human capital	Employees' formal education (AVG_EDU_YEARS_WORKERS)	Workers' average formal educational level.	QP
	Training (TRAIN_EMP)	Identifies if firms have expenses with employee training [binary variable].	SCIE
Corporate governance characteristics	TMT Size (TMT_SIZE)	Number of individuals in firms' TMT.	QP
Strategic characteristics	Leverage (LEV)	Ratio between total debt and equity.	SCIE
	R&D Intensity (TEM_RD)	Identifies firms that invest in R&D (with R&D expenses) [binary variable].	SCIE
Structural characteristics	Firm Size (FIRM_SIZE)	Number of total employees in the firm [categorical variable].	QP
	Firm Age (FIRM_AGE)	Number of years since the firm's foundation.	QP

Variable Name		Description	Source
	Industry (IND)	Industry firms operate in [categorical variable].	SCIE
	Region (REG)	Firms' main location (identified by NUTS II) [categorical variable].	SCIE
	Foreign ownership (MAJ_FOR_OWN)	Identifies firms with majority foreign ownership (over 50% of their capital is foreign) [binary variable].	QP
	Export intensity (EXP_INT)	Percentage of sales outside Portugal of total sales.	SCIE
Year (YEAR)			QP

Source: Own elaboration.

It is important to take note that, since QP has its information regarding employees disaggregated at a worker level (i.e., the observations present in the employee portion of this database represent an employee in a given firm), it was necessary to 'gcollapse' (STATA command) the individual's characteristics to a firm-level view.

As a title of example, we first worked to define the average levels of education at the employees' level (individual view) in the QP database (initial variable named EDU_YEARS), for both TMT (EDU_YEARS_TMT) and remaining employees (EDU_YEARS_ WORKERS, later used to create the control variable AVG_EDU_YEARS_WORKERS); then, we had to aggregate all the observations of employees/TMT of a given firm by using the command 'gcollapse', which, in this particular case, calculated the average of the initially created variables EDU_YEARS (creating automatically a variable which we named AVG_EDU_YEARS_TMT and another AVG_EDU_YEARS_WORKERS). Accordingly, AVG_EDU_YEARS_TMT represents the average of the TMT members' average years of formal education per TMT and firm.

4. Empirical Results

4.1. Descriptive statistics analysis

The economic performance variables – gross value added at market prices and factor prices, in absolute terms (GVA_MP, GVA_FP) and per employee (GVA_MP_EMPL, GVA_FP_EMPL) present 2,183,055 observations (Table 3). In this sample, the real gross value added is, on average, of 415,476.1 euros (standard-deviation of 6,159,297 euros), at market prices, and of 416,316 euros (standard-deviation of 6,077,245 euros), at factor prices; while the average values, per employee, are around 21 thousand euros – on average, 21,470.6 euros per employee (standard-deviation of 201,699.3 euros), at market prices, and 21,422.5 euros (standard-deviation of 188,683.5 euros) per employee, at factor prices.

Regarding the financial variables – ROA_NR, ROA_EBIT and ROE – we observe that, on average, the companies seem to be unprofitable (suggested by the negative averages across these variables); however, these variables present high standard-deviations and extreme values as their minimum and maximum demonstrate an highly skewed distribution – this was taken into consideration when analysing the results of the different models with these variables as dependent variables (this issue will be addressed in the next section).

Regarding the independent variables, the ones related to TMT's formal education level, AVG_EDU_YEARS_TMT and PERC_DIPLOMADO_TMT, they include 2,178,949 and 2,183,055 observations, respectively. The variable representing TMT's average years of formal education (AVG_EDU_YEARS_TMT) has an average value of 10.72, indicating that, on average, TMT members have not completed higher education (which would typically correspond to, at least, 15 years of completed formal education). This aligns with the fact that, when observing the average PERC_DIPLOMADO_TMT, we can see that, on average, 27.9% of TMT members have a higher education degree.

On the other hand, the variables regarding TMT's members' formal education field – PERC_STEM_TMT, PERC_BUSIN_TMT, TEM_STEM and TEM_BUSINESS –, all involving 2,183,055 observations. The first two variables, PERC_STEM_TMT and PERC_BUSIN_TMT, present an average of 6.8% and 6.1%, respectively, indicating that, on average, a small portion of TMT members have education on these fields. The remaining two variables, TEM_STEM and TEM_BUSINESS, present that a small portion of our total

observations have TMTs in which at least one member has a degree in these fields (these two variables present an average of 9.2% and 9.0%, respectively).

With respect to the variables representative of the connection between TMT members' field of study and firms' main activity – TMT_EDU_IND, PERC_TMT_EDU_IND and MAJ_ TMT_EDU_IND – their average values (0.11, 9.17 and 0.10, respectively) suggest that there is only a small portion of the total observations where TMT members have formal education in a field of study related to the firms' industry.

In addition, in the variables representative of TMT's formal education diversity, DIV_EDU_ YEARS_TMT and DIV_EDU_FIELD_TMT, with 2,181,380 and 2,183,055 observations, respectively, it can be observed that while diversity does exist in some companies, on average, there is small heterogeneity in TMT's academic background.

Moving on to the experience variables, the variable representative of TMT's average experience level (in years) – AVG_EXPERIENCE_TMT – presents an average of 30.5, meaning that, on average, TMT's average experience level is of 30.5 years. When analysing TMT's experience type, the variable TMT_SAME_INDUSTRY_EXP shows that TMT members have mostly experience in the same industry as the one of the company they are currently working in, with 97.7% of the observations having at least one member of its TMT with prior experience in the firm's industry (as seen by its average), this is also supported by the two alternative variables for TMT_SAME_INDUSTRY_EXP – PERC_TMT_SAME_ INDUSTRY_EXP and MAJ_TMT_SAME_INDUSTRY_EXP – which show that, on average, 96% of TMT members have experience in the same industry as the one of the company they are currently working (in a given year) and that 97.5% of the observations have the majority of TMT members with professional experience in the firm's industry. The variable TOTAL_INDUSTRY_EXPERIENCE still suggests that, while there is high degree of industry specialization, there still is a presence of other industry experience with TMT having, on average, experience in 1.5 industries. These conclusions are also supported by the variable representative of professional experience diversity across industries, DIV_EXP_ INDUSTRY_TMT, which demonstrates that, on average, there is low diversity of industries in which TMT members' have experience in, as well as, when concerned to the diversity in terms of years of experience (as seen by DIV_EXP_YEARS_TMT).

With respect to the control variables, most of them present 2,183,055 observations, with the exception of AVG_EDU_YEARS_WORKERS and LEV with 1,788,124 and 2,182,989 observations, respectively.

Similarly to what was demonstrated by the variable representative of TMT's average education years, the control variable for employees' (non TMT) average education years – AVG_EDU_YEARS_WORKERS – also seems to show that the average education level of employees is, on average, 9.7 years, i.e., not holding higher education degrees.

Furthermore, it appears to be rare for companies to invest in employee training, having R&D activities and having foreign ownership over the 50%, in particular on average, only 0.81% of the observations report to have employee training (TRAIN_EMP), 1.6% report having R&D spending (TEM_RD) and 2% with predominantly foreign capital (MAJ_FOR_OWN). Additionally to being mostly domestically owned, most of the companies are, on average, 14.2 years old (FIRM_AGE) and with a small exporting intensity (EXP_INT presents an average of 6.64%); they can also be characterised as being mainly micro companies (79.27% of the observations), from the North (39.38% of the observations), of trade activities (29.06% of the observations) – see Table A4, in Appendix. The size of TMT are predominately of a small scale, with TMT_SIZE presenting an average of 1.56 (~2) members.

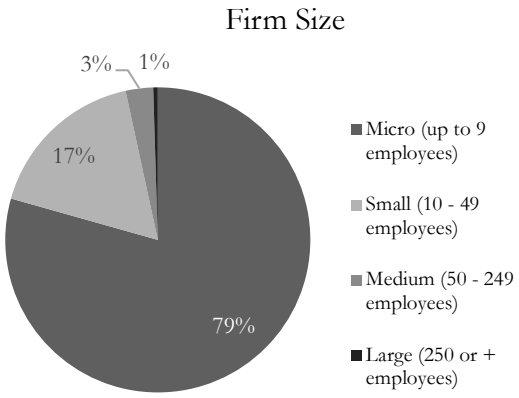


Figure 5: Sample composition by firm size

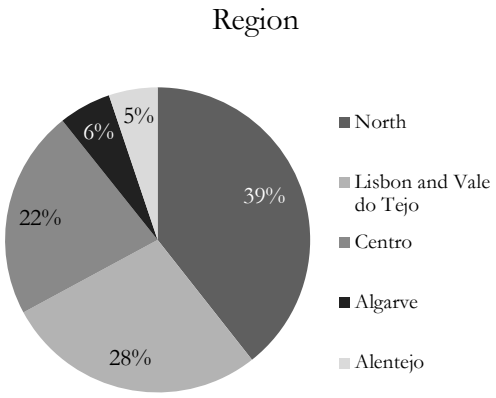


Figure 6: Sample composition by region

Source: Own elaboration.

Table 3: Variables' descriptive statistics

Variable Name				Descriptive Statistics				
				Obs.	Average	St. Dev.	Min.	Máx.
Dependent Variable	Firm performance	Economic	GVA_MP	2 183 055	415476.1	6159297	-4.04e+08	1.34e+09
			GVA_FP	2 183 055	416316	6077245	-4.04e+08	1.30e+09
			GVA_MP_EMPL	2 183 055	21470.63	201699.3	-2.30e+07	8.10e+07
			GVA_FP_EMPL	2 183 055	21422.51	188683.5	-2.30e+07	7.61e+07
			log_GVA_MP	2 028 349	11.20884	1.576283	-0.1678084	21.01438
			log_GVA_FP	2 035 707	11.21603	1.572197	-0.1678084	20.98567
			log_GVA_MP_EMPL	2 028 349	9.629923	0.9231772	-2.423104	18.2097
			log_GVA_FP_EMPL	2 035 707	9.635911	0.9112199	-1.410763	18.14725
		Financial	ROA_NR	2 181 959	-0.6297143	176.5202	-245360.5	5665.478
			ROA_EBIT	2 181 959	-0.5982276	173.503	-241163	5665.478
			ROE	2 182 898	-0.1650899	262.3705	-237608	65066.5
Independent Variables	EDU_LEVEL	AVG_EDU_YEARS_TMT		2 178 949	10.72123	3.638677	0	20
		PERC_DIPLOMADO_TMT		2 183 055	27.87564	42.74696	0	100
	EDU_TYPE	PERC_STEM_TMT		2 183 055	6.770249	23.18661	0	100
		PERC_BUSIN_TMT		2 183 055	6.144862	21.71476	0	100
		TEM_STEM		2 183 055	0.091945	0.2889484	0	1
		TEM_BUSINESS		2 183 055	0.0896702	0.2857088	0	1
		TMT_EDU_IND		2 183 055	0.1129958	0.3165877	0	1
		PERC_TMT_EDU_IND		2 183 055	9.168185	27.3382	0	100
		MAJ_TMT_EDU_IND		2 183 055	0.0990745	0.298762	0	1
	EDU_DIV	DIV_EDU_YEARS_TMT		2 181 380	0.4782823	1.241522	0	11.31371
		DIV_EDU_FIELD_TMT		2 183 055	0.0487873	0.1514642	0	0.859097
	EXP_LEVEL	AVG_EXPERIENCE_TMT		2 170 974	30.53595	11.13045	0	62
	EXP_TYPE	TMT_SAME_INDUSTRY_EXP		2 183 055	0.9767665	0.1506443	0	1
		TOTAL_INDUSTRY_EXPERIENCE		2 183 055	1.491064	1.171828	1	29
		PERC_TMT_SAME_INDUSTRY_EXP		2 183 055	96.01721	16.91813	0	100
		MAJ_TMT_SAME_INDUSTRY_EXP		2 183 055	0.9745595	0.1574588	0	1
	EXP_DIV	DIV_EXP_YEARS_TMT		2 173 831	2.146104	4.7351	0	41.01219
		DIV_EXP_INDUSTRY_TMT		2 183 055	0.2297658	0.4040165	0	3.262569
Other independent / control variables (X)	AVG_EDU_YEARS_WORKERS			1 788 124	9.728086	2.851407	0	20
	TRAIN_EMP			2 183 055	0.0080584	0.0894064	0	1
	TMT_SIZE			2 183 055	1.563276	4.283612	1	1528
	LEV			2 182 898	2.272147	15.39154	-82.89287	130.8854
	TEM_RD			2 183 055	0.0160097	0.1255124	0	1
	FIRM_SIZE			2 183 055	1.253028	0.5765479	1	9
	FIRM_AGE			2 183 055	14.16667	13.11752	0	525
	IND			2 183 055	13.79974	6.589714	1	34
	REG			2 183 055	14.35613	2.771891	11	18
	MAJ_FOR_OWN			2 183 055	0.0198662	0.1395405	0	1
	EXP_INT			2 183 055	6.643908	20.82797	0	100
	YEAR			2 183 055	2016.634	4.069237	2010	2023

Source: Own elaboration.

4.2. Presentation of the estimation models

To test our hypotheses, we have estimated 10 models, using panel data with fixed effects, for each of the dependent variables (i.e., economic and financial performance indicators) created, with the changes between models resting in the alternative independent variables used to assess TMT's level and type of formal education, and type of professional experience.

We have estimated the models for each of the created dependent variables always using fixed effects, distinguishing them from one another through the change of a single variable in each model (when compared to the first model). Looking at Table 4,[22] in Model 1, formal education is assessed by average education years (AVG_EDU_YEARS), the percentage of TMT members with a degree in STEM (PERC_STEM_TMT) and identified when at least one TMT member had formal education in a field of study connected to the firm's industry (TMT_EDU_IND) and had prior experience in the firms' industry (TMT_SAME_ INDUSTRY_ EXP). The aforementioned variables of Model 1 are the ones that are changed (one by one) in the following models (with the changes made in Model 2 were not applied to the following models, for example), concerning TMT's formal education level, formal education type [field of study] and professional experience type [industry]. In addition to these, Model 1 assesses the diversity of education years (DIV_EDU_YEARS_TMT) and field of study (DIV_EDU_YEARS_TMT), TMT's average years of professional experience (AVG_EXPERIENCE_TMT) and the diversity of years of professional experience (DIV_EXP_YEARS_TMT) and industry (DIV_EXP_INDUSTRY_TMT) – these five variables, together with all the control variables, remain unchanged throughout the models.

When transitioning to Model 2, the only change lies with the fact that TMT education level is no longer measured by AVG_EDU_YEARS, but by the percentage of TMT members' with an university degree (PERC_DIPLOMADO_TMT); from this second model onwards, we consider AVG_EDU_YEARS to assess formal education level.[23] In Model 3, in

[22] In this table is presented the estimation results for our main six model (Models 1 to 6) considering logarithm of real gross value added, at market prices, per employee, as the dependent variable; while Table A12, in Appendix, presents the results for Models 7 to 10 for the same dependent variable. This aspect will be further developed in the following section.
Please bear in mind that the following presentation of the construction of Models 1 to 10 also applies to the estimations shown in Tables A13 to A22, with the only difference being the dependent variable used.

[23] It is important to keep in mind that the differences between models we present here are always when compared to model 1, i.e., the changes in variables (facing model 1) made in one model do not apply to the following models.

comparison to Model 1, we changed PERC_STEM_TMT for PERC_BUSIN_TMT; similarly, in Models 4 and 5, instead of considering the percentage of TMT members with those fields of education (i.e., STEM and Business), we identified when at least one TMT member had a degree in such (i.e., when compared to Model 1, PERC_STEM_TMT was replaced for TEM_STEM, in Model 4, and TEM_BUSINESS, in Model 5). Model 6 differs from model 1 by considering the total number of industries in which TMT, as a whole, had prior experience in (TOTAL_INDUSTRY_EXPERIENCE), instead of TMT_SAME_ INDUSTRY_EXP.

In addition to the six models, and as shown in Table A12, in Appendix,[24] we created another four auxiliar models, as a way to further explore the robustness of our estimations, once again changing one variable at the time when comparing to Model 1 – Models 7 to 8, instead of TMT_SAME_INDUSTRY_EXP consider PERC_TMT_SAME_INDUSTRY_EXP and MAJ_TMT_SAME_INDUSTRY_ EXP (i.e., instead of identifying when at least one TMT member had prior experience in the firms' industry, it analyses the percentage of members and when the majority of TMT members fall under this condition); Models 9 to 10, instead of considering when at least one TMT member had formal education in a field of study connected to the firm's industry (TMT_EDU_IND), consider when the majority of TMT members (MAJ_TMT_EDU_IND) and the percentage of such (PERC_TMT_ EDU_IND) that fall under such condition.

4.3. Test of hypotheses

In Table 4, we present the results of the main models (Models 1 to 6) for the logarithm of the economic performance variable GVA_MP_EMPL (real gross value added, at market prices, per employee – log_GVA_MP_EMPL); while the results of Models 7 to 10, for the same dependent variable, are presented in Table A12, in Appendix.

The results presented in Table 4, for the most part, do not differ from those obtained with the remaining economic performance variables (GVA_MP, GVA_FP, GVA_FP_EMPL), demonstrating the robustness of our estimations – see in Table A13-A19, in the Appendix. However, when performance of the firms is measured by the financial variables (ROA_NR, ROA_EBIT and ROE), some differences arise – see in Table A20-A22, in the Appendix.

[24] Please bear in mind that the following presentation of the construction of Models 1 to 10 also applies to the estimations shown in Tables A13 to A22, with the only difference being the dependent variable used.

Because accounting-based profitability measures in Portugal over 2010 – 2023 are materially affected by heterogeneous factors, such as, accounting regimes (Accounting Standardisation System [*Sistema de Normalização Contabilística*] (SNC) tiers), tax-policy features (including the 2014 Corporate Income Tax [*Imposto sobre o Rendimento das Pessoas Coletivas*] (CIT/IRC) reform and local/state surtaxes), audit-quality and earnings-management dynamics documented in national studies, and large episodic policy interventions (crisis-era subsidies and moratoria), we treat ROA and ROE as secondary / robustness measures and focus our interpretation on real gross value added (GVA) and GVA per employee (see OECD, 2001; Alves, 2012; Pereira & Alves, 2017; Lopes, 2018). First, GVA is recommended, by Eurostat and Statistics Portugal, as the standard measure for assessing productivity and economic contribution, as it directly reflects firms' capacity to generate value through production activities and is less affected by financial structure, depreciation policies, or extraordinary items. In contrast, ROA and ROE are accounting-based measures whose numerators (net results or operating income [EBIT]) and denominators (assets or equity) are highly sensitive to recognition and valuation choices. Second, during the period under analysis, Portugal implemented the IFRS--inspired 'SNC', which operates with three regimes (full, simplified, and micro-entity standards). This tiered system means that firms of different sizes follow different recognition and measurement rules, affecting key components of ROA and ROE. As the sample includes a large share of small and medium-sized enterprises (SMEs), such heterogeneity undermines the comparability of accounting-based returns. Third, the Portuguese corporate tax system introduces additional distortions. Besides changes in the statutory corporate tax rate, firms are subject to layered surcharges (*municipal derrama* and state surcharge) and "autonomous taxation" on certain expenses (e.g., vehicles, undocumented costs, and some management bonuses). These elements influence reported net results independently of operational efficiency, thereby contaminating ROA and ROE measures. Fourth, empirical studies have documented earnings management practices in Portuguese non-listed firms, particularly through discretionary accruals; these practices alter accounting profitability indicators, but have less direct impact on GVA (Alves, 2012). Finally, during crisis periods such as the sovereign debt crisis (2011 – 2013) and the COVID-19 pandemic (2020 – 2021), subsidies, moratoria, impairments, and revaluations disproportionately affected reported profits and equity, generating swings in ROA and ROE not necessarily aligned with operational performance.

Taken together, these factors suggest that financial performance indicators in Portugal during this period are subject to substantial institutional and reporting noise, which reduces their validity as measures of underlying firm performance. In contrast, economic performance indicators based on real GVA and real GVA per employee offer a more robust and conceptually consistent basis for evaluating the impact of top management teams' human capital. For these reasons, the discussion of results focuses primarily on the economic performance measures, while financial ratios are reported as supplementary outcomes (Table A20-A22, in the Appendix).

Before turning to the substantive interpretation of results, it is important to consider the robustness and adequacy of the estimated models. Across all specifications, the Breusch–Pagan test strongly rejects the null of homoskedasticity (p-value smaller than 0.1%; '$p < 0.001$'), justifying the use of robust standard errors. The Hausman test consistently indicates that the fixed effects estimator is appropriate, confirming that unobserved firm-specific heterogeneity is correlated with the explanatory variables (Verbeek, 2017). The models explain around 4% of the within-firm variation in performance ($R^2 \approx 0.04$),[25] across models, which is comparable to other large-scale panel studies of TMT and firm outcomes (e.g., Urquhart & Zhang, 2022; Hernández-Atienza *et al.*, 2024), where explanatory power tends to be modest due to the multifactorial nature of performance. Importantly, all specifications yield highly significant F-statistics ($p < 0.001$), confirming the joint explanatory power of the included variables. Moreover, variance inflation factors (VIFs) remain well below conventional thresholds (maximum $\approx$ 6.3), [26] suggesting no serious multicollinearity concerns. Taken together, these indicators support that the models are correctly specified, statistically sound, and provide a reliable basis for hypothesis testing.

Across all model specifications, as presented in Table 4, the results show a consistent and statistically significant positive relationship between TMT's level of education and firm performance, as measured by real gross value added per employee. In particular, in Model 1, an additional year of TMTs' average education years is associated with a 0.3% increase,

[25] The reported R^2 corresponds to the within R^2 from the fixed effects estimation. It measures the proportion of the variation in the dependent variable within individuals over time that is explained by the explanatory variables, after controlling for unit-specific fixed effects. Unlike the overall R^2, it does not capture variation between individuals, as this is absorbed by the fixed effects.

[26] This represents the highest maximum VIF value of the models analyzing the impact of TMT's formal education and professional experience on economic performance (measured as the logarithm of real gross value added, at market prices, per employee) are registered in Model 6.

statistically significant at 1% significance level, in real gross value added per employee, at market prices, regardless of the model formulation (i.e., Models 3 to 6 corroborate this result). This positive effect is equally significant when analysing the percentage of TMT with a university degree (i.e., Model 2), which shows that a one percentage point increase in the percentage of TMT members that are graduates is associated with an 0.01% increase, statistically significant at 5% significance level, in real gross value added per employee, at market prices. This means that firms whose top managers have more years of formal education show higher gross value added per worker. The positive, highly significant coefficients for the level of TMT education indicate that managerial skills and absorptive capacity translate into efficiency and value creation at the shop floor level. More educated TMTs may better interpret signals, evaluate investments, deploy data-driven controls, and coordinate complementary assets.

The effect of the field of education is generally weak, with coefficients close to zero and significant only in one specification (Model 5). Model 3 (includes PERC_BUSIN_TMT) shows a tiny, positive, but not robust coefficient (not statistically significant), while Model 5 (which considers TEM_BUSINESS, as an alternative to Model 1's PERC_STEM_TMT) is marginally significant, showing that firms with at least one TMT member with an degree in a business field have, on average, 1.04% higher real gross value added, at market prices, per employee, statistically significant at 10% significance level, than firms without it. This suggests that simply having a business-trained manager is not strongly or consistently linked to higher firm performance, at least after controlling for workers' education and other firm--level characteristics. It could imply that generic business training is less critical than either general education or industry-specific knowledge. One interpretation is that the returns from business training are obtained/realized through better organizational processes that are already partially captured by other covariates (e.g., training intensity, export orientation), or that business skills are widely diffused across managers, reducing cross-sectional variation.

The match between TMT's education field and the firm's main industry of activity shows a strong, positive, and robust effect across models. In particular, firms with at least one TMT member with formal education in a field of study associated with firms' industry have, on average, 1.4% higher real gross value added, at market prices, per employee, than firms without it, statistically significant at 1% level; this impact is slightly smaller in Model 2 and 3, of, on average, 1.3%, statistically significant at 5% significance level, and 0.91%, statistically

significant at 10% significance level, respectively, but of no statistically significance in Model 5. This is one of the clearest results: when at least one TMT member has formal education in a field of study aligned with the firm's industry, performance improves. This supports the "fit" hypothesis: a domain-specific human capital mechanism, i.e., managers who understand the firm's technological and market primitives – production functions, input quality, regulatory constraints, demand drivers –, can select technologies, monitor quality, and adapt to shocks more effectively. Thus, domain-specific knowledge matters more than generalist business knowledge.

Regarding formal education diversity measures, the results are mixed. Diversity in levels of formal education is consistently positive and statistically significant. The results show that a one additional year in the standard-deviation of TMT average education is associated with an 0.2% increase in firms' real gross value added, at market prices, per employee, statistically significant at 1% significance level across models (with the exception of Model 6, where the statistically significance drops to 5% significance level). This indicates that TMTs combining different educational levels (Bachelor's, Master's, PhD's degrees) foster better outcomes, perhaps because it allows both strategic vision and operational pragmatism to coexist.

In contrast, diversity in fields of education shows no statistically significant effect across all models, suggesting that heterogeneity of fields of study does not automatically translate into higher performance. In other words, diversity in levels of education is beneficial, possibly because it blends strategic/analytical capabilities (e.g., MSc/PhD) with execution oriented pragmatism (e.g., Bachelor/technical diplomas); in contrast, diversity in fields of study is largely neutral (and statistically insignificant in all models): simply mixing STEM, business, and other disciplines does not automatically enhance performance in the absence of a clear complementarities structure. This is consistent with the idea that cognitive diversity needs problem structure fit; otherwise, coordination costs may offset creative gains.

Table 4: The impact of TMT's formal education and professional experience on economic performance (Fixed effects estimation, dependent variable: log of real gross value added, at market prices, per employee)

		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
TMT's Education		**0.0025*** (0.001)**	**0.0001** (0.000)**	**0.0025*** (0.001)**	**0.0026*** (0.001)**	**0.0025*** (0.001)**	**0.0025*** (0.001)**
TMT's Field of Education		0.0000 (0.000)	0.0000 (0.000)	0.0001 (0.000)	0.0018 (0.005)	**0.0104* (0.005)**	0.0000 (0.000)
TMT's Formal Education Field of Study and Industry Match		**0.0135*** (0.005)**	**0.0128** (0.005)**	**0.0091* (0.006)**	**0.0135*** (0.005)**	0.0080 (0.006)	**0.0143*** (0.005)**
Diversity of TMT's Field of Education		0.0011 (0.008)	0.0016 (0.008)	0.0022 (0.007)	0.0003 (0.008)	-0.0026 (0.008)	0.0016 (0.008)
Diversity of TMT's Level of Education		**0.0024*** (0.001)**	**0.0024*** (0.001)**	**0.0024*** (0.001)**	**0.0024*** (0.001)**	**0.0025*** (0.001)**	**0.0023** (0.001)**
TMT's Level of Experience		**0.0008*** (0.000)**	**0.0005*** (0.000)**	**0.0008*** (0.000)**	**0.0008*** (0.000)**	**0.0008*** (0.000)**	**0.0010*** (0.000)**
TMT's Type of Experience (Industry)		**0.1619*** (0.006)**	**0.1620*** (0.006)**	**0.1620*** (0.006)**	**0.1619*** (0.006)**	**0.1620*** (0.006)**	**-0.0115*** (0.002)**
Diversity of TMT's Industry Experience		**-0.0234*** (0.003)**	**-0.0236*** (0.003)**	**-0.0235*** (0.003)**	**-0.0234*** (0.003)**	**-0.0235*** (0.003)**	**0.0250*** (0.005)**
Diversity of TMT's Level of Experience		**-0.0008*** (0.000)**	**-0.0008*** (0.000)**	**-0.0008*** (0.000)**	**-0.0008*** (0.000)**	**-0.0008*** (0.000)**	**-0.0008*** (0.000)**
Workers Average Level of Education		0.0015*** (0.001)	0.0016*** (0.001)	0.0015*** (0.001)	0.0015*** (0.001)	0.0015*** (0.001)	0.0013** (0.001)
Training		0.0296*** (0.006)	0.0296*** (0.006)	0.0296*** (0.006)	0.0296*** (0.006)	0.0296*** (0.006)	0.0290*** (0.006)
TMT Size		-0.0001 (0.000)	-0.0001 (0.000)	-0.0001 (0.000)	-0.0001 (0.000)	-0.0001 (0.000)	0.0001 (0.000)
Leverage		0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)
Presence of R&D		0.0374*** (0.006)	0.0372*** (0.006)	0.0374*** (0.006)	0.0374*** (0.006)	0.0373*** (0.006)	0.0386*** (0.006)
Firm Size		Yes	Yes	Yes	Yes	Yes	Yes
Firm Age		0.0007 (0.002)	0.0007 (0.002)	0.0007 (0.002)	0.0007 (0.002)	0.0007 (0.002)	0.0006 (0.002)
Industry		Yes	Yes	Yes	Yes	Yes	Yes
Region		Yes	Yes	Yes	Yes	Yes	Yes
Multinational		0.0040 (0.012)	0.0036 (0.012)	0.0040 (0.012)	0.0040 (0.012)	0.0040 (0.012)	0.0058 (0.012)
Export		0.0022*** (0.000)	0.0022*** (0.000)	0.0022*** (0.000)	0.0022*** (0.000)	0.0022*** (0.000)	0.0022*** (0.000)
Year		Yes	Yes	Yes	Yes	Yes	Yes
N		1690190	1690190	1690190	1690190	1690190	1690190
Number of firms		285503	285503	285503	285503	285503	285503
OLS	VIF max [mean]	2.61 [1.36]	2.25 [1.35]	2.47 [1.37]	2.57 [1.37]	2.44 [1.38]	6.35 [1.50]
	Breusch–Pagan (p-value)	5791.73 (0.0000)	6232.74 (0.0000)	5953.12 (0.0000)	6059.64 (0.0000)	5924.68 (0.0000)	5243.98 (0.0000)
R-squared (within)		0.0413	0.0412	0.0413	0.0413	0.0413	0.0402
F statistic (overall)		575.6371 (0.0000)	575.5759 (0.0000)	575.6520 (0.0000)	575.6298 (0.0000)	575.6512 (0.0000)	568.0078 (0.0000)
Root MSE		0.4521	0.4521	0.4521	0.4521	0.4521	0.4523
Hausman Test		21370.11 (0.0000)	19216.84 (0.0000)	21269.33 (0.0000)	21432.06 (0.0000)	21366.43 (0.0000)	20934.87 (0.0000)

Notes: Robust standard errors in parentheses. Significance levels: *, 10%; **, 5%; ***, 1%. All models considered as the dependent variable the logarithm of real gross value added, at market prices, per employee, and conducted a panel data fixed effects estimation. In Model 1 the independent variables were AVG_EDU_YEARS, PERC_STEM_TMT, TMT_EDU_IND, DIV_EDU_YEARS_TMT and DIV_EDU_YEARS_TMT (regarding formal education), and AVG_EXPERIENCE_TMT, TMT_SAME_INDUSTRY_EXP, DIV_EXP_YEARS_TMT, and DIV_EXP_INDUSTRY_TMT (regarding professional experience). The remaining models used the same variables with the exception of the following changes: Model 2, instead of AVG_EDU_YEARS considers PERC_DIPLOMADO_TMT; Model 3, 4 and 5, change PERC_STEM_TMT to PERC_BUSIN_TMT, TEM_STEM and TEM_BUSINESS, respectively. Finally, Model 6 considers TOTAL_INDUSTRY_EXPERIENCE instead of TMT_SAME_INDUSTRY_EXP. The control variables remain unchanged throughout the models.
Source: Own elaboration.

In terms of professional experience, TMT's professional experience (measured in years) also displays a positive and robust association with firm performance, in particular, results show that one additional year of TMTs average years of experience leads to an increase of 0.1%, on average, on firms' real gross value added, at market prices, per employee, statistically significant at 1% significance level. Accordingly, more experienced teams seem to improve firm productivity, probably by making fewer mistakes and navigating uncertainty better. This accords with learning by doing and tacit knowledge channels: seasoned TMTs avoid common pitfalls, calibrate risk more accurately, and can execute complex reorganizations, using prior experiences as a guide in their decision-making process.

Professional experience in the same industry as the firm is one of the strongest predictors of firm performance, with large and significant coefficients in nearly all specifications, except in Model 6, where the effect turns negative. Indeed, from Models 1 to 5, TMT's industry experience is very strong, with firms that have at least one TMT member with prior professional experience in the firms' industry presenting, on average, 16.2% higher real gross value added, at market prices, per employee, than firms without any TMT member under this condition, statistically significant at 1% significance level, suggesting that when at least one TMT member has experience in the firm's industry, performance increases substantially, which is consistent with domain familiarity and richer networks. However, in Model 6 (which, instead, considers TOTAL_INDUSTRY_EXPERIENCE), the sign flips to negative, suggesting that an additional industry in the total number of industries in which TMT (as a whole) has experience in, leads to a decrease of 1.15% of real gross value added, at market prices, per employee, statistically significant at 1% significance level, while diversity of industry experience becomes positive. All in all, this indicates a trade-off: having industry-matching experience is beneficial, but too much "depth" in the same industry (i.e., homogeneity) can bind/lock firms in, while having managers from multiple industries allows the introduction/consideration of complementary perspectives.

In contrast, the impact of diversity in industry experience is negative and significant in five of the six models (Model 1 to 5) – a 0.1 increase in TMT's experience field/industry diversity index is associated to a 0.24% decrease of firms' real gross value added, at market prices, per employee, statistically significant at 1% significance level –, with only one specification (Model 6) suggesting a positive effect – a 0.1 increase in TMT's experience field/industry diversity index is associated to a 0.25% increase of firms' real gross value added, at market

prices, per employee, statistically significant at 1% significance level. This suggests nonlinear effects: moderate diversity may fragment decision-making, but when we consider the breadth of professional experience (i.e., when we consider the total number of industries in which TMT (as a whole) has experience in, represented by TOTAL_INDUSTRY_EXPERIENCE, and used in Model 6 as an alternative to TMT_SAME_INDUSTRY_EXP), diverse industry backgrounds boost performance.

Likewise, experience level diversity consistently exhibits a small but negative and highly significant effect – the results show that an additional year of the standard-deviation of TMTs of experience decreases firms' real gross value added, at market prices, per employee, by 0.1%, statistically significant at 1% significance level across all models, – implying that heterogeneity in years of experience harms performance (perhaps teams with very junior and very senior managers clash, reducing cohesion).

In essence, and as shown in Table 5, education level and industry-matching matter most. Diversity of educational level is beneficial, but diversity of fields of study is neutral (or at least not systematically helpful). Professional experience is crucial, but its effects are subtle. Having experienced managers in the same industry is good, but too much homogeneity is risky. Industry-diverse teams can be valuable, but only when this diversity is structured (breadth) rather than fragmented. Level-diverse experience (large gaps between seniority levels) seems harmful.

Table 5: Overall results from the hypotheses' test

Hypothesis	Description	Result
H1a	TMT with high levels of formal education tend to foster firms' performance.	Validated
H1b	TMT with formal education in business-related fields is associated with higher firms' performance.	Partially validated
H1c	TMT with formal education in fields related to firms' activities is likely to enhance firms' performance.	Validated
H1d	TMT having individuals with diverse levels of formal education and/or diverse fields of study are associated with firms characterized by higher levels of performance.	Partially validated
H2a	TMT with more years of professional experience tend to foster firms' performance.	Validated
H2b	TMT with professional experience in business-related fields is associated with higher firms' performance.	Validated
H2c	TMT having individuals with diverse professional experiences are associated with firms characterized by higher levels of performance.	Not validated

Source: Own elaboration.

Regarding the control variables, the estimates of the coefficient of workers' education is positive and significant, i.e., complements TMT education. In particular, results show that an additional year of workers' average formal educational level leads to an increase of 0.15% of firms' real gross value added, at market prices, per employee, statistically significant at 1% significance level. Training (firm-level) reveals a very strong positive effect, suggesting human capital investments at the workforce level are critical. The R&D presence is strongly positive, as expected. Firms that invest in employee training and in R&D present, on average, 2.96% and 3.7%, respectively, higher real gross value added, at market prices, per employee, when compared with firms that do not invest in such, statistically significant at 1% significance level. Thus, the positive, robust effects of workers' average education and training underscore that TMT human capital complements shop floor capabilities. Higher TMT quality may be especially productive when it can be translated into workforce practices (training systems, process improvements) and technology choices (R&D engagement). The strong positive association with R&D presence is consistent with this complementarity story: capable TMTs may select into R&D and also extract more value from it.

Industry and region fixed effects imply that the estimated relationships are within firms over time. These effects capture changes in TMT composition and capabilities, rather than cross industry differences, strengthening causal interpretation under the assumption that unobserved time varying confounders are limited.

Export intensity and leverage are positive but small, suggesting that external orientation and disciplined financing provide additional, albeit modest, channels for performance gains alongside TMT human capital.

Firm size and age show limited direct effects once fixed effects are included; returns to TMT attributes thus do not appear confined to a particular size/age segment within firms over time.

4.4. Discussion of the results

Using a very large, representative panel of private, non-financial firms in mainland Portugal, as a result of the that merger of QP and SCIE databases, at the firm-level, this study aimed to examine the impact of top management teams' (TMT) formal education and professional experience on firm performance, having found robust evidence that, between 2010 and 2023, the human capital of TMT is systematically associated with firm performance, proxied by the

logarithm of real gross value added, at market prices, per employee. The results show that formal education and professional experience matter, but not uniformly: (i) higher average education of the TMT displays small, but consistent positive effects; (ii) industry matched education within the TMT is particularly valuable; (iii) education level diversity (different degrees coexisting in the TMT) is beneficial, while field of study diversity is neutral; (iv) higher average experience is beneficial; (v) industry matched experience has a strong positive association in most specifications, yet too much homogeneity in industry backgrounds may reduce the benefits of cross fertilization; and (vi) diversity in years of experience within the TMT tends to be detrimental.

The findings showing a positive relationship between formal education level and firm performance, align with this study's theoretical framework, in particular, with Human Capital (HCT) (Becker, 1993; Teixeira, 2002; Hatch & Dyer, 2004, Crook *et al.*, 2011) and Upper Echelons Theory (UET) (Hambrick & Mason, 1984; Li & Singal, 2019; Mun *et al.*, 2020; Nawaz, 2022; Bilal *et al.*, 2023) which state that investments in formal education provide individuals with knowledge and skills to be more productive, influencing how challenges are viewed and (strategic) decisions are made, ultimately, impacting firm performance. Moreover, the finding that TMT with formal education in business-related fields and/or in fields related to firms' activities is associated with higher firms' performance, suggests that, additionally to the level of formal education, the field of study may also provide individuals with knowledge and skills about the different aspects of firm's operations and industry dynamics, influencing decisions made and firm performance.

With regard to TMT having individuals with diverse levels of formal education and/or diverse fields of study, we were only able to confirm that diversity of TMTs' level of formal education lead firms to have higher levels of performance, conversely to what some other studies found – e.g., Hernández-Atienza *et al.* (2024) concluded that the diversity of the field of education of executive directors positively impacted firm performance and that of non-executive and independent directors were insignificant – suggesting that having diversity of formal education levels within the firm can introduce different perspectives and information that impact decision-making and firm performance, consistent with behavioural theory of the firm (e.g., Cyert & March, 1963) and strength of weak ties (Granovetter, 1973) .

In addition, and similarly to what happens with formal education, this study supports that TMT with more years of professional experience and with professional experience in

business-related fields (in this study interpreted as having past experience in the same industry in which TMT members are working in) tend to foster firms' performance, supporting HCT (Becker, 1993; Teixeira, 2002; Hatch & Dyer, 2004; Crook *et al.*, 2011) and UET (Hambrick & Mason, 1984; Li & Singal, 2019; Mun *et al.*, 2020; Nawaz, 2022; Bilal *et al.*, 2023), which consider that professional experience (together with the knowledge/skills acquired with formal education and psychological characteristics) positively impact individuals' ability to perform their tasks and how they process information and make decisions, positively influencing firm performance. Having years of experience in which individuals can rely on, as well as having a better understanding on how the firm's industry operates, can potentially allow TMT members to make better decisions, risk assessments, and implement new and better operations/processes/strategies, based on what they have previously experienced and, consequently, improve firm performance. These results, especially the ones concerning TMT members having past experience in the same industry as their current one, contrast with the findings of Sidki *et al.* (2024), which concluded that supervisory board members' industry experience – also defined as having previously worked in the industry –, did not significantly impact firm performance; however, this difference may be due to what we have considered to be part of the TMT.

Finally, it is worth noting that our hypothesis concerning professional experience diversity, both in terms of level [years] and type [industry], was not confirmed. Our results show, in fact, that professional experience diversity can harm firm performance, which can be result from the of hindering idea sharing, impacting the decision-making process. These findings are somewhat contrasting with previous research, such as Krieweth *et al.* (2024), which evidenced that TMT's functional background diversity was positively associated with the occurrence of inter-firm coopetition and with its competition intensity in inter-firm coopetition, and negatively associated with cooperation in inter-firm coopetition.

The (sometimes) unexpected results, especially when concerning the diversity of TMT formal education and professional experience, are a reflection of what literature has named as double-edge sword (e.g., Milliken & Martins, 1996; Chi *et al.*, 2009; Li & He, 2023): on the one hand, providing firms with different ideas and perspectives can be beneficial for the firms' performance, but, on the other hand, it can also hinder the decision-making process and communication, possibly leading to conflicts due to the multitude of opinions taken into consideration.

5. Conclusion

This study draws upon the four main theories used in studies that focus on the impact of TMT characteristics (Human Capital Theory, Resource Dependence Theory, Agency Theory and Upper Echelons Theory) and the literature on TMTs and human capital, to examine how TMT members' human capital, in particular their formal education and professional experience, impacts the performance of firms operating in Portugal.

For this purpose, we resorted to and integrated two databases (QP and SCIE) with information about both Portuguese firms and their employees, with the final panel having 2,183,055 observations comprising 363,308 firms, over the period 2010 – 2023.

5.1. Main results

Overall, the evidence shows that who sits at the top matters, and matters in patterned ways: specific education and experience aligned with the firm's domain, combined with curated diversity (education levels and adjacent industry breadth) and managed seniority dispersion, are associated with superior productivity performance. These findings contribute to a more granular understanding of how TMT's human capital shapes firm-level value creation in a European, economy-wide setting.

As expected, the results emphasize the importance of human capital, particularly formal education and professional experience, to enhance firms' performance. Our results confirm our hypotheses regarding the impact of TMT's formal education, in particular on how TMTs having more years of formal education, studying in a business/management field or in a field of study directly related to the firm's main activity, as well as the TMTs diversity in terms of level of formal education, contribute positively to firm performance.

The results further support that TMTs with more years of professional experience and with prior experience in the same industry as the current firm positively impact firm performance, while professional experience diversity, in both level and type, appears to harm firm performance.

5.2. Contributions to literature

The present study contributes to the literature in novel ways and at different levels (methodologically, empirically, and conceptually).

First, in contrast to existing empirical studies, it involves an economy-wide, micro-linked TMT panel, comprising a matched QP-SCIE firm-level panel, covering the 2010 – 2023 period, with approximately 2.18 million firm-years, and around 363 thousand (Portuguese) firms; such orders of magnitude are larger and more representative than most TMT studies (which lean, for instance, on listed firms, CEO-centric data, firms of a specific industry, or survey slices). Crucially, it covers the private, non-financial, wage-employing sectors across an entire economy, and not just public firms, reducing selection on listing, governance regimes, or disclosure. Moreover, the clustering of employee characteristics (retrieved from QP) from an individual to a firm level, allowed for a longitudinal analysis of firms' TMT composition throughout the years.

Second, by using real gross value added (GVA) per employee, it aligns TMT research with the productivity literature, moving beyond ROA/Tobin's Q, and tying managerial human capital to value creation, rather than valuation noise.

Third, it proposes original alignment measures for both formal education and professional experience (binary presence, majority, percentage, and breadth counts), operationalizing specific human capital at the TMT level more precisely than generic "MBA/tenure" proxies. In addition to the two above-mentioned contributions, this study further contributes at the empirical level by considering diverse economic and financial indicators to assess firm performance, thereby strengthening the robustness and, consequently, the reliability of our results and subsequent conclusions.

Fourth, it presented new differentiation within 'diversity' – curated breadth vs. dispersion –, separating education-level diversity (beneficial) from field-of-study diversity (neutral), and industry breadth (beneficial when conceptualized as team-level breadth) from experience--level dispersion (harmful). This reframes the classic diversity–performance paradox (balancing the positive and hindering impacts of diversity on firm performance), with a design principle – curated heterogeneity (breadth with integrability) beats unstructured dispersion.

Fifth, the results show that fit (i.e., specificity) dominates generic credentials, providing a unifying mechanism that reconciles mixed findings in upper echelons: the importance of who managers are is heightened/amplified when who they are is aligned with what the firm does.

Finally, this study's integrated and in depth analysis of different human capital dimensions (level, type and diversity), evidenced that TMT's human capital co-moves with worker education/training and R&D, supporting a systems view: managerial human capital is an upstream enabler that amplifies returns to downstream capabilities.

5.3. Theoretical, managerial, and policy implications

From a theoretical perspective, the results refine Upper Echelons Theory by showing that managerial characteristics influence firm performance, not simply through their presence, but through their fit with industry demands. Formal education and professional experience that are directly related to the firm's sector generate stronger productivity gains than generic credentials, underscoring the importance of contextual alignment. This also extends Human Capital Theory by distinguishing between general and specific forms of managerial human capital: while both matter, the marginal returns to industry-specific knowledge and experience are higher, highlighting the value of specialized managerial capital in driving firm outcomes. Furthermore, the results help reconcile the long-standing diversity–performance paradox. Rather than treating diversity as a uniform construct, we show that its effects depend on the type and structure – diversity in education levels enhances performance by combining complementary forms of knowledge, whereas excessive dispersion in experience levels undermines coordination, and industry diversity can be beneficial if balanced with depth in core activities.

For managers and practitioners, the evidence offers concrete guidance for the design and composition of top management teams. Firms benefit from including in their TMT at least one member with formal education and professional experience directly matched to their industry, while at the same time avoiding excessive homogeneity that limits perspective breadth. When recruiting or promoting executives, priority should be given to candidates who either strengthen industry-specific knowledge or bring adjacent-industry experience that introduces transferable insights. Effective team design also involves maintaining some variety in education levels – for example, combining advanced academic training with more practical qualifications –, while managing gaps in seniority through mentoring structures and clear role

definitions, in order to mitigate coordination frictions. Moreover, the complementarities revealed in the results indicate that investments in TMT's human capital are most effective when paired with workforce training and R&D spending, which together amplify the productivity pay-offs.

Finally, the study carries policy implications for productivity and innovation strategies. The results suggest that initiatives should go beyond promoting generic managerial diplomas and, instead, focus on targeted upskilling programs that build industry-specific managerial capabilities. Policies that encourage the mobility of managers across adjacent industries can also help transfer best practices and broaden firms' absorptive capacity. In addition, co--funding schemes that integrate managerial and workforce training, rather than addressing them in isolation, appear especially promising, as they leverage complementarities between leadership skills and workforce development. Collectively, these measures would not only strengthen firm-level performance but also contribute to aggregate productivity growth in the Portuguese economy.

5.4. Limitations and suggestions for future research

In spite of its contributions, this study entails several limitations, which, nevertheless, constitute paths for future research.

First, at the levels of the measurement of professional experience and formal education, the average years and percentage measures may hide within team role differences and complementarities (e.g., CEO vs CFO vs COO). Second, there are potential issues concerning selection and timing – TMT's human capital may both influence and respond to performance (bidirectional causality); fixed effects mitigate level bias, but dynamic endogeneity may remain. Thirdly, regarding the industry match proxies, the mapping between degrees/experience and industry may be coarse for multi-product firms or evolving technologies. Fourthly, gross value added per employee captures productivity, but not risk-adjusted returns or innovation outputs directly. Moreover, we have to keep in mind that this study focuses on the Portuguese context, which has its own characteristics – e.g., accounting regimes, tax-policy features, large episodic policy interventions, as well as the predominance of SMEs in its business fabric – which can constrain the generalisation of our conclusions to other countries, especially if vastly different from Portugal. Another aspect to consider is the chosen time period (2010 – 2023), which includes the COVID-19 pandemic, a shock that

deeply impacted firms across sectors and in various ways. It is also important to note that firms' ability to react (effectively) to such shock can be (significantly) different.

Future research may employ dynamic panel estimators (e.g., system GMM) or event study designs around TMT changes to sharpen causal inference. Additionally, another possibility is to disaggregate by TMT role to test whether industry-matched education/experience is more valuable in certain positions (e.g., Chief Technology Officer (CTO) vs CFO). Another challenging avenue for further research is to explore non-linearities and thresholds, i.e., to explore optimal mixes of depth and breadth (e.g., inverted U in industry breadth effects), and interactions with R&D and exporting. Furthermore, to assess micro mechanisms, namely, the link to Human Resources (HR) practices, the adoption of digital technologies, and organizational routines, to identify transmission channels from TMT attributes to productivity. Future research may also explore if TMT's characteristics influenced firm's reaction to the COVID-19 pandemic shock; however, this requires data on post-pandemic years which, at the present, are not available yet. Finally, another avenue of research may also consist of conducting this analysis considering other countries (especially those with available databases with information at firm and employee levels) and comparing results with those of the present study.

References

Adams, M., & Baker, P. L. (2021). Does boardroom nationality affect the performance of UK insurers? *British Accounting Review*, *53*(5), Article 100923. https://doi.org/10.1016/j.bar.2020.100923

Adorjan, A. (2023). Towards a researcher-in-the-loop driven curation approach for quantitative and qualitative research methods. In A. Abelló, P. Vassiliadis, O. Romero, R. Wrembel, F. Bugiotti, J. Gamper, Solar, G. V., & E. Zumpano (Eds.), *Communications in Computer and Information Science – 27th European Conference on Advances in Databases and Information Systems (ADBIS)* (pp. 647–655). Springer International Publishing.

Aghazada, E., & Ashyrov, G. (2022). Role of institutions in the corruption and firm innovation nexus: Evidence from former Soviet Union countries. *Post-Communist Economies*, *34*(6), 779-806. https://doi.org/10.1080/14631377.2021.2006495

Ahamed, F. T., Houqe, M. N., & van Zijl, T. (2023). Meta-analysis of the impact of financial constraints on firm performance. *Accounting and Finance*, *63*(2), 1671-1707. https://doi.org/10.1111/acfi.12923

Alexandre, F., Cruz, S., & Portela, M. (2021). Financial distress and the role of management in micro and small-sized firms. OECD Productivity Working Papers n.º 27, 2021, NIPE WP 6/2020, IZA Discussion Paper No. 13738.

Alves, S. (2012). Ownership structure and earnings management: Evidence from Portugal. *Australasian Accounting, Business and Finance Journal*, *6*(1), 57–74.

Ardito, C., Berton, F., Pacelli, L., & Passerini, F. (2022). Employment protection, workforce mix and firm performance. *The B. E. Journal of Economic Analysis & Policy*, *22*(3), 611-621. https://doi.org/10.1515/bejeap-2021-0396

Bai, J., & Mkrtchyan, A. (2023). What do outside CEOs really do? Evidence from plant-level data. *Journal of Financial Economics*, *147*(1), 27-48. https://doi.org/10.1016/j.jfineco.2022.10.001

Baishya, S., Karna, A., Mahapatra, D., Kumar, S., & Mukherjee, D. (2025). Dynamic managerial capabilities: A critical synthesis and future directions. *Journal of Business Research*, *186*, Article 115015. https://doi.org/10.1016/j.jbusres.2024.115015

Banerjee, P., & Deb, S. G. (2023). Capital investment, working capital management, and firm performance: Role of managerial ability in US logistics industry. *Transportation Research Part E: Logistics and Transportation Review*, *176*, Article 103224. https://doi.org/10.1016/j.tre.2023.103224

Bantel, K. A., & Jackson, S. E. (1989). Top management and innovations in banking: Does the composition of the top team make a difference? *Strategic Management Journal*, *10*, 107-124. http://www.jstor.org/stable/2486585

Basias, N., & Pollalis, Y. (2018). Quantitative and qualitative research in business & technology: Justifying a suitable research methodology. *Review of Integrative Business and Economics Research*, *7*, 91-105.

Bataineh, M. J., Sánchez-Sellero, P., & Ayad, F. (2024). The role of organizational innovation in the development of green innovations in Spanish firms. *European Management Journal*, *42*(4), 527-538. https://doi.org/10.1016/j.emj.2023.01.006

Baum, C. F., Lööf, H., Stephan, A., & Viklund-Ros, I. (2022). Innovation by start-up firms: The role of the board of directors for knowledge spillovers. *Research Policy*, *51*(1), Article 104375. https://doi.org/10.1016/j.respol.2021.104375

Becker, G. S. (1962). Investment in human capital: A theoretical analysis. *Journal of Political Economy*, *70*(5), 9-49. http://www.jstor.org/stable/1829103

Becker, G. S. (1992). Human capital and the economy. *Proceedings of the American Philosophical Society*, *136*(1), 85–92. http://www.jstor.org/stable/986801

Becker, G. S. (1993). *Human capital: A theoretical and empirical analysis with special reference to education* (3rd ed.). The University of Chicago Press.

Bilal, Komal, B., Ezeani, E., Usman, M., Kwabi, F., & Ye, C. (2023). Do the educational profile, gender, and professional experience of audit committee financial experts improve financial reporting quality? *Journal of International Accounting, Auditing and Taxation*, *53*, Article 100580. https://doi.org/10.1016/j.intaccaudtax.2023.100580

Bischoff, T. S., Hipp, A., & Runst, P. (2023). Firm innovation and generalized trust as a regional resource. *Research Policy*, *52*(8), Article 104813. https://doi.org/10.1016/j.respol.2023.104813

Bogilović, S., Bortoluzzi, G., Černe, M., Ghasemzadeh, K., & Žnidaršič, J. (2020). Diversity, climate and innovative work behavior. *European Journal of Innovation Management*, *24*(5), 1502-1524. https://doi.org/10.1108/ejim-03-2020-0100

Boikos, S., Pinar, M., & Stengos, T. (2023). Bribery, on-the-job training, and firm performance. *Small Business Economics*, *60*(1), 37-58. https://doi.org/10.1007/s11187-022-00633-6

Bonini, S., Deng, J., Ferrari, M., John, K., & Ross, D. G. (2022). Long-tenured independent directors and firm performance. *Strategic Management Journal*, *43*(8), 1602-1634. https://doi.org/10.1002/smj.3370

Boubaker, S., Clark, E., & Mefteh-Wali, S. (2020). Does the CEO elite education affect firm hedging policies? *Quarterly Review of Economics and Finance*, *77*, 340-354. https://doi.org/10.1016/j.qref.2019.11.004

Braunerhjelm, P., & Lappi, E. (2023). Employees' entrepreneurial human capital and firm performance. *Research Policy*, *52*(2), Article 104703. https://doi.org/10.1016/j.respol.2022.104703

Breuer, M., & Dehaan, E. (2024). Using and interpreting fixed effects models. *Journal of Accounting Research*, *62*(4), 1183-1226. https://doi.org/10.1111/1475-679x.12559

Byrne, D. (1961). Interpersonal attraction and attitude similarity. *The Journal of Abnormal and Social Psychology*, *62*(3), 713-715. https://doi.org/10.1037/h0044721

Byrne, D. (1971). *The attraction paradigm*. Academic Press.

Byrne, D., Clore, G. L., & Worchel, P. (1966). Effect of economic similarity-dissimilarity on interpersonal attraction. *Journal of Personality and Social Psychology*, *4*(2), 220-224. https://doi.org/10.1037/h0023559

Chen, M., Liu, H. F., & Tang, X. L. (2022). Do more concentrated supplier portfolios benefit firm innovation? The moderating roles of financial slack and growth opportunities.

International Journal of Operations & Production Management, *42*(12), 1905-1936. https://doi.org/10.1108/ijopm-03-2022-0206

Chi, N. W., Huang, Y. M., & Lin, S. C. (2009). A double-edged sword? Exploring the curvilinear relationship between organizational tenure diversity and team innovation: The moderating role of team-oriented HR practices. *Group & Organization Management*, *34*(6), 698-726. https://doi.org/10.1177/1059601109350985

Choi, H., Karim, K., & Tao, A. (2023). CEO origin and stock price crash risk: Insider versus outsider CEOs. *Corporate Governance: An International Review*, *31*(1), 105-126. https://doi.org/10.1111/corg.12442

Coşkun, R., & Öztürk, O. (2023). Dependence as strategy: Extending resource dependence theory and clarifying its understanding of the strategic options of dependent firms. *International Journal of Organizational Analysis, 32*(9), 1982-2009. https://doi.org/10.1108/IJOA-07-2023-3886

Crook, T. R., Todd, S. Y., Combs, J. G., Woehr, D. J., & Ketchen, D. J. (2011). Does human capital matter? A meta-analysis of the relationship between human capital and firm performance. *Journal of Applied Psychology*, *96*(3), 443-456. https://doi.org/10.1037/a0022147

Cyert, R. M., & March, J. G. (1963). *A behavioral theory of the firm*. Prentice-Hall.

Dalziel, T., Gentry, R.J., & Bowerman, M. (2011). An integrated agency–resource dependence view of the influence of directors' human and relational capital on firms' R&D spending. *Journal of Management Studies*, *48*, 1217-1242. https://doi.org/10.1111/j.1467-6486.2010.01003.x

Danley, T., & Eriksson, R. H. (2022). Co-worker complementarities and new firm survival. *Industry and Innovation*, *29*(8), 969-991. https://doi.org/10.1080/13662716.2022.2109454

Davenport, T. (2007). *Capital humano: Criando vantagens competitivas através das pessoas* (A. Castro, Trans.). Público – Comunicação Social. (Original work published 1999)

Davoine, E., & Schmid, S. (2022). Career patterns of top managers in Europe: Signs of further globalisation? *European Management Journal*, *40*(4), 467-474. https://doi.org/10.1016/j.emj.2022.05.007

Fama, E. F., & Jensen, M. C. (1983). Separation of ownership and control. *The Journal of Law & Economics*, *26*(2), 301-325. http://www.jstor.org/stable/725104

Geulen, M., Greven, A., Fischer-Kreer, D., & Brettel, M. (2024). Why do firms fail? A new view on bankruptcy from the angle of top management team heterogeneity. *Review of Managerial Science*, *18*(11), 3297-3331. https://doi.org/10.1007/s11846-023-00716-y

Goll, I., & Rasheed, A. A. (2005). The relationships between top management demographic characteristics, rational decision making, environmental munificence, and firm performance. *Organization Studies*, *26*(7), 999-1023. https://doi.org/10.1177/0170840605053538

Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology*, *78*(6), 1360-1380. http://www.jstor.org/stable/2776392

Hambrick, D. C. (2007). Upper echelons theory: An update. *The Academy of Management Review*, *32*(2), 334-343. http://www.jstor.org/stable/20159303

Hambrick, D. C., & Mason, P. A. (1984). Upper echelons: The organization as a reflection of its top managers. *The Academy of Management Review*, *9*(2), 193-206. https://doi.org/10.2307/258434

Haque, M. R., Choi, B., Lee, D., & Wright, S. (2022). Insider vs. outsider CEO and firm performance: Evidence from the Covid-19 pandemic. *Finance Research Letters*, *47*, Article 102609. https://doi.org/10.1016/j.frl.2021.102609

Hatch, N. W., & Dyer, J. H. (2004). Human capital and learning as a source of sustainable competitive advantage. *Strategic Management Journal*, *25*(12), 1155-1178. https://doi.org/10.1002/smj.421

Hazzaa, O. T., Abdullah, D. F., & Sadaa, A. M. (2024). Influence of CEO characteristics and audit committee on financial performance: Evidence from Iraq. *Journal of Open*

Innovation: Technology, Market, and Complexity, *10*(2), Article 100290. https://doi.org/10.1016/j.joitmc.2024.100290

Henderson, D. J., Soberon, A., & Rodriguez-Poo, J. M. (2021). Nonparametric multidimensional fixed effects panel data models. *Econometric Reviews*, *41*(3), 321-358. https://doi.org/10.1080/07474938.2021.1957283

Hernández-Atienza, F., Rodríguez-Sanz, J. A., & Tejerina-Gaite, F. (2024). The pathways of board diversity in European contexts: Exploring the influence of director types on firm performance. *Research in International Business and Finance*, *72*, Article 102501. https://doi.org/10.1016/j.ribaf.2024.102501

Hill, T. D., Davis, A. P., Roos, J. M., & French, M. T. (2020). Limitations of fixed-effects models for panel data. *Sociological Perspectives*, *63*(3), 357-369. https://www.jstor.org/stable/26967991

Hillman, A. J., & Dalziel, T. (2003). Boards of directors and firm performance: Integrating agency and resource dependence perspectives. *Academy of Management Review*, *28*(3), 383–396. https://doi.org/10.5465/amr.2003.10196729

Hsiao, C. (2022). *Analysis of panel data*. Cambridge University Press.

Huang, H., & Hao, S. B. (2024). Birds of a feather flock together: The impact of top management team faultlines on environmental, social, and governance performance. *Business Ethics the Environment & Responsibility*, *18*. https://doi.org/10.1111/beer.12767

Istipliler, B., Ahrens, J. P., Bort, S., & Isaak, A. (2023). Is exposure to the family firm always good for the next CEO? How successor pre-succession firm experience affects post-succession performance in family firms. *Journal of Business Research*, *167*, Article 114179. https://doi.org/10.1016/j.jbusres.2023.114179

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, *3*(4), 305-360. https://doi.org/10.1016/0304-405X(76)90026-X

Jiang, H. M., & Kim, E. (2022). Characteristics of top management team and Chinese tax planning nexus: Findings from a fuzzy-set qualitative comparative analysis. *Frontiers in Psychology*, *13*, Article 964278. https://doi.org/10.3389/fpsyg.2022.964278

Jiao, Y. S., Zhu, R. H., Fu, J. L., Liu, Q., & Li, X. W. (2024). Unraveling the dark side of resilience: Entrepreneurial resilience diversity in new venture teams and entrepreneurial performance. *Journal of Organizational Change Management*, *37*(7), 1594-1615. https://doi.org/10.1108/jocm-03-2024-0171

Jung, H., Lee, Y. G., & Park, S. H. (2023). Just diverse among themselves: How does negative performance feedback affect boards' expertise vs. ascriptive diversity? *Organization Science*, *34*(2), 657-679. https://doi.org/10.1287/orsc.2022.1595

Kallias, A., Kallias, K., Tsalkamas, I., & Zhang, S. (2023). One size does not fit all: The conditional role of CEO education on IPO performance. *Journal of Business Research*, *157*, Article 113560. https://doi.org/10.1016/j.jbusres.2022.113560

Karlilar, S., Balcilar, M., & Emir, F. (2023). Environmental sustainability in the OECD: The power of digitalization, green innovation, renewable energy and financial development. *Telecommunications Policy*, *47*(6), Article 102568. https://doi.org/10.1016/j.telpol.2023.102568

Kiss, A. N., Cortes, A. F., & Herrmann, P. (2022). CEO proactiveness, innovation, and firm performance. *The Leadership Quarterly*, *33*(3), Article 101545. https://doi.org/10.1016/j.leaqua.2021.101545

Knapp, J. R., Dalziel, T., & Lewis, M. W. (2011). Governing top managers: Board control, social categorization, and their unintended influence on discretionary behaviors. *Corporate Governance - An International Review*, *19*(4), 295-310. https://doi.org/10.1111/j.1467-8683.2011.00845.x

Kramarić, T. P., & Miletić, M. (2022). The influence of demographic, cultural, and educational background in the boardroom on firm performance – The Croatian evidence. *Zbornik radova Ekonomskog fakulteta u Rijeci / Proceedings of Rijeka Faculty of Economics*, *40*(1), 79-95. https://doi.org/10.18045/zbefri.2022.1.79

Krieweth, C., Guragata-Balasa, P., Greven, A., & Brettel, M. (2024). The role of top management teams' functional background diversity in firms' coopetitive behavior. *Industrial Marketing Management*, *117*, 275-287. https://doi.org/10.1016/j.indmarman.2023.12.023

Kuehn, D., & Rohlfing, I. (2024). Do quantitative and qualitative research reflect two distinct cultures? An empirical analysis of 180 articles suggests "no". *Sociological Methods & Research*, *53*(3), 1035-1070. https://doi.org/10.1177/00491241221082597

Kumar, A. (2023). Leadership and decision-making: Top management team age demographic and environmental strategy. *Journal of Management & Organization*, *29*(1), 69-85. https://doi.org/10.1017/jmo.2019.91

Lei, X., Shen, Z. Y., Štreimikienė, D., Baležentis, T., Wang, G., & Mu, Y. (2024). Digitalization and sustainable development: Evidence from OECD countries. *Applied Energy*, *357*, Article 122480. https://doi.org/10.1016/j.apenergy.2023.122480

Li, B., Wang, J., Nassani, A. A., Binsaeed, R. H., & Li, Z. (2023). The future of green energy: A panel study on the role of renewable resources in the transition to a green economy. *Energy Economics*, *127*, Article 107026. https://doi.org/10.1016/j.eneco.2023.107026

Li, X. Y., Shen, Y., & Zhou, Q. K. (2024). Confidence intervals of treatment effects in panel data models with interactive fixed effects. *Journal of Econometrics*, *240*(1), 27, Article 105684. https://doi.org/10.1016/j.jeconom.2024.105684

Li, Y. X., & He, C. (2023). Board diversity and corporate innovation: Evidence from Chinese listed firms. *International Journal of Finance & Economics*, *28*(1), 1092-1115. https://doi.org/10.1002/ijfe.2465

Li, Y., & Singal, M. (2019). Firm performance in the hospitality industry: Do CEO attributes and compensation matter? *Journal of Hospitality & Tourism Research*, *43*(2), 272-282. https://doi.org/10.1177/1096348018776453

Lopes, A. P. (2018). Audit quality and earnings management: Evidence from Portugal. *Athens Journal of Business & Economics*, *4*(2), 179-192. https://doi.org/10.30958/ajbe.4.2.4

Ma, Y. Q., Ni, Y. N., & Meng, N. (2024). Financial development and the impact of FDI on firm innovation: Evidence from bank deregulation in China. *International Review of Economics & Finance*, *94*, Article 103390. https://doi.org/10.1016/j.iref.2024.103390

Madyan, M., Harymawan, I., Minanurohman, A., & Setiawan, W. R. (2023). The impact of top management education from reputable universities on corporate capital structure: Evidence from Indonesia. *Global Business Review*. https://doi.org/10.1177/09721509231182525

Masso, J., & Vahter, P. (2023). Joining and exiting the value chain of foreign multinationals and performance of their local suppliers: Evidence from interfirm transaction data. *Industrial and Corporate Change*, *32*(4), 848-875. https://doi.org/10.1093/icc/dtad004

Mesnik, S. S., Gama, M. A. B., & Carneiro, J. M. T. (2023). Testing the contributions of outside directors: Should family firms respond differently? *Revista Brasileira de Gestao de Negocios*, *25*(3), 405-420. https://doi.org/10.7819/rbgn.v25i3.4228

Miller, J. L. (2002). The board as a monitor of organizational activity: The applicability of agency theory to nonprofit boards. *Nonprofit Management and Leadership*, *12*(4), 429-450. https://doi.org/10.1002/nml.12407

Miller, T., & Triana, M. D. (2009). Demographic diversity in the boardroom: Mediators of the board diversity-firm performance relationship. *Journal of Management Studies, 46*(5), 755-786. https://doi.org/10.1111/j.1467-6486.2009.00839.x

Milliken, F. J., & Martins, L. L. (1996). Searching for common threads: Understanding the multiple effects of diversity in organizational groups. *The Academy of Management Review*, *21*(2), 402-433. https://doi.org/10.2307/258667

Mun, S., Han, S. H., & Seo, D. (2020). The impact of CEO educational background on corporate cash holdings and value of excess cash. *Pacific-Basin Finance Journal*, *61*, Article 101339. https://doi.org/10.1016/j.pacfin.2020.101339

Nawaz, T. (2022). What's in an education? Implications of CEO education for financial inclusion. *International Journal of Finance and Economics*, *27*(3), 3741-3753. https://doi.org/10.1002/ijfe.2348

Njinyah, S. Z., Areneke, G., Ofori, I. K., & Lepawa, G. L. C. (2024). The mediation effect of innovation in the relationship between external knowledge and firm performance in Africa. *Africa Journal of Management*, *10*(3), 259-281. https://doi.org/10.1080/23322373.2024.2375948

OECD (2001), *Measuring productivity - OECD manual: Measurement of aggregate and industry-level productivity growth*, Paris: OECD Publishing. https://doi.org/10.1787/9789264194519-en.

Peng, Q. P., Zhong, X., Zhou, H. K., & Liu, S. S. (2022). Internationalization speed and firm innovation: The moderating roles of negative attainment discrepancy and state-ownership. *Chinese Management Studies*, *16*(3), 609-626. https://doi.org/10.1108/cms-02-2021-0069

Pereira, A. & Alves, M. (2017). Earnings management and European regulation 1606/2002: Evidence from non-financial Portuguese companies listed in Euronext. *Revista de Contabilidad – Spanish Accounting Review*, *20*(2), 107-117. https://doi.org/10.1016/j.rcsar.2017.05.002

Pfeffer, J., & Salancik, G. R. (2003). *The external control of organizations: A resource dependence perspective*. Stanford University Press. (Original work published 1978)

Qu, R. T., Timmermann, A., & Zhu, Y. C. (2024). Comparing forecasting performance with panel data. *International Journal of Forecasting*, *40*(3), 918-941. https://doi.org/10.1016/j.ijforecast.2023.08.001

Salimi, M., Frigotto, M. L., Zaninotto, E., & Vatiero, M. (2024). The fast-track ascent to the top: The role of human capital in European listed firms. *European Management Journal*. https://doi.org/10.1016/j.emj.2024.02.002

Schmid, S., & Baldermann, S. (2021). CEOs' international work experience and compensation. *Management International Review*, *61*(3), 313-364. https://doi.org/10.1007/s11575-021-00444-z

Schmid, S., & Mitterreiter, S. (2021). Top managers' career variety and time to the top. *European Management Review*, *18*(4), 476-499. https://doi.org/10.1111/emre.12478

Sidki, M., Boerger, L., & Boll, D. (2024). The effect of board members' education and experience on the financial performance of German state-owned enterprises. *Journal of Management and Governance*, *28*(2), 445-482. https://doi.org/10.1007/s10997-022-09663-4

Sikarwar, E. (2022). Board attributes, hedging activities and exchange rate risk: Multi-country firm-level evidence. *Economic Modelling*, *110*, Article 105800. https://doi.org/10.1016/j.econmod.2022.105800

Smulowitz, S. J., Smulowitz, M., & Cossin, D. (2025). More risk-averse or more innovative? The effect of women board membership and aspirations on patent activity. *Research Policy*, *54*(1), Article 105109. https://doi.org/10.1016/j.respol.2024.105109

Statistics Portugal. (2007). *Classificação Portuguesa das Actividades Económicas, Revisão 3*. Instituto Nacional de Estatística. https://www.ine.pt/xurl/pub/10376048

Statistics Portugal. (2025a). Quadros de Pessoal [Data set], (2010-2023). Instituto Nacional de Estatística.

Statistics Portugal. (2025b). Sistema de contas integradas das empresas [Data set], (2010-2023). Instituto Nacional de Estatística.

Statistics Portugal. (2025c, January 13). *Índice de preços no consumidor (IPC, Base - 2012) por localização geográfica e agregados especiais; anual.* Instituto Nacional de Estatística. Retrieved May 29, 2025. https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indOcorrCod=0003863&contexto=bd&selTab=tab2

Teixeira, A.A.C. (2002). On the link between human capital and firm performance: A theoretical and empirical survey. FEP Working Paper n. º 121, November 2002.

Teixeira, A.A.C., & Santos, L. (2016). Innovation performance in service companies and KIBS vis-à-vis manufacturing: The relevance of absorptive capacity and openness. *Review of Business Management*, *18*(59), 43-66. https://doi.org/10.7819/rbgn.v18i59.2215

Turner, J. C., Hogg, M. A., Oakes, P. J., Reicher, S. D., & Wetherell, M. S. (1987). *Rediscovering the social group: A self-categorization theory*. Basil Blackwell.

Ullah, I., Rahman, M. U., & Zeb, A. (2024). CEOs scientific background and firm innovation: Evidence from China. *International Journal of Innovation Science*. https://doi.org/10.1108/IJIS-03-2022-0058

Urquhart, A., & Zhang, H. (2022). PhD CEOs and firm performance. *European Financial Management*, *28*(2), 433-481. https://doi.org/10.1111/eufm.12316

Ushie, A. M., Jiang, X., Ali, A., & Abdul, Q. (2024). Enhancing sustainable fit between corporate social responsibility and innovation: Implications for firm performance. *Corporate Social Responsibility and Environmental Management*, *31*(6), 6419-6437. https://doi.org/10.1002/csr.2922

Uyar, A., Kuzey, C., Kilic, M., & Karaman, A. S. (2021). Board structure, financial performance, corporate social responsibility performance, CSR committee, and CEO duality: Disentangling the connection in healthcare. *Corporate Social Responsibility and Environmental Management*, *28*(6), 1730-1748. https://doi.org/10.1002/csr.2141

Veeravel, V., Murugesan, V. P., & Narayanamurthy, V. (2024). Does ESG disclosure really influence the firm performance? Evidence from India. *Quarterly Review of Economics and Finance*, *95*, 193-202. https://doi.org/10.1016/j.qref.2024.03.008

Verbeek, M. (2017). *A guide to modern econometrics* (5th ed.). John Wiley & Sons, Inc.

Verhoef, M. J., & Casebeer, A. L. (1997). Broadening horizons: Integrating quantitative and qualitative research. *Canadian Journal of Infectious Diseases and Medical Microbiology*, *8*(2), 65-66. https://doi.org/10.1155/1997/349145

Verma, R., Sharma, D., & Priyanka. (2022). Relationship among environmental performance, R&D expenditure and financial performance: Evidence from Indian manufacturing firms. *Global Business Review*, *23*(6), 1316-1335. https://doi.org/10.1177/09721509221129565

Wang, Q., Zhou, Y., Zhao, X., & Zeng, Y. (2025). Collaborative culture, product quality, and firm performance. *Economics Letters*, *246*, Article 112073. https://doi.org/10.1016/j.econlet.2024.112073

Wu, C. H., & Nguyen, T. K. T. (2024). ESG and firm performance: The effects of foreigners on board and export orientation. *Business Strategy and Development*, *7*(4), Article e70029. https://doi.org/10.1002/bsd2.70029

Wu, S., Tang, W., Fu, Q., & Xu, Y. (2024). The "educational capital" of corporate boards and initial public offering pricing: Evidence from the US initial public offerings. *Managerial and Decision Economics*, *45*(4), 1756-1772. https://doi.org/10.1002/mde.4098

Xie, Q., Li, W. W., & Lou, X. (2022). Exploring an inverted U-shaped relationship between top management team task-related faultlines and top executive hubris. *Leadership & Organization Development Journal*, *43*(7), 1013-1027. https://doi.org/10.1108/lodj-01-2022-0026

Xu, J., & Li, H. (2023). Managerial human capital and corporate R&D investment. *Journal of Economic Behavior and Organization*, *213*, 151-171. https://doi.org/10.1016/j.jebo.2023.07.021

Xu, Q., Fernando, G. D., & Schneible, R. A. (2022). Age diversity, firm performance and managerial ability. *Review of Accounting and Finance*, *21*(4), 276-298. https://doi.org/10.1108/raf-09-2021-0232

Yilmaz, M. K., Hacioglu, U., Tatoglu, E., Aksoy, M., & Duran, S. (2023). Measuring the impact of board gender and cultural diversity on corporate governance and social performance: Evidence from emerging markets. *Economic Research-Ekonomska Istrazivanja*, *36*(1), 3125-3159. https://doi.org/10.1080/1331677X.2022.2106503

Zhang, Q., Chen, J. D., Zhang, P. H., & Liu, H. (2022). How does the business cycle affect firm innovation? Evidence from China's listed companies. *Emerging Markets Finance and Trade*, *58*(5), 1390-1414. https://doi.org/10.1080/1540496x.2021.1877132

Zhang, W., Qin, C., & Zhang, W. Y. (2023). Top management team characteristics, technological innovation and firm's greenwashing: Evidence from China's heavy-polluting industries. *Technological Forecasting and Social Change*, *191*, Article 122522. https://doi.org/10.1016/j.techfore.2023.122522

Zhu, C. L., Xiao, Y. H., & Wang, R. X. (2023). Behavioral influences on the relationship between firms' aspiration performance gap and innovation input: The moderating role of executives' vocational socialization. *Journal of Product Innovation Management*, *40*(3), 358-380. https://doi.org/10.1111/jpim.12665

Appendix

Table A1: Description of the original data of both databases, Quadros de Pessoal (QP) and Sistema de Contas Integradas das Empresas (SCIE)

Year	QP		SCIE
	Number of Employees	Number of Firms	Number of Firms
2010	2 897 820	295 040	1 145 390
2011	2 850 518	292 369	1 113 559
2012	2 666 492	279 363	1 065 173
2013	2 656 456	276 746	1 098 409
2014	2 737 586	281 100	1 128 258
2015	2 818 186	283 714	1 163 082
2016	2 925 918	287 277	1 196 102
2017	3 058 916	290 409	1 242 693
2018	3 177 414	293 732	1 278 164
2019	3 231 636	287 172	1 318 330
2020	3 200 511	288 847	1 301 000
2021	3 221 122	282 736	1 342 116
2022	3 466 022	296 610	1 437 254
2023	3 629 889	303 785	1 510 274
Average	**3 038 463**	**288 493**	**1 238 557**

Source: Own elaboration.

Table A2: Description of the firms eliminated from the SCIE database

Year	Total number of firms in SCIE	Firms eliminated					Total firms eliminated	% total firms eliminated				
		Sole proprietorship	Without Assets, Liabilities and Equity	Without Assets, Sales, Earnings	Located in Madeira, Azores, Overseas	Operating in (CAE rev. 3) Sections A and B (Divisions 01-09), and of Sections O, T, and U (Divisions 84, 97-99)		Micro	Small	Administrative and support service activities (Section N)	Wholesale and retail trade; repair of motor vehicles and motorcycles (Section G)	Agriculture; animal production; hunting; forestry; fishing (Section A)
2010	1 145 390	784 155	1 654	641	13 188	10 557	810 195	99.4%	0.5%	16.8%	19.5%	6.6%
2011	1 113 559	751 708	1 693	768	12 876	10 993	778 038	99.4%	0.5%	16.5%	19.5%	7.3%
2012	1 065 173	709 404	1 586	973	12 577	11 738	736 278	99.5%	0.5%	16.8%	19.3%	7.7%
2013	1 098 409	741 832	1 587	980	12 452	12 740	769 591	99.5%	0.4%	16.2%	17.7%	14.0%
2014	1 128 258	764 902	1 487	1 072	12 660	13 791	793 912	99.6%	0.4%	16.8%	16.5%	16.2%
2015	1 163 082	790 881	1 554	1 211	12 879	14 931	821 456	99.6%	0.4%	17.3%	15.8%	16.2%
2016	1 196 102	815 167	1 441	1 297	13 045	15 732	846 682	99.6%	0.4%	17.9%	15.1%	15.7%
2017	1 242 693	847 726	1 385	1 328	13 588	16 670	880 697	99.6%	0.4%	18.5%	14.3%	15.1%
2018	1 278 164	864 397	1 321	1 601	14 345	17 314	898 978	99.6%	0.4%	18.6%	13.7%	14.8%
2019	1 318 330	879 371	1 269	1 681	15 104	18 004	915 429	99.5%	0.4%	18.9%	13.3%	14.2%
2020	1 301 000	850 584	1 115	1 616	15 514	18 587	887 416	99.5%	0.4%	18.1%	13.2%	14.3%
2021	1 342 116	873370	1 041	1 689	16 534	19 218	911 852	99.5%	0.4%	18.7%	12.8%	13.8%
2022	1 437 254	948 447	1 152	1 847	17 541	19 801	988 788	99.5%	0.4%	20.6%	11.8%	12.5%
2023	1 510 274	997 523	1 218	2 097	18 487	20 436	1 039 761	99.5%	0.4%	21.8%	11.1%	11.6%
Average	**1 238 557**	**829 962**	**1 393**	**1 343**	**14 342**	**15 751**	**862 791**	**99.5%**	**0.4%**	**18.3%**	**15.0%**	**12.9%**

Source: Own elaboration.

Table A3: Description of the firms with ALWAYS_HAVE_TMT equal to 0

Year	SCIE	QP	Merged database	No. firms that have TMT=0	% firms eliminated (TMT=0)					
	No. firms after 'cleaning'	**No. firms**	**No. firms**		Micro	Age <=3 years	Wholesale and retail trade; repair of motor vehicles and motorcycles (Section G)	Manufacturing (Section C)	North	Lisboa and Vale do Tejo
2010	335 195	295 040	172 255	15 848	78.9%	22.9%	24.9%	12.8%	37.9%	29.3%
2011	335 521	292 369	171 078	15 842	79.1%	22.5%	25.6%	12.3%	37.8%	30.1%
2012	328 895	279 363	162 686	15 707	79.6%	22.6%	26.0%	12.8%	38.3%	29.5%
2013	328 818	276 746	162 534	16 427	79.9%	23.6%	25.7%	13.1%	38.4%	29.4%
2014	334 346	281 100	165 895	16 992	79.7%	24.8%	26.0%	12.6%	38.9%	29.3%
2015	341 626	283 714	167 464	17 291	79.5%	25.6%	25.7%	12.8%	39.2%	29.1%
2016	349 420	287 277	170 226	17 582	79.2%	24.7%	26.0%	12.8%	38.9%	29.1%
2017	361 996	290 409	172 983	17 934	78.6%	23.0%	25.6%	12.5%	39.0%	29.6%
2018	379 186	293 732	175 943	17 820	77.4%	22.1%	24.9%	12.5%	38.7%	29.7%
2019	402 901	287 172	174 700	17 108	76.5%	20.3%	24.6%	12.6%	38.9%	29.9%
2020	413 584	288 847	177 228	16 778	76.4%	18.4%	24.4%	12.2%	39.5%	29.5%
2021	430 264	282 736	173 953	16 090	76.7%	17.6%	24.3%	12.2%	39.6%	29.4%
2022	448 466	296 610	182 115	16 132	75.8%	15.7%	24.3%	12.5%	40.2%	29.0%
2023	470 513	303 785	186 774	15 228	74.3%	13.3%	24.0%	12.4%	39.9%	37.0%
Average	**375 767**	**288 493**	**172 560**	**16 627**	**78.0%**	**21.2%**	**25.2%**	**12.6%**	**38.9%**	**30.0%**

Source: Own elaboration.

Table A4: Description of the firms that constitute the final panel

Year	Final Panel's No. firms	Size				Industry			Age <=3 years	Region				
		Micro	Small	Medium	Large	Wholesale and retail trade; repair of motor vehicles and motorcycles (Section G)	Manufacturing (Section C)	Construction (Section F)		North	Lisbon and Vale do Tejo	Centro	Alentejo	Algarve
2010	156 407	78.2%	18.5%	2.9%	0.5%	30.7%	15.2%	14.2%	20.9%	37.8%	28.2%	23.2%	5.4%	5.4%
2011	155 236	78.9%	17.8%	2.8%	0.5%	30.5%	15.0%	13.7%	20.5%	38.2%	27.8%	23.2%	5.5%	5.3%
2012	146 979	79.8%	16.9%	2.8%	0.5%	30.7%	15.0%	12.8%	19.6%	38.7%	27.5%	23.2%	5.4%	5.2%
2013	146 107	80.3%	16.5%	2.7%	0.5%	30.8%	15.1%	12.3%	20.7%	39.2%	27.2%	23.0%	5.4%	5.2%
2014	148 903	80.3%	16.5%	2.8%	0.5%	30.6%	15.2%	11.9%	21.7%	39.5%	27.0%	22.8%	5.4%	5.3%
2015	150 173	79.6%	17.1%	2.8%	0.5%	30.5%	15.2%	11.8%	22.0%	39.6%	27.0%	22.7%	5.4%	5.4%
2016	152 644	79.2%	17.4%	2.9%	0.5%	29.9%	15.1%	11.8%	22.2%	39.8%	26.8%	22.6%	5.3%	5.5%
2017	155 049	78.6%	17.8%	3.0%	0.5%	29.4%	15.0%	12.0%	21.1%	39.8%	26.8%	22.6%	5.3%	5.5%
2018	158 123	78.1%	18.3%	3.1%	0.5%	28.7%	14.7%	12.3%	20.6%	39.8%	27.0%	22.3%	5.2%	5.6%
2019	157 592	77.6%	18.7%	3.2%	0.6%	28.0%	14.3%	12.9%	20.3%	39.8%	26.7%	22.4%	5.2%	5.9%
2020	160 450	78.1%	18.3%	3.1%	0.5%	27.8%	13.7%	13.3%	19.3%	39.8%	27.0%	22.2%	5.2%	5.8%
2021	157 863	77.9%	18.3%	3.2%	0.6%	27.4%	13.6%	13.6%	18.1%	39.9%	26.8%	22.4%	5.2%	5.8%
2022	165 983	77.4%	18.8%	3.3%	0.6%	26.8%	13.3%	13.9%	17.6%	39.8%	27.0%	22.2%	5.3%	5.7%
2023	171 546	76.9%	19.1%	3.3%	0.6%	26.1%	12.9%	14.3%	16.5%	39.6%	34.7%	16.3%	3.4%	6.0%
Global average		**78.6%**	**17.9%**	**3.0%**	**0.5%**	**29.1%**	**14.5%**	**12.9%**	**20.1%**	**39.4%**	**27.7%**	**22.2%**	**5.2%**	**5.5%**

Source: Own elaboration.

Table A5: Key for transforming the categorical variable 'habil' (2 and 3) into average years of schooling

Degree / Academic Qualifications	QP code ('habil')	Average Years of Schooling Attributed
Professional higher technical course *(Curso técnico superior profissional)*	0	14
Does not know how to write or read *(Não sabe ler nem escrever)*	111	0
Knows how to read and write, but below/without the 1st cycle of basic education *(Sabe ler e escrever sem possuir 1.º ciclo ensino básico)*	112	2
1st cycle of basic education *(1.º ciclo do ensino básico)*	21	4
2nd cycle of basic education *(2.º ciclo do ensino básico)*	22	6
3rd cycle of basic education *(3.º ciclo do ensino básico)*	23	9
High school *(Ensino secundário)*	31	12
Post-secondary bellow education level IV *(Ensino pós-secundário não superior nível IV)*	40	13,5
Bachelor's degree *(Bacharelato)*	50	15
Undergraduate *(Licenciatura)*	60	15
Masters *(Mestrado)*	70	17
Doctorate, PhD *(Doutoramento)*	80	20
Ignored *(Ignorado)*	90	Missing (.)

Note: Observations initially assigned to the category 90, labelled as "Ignored", were changed to missing, so to not impact the calculations when we aggregated the data from an individual/employee level into an overall perspective/level of the firm, through the use of the command gcollapse – with this, it was calculated the average of the individual's academic qualifications (in years) for TMTs and workers as a whole, while disregarding observations for which the academic qualifications are unknown. In other words, with this change, the observations representing unknown academic qualifications did not contribute to the calculation of the average level of education (years), either for the case of TMT's formal education level (years), as well as for the worker's formal education level (years).

Source: Own elaboration.

Table A6: Key for transforming the categorical variable 'habil2' into fields of study

Field of Study		Categories of the variable 'habil2' (QP)
Educational Sciences *(Ciências da Educação)*		14, 414, 514, 614, 714, 814
Arts *(Artes)*		21, 421, 521, 621, 721, 821
Humanities *(Humanidades)*		22, 422, 522, 622, 722, 822
Social and Behavioral Sciences *(Ciências Sociais e do Comportamento)*		31, 431, 531, 631, 731, 831
Information and Journalism *(Informação e Jornalismo)*		32, 432, 532, 632, 732, 832
Business Sciences *(Ciências Empresariais)*		34, 434, 534, 634, 734, 834
Law *(Direito)*		38, 438, 538, 638, 738, 838
STEM	Life Sciences *(Ciências da Vida)*	42, 442, 542, 642, 742, 842
	Physiscal Sciences *(Ciências Físicas)*	44, 444, 544, 644, 744, 844
	Mathematics and Statistics *(Matemática e Estatística)*	46, 446, 546, 646, 746, 846
	Computer Science *(Informática)*	48, 448, 548, 648, 748, 848
	Engineering and Related Techniques *(Engenharia e Técnicas Afins)*	52, 452, 552, 652, 752, 852
Manufacturing Industries *(Indústrias Transformadoras)*		54, 454, 554, 654, 754, 854
Architecture and Construction *(Arquitectura e Construção)*		58, 458, 558, 658, 758, 858
Agriculture, Forestry and Fisheries *(Agricultura, Silvicultura e Pescas)*		62, 462, 562, 662, 762, 862
Veterinary Sciences *(Ciências Veterinárias)*		64, 464, 564, 664, 764, 864
Health *(Saúde)*		72, 472, 572, 672, 772, 872
Social Services *(Serviços Sociais)*		76, 476, 576, 676, 776, 876
Personal Services *(Serviços Pessoais)*		81, 481, 581, 681, 781, 881
Transportation Services *(Serviços de Transporte)*		84, 484, 584, 684, 784, 884
Environmental Protection *(Proteção Ambiental)*		85, 485, 585, 685, 785, 885
Security Services *(Serviços de Segurança)*		86, 486, 586, 686, 786, 886
Unknown/Unspecified *(Desconhecido/Não Especificado)*		499, 599, 699, 799, 899, 99
Not Applicable – Highschool or below *(Não Aplicável - Ensino Secundário ou inferior)*		111, 112, 211, 212, 221, 222, 231, 232, 233, 234, 311, 312, 313, 314, 315, 31
Ignored *(Ignorada)*		999

Source: Own elaboration.

Table A7: Key for associating firms' industry with TMT's field of study

Field of Study	CAE Rev. 3 Code	CAE Rev. 3 Description
Educational Sciences *(Ciências da Educação)*	85	Education *(Educação)*
Arts *(Artes)*	59	Film, video, television programme production, sound recording and music editing activities *(Actividades cinematográficas, de vídeo, de produção de programas de televisão, de gravação de som e de edição de música)*
	90	Theatre, music, dance and other artistic and literary activities *(Actividades de teatro, de música, de dança e outras actividades artísticas e literárias)*
	91	Activities of libraries, archives, museums and other cultural activities *(Actividades das bibliotecas, arquivos, museus e outras actividades culturais)*
	93	Sports, leisure, and recreational activities *(Actividades desportivas, de diversão e recreativas)*
Humanities *(Humanidades)*	91	Activities of libraries, archives, museums and other cultural activities *(Actividades das bibliotecas, arquivos, museus e outras actividades culturais)*
Social and Behavioral Sciences *(Ciências Sociais e do Comportamento)*	94	Activities of associative organisations *(Actividades das organizações associativas)*
	99	Activities of international organisations and other extraterritorial institutions *(Actividades dos organismos internacionais e outras instituições extra-territoriais)*
Information and Journalism *(Informação e Jornalismo)*	58	Publishing activities *(Actividades de edição)*
	60	Radio and television activities *(Actividades de rádio e de televisão)*
	63	Information services activities *(Actividades dos serviços de Informação)*
Law *(Direito)*	69	Legal and accounting activities *(Actividades jurídicas e de contabilidade)*
STEM	26	Manufacture of computer equipment, communications equipment, and electronic and optical products *(Fabricação de equipamentos informáticos, equipamento para comunicações e produtos electrónicos e ópticos)*
	33	Repair, maintenance and installation of machinery and equipment *(Reparação, manutenção e instalação de máquinas e equipamentos)*
	35	Electricity, gas, steam, hot and cold water, and cold air *(Electricidade, gás, vapor, água quente e fria e ar frio)*
	61	Telecommunications *(Telecomunicações)*
	62	Computer consultancy and programming and related activities *(Consultoria e programação informática e actividades relacionadas)*
	63	Information services activities *(Actividades dos serviços de Informação)*

Field of Study	CAE Rev. 3 Code	CAE Rev. 3 Description
	72	Scientific research and development activities *(Actividades de investigação científica e de desenvolvimento)*
	95	Repair of computers and personal and household goods *(Reparação de computadores e de bens de uso pessoal e doméstico)*
Business Sciences *(Ciências Empresariais)*	45	Trade, maintenance and repair of motor vehicles and motorcycles *(Comércio, manutenção e reparação, de veículos automóveis e motociclos)*
	46	Wholesale trade (including agents), except for motor vehicles and motorcycles *(Comércio por grosso (inclui agentes), excepto de veículos automóveis e motociclos)*
	47	Retail trade, except for motor vehicles and motorcycles *(Comércio a retalho, excepto de veículos automóveis e motociclos)*
	55	Accommodation *(Alojamento)*
	56	Restaurants and similar establishments *(Restauração e similares)*
	64	Financial service activities, except insurance and pension funds *(Actividades de serviços financeiros, excepto seguros e fundos de pensões)*
	65	Insurance, reinsurance and pension funds, except compulsory social security *(Seguros, resseguros e fundos de pensões, excepto segurança social obrigatória)*
	66	Auxiliary financial and insurance services *(Actividades auxiliares de serviços financeiros e dos seguros)*
	68	Real estate activities *(Actividades imobiliárias)*
	70	Headquarters and management consulting activities *(Actividades das sedes sociais e de consultoria para a gestão)*
	73	Advertising, market research and opinion polls *(Publicidade, estudos de mercado e sondagens de opinião)*
	74	Other consulting, scientific, technical and similar activities *(Outras actividades de consultoria, científicas, técnicas e similares)*
	77	Rental activities *(Actividades de aluguer)*
	78	Employment activities *(Actividades de emprego)*
	79	Travel agencies, tour operators, other booking services and related activities *(Agências de viagem, operadores turísticos, outros serviços de reservas e actividades relacionadas)*
	82	Administrative and support service activities provided to companies *(Actividades de serviços administrativos e de apoio prestados às empresas)*
	92	Lotteries and other gambling games *(Lotarias e outros jogos de aposta)*

Field of Study	CAE Rev. 3 Code	CAE Rev. 3 Description
Manufacturing Industries *(Indústrias Transformadoras)*	10	Food industries *(Indústrias alimentares)*
	11	Beverage industry *(Indústria das Bebidas)*
	12	Tobacco industry *(Indústria do tabaco)*
	13	Textile manufacturing *(Fabricação de têxteis)*
	14	Clothing industry *(Indústria do vestuário)*
	15	Leather and leather products industry *(Indústria do couro e dos produtos do couro)*
	16	Wood and cork industries and their products, except furniture; Manufacture of basketry and wickerwork products (*Indústrias da madeira e da cortiça e suas obras, excepto mobiliário; Fabricação de obras de cestaria e de espartaria)*
	17	Manufacture of pulp, paper, cardboard and related products *(Fabricação de pasta, de papel, de cartão e seus artigos)*
	18	Printing and reproduction of recorded media *(Impressão e reprodução de suportes gravados)*
	19	Manufacture of coke, refined petroleum products and fuel agglomerates *(Fabricação de coque, produtos petrolíferos refinados e de aglomerados de combustíveis)*
	20	Manufacture of chemicals and man-made fibres, except pharmaceuticals *(Fabricação de produtos químicos e de fibras sintéticas ou artificiais, excepto produtos farmacêuticos)*
	22	Manufacture of rubber and plastic products *(Fabricação de artigos de borracha e de matérias plásticas)*
	23	Manufacture of other non-metallic mineral products *(Fabrico de outros produtos minerais não metálicos)*
	24	Basic metal industries *(Indústrias metalúrgicas de base)*
	25	Manufacture of metal products, except machinery and equipment *(Fabricação de produtos metálicos, excepto máquinas e equipamentos)*
	27	Manufacture of electrical equipment *(Fabricação de equipamento eléctrico)*
	28	Manufacture of machinery and equipment *(Fabricação de máquinas e de equipamentos, n.e.)*
	29	Manufacture of motor vehicles, trailers, semi-trailers and components for motor vehicles *(Fabricação de veículos automóveis, reboques, semi-reboques e componentes para veículos automóveis)*
	30	Manufacture of other transport equipment *(Fabricação de outro equipamento de transporte)*

Field of Study	CAE Rev. 3 Code	CAE Rev. 3 Description
	31	Manufacture of furniture and mattresses *(Fabrico de mobiliário e de colchões)*
	36	Water collection, treatment and distribution *(Captação, tratamento e distribuição de água)*
	37	Wastewater collection, drainage and treatment *(Recolha, drenagem e tratamento de águas residuais)*
	39	Decontamination and similar activities *(Descontaminação e actividades similares)*
	32	Other manufacturing industries *(Outras indústrias transformadoras)*
Architecture and Construction *(Arquitectura e Construção)*	41	Real estate development (building project development); building construction *(Promoção imobiliária (desenvolvimento de projectos de edifícios); construção de edifícios)*
	42	Civil engineering *(Engenharia civil)*
	43	Specialised construction activities *(Actividades especializadas de construção)*
	71	Architectural, engineering and related technical activities; testing and technical analysis activities *(Actividades de arquitectura, de engenharia e técnicas afins; actividades de ensaios e de análises técnicas)*
	81	Activities related to buildings, planting and garden maintenance *(Actividades relacionadas com edifícios, plantação e manutenção de jardins)*
Agriculture, Forestry and Fisheries *(Agricultura, Silvicultura e Pescas)*	1	Agriculture, animal production, hunting and related service activities *(Agricultura, produção animal, caça e actividades dos serviços relacionados)*
	2	Forestry and woodland management *(Silvicultura e exploração florestal)*
	3	Fishing and aquaculture *(Pesca e aquicultura)*
Veterinary Sciences *(Ciências Veterinárias)*	75	Veterinary activities *(Actividades veterinárias)*
Health *(Saúde)*	21	Manufacture of basic pharmaceutical products and pharmaceutical preparations *(Fabricação de produtos farmacêuticos de base e de preparações farmacêuticas)*
	86	Human health activities *(Actividades de saúde humana)*
Social Services *(Serviços Sociais)*	87	Social support activities with accommodation *(Actividades de apoio social com alojamento)*
	88	Social support activities without accommodation *(Actividades de apoio social sem alojamento)*

Field of Study	CAE Rev. 3 Code	CAE Rev. 3 Description
Personal Services *(Serviços Pessoais)*	96	Other personal service activities *(Outras actividades de serviços pessoais)*
Transportation Services *(Serviços de Transporte)*	49	Land transport and transport by pipeline or gas pipeline *(Transportes terrestres e transportes por oledutos ou gasodutos)*
	50	Transport by water *(Transportes por água)*
	51	Air transport *(Transportes aéreos)*
	52	Storage and transport support activities (including handling) *(Armazenagem e actividades auxiliares dos transportes(inclui manuseamento))*
	53	Postal and courier activities *(Actividades postais e de courier)*
Environmental Protection *(Proteção Ambiental)*	36	Water collection, treatment and distribution *(Captação, tratamento e distribuição de água)*
	37	Wastewater collection, drainage and treatment *(Recolha, drenagem e tratamento de águas residuais)*
	38	Waste collection, treatment and disposal; material recovery *(Recolha, tratamento e eliminação de resíduos; valorização de materiais)*
	39	Decontamination and similar activities *(Descontaminação e actividades similares)*
Security Services *(Serviços de Segurança)*	80	Research and security activities *(Actividades de investigação e segurança)*
Unknown/Unspecified *(Desconhecido/Não Especificado)*	Without matching with industry.	
Not Applicable – Highschool or below *(Não Aplicável – Ensino Secundário ou inferior)*		
Ignored *(Ignorada)*		

Source: Own elaboration.

Table A8: Categories of the variable representative of Firm Size (SIZE)

Category Number	Category Name
1	1 – 9 people/employees
2	10 – 49 people/employees
3	50 – 249 people/employees
4	250 or more people/employees
9	Without employees

Source: Own elaboration.

Table A9: Codes of CAE Rev. 3

Code	Designation in Portuguese	Designation in English	Divisions (Divisões)
A	Agricultura, produção animal, caça, floresta e pesca	Agriculture; animal production; hunting; forestry; fishing	01–03
B	Indústria extrativa	Mining and quarrying	05–09
C	Indústrias transformadoras	Manufacturing	10–33
D	Eletricidade, gás, vapor e ar condicionado	Electricity; gas; steam and air conditioning supply	35
E	Captação, tratamento e distribuição de água; saneamento, gestão de resíduos e despoluição	Water supply; sewerage; waste management and remediation activities	36–39
F	Construção	Construction	41–43
G	Comércio por grosso e a retalho; reparação de veículos automóveis e motociclos	Wholesale and retail trade; repair of motor vehicles and motorcycles	45–47
H	Transportes e armazenagem	Transportation and storage	49–53
I	Alojamento e restauração	Accommodation and food service activities	55–56
J	Informação e comunicação	Information and communication	58–63
K	Atividades financeiras e de seguros	Financial and insurance activities	64–66
L	Atividades imobiliárias	Real estate activities	68
M	Atividades profissionais, científicas e técnicas	Professional, scientific and technical activities	69–75
N	Atividades administrativas e dos serviços de apoio	Administrative and support service activities	77–82
O	Administração pública e defesa; segurança social obrigatória	Public administration and defence; compulsory social security	84
P	Educação	Education	85
Q	Atividades de saúde humana e apoio social	Human health and social work activities	86–88
R	Atividades artísticas, de espetáculos, desportivas e recreativas	Arts, entertainment, recreation and sports activities	90–93
S	Outras atividades de serviços	Other service activities	94–96
T	Atividades de famílias enquanto empregadoras; atividades de produção para uso próprio	Activities of households as employers; undifferentiated production for own use	97–98
U	Atividades de organizações e organismos extraterritoriais	Activities of extraterritorial organizations and bodies	99

Source: Adapted from Statistics Portugal (2007).

Table A10: Key for transforming the industry variable CAE (Rev.3) into Industry

Industry Created		Industries considered per Category (Divisions of CAE Rev.3)	
Code	**Category**		
1	Food and Beverages *(Indústria Alimentar e de Bebidas)*	10	Food industry *(Indústrias alimentares)*
		11	Beverage industry *(Indústria das bebidas)*
2	Tobacco *(Indústria do Tabaco)*	12	Tobacco industry *(Indústria do tabaco)*
3	Textile and Apparel *(Indústria Têxtil e de Vestuário)*	13	Manufacture of textiles *(Fabrico de têxteis)*
		14	Apparel industry *(Indústria do vestuário)*
		15	Leather and leather products industry *(Indústria do couro e dos produtos do couro)*
4	Wood, Paper and Printing *(Indústria de Madeira, Papel e Impressão)*	16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials *(Indústrias da madeira e da cortiça e suas obras, excepto mobiliário; fabricação de obras de cestaria e de espartaria)*
		17	Manufacture of pulp, paper and paper products *(Fabricação de pasta, de papel, de cartão e seus artigos)*
		18	Printing and reproduction of recorded media *(Impressão e reprodução de suportes gravados)*
5	Chemical and Non-Metallic Product Manufacturing Industries *(Indústrias de Transformação Química e de Produtos Não Metálicos)*	19	Manufacture of refined petroleum products and fuel pellets *(Fabricação de coque, produtos petrolíferos refinados e de aglomerados de combustíveis)*
		20	Manufacture of chemical products and man-made fibres, except pharmaceutical products *(Fabricação de produtos químicos e de fibras sintéticas ou artificiais, excepto produtos farmacêuticos)*
		21	Manufacture of basic pharmaceutical products and pharmaceutical preparations *(Fabricação de produtos farmacêuticos de base e de preparações farmacêuticas)*
		22	Manufacture of rubber and plastic products *(Fabricação de artigos de borracha e de matérias plásticas)*
		23	Manufacture of other non-metallic mineral products *(Fabrico de outros produtos minerais não metálicos)*

Industry Created		Industries considered per Category (Divisions of CAE Rev.3)	
Code	**Category**		
6	Metal and Metal Products *(Indústria Metalúrgica e Produtos Metálicos)*	24	Indústrias metalúrgicas de base *(Basic metallurgical industries)*
		25	Manufacture of metal products, except machinery and equipment *(Fabricação de produtos metálicos, excepto máquinas e equipamentos)*
7	Electronic, Mechanical and Automotive *(Indústria Eletrónica, Mecânica e Automobilística)*	26	Manufacture of computer and communications equipment, and electronic and optical products *(Fabricação de equipamentos informáticos, equipamento para comunicações e produtos electrónicos e ópticos)*
		27	Manufacture of electrical equipment *(Fabricação de equipamento eléctrico)*
		28	Manufacture of machinery and equipment *(Fabricação de máquinas e de equipamentos, n.e.)*
		29	Manufacture of motor vehicles, trailers, semi-trailers and components for motor vehicles *(Fabricação de veículos automóveis, reboques, semi-reboques e componentes para veículos automóveis)*
		30	Manufacture of other transport equipment *(Fabricação de outro equipamento de transporte)*
8	Furniture and Other Manufacturing *(Indústrias de Mobiliário e Outras Indústrias Transformadoras)*	31	Furniture and mattress manufacturing *(Fabrico de mobiliário e de colchões)*
		32	Other manufacturing industries *(Outras indústrias transformadoras)*
9	Repair, maintenance and installation of machinery and equipment *(Reparação, Manutenção e Instalação de Máquinas e Equipamentos)*	33	Repair, maintenance and installation of machinery and equipment *(Reparação, manutenção e instalação de máquinas e equipamentos)*
10	Energy and Natural Resources, Water and Waste Management *(Energia e Gestão de Recursos Naturais, Hídricos e de Resíduos)*	35	Electricity; gas; steam and air conditioning supply *(Electricidade, gás, vapor, água quente e fria e ar frio)*
		36	Water collection, treatment and supply *(Captação, tratamento e distribuição de água)*
		37	Wastewater collection, drainage and treatment *(Recolha, drenagem e tratamento de águas residuais)*
		38	Waste collection, treatment and disposal; material valorisation *(Recolha, tratamento e eliminação de resíduos; valorização de materiais)*
		39	Decontamination and similar activities *(Descontaminação e actividades similares)*
11	Construction and Real Estate Activities *(Construção e Imobiliário)*	41	Property development (development of building projects); building construction *(Promoção imobiliária (desenvolvimento de projectos de edifícios); construção de edifícios)*
		42	Civil engineering *(Engenharia civil)*

Industry Created		Industries considered per Category (Divisions of CAE Rev.3)	
Code	**Category**		
		43	Specialised construction activities *(Actividades especializadas de construção)*
		68	Real estate activities *(Actividades imobiliárias)*
12	Trade – wholesale and retail; repair of motor vehicles and motorcycles) *(Atividades de Comércio – comércio por grosso e a retalho; reparação de veículos automóveis e motociclos)*	45	Trade, maintenance and repair of motor vehicles and motorcycles *(Comércio, manutenção e reparação, de veículos automóveis e motociclos)*
		46	Wholesale trade (including agents), except of motor vehicles and motorbikes *(Comércio por grosso (inclui agentes), excepto de veículos automóveis e motociclos)*
		47	Retail trade, except of motor vehicles and motorbikes *(Comércio a retalho, excepto de veículos automóveis e motociclos)*
13	Transportation and storage *(Transportes e armazenagem)*	49	Land transport and transport via oil or gas pipelines *(Transportes terrestres e transportes por oleodutos ou gasodutos)*
		50	Water transport *(Transportes por água)*
		51	Air transport *(Transportes aéreos)*
		52	Warehousing and auxiliary transport activities (includes handling) *(Armazenagem e actividades auxiliares dos transportes (inclui manuseamento)*
14	Postal Activities *(Atividades Postais)*	53	Postal and courier activities *(Actividades postais e de courier)*
15	Accommodation and Food Services Activities *(Alojamento e Restauração)*	55	Lodging *(Alojamento)*
		56	Restaurants and similar *(Restauração e similares)*
16	Information and Communication Activities *(Atividades de Informação e de Comunicação)*	58	Publishing activities *(Actividades de edição)*
		59	Film, video, television programme production, sound recording and music editing activities *(Actividades cinematográficas, de vídeo, de produção de programas de televisão, de gravação de som e de edição de música)*
		60	Radio and television *(Actividades de rádio e de televisão)*
		61	Telecommunications *(Telecomunicações)*
		62	Computer consultancy and programming and related activities *(Consultoria e programação informática e actividades relacionadas)*

Industry Created		Industries considered per Category (Divisions of CAE Rev.3)	
Code	**Category**		
		63	Information services *(Actividades dos serviços de informação)*
17	Financial and Insurance Activities *(Atividades Financeiras e Seguros)*	64	Financial services activities, except insurance and pension funding *(Actividades de serviços financeiros, excepto seguros e fundos de pensões)*
		65	Insurance, reinsurance and pension funds, except compulsory social security *(Seguros, resseguros e fundos de pensões, excepto segurança social obrigatória)*
		66	Financial services and insurance support activities *(Actividades auxiliares de serviços financeiros e dos seguros)*
18	Consulting, Scientific and Technical Activities *(Atividades de Consultoria, Científicas e Técnica)*	69	Legal and accounting activities *(Actividades jurídicas e de contabilidade)*
		70	Corporate and management consultancy activities *(Actividades das sedes sociais e de consultoria para a gestão)*
		71	Architectural, engineering and related technical activities; technical testing and analysis activities *(Actividades de arquitectura, de engenharia e técnicas afins; actividades de ensaios e de análises técnicas)*
		72	Scientific research and development activities *(Actividades de investigação científica e de desenvolvimento)*
		73	Advertising, market research and opinion polls *(Publicidade, estudos de mercado e sondagens de opinião)*
		74	Other consultancy, scientific, technical and similar activities *(Outras actividades de consultoria, científicas, técnicas e similares)*
19	Veterinary Activities *(Atividades Veterinárias)*	75	Veterinary activities *(Actividades veterinárias)*
20	Rental Activities *(Atividades de Aluguer)*	77	Rental activities *(Actividades de aluguer)*
21	HR/Employment Activities *(Atividades de RH/Emprego)*	78	Employment activities *(Actividades de emprego)*
22	Tourism *(Atividades de Turismo)*	79	Travel agencies, tour operators, other reservation services and related activities *(Agências de viagem, operadores turísticos, outros serviços de reservas e actividades relacionadas)*
23	Specialised Activities – Security and Building Maintenance *(Atividades Especializadas – Segurança e Manutenção de Edifícios)*	80	Investigation and security activities *(Actividades de investigação e segurança)*
		81	Activities related to buildings, planting and garden maintenance *(Actividades relacionadas com edifícios, plantação e manutenção de jardins)*

Industry Created		Industries considered per Category (Divisions of CAE Rev.3)	
Code	**Category**		
24	Administrative and Business Related Activities *(Atividades Administrativas e de Apoio a Empresas)*	82	Actividades de serviços administrativos e de apoio prestados às empresas *(Actividades de serviços administrativos e de apoio prestados às empresas)*
25	Public administration and defence; compulsory social security *(Administração pública e defesa; Segurança Social obrigatória)*	84	Public administration and defence; compulsory Social Security *(Administração pública e defesa; Segurança Social obrigatória)*
26	Education *(Educação)*	85	Education *(Educação)*
27	Health *(Saúde Humana)*	86	Human health activities *(Actividades de saúde humana)*
28	Social Work Services *(Serviços de Apoio Social)*	87	Social support activities with accommodation *(Actividades de apoio social com alojamento)*
		88	Social support activities without accommodation *(Actividades de apoio social sem alojamento)*
29	Cultural Activities / Arts *(Atividades Culturais / Artísticas)*	90	Theatre, music, dance and other artistic and literary activities *(Actividades de teatro, de música, de dança e outras actividades artísticas e literárias)*
		91	Activities of libraries, archives, museums and other cultural activities *(Actividades das bibliotecas, arquivos, museus e outras actividades culturais)*
30	Lotteries and Gambling *(Lotarias e Jogos de Aposta)*	92	Lotteries and other gambling games *(Lotarias e outros jogos de aposta)*
31	Entertainment, Recreation and Sports *(Actividades desportivas, de diversão e recreativas)*	93	Entertainment, recreation and sports activities *(Actividades desportivas, de diversão e recreativas)*
32	Activities of Membership Organisations *(Atividades das Organizações Associativas)*	94	Activities of associative organisations *(Actividades das organizações associativas)*
33	Repair of Personal/Household Goods *(Reparação de Bens de Uso Pessoal/Doméstico)*	95	Computers and personal/household goods repair *(Reparação de computadores e de bens de uso pessoal e doméstico)*
34	Other Activities to Third Parties *(Outras Atividades a Terceiros)*	96	Other personal service activities *(Outras actividades de serviços pessoais)*
		97	Household domestic activities *(Actividades das famílias empregadoras de pessoal doméstico)*
35	Services for Personnal Use *(Serviços para Uso Próprio)*	98	Production of goods and services by households for their own use *(Actividades de produção de bens e serviços pelas famílias para uso próprio)*
36	International Organisations and Extra-territorial Institutions *(Atividades de Organismos Internacionais e Instituições extra-territoriais)*	99	Activities of international organisations and other extra-territorial institutions *(Actividades dos organismos internacionais e outras instituições extra-territoriais)*

Industry Created		Industries considered per Category (Divisions of CAE Rev.3)	
Code	**Category**		
37	Agriculture and Hunting *(Agricultura e Caça)*	01	Agriculture, animal production, hunting and related service activities *(Agricultura, produção animal, caça e actividades dos serviços relacionados)*
38	Forestry *(Silvicultura e Exploração Florestal)*	02	Forestry *(Silvicultura e exploração florestal)*
39	Pesca *(Fishing)*	03	Fisheries and aquaculture *(Pesca e aquicultura)*
40	Mining and Quarrying *(Indústria Extrativa)*	05	Mining coal and lignite *(Extracção de hulha e lenhite)*
		06	Extraction of crude oil and natural gas *(Extracção de petróleo bruto e gás natural)*
		07	Extraction and preparation of metal minerals *(Extracção e preparação de minérios metálicos)*
		08	Other extractive industries *(Outras indústrias extractivas)*
		09	Mining and quarrying service activities *(Actividades dos serviços relacionados com as indústrias extractivas)*

Source: Own elaboration.

Table A11: Categories of the variable representative of Region (REGION).

Category Number	Category Name
11	North
15	Algarve
16	Centro
17	Lisbon and Vale do Tejo
18	Alentejo

Source: Own elaboration.

Table A12: The impact of TMT's formal education and professional experience on economic performance (Fixed effects estimation, dependent variable: log of real gross value added, at market prices, per employee) (Models 7 to 10)

	Model 7	Model 8	Model 9	Model 10
TMT's Level of Education	**0.0026*** (0.001)**	**0.0025*** (0.001)**	**0.0026*** (0.001)**	**0.0024*** (0.001)**
TMT's Field of Education	0.0000 (0.000)	0.0000 (0.000)	0.0000 (0.000)	0.0000 (0.000)
TMT's Formal Education Field of Study and Industry Match	**0.0136*** (0.005)**	**0.0136*** (0.005)**	**0.0108** (0.005)**	**0.0002*** (0.000)**
Diversity of TMT's Field of Education	0.0010 (0.008)	0.0012 (0.008)	0.0050 (0.007)	0.0068 (0.007)
Diversity of TMT's Level of Education	**0.0024*** (0.001)**	**0.0024*** (0.001)**	**0.0024*** (0.001)**	**0.0024*** (0.001)**
TMT's Level of Experience	**0.0008*** (0.000)**	**0.0008*** (0.000)**	**0.0008*** (0.000)**	**0.0008*** (0.000)**
TMT's Type of Experience (Industry)	**0.0013*** (0.000)**	**0.1458*** (0.005)**	**0.1619*** (0.006)**	**0.1618*** (0.006)**
Diversity of TMT's Industry Experience	-0.0024 (0.003)	**-0.0194*** (0.003)**	**-0.0234*** (0.003)**	**-0.0234*** (0.003)**
Diversity of TMT's Level of Experience	**-0.0007*** (0.000)**	**-0.0008*** (0.000)**	**-0.0008*** (0.000)**	**-0.0008*** (0.000)**
Workers Average Level of Education	0.0015*** (0.001)	0.0015** (0.001)	0.0015*** (0.001)	0.0015*** (0.001)
Training	0.0297*** (0.006)	0.0296*** (0.006)	0.0296*** (0.006)	0.0295*** (0.006)
TMT Size	-0.0001 (0.000)	-0.0001 (0.000)	-0.0001 (0.000)	-0.0001 (0.000)
Leverage	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)
Presence of R&D	0.0352*** (0.006)	0.0368*** (0.006)	0.0374*** (0.006)	0.0373*** (0.006)
Firm Size	Yes	Yes	Yes	Yes
Firm Age	0.0007 (0.002)	0.0007 (0.002)	0.0007 (0.002)	0.0007 (0.002)
Industry	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes
Multinational	0.0012 (0.012)	0.0036 (0.012)	0.0040 (0.012)	0.0040 (0.012)
Export	0.0022*** (0.000)	0.0022*** (0.000)	0.0022*** (0.000)	0.0022*** (0.000)
Year	Yes	Yes	Yes	Yes
N	1690190	1690190	1690190	1690190
Number of firms	285503	285503	285503	285503
OLS – VIF max [mean]	2.61 [1.36]	2.61 [1.36]	2.64 [1.36]	2.66 [1.36]
OLS – Breusch–Pagan (p-value)	6064.93 (0.0000)	6003.77 (0.0000)	5897.40 (0.0000)	5954.45 (0.0000)
Log likelihood	-1.1e+06	-1.1e+06	-1.1e+06	-1.1e+06
R-squared (within)	0.0413	0.0412	0.0413	0.0413
F statistic (overall)	576.5709 (0.0000)	575.6337 (0.0000)	575.5027 (0.0000)	575.6599 (0.0000)
Root MSE	0.4521	0.4521	0.4521	0.4521
Hausman Test	21266.01 (0.0000)	21402.70 (0.0000)	21386.43 (0.0000)	21357.64 (0.0000)

Notes: Robust standard errors in parentheses. Significance levels: *, 10%; **, 5%; ***, 1%. All models considered as the dependent variable the logarithm of real gross value added, at market prices, per employee, and conducted a panel data fixed effects estimation. In Model 1 the independent variables were AVG_EDU_YEARS, PERC_STEM_TMT, TMT_EDU_IND, DIV_EDU_YEARS_TMT and DIV_EDU_YEARS_TMT (regarding formal education), and AVG_ EXPERIENCE_TMT, TMT_SAME_INDUSTRY_EXP, DIV_EXP_YEARS_TMT, and DIV_EXP_INDUSTRY_ TMT (regarding professional experience). The remaining models used the same variables with the exception of the following changes: Model 7, instead of TMT_SAME_INDUSTRY_EXP considers PERC_TMT_SAME_INDUSTRY_EXP, while Model 8, changes TMT_SAME_INDUSTRY_EXP to MAJ_TMT_SAME_INDUSTRY_EXP; finally, Models 9 and 10 consider MAJ_TMT_EDU_IND and PERC_TMT_EDU_IND, respectively, instead of TMT_EDU_IND. The control variables remain unchanged throughout the models.
Source: Own elaboration.

Table A13: The impact of TMT's formal education and professional experience on economic performance (Fixed effects estimation, dependent variable: log of gross value added, at factor prices, per employee)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
TMT's Level of Education	**0.0027*** (0.001)**	**0.0001** (0.000)**	**0.0025*** (0.001)**	**0.0027*** (0.001)**	**0.0026*** (0.001)**	**0.0026*** (0.001)**	**0.0027*** (0.001)**	**0.0027*** (0.001)**	**0.0027*** (0.001)**	**0.0026*** (0.001)**
TMT's Field of Education	0.0000 (0.000)	0.0000 (0.000)	**0.0002** (0.000)**	-0.0003 (0.005)	**0.0146*** (0.005)**	-0.0000 (0.000)	-0.0000 (0.000)	0.0000 (0.000)	-0.0000 (0.000)	0.0000 (0.000)
TMT's Formal Education Field of Study and Industry Match	**0.0105** (0.005)**	**0.0101** (0.005)**	0.0043 (0.005)	**0.0104** (0.005)**	0.0031 (0.006)	**0.0113** (0.005)**	**0.0106** (0.005)**	**0.0106** (0.005)**	**0.0098** (0.005)**	**0.0002*** (0.000)**
Diversity of TMT's Field of Education	0.0030 (0.007)	0.0035 (0.007)	0.0043 (0.007)	0.0032 (0.008)	-0.0025 (0.008)	0.0038 (0.007)	0.0029 (0.007)	0.0032 (0.007)	0.0058 (0.007)	0.0074 (0.007)
Diversity of TMT's Level of Education	**0.0025*** (0.001)**	**0.0025*** (0.001)**	**0.0026*** (0.001)**	**0.0025*** (0.001)**	**0.0026*** (0.001)**	**0.0024*** (0.001)**	**0.0026*** (0.001)**	**0.0025*** (0.001)**	**0.0025*** (0.001)**	**0.0025*** (0.001)**
TMT's Level of Experience	**0.0006*** (0.000)**	**0.0003** (0.000)**	**0.0006*** (0.000)**	**0.0006*** (0.000)**	**0.0006*** (0.000)**	**0.0008*** (0.000)**	**0.0007*** (0.000)**	**0.0007*** (0.000)**	**0.0006*** (0.000)**	**0.0006*** (0.000)**
TMT's Type of Experience (Industry)	**0.1573*** (0.006)**	**0.1575*** (0.006)**	**0.1574*** (0.006)**	**0.1573*** (0.006)**	**0.1574*** (0.006)**	**-0.0129*** (0.002)**	**0.0013*** (0.000)**	**0.1419*** (0.005)**	**0.1573*** (0.006)**	**0.1573*** (0.006)**
Diversity of TMT's Industry Experience	**-0.0246*** (0.002)**	**-0.0248*** (0.002)**	**-0.0247*** (0.002)**	**-0.0246*** (0.002)**	**-0.0247*** (0.002)**	**0.0272*** (0.005)**	**-0.0042* (0.002)**	**-0.0207*** (0.002)**	**-0.0245*** (0.002)**	**-0.0245*** (0.002)**
Diversity of TMT's Level of Experience	**-0.0008*** (0.000)**	**-0.0008*** (0.000)**	**-0.0008*** (0.000)**	**-0.0008*** (0.000)**	**-0.0008*** (0.000)**	**-0.0008*** (0.000)**	**-0.0008*** (0.000)**	**-0.0008*** (0.000)**	**-0.0008*** (0.000)**	**-0.0008*** (0.000)**
Workers Average Level of Education	0.0026*** (0.001)	0.0028*** (0.001)	0.0026*** (0.001)	0.0026*** (0.001)	0.0026*** (0.001)	0.0024*** (0.001)	0.0026*** (0.001)	0.0026*** (0.001)	0.0026*** (0.001)	0.0026*** (0.001)
Training	0.0392*** (0.006)	0.0392*** (0.006)	0.0392*** (0.006)	0.0392*** (0.006)	0.0392*** (0.006)	0.0385*** (0.006)	0.0393*** (0.006)	0.0392*** (0.006)	0.0392*** (0.006)	0.0392*** (0.006)
TMT Size	0.0000 (0.000)	-0.0000 (0.000)	0.0000 (0.000)	0.0000 (0.000)	-0.0000 (0.000)	0.0002 (0.000)	-0.0000 (0.000)	0.0000 (0.000)	0.0000 (0.000)	0.0000 (0.000)
Leverage	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)
Presence of R&D	0.0435*** (0.005)	0.0433*** (0.005)	0.0434*** (0.005)	0.0435*** (0.005)	0.0434*** (0.005)	0.0450*** (0.005)	0.0414*** (0.005)	0.0429*** (0.005)	0.0435*** (0.005)	0.0435*** (0.005)
Firm Size	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Age	0.0002 (0.002)	0.0002 (0.002)	0.0002 (0.002)	0.0002 (0.002)	0.0002 (0.002)	0.0001 (0.002)	0.0002 (0.002)	0.0002 (0.002)	0.0002 (0.002)	0.0002 (0.002)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Multinational	0.0088 (0.012)	0.0084 (0.012)	0.0088 (0.012)	0.0088 (0.012)	0.0088 (0.012)	0.0111 (0.012)	0.0061 (0.012)	0.0084 (0.012)	0.0088 (0.012)	0.0088 (0.012)
Export	0.0022*** (0.000)	0.0022*** (0.000)	0.0022*** (0.000)	0.0022*** (0.000)	0.0022*** (0.000)	0.0022*** (0.000)	0.0022*** (0.000)	0.0022*** (0.000)	0.0022*** (0.000)	0.0022*** (0.000)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1697246	1697246	1697246	1697246	1697246	1697246	1697246	1697246	1697246	1697246
Number of firms	286211	286211	286211	286211	286211	286211	286211	286211	286211	286211
OLS – VIF max [mean]	2.62 [1.36]	2.25 [1.35]	2.47 [1.37]	2.57 [1.37]	2.44 (1.38)	6.35 [1.50]	2.62 [1.36]	2.62 [1.36]	2.64 [1.36]	2.66 [1.36]
OLS – Breusch–Pagan (p-value)	6259.07 (0.0000)	6464.20 (0.0000)	6180.62 (0.0000)	6308.71 (0.0000)	6154.59 (0.0000)	5468.45 (0.0000)	6286.90 (0.0000)	6253.35 (0.0000)	6146.03 (0.0000)	6203.47 (0.0000)
Log likelihood	-1.0e+06	-1.0e+06	-1.0e+06	-1.0e+06	-1.0e+06	-1.0e+06	-1.0e+06	-1.0e+06	-1.0e+06	-1.0e+06
R-squared (within)	0.0423	0.0423	0.0423	0.0423	0.0423	0.0413	0.0423	0.0422	0.0423	0.0423
F statistic (overall)	552.6788 (0.0000)	552.5497 (0.0000)	552.8024 (0.0000)	552.6753 (0.0000)	552.8052 (0.0000)	545.0186 (0.0000)	553.3826 (0.0000)	552.8974 (0.0000)	552.6171 (0.0000)	552.6955 (0.0000)
Root MSE	0.4433	0.4433	0.4433	0.4433	0.4433	0.4435	0.4433	0.4433	0.4433	0.4433
Hausman Test	28852.25 (0.0000)	23345.92 (0.0000)	28819.38 (0.0000)	28894.43 0.0000	28801.82 (0.0000)	27980.23 (0.0000)	28232.60 (0.0000)	28907.22 (0.0000)	28852.91 (0.0000)	28810.20 (0.0000)

Notes: Robust standard errors in parentheses. Significance levels: *, 10%; **, 5%; ***, 1%. All models considered as the dependent variable the logarithm of real gross value added, at factor prices, per employee, and conducted a panel data fixed effects estimation. In Model 1 the independent variables were AVG_EDU_YEARS, PERC_STEM_TMT, TMT_EDU_IND, DIV_EDU_YEARS_TMT and DIV_EDU_YEARS_TMT (regarding formal education), and AVG_EXPERIENCE_TMT, TMT_SAME_INDUSTRY_EXP, DIV_EXP_YEARS_TMT, and DIV_EXP_INDUSTRY_ TMT (regarding professional experience). The remaining models used the same variables with the exception of the following changes: Model 2, instead of AVG_EDU_YEARS considers

PERC_DIPLOMADO_TMT; Model 3, 4 and 5, change PERC_STEM_TMT to PERC_BUSIN_TMT, TEM_STEM and TEM_BUSINESS, respectively; finally, Model 6 considers TOTAL_INDUSTRY_EXPERIENCE instead of TMT_SAME_INDUSTRY_EXP. The final four models consider the following changes: Model 7, instead of TMT_SAME_INDUSTRY_EXP considers PERC_TMT_SAME_INDUSTRY_EXP, while Model 8, changes TMT_SAME_INDUSTRY_EXP to MAJ_TMT_SAME_INDUSTRY_EXP; finally, Models 9 and 10 consider MAJ_TMT_EDU_IND and PERC_TMT_EDU_IND, respectively, instead of TMT_ EDU_IND. The control variables remain unchanged throughout the models.
Source: Own elaboration.

Table A14: The impact of TMT's formal education and professional experience on economic performance (Fixed effects estimation, dependent variable: log of gross value added, at market prices)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
TMT's Level of Education	**0.0042*** (0.001)**	**0.0002*** (0.000)**	**0.0042*** (0.001)**	**0.0039*** (0.001)**	**0.0040*** (0.001)**	**0.0046*** (0.001)**	**0.0043*** (0.001)**	**0.0043*** (0.001)**	**0.0047*** (0.001)**	**0.0045*** (0.001)**
TMT's Field of Education	-0.0001 (0.000)	-0.0001 (0.000)	-0.0001 (0.000)	**0.0140** (0.006)**	**0.0193*** (0.007)**	-0.0001 (0.000)	-0.0001 (0.000)	-0.0001 (0.000)	-0.0001 (0.000)	-0.0001 (0.000)
TMT's Formal Education Field of Study and Industry Match	**0.0150** (0.006)**	**0.0139** (0.006)**	**0.0174*** (0.007)**	**0.0172*** (0.006)**	0.0057 (0.007)	**0.0158*** (0.006)**	**0.0150** (0.006)**	**0.0151** (0.006)**	**-0.0136** (0.006)**	-0.0000 (0.000)
Diversity of TMT's Field of Education	**0.1246*** (0.009)**	**0.1253*** (0.009)**	**0.1237*** (0.009)**	**0.1163*** (0.010)**	**0.1168*** (0.009)**	**0.1181*** (0.009)**	**0.1246*** (0.009)**	**0.1248*** (0.009)**	**0.1339*** (0.009)**	**0.1313*** (0.009)**
Diversity of TMT's Level of Education	**0.0097*** (0.001)**	**0.0096*** (0.001)**	**0.0097*** (0.001)**	**0.0098*** (0.001)**	**0.0098*** (0.001)**	**0.0099*** (0.001)**	**0.0097*** (0.001)**	**0.0096*** (0.001)**	**0.0095*** (0.001)**	**0.0096*** (0.001)**
TMT's Level of Experience	**0.0031*** (0.000)**	**0.0027*** (0.000)**	**0.0031*** (0.000)**	**0.0031*** (0.000)**	**0.0031*** (0.000)**	**0.0035*** (0.000)**	**0.0032*** (0.000)**	**0.0032*** (0.000)**	**0.0031*** (0.000)**	**0.0031*** (0.000)**
TMT's Type of Experience (Industry)	**0.2243*** (0.006)**	**0.2246*** (0.006)**	**0.2243*** (0.006)**	**0.2244*** (0.006)**	**0.2245*** (0.006)**	**0.0273*** (0.002)**	**0.0021*** (0.000)**	**0.2075*** (0.006)**	**0.2245*** (0.006)**	**0.2244*** (0.006)**
Diversity of TMT's Industry Experience	**0.1410*** (0.003)**	**0.1406*** (0.003)**	**0.1410*** (0.003)**	**0.1409*** (0.003)**	**0.1408*** (0.003)**	**0.0973*** (0.006)**	**0.1705*** (0.003)**	**0.1460*** (0.003)**	**0.1409*** (0.003)**	**0.1409*** (0.003)**
Diversity of TMT's Level of Experience	**0.0047*** (0.000)**	**0.0046*** (0.000)**	**0.0047*** (0.000)**	**0.0047*** (0.000)**	**0.0047*** (0.000)**	**0.0047*** (0.000)**	**0.0047*** (0.000)**	**0.0047*** (0.000)**	**0.0047*** (0.000)**	**0.0047*** (0.000)**
Workers Average Level of Education	0.0012* (0.001)	0.0015** (0.001)	0.0012* (0.001)	0.0013* (0.001)	0.0013* (0.001)	0.0009 (0.001)	0.0013** (0.001)	0.0012* (0.001)	0.0012* (0.001)	0.0012* (0.001)
Training	-0.0012 (0.007)	-0.0011 (0.007)	-0.0012 (0.007)	-0.0012 (0.007)	-0.0012 (0.007)	-0.0018 (0.007)	-0.0009 (0.007)	-0.0012 (0.007)	-0.0012 (0.007)	-0.0012 (0.007)
TMT Size	0.0045*** (0.002)	0.0045*** (0.001)	0.0045*** (0.001)	0.0045*** (0.001)	0.0045*** (0.001)	0.0041*** (0.001)	0.0045*** (0.001)	0.0045*** (0.002)	0.0045*** (0.001)	0.0046*** (0.002)
Leverage	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)
Presence of R&D	0.1521*** (0.007)	0.1518*** (0.007)	0.1521*** (0.007)	0.1518*** (0.007)	0.1519*** (0.007)	0.1442*** (0.007)	0.1489*** (0.007)	0.1513*** (0.007)	0.1521*** (0.007)	0.1521*** (0.007)
Firm Size	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Age	-0.0001 (0.003)	-0.0001 (0.003)	-0.0001 (0.003)	-0.0001 (0.003)	-0.0001 (0.003)	0.0001 (0.003)	-0.0001 (0.003)	-0.0001 (0.003)	-0.0001 (0.003)	-0.0001 (0.003)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Multinational	0.0410*** (0.015)	0.0404*** (0.015)	0.0410*** (0.015)	0.0410*** (0.015)	0.0410*** (0.015)	0.0313** (0.015)	0.0369** (0.015)	0.0405*** (0.015)	0.0410*** (0.015)	0.0410*** (0.015)
Export	0.0031*** (0.000)	0.0031*** (0.000)	0.0031*** (0.000)	0.0031*** (0.000)	0.0031*** (0.000)	0.0030*** (0.000)	0.0031*** (0.000)	0.0031*** (0.000)	0.0031*** (0.000)	0.0031*** (0.000)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1690190	1690190	1690190	1690190	1690190	1690190	1690190	1690190	1690190	1690190
Number of firms	285503	285503	285503	285503	285503	285503	285503	285503	285503	285503
OLS — VIF max [mean]	2.61 [1.36]	2.25 [1.35]	2.47 [1.37]	2.57 [1.37]	2.44 [1.38]	6.35 [1.50]	2.61 [1.36]	2.61 [1.36]	2.64 [1.36]	2.66 [1.36]
OLS — Breusch–Pagan (p-value)	16368.17 (0.0000)	16257.10 (0.0000)	16250.04 (0.0000)	16563.58 (0.0000)	16307.11 (0.0000)	17650.67 (0.0000)	16500.79 (0.0000)	16418.10 (0.0000)	15993.13 (0.0000)	16069.73 (0.0000)
Log likelihood	-1.2e+06	-1.2e+06	-1.2e+06	-1.2e+06	-1.2e+06	-1.2e+06	-1.2e+06	-1.2e+06	-1.2e+06	-1.2e+06
R-squared (within)	0.1474	0.1473	0.1474	0.1474	0.1474	0.1460	0.1480	0.1474	0.1474	0.1474
F statistic (overall)	1.5e+03 (0.0000)	1.5e+03 (0.0000)	1.5e+03 (0.0000)	1.5e+03 (0.0000)	1.5e+03 (0.0000)	1.5e+03 (0.0000)	1.6e+03 (0.0000)	1.5e+03 (0.0000)	1.5e+03 (0.0000)	1.5e+03 (0.0000)
Root MSE	0.4871	0.4871	0.4871	0.4871	0.4871	0.4874	0.4869	0.4870	0.4871	0.4871
Hausman Test	144269.77 (0.0000)	143004.91 (0.0000)	144287.56 (0.0000)	144083.90 (0.0000)	144131.08 (0.0000)	141769.86 (0.0000)	143693.24 (0.0000)	144694.34 (0.0000)	144557.45 (0.0000)	144331.32 (0.0000)

Notes: Robust standard errors in parentheses. Significance levels: *, 10%; **, 5%; ***, 1%. All models considered as the dependent variable the logarithm of real gross value added, at market prices, and conducted a panel data fixed effects estimation. In Model 1 the independent variables were AVG_EDU_YEARS, PERC_STEM_TMT, TMT_ EDU_IND, DIV_EDU_YEARS_TMT and DIV_EDU_YEARS_TMT (regarding formal education), and AVG_EXPERIENCE_TMT, TMT_SAME_INDUSTRY_EXP, DIV_EXP_YEARS_ TMT, and DIV_EXP_INDUSTRY_ TMT (regarding professional experience). The remaining models used the same variables with the exception of the following changes: Model 2, instead of AVG_EDU_YEARS considers PERC_DIPLOMADO_TMT; Model 3, 4 and 5, change PERC_STEM_TMT to PERC_BUSIN_TMT, TEM_STEM and TEM_BUSINESS, respectively; finally, Model 6 considers TOTAL_INDUSTRY_EXPERIENCE instead of TMT_SAME_INDUSTRY_EXP. The final four models consider the following changes: Model 7, instead of TMT_SAME_INDUSTRY_EXP considers PERC_TMT_SAME_INDUSTRY_EXP, while Model 8, changes TMT_SAME_INDUSTRY_EXP to MAJ_TMT_ SAME_INDUSTRY_EXP; finally, Models 9 and 10 consider MAJ_TMT_EDU_IND and PERC_TMT_EDU_IND, respectively, instead of TMT_ EDU_IND. The control variables remain unchanged throughout the models.
Source: Own elaboration.

Table A15: The impact of TMT's formal education and professional experience on economic performance (Fixed effects estimation, dependent variable: log of gross value added, at factor prices)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
TMT's Level of Education	**0.0044*** (0.001)**	**0.0002*** (0.000)**	**0.0043*** (0.001)**	**0.0041*** (0.001)**	**0.0041*** (0.001)**	**0.0048*** (0.001)**	**0.0045*** (0.001)**	**0.0045*** (0.001)**	**0.0049*** (0.001)**	**0.0047*** (0.001)**
TMT's Field of Education	-0.0001 (0.000)	-0.0001 (0.000)	-0.0000 (0.000)	**0.0118** (0.006)**	**0.0224*** (0.007)**	-0.0001 (0.000)	-0.0001 (0.000)	-0.0001 (0.000)	-0.0001 (0.000)	-0.0001 (0.000)
TMT's Formal Education Field of Study and Industry Match	**0.0116* (0.006)**	**0.0107* (0.006)**	**0.0125* (0.007)**	**0.0136** (0.006)**	0.0010 (0.007)	**0.0123** (0.006)**	**0.0116* (0.006)**	**0.0117** (0.006)**	**-0.0147** (0.006)**	-0.0000 (0.000)
Diversity of TMT's Field of Education	**0.1276*** (0.009)**	**0.1284*** (0.009)**	**0.1269*** (0.009)**	**0.1205*** (0.010)**	**0.1185*** (0.009)**	**0.1213*** (0.009)**	**0.1276*** (0.009)**	**0.1278*** (0.009)**	**0.1356*** (0.009)**	**0.1328*** (0.009)**
Diversity of TMT's Level of Education	**0.0098*** (0.001)**	**0.0097*** (0.001)**	**0.0098*** (0.001)**	**0.0099*** (0.001)**	**0.0100*** (0.001)**	**0.0101*** (0.001)**	**0.0098*** (0.001)**	**0.0098*** (0.001)**	**0.0097*** (0.001)**	**0.0097*** (0.001)**
TMT's Level of Experience	**0.0030*** (0.000)**	**0.0025*** (0.000)**	**0.0030*** (0.000)**	**0.0030*** (0.000)**	**0.0030*** (0.000)**	**0.0034*** (0.000)**	**0.0030*** (0.000)**	**0.0030*** (0.000)**	**0.0030*** (0.000)**	**0.0030*** (0.000)**
TMT's Type of Experience (Industry)	**0.2194*** (0.006)**	**0.2196*** (0.006)**	**0.2194*** (0.006)**	**0.2194*** (0.006)**	**0.2195*** (0.006)**	**0.0258*** (0.002)**	**0.0020*** (0.000)**	**0.2032*** (0.006)**	**0.2195*** (0.006)**	**0.2194*** (0.006)**
Diversity of TMT's Industry Experience	**0.1396*** (0.003)**	**0.1393*** (0.003)**	**0.1396*** (0.003)**	**0.1395*** (0.003)**	**0.1394*** (0.003)**	**0.0993*** (0.006)**	**0.1685*** (0.003)**	**0.1445*** (0.003)**	**0.1395*** (0.003)**	**0.1396*** (0.003)**
Diversity of TMT's Level of Experience	**0.0046*** (0.000)**	**0.0046*** (0.000)**	**0.0046*** (0.000)**	**0.0046*** (0.000)**	**0.0046*** (0.000)**	**0.0046*** (0.000)**	**0.0047*** (0.000)**	**0.0046*** (0.000)**	**0.0046*** (0.000)**	**0.0046*** (0.000)**
Workers Average Level of Education	0.0024*** (0.001)	0.0027*** (0.001)	0.0024*** (0.001)	0.0024*** (0.001)	0.0024*** (0.001)	0.0021*** (0.001)	0.0025*** (0.001)	0.0024*** (0.001)	0.0024*** (0.001)	0.0024*** (0.001)
Training	0.0081 (0.007)	0.0081 (0.007)	0.0081 (0.007)	0.0081 (0.007)	0.0080 (0.007)	0.0074 (0.007)	0.0084 (0.007)	0.0081 (0.007)	0.0081 (0.007)	0.0081 (0.007)
TMT Size	0.0047*** (0.002)	0.0046*** (0.002)	0.0047*** (0.002)	0.0046*** (0.002)	0.0046*** (0.002)	0.0042*** (0.001)	0.0046*** (0.002)	0.0047*** (0.002)	0.0047*** (0.002)	0.0047*** (0.002)
Leverage	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)	0.0005*** (0.000)
Presence of R&D	0.1581*** (0.007)	0.1578*** (0.007)	0.1580*** (0.007)	0.1578*** (0.007)	0.1578*** (0.007)	0.1505*** (0.007)	0.1549*** (0.007)	0.1573*** (0.007)	0.1580*** (0.007)	0.1581*** (0.007)
Firm Size	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Age	-0.0006 (0.003)	-0.0006 (0.003)	-0.0006 (0.003)	-0.0006 (0.003)	-0.0006 (0.003)	-0.0004 (0.003)	-0.0005 (0.003)	-0.0006 (0.003)	-0.0006 (0.003)	-0.0006 (0.003)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Multinational	0.0454*** (0.015)	0.0447*** (0.015)	0.0454*** (0.015)	0.0454*** (0.015)	0.0453*** (0.015)	0.0361** (0.015)	0.0414*** (0.015)	0.0449*** (0.015)	0.0453*** (0.015)	0.0453*** (0.015)
Export	0.0030*** (0.000)	0.0030*** (0.000)	0.0030*** (0.000)	0.0030*** (0.000)	0.0030*** (0.000)	0.0030*** (0.000)	0.0030*** (0.000)	0.0030*** (0.000)	0.0030*** (0.000)	0.0030*** (0.000)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1697246	1697246	1697246	1697246	1697246	1697246	1697246	1697246	1697246	1697246
Number of firms	286211	286211	286211	286211	286211	286211	286211	286211	286211	286211
OLS – VIF max [mean]	2.62 [1.36]	2.25 [1.35]	2.47 [1.37]	2.57 [1.37]	2.44 [1.38]	6.35 [1.50]	2.62 [1.36]	2.62 [1.36]	2.64 [1.36]	2.66 [1.36]
OLS – Breusch–Pagan (p-value)	17601.48 (0.0000)	17449.54 (0.0000)	17463.25 (0.0000)	17808.57 (0.0000)	17532.15 (0.0000)	18941.63 (0.0000)	17725.75 (0.0000)	17659.28 (0.0000)	17221.01 (0.0000)	17300.48 (0.0000)
Log likelihood	-1.2e+06	-1.2e+06	-1.2e+06	-1.2e+06	-1.2e+06	-1.2e+06	-1.2e+06	-1.2e+06	-1.2e+06	-1.2e+06
R-squared (within)	0.1518	0.1518	0.1518	0.1518	0.1518	0.1504	0.1524	0.1518	0.1518	0.1518
F statistic (overall)	1.5e+03 (0.0000)	1.5e+03 (0.0000)	1.5e+03 (0.0000)	1.5e+03 (0.0000)	1.5e+03 (0.0000)	1.5e+03 (0.0000)	1.5e+03 (0.0000)	1.5e+03 (0.0000)	1.5e+03 (0.0000)	1.5e+03 (0.0000)
Root MSE	0.4791	0.4792	0.4792	0.4791	0.4791	0.4795	0.4790	0.4791	0.4791	0.4792
Hausman Test	153764.04 (0.0000)	152492.70 (0.0000)	153803.01 (0.0000)	153552.69 (0.0000)	153572.27 (0.0000)	152682.96 (0.0000)	153268.96 (0.0000)	154247.37 (0.0000)	154047.67 (0.0000)	153837.65 (0.0000)

Notes: Robust standard errors in parentheses. Significance levels: *, 10%; **, 5%; ***, 1%. All models considered as the dependent variable the logarithm of real gross value added, at factor prices, and conducted a panel data fixed effects estimation. In Model 1 the independent variables were AVG_EDU_YEARS, PERC_STEM_TMT, TMT_ EDU_IND, DIV_ EDU_YEARS_TMT and DIV_EDU_YEARS_TMT (regarding formal education), and AVG_ EXPERIENCE_TMT, TMT_SAME_INDUSTRY_EXP, DIV_EXP_YEARS_TMT, and DIV_EXP_INDUSTRY_ TMT (regarding professional experience). The remaining models used the same variables with the exception of the following changes: Model 2, instead of AVG_EDU_YEARS considers PERC_DIPLOMADO_TMT; Model 3, 4 and 5, change PERC_STEM_TMT to PERC_BUSIN_TMT, TEM_STEM and TEM_BUSINESS, respectively; finally, Model 6 considers TOTAL_INDUSTRY_EXPERIENCE instead of TMT_SAME_INDUSTRY_EXP. The final four models consider the following changes: Model 7, instead of TMT_SAME_INDUSTRY_EXP considers PERC_TMT_SAME_ INDUSTRY_EXP, while Model 8, changes TMT_SAME_INDUSTRY_EXP to MAJ_TMT_SAME_INDUSTRY_EXP; finally, Models 9 and 10 consider MAJ_TMT_EDU_IND and PERC_TMT_EDU_IND, respectively, instead of TMT_ EDU_IND. The control variables remain unchanged throughout the models.
Source: Own elaboration.

Table A16: The impact of TMT's formal education and professional experience on economic performance (Fixed effects estimation, dependent variable: real gross value added, at market prices, per employee)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
TMT's Level of Education	83.5492 (135.075)	4.2655 (9.882)	71.9587 (118.791)	70.3689 (114.322)	60.5894 (126.514)	93.2865 (138.551)	83.6859 (135.105)	83.3497 (135.067)	132.8153 (163.143)	118.4620 (150.695)
TMT's Field of Education	-6.0144 (19.856)	-6.2396 (20.847)	1.2724 (17.853)	160.7049 (895.171)	1.8e+03 (2755.514)	-5.9185 (19.824)	-6.0436 (19.857)	-6.0129 (19.856)	-8.9283 (21.517)	-7.9804 (20.648)
TMT's Formal Education Field of Study and Industry Match	326.4845 (1032.035)	301.1392 (1108.888)	320.0698 (1106.643)	383.7353 (1033.169)	-5.7e+02 (1578.101)	317.9888 (1033.856)	326.6509 (1032.689)	325.9677 (1032.292)	-2.6e+03 (2530.714)	-18.2071 (17.210)
Diversity of TMT's Field of Education	2.0e+03 (1734.490)	2.0e+03 (1737.558)	1.9e+03 (1696.756)	1.8e+03 (1657.148)	1.2e+03 (2118.495)	1.8e+03 (1740.597)	2.0e+03 (1733.794)	2.0e+03 (1734.758)	2.6e+03 (2063.930)	2.1e+03 (1913.879)
Diversity of TMT's Level of Education	-1.6e+02 (104.932)	-1.6e+02 (104.754)	-1.6e+02 (105.270)	-1.6e+02 (104.092)	-1.5e+02 (106.211)	-1.5e+02 (105.506)	-1.6e+02 (104.938)	-1.6e+02 (104.926)	-1.7e+02 (108.166)	-1.7e+02 (106.841)
TMT's Level of Experience	24.7022 (41.494)	15.7875 (28.634)	24.3152 (40.333)	24.1294 (40.570)	25.6415 (39.281)	28.4378 (42.385)	24.8122 (41.638)	24.1734 (41.520)	26.5274 (42.564)	25.5848 (41.902)
TMT's Type of Experience (Industry)	**1.1e+03*** **(635.767)**	**1.1e+03*** **(636.941)**	**1.1e+03*** **(636.364)**	**1.1e+03*** **(636.047)**	**1.1e+03*** **(632.515)**	1.0e+03 (1145.148)	**10.2780**** **(4.876)**	**1.4e+03**** **(616.815)**	**1.1e+03*** **(635.703)**	**1.1e+03*** **(635.704)**
Diversity of TMT's Industry Experience	46.2961 (570.074)	39.2272 (572.230)	44.9469 (570.877)	44.6142 (571.157)	28.4546 (562.419)	-2.4e+03 (2814.542)	192.9379 (532.679)	25.1804 (548.224)	30.0138 (568.311)	40.0952 (569.134)
Diversity of TMT's Level of Experience	23.0507 (26.071)	22.3800 (26.354)	23.1288 (26.015)	23.1025 (26.085)	22.7405 (26.024)	23.2643 (26.094)	23.3063 (26.062)	23.2151 (26.066)	23.2297 (26.041)	23.0744 (26.026)
Workers Average Level of Education	48.3320 (77.171)	53.8910 (81.334)	49.3839 (77.814)	49.5589 (77.754)	50.1404 (77.208)	45.9152 (76.747)	48.7488 (77.194)	48.9202 (77.132)	45.2354 (77.255)	46.0668 (77.154)
Training	2.0e+03*** (749.419)	2.0e+03*** (749.400)	2.0e+03*** (749.560)	2.0e+03*** (749.557)	1.9e+03*** (749.524)	2.0e+03*** (749.523)	2.0e+03*** (749.477)	2.0e+03*** (749.438)	2.0e+03*** (749.168)	2.0e+03*** (749.610)
TMT Size	0.4526 (44.173)	0.2779 (44.068)	0.6133 (44.131)	0.1852 (43.929)	-1.4697 (43.746)	-15.5713 (38.188)	0.4057 (44.175)	0.5294 (44.196)	-1.3840 (43.813)	0.2051 (44.152)
Leverage	23.5677 (16.176)	23.5609 (16.176)	23.5706 (16.176)	23.5701 (16.176)	23.5794 (16.177)	23.5072 (16.173)	23.5711 (16.178)	23.5830 (16.178)	23.5301 (16.175)	23.5398 (16.175)
Presence of R&D	1.5e+03 (1479.729)	1.5e+03 (1475.633)	1.5e+03 (1474.316)	1.5e+03 (1473.345)	1.5e+03 (1484.639)	1.2e+03 (1499.476)	1.5e+03 (1479.738)	1.5e+03 (1479.560)	1.5e+03 (1475.857)	1.5e+03 (1480.753)
Firm Size	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Age	-9.7317 (51.825)	-9.6247 (51.857)	-9.9219 (51.827)	-9.9571 (51.805)	-9.1750 (52.304)	-2.5819 (53.614)	-9.5183 (51.794)	-9.7059 (51.797)	-9.4358 (51.478)	-9.7572 (51.533)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Multinational	-4.2e+03 (4527.677)	-4.2e+03 (4519.930)	-4.2e+03 (4527.127)	-4.2e+03 (4527.328)	-4.2e+03 (4528.164)	-4.5e+03 (4508.259)	-4.2e+03 (4527.337)	-4.2e+03 (4528.066)	-4.2e+03 (4530.610)	-4.2e+03 (4529.284)
Export	63.8351*** (13.612)	63.8273*** (13.613)	63.8298*** (13.625)	63.8289*** (13.610)	63.7769*** (13.650)	63.4318*** (13.872)	63.8187*** (13.607)	63.8388*** (13.607)	63.8001*** (13.606)	63.8201*** (13.611)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1771427	1771427	1771427	1771427	1771427	1771427	1771427	1771427	1771427	1771427
Number of firms	297817	297817	297817	297817	297817	297817	297817	297817	297817	297817
OLS — VIF max [mean]	2.59 [1.36]	2.22 [1.35]	2.45 [1.37]	2.55 [1.36]	2.42 [1.38]	6.35 [1.50]	2.59 [1.36]	2.59 [1.36]	2.62 [1.36]	2.64 [1.36]
OLS — Breusch–Pagan (p-value)	2.18e+07 (0.0000)	2.23e+07 (0.0000)	2.11e+07 (0.0000)	2.19e+07 (0.0000)	2.13e+07 (0.0000)	2.18e+07 (0.0000)	2.17e+07 (0.0000)	2.18e+07 (0.0000)	2.18e+07 (0.0000)	2.18e+07 (0.0000)
Log likelihood	-2.2e+07	-2.2e+07	-2.2e+07	-2.2e+07	-2.2e+07	-2.2e+07	-2.2e+07	-2.2e+07	-2.2e+07	-2.2e+07
R-squared (within)	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008
F statistic (overall)	42.6465 (0.0000)	40.8301 (0.0000)	42.9309 (0.0000)	42.7184 (0.0000)	44.7415 (0.0000)	42.6727 (0.0000)	42.5900 (0.0000)	42.6982 (0.0000)	43.7420 (0.0000)	42.7061 (0.0000)
Root MSE	7.2e+04	7.2e+04	7.2e+04	7.2e+04	7.2e+04	7.2e+04	7.2e+04	7.2e+04	7.2e+04	7.2e+04
Hausman Test	1842.39 (0.0000)	1682.76 (0.0000)	1824.80 (0.0000)	1840.49 (0.0000)	1818.42 (0.0000)	1841.74 (0.0000)	1836.58 (0.0000)	1844.20 (0.0000)	1871.94 (0.0000)	1860.57 (0.0000)

Notes: Robust standard errors in parentheses. Significance levels: *, 10%; **, 5%; ***, 1%. All models considered as the dependent variable the real gross value added, at market prices, per employee, and conducted a panel data fixed effects estimation. In Model 1 the independent variables were AVG_EDU_YEARS, PERC_STEM_TMT, TMT_EDU_IND, DIV_EDU_YEARS_TMT and DIV_EDU_YEARS_TMT (regarding formal education), and AVG_EXPERIENCE_TMT, TMT_SAME_INDUSTRY_EXP, DIV_EXP_YEARS_TMT, and DIV_EXP_INDUSTRY_TMT (regarding professional experience), The remaining models used the same variables with the exception of the following changes: Model 2, instead of AVG_EDU_YEARS considers PERC_DIPLOMADO_TMT; Model 3, 4 and 5, change PERC_STEM_TMT to PERC_BUSIN_TMT, TEM_STEM and TEM_BUSINESS,

respectively; finally, Model 6 considers TOTAL_INDUSTRY_EXPERIENCE instead of TMT_SAME_INDUSTRY_EXP. The final four models consider the following changes: Model 7, instead of TMT_SAME_INDUSTRY_EXP considers PERC_TMT_ SAME_INDUSTRY_EXP, while Model 8, changes TMT_SAME_INDUSTRY_EXP to MAJ_TMT_SAME_INDUSTRY_EXP; finally, Models 9 and 10 consider MAJ_TMT_EDU_IND and PERC_TMT_EDU_IND, respectively, instead of TMT_EDU_IND. The control variables remain unchanged throughout the models.
Source: Own elaboration.

Table A17: The impact of TMT's formal education and professional experience on economic performance (Fixed effects estimation, dependent variable: real gross value added, at factor prices, per employee)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
TMT's Level of Education	86.8578	4.3616	74.5331	70.7305	64.0832	96.0411	87.0558	86.6885	136.9552	121.6050
	(134.459)	(9.745)	(118.119)	(113.666)	(125.851)	(137.975)	(134.488)	(134.450)	(162.767)	(150.244)
TMT's Field of Education	-5.3421	-5.5490	3.2494	395.6790	2.0e+03	-5.2569	-5.3820	-5.3411	-8.2987	-7.2928
	(19.854)	(20.859)	(17.776)	(887.897)	(2754.263)	(19.821)	(19.854)	(19.854)	(21.524)	(20.653)
TMT's Formal Education Field of Study and Industry Match	305.2617	280.5341	224.8957	385.7577	-6.7e+02	299.5704	305.5868	305.2472	-2.7e+03	-18.3078
	(1015.345)	(1095.905)	(1083.086)	(1019.746)	(1560.869)	(1017.386)	(1015.964)	(1015.617)	(2532.441)	(17.206)
Diversity of TMT's Field of Education	1.8e+03	1.9e+03	1.8e+03	1.6e+03	1.1e+03	1.7e+03	1.8e+03	1.8e+03	2.5e+03	2.0e+03
	(1734.831)	(1737.893)	(1698.479)	(1650.531)	(2116.169)	(1741.511)	(1734.137)	(1735.094)	(2061.884)	(1912.221)
Diversity of TMT's Level of Education	-1.6e+02	-1.6e+02	-1.6e+02	-1.6e+02	-1.5e+02	-1.5e+02	-1.6e+02	-1.6e+02	-1.7e+02	-1.6e+02
	(101.259)	(101.171)	(101.561)	(100.086)	(102.326)	(102.076)	(101.261)	(101.249)	(104.277)	(102.927)
TMT's Level of Experience	20.4196	11.0828	20.1991	19.7348	21.5188	24.5998	20.6049	19.9901	22.2814	21.2983
	(41.370)	(28.448)	(40.206)	(40.439)	(39.151)	(42.241)	(41.507)	(41.392)	(42.442)	(41.778)
TMT's Type of Experience (Industry)	**1.5e+03*** **	**1.5e+03*** **	**1.5e+03*** **	**1.5e+03*** **	**1.5e+03*** **	**936.8112**	**13.9596*** **	**1.8e+03*** **	**1.5e+03*** **	**1.5e+03*** **
	(530.696)	**(531.979)**	**(531.337)**	**(531.017)**	**(526.721)**	**(1144.317)**	**(4.168)**	**(539.637)**	**(530.660)**	**(530.651)**
Diversity of TMT's Industry Experience	-10.8243	-18.0900	-13.1223	-13.8809	-29.9161	-2.2e+03	191.4505	-17.3931	-27.5124	-17.0421
	(566.103)	(568.369)	(566.797)	(567.103)	(558.223)	(2814.549)	(528.324)	(544.316)	(564.359)	(565.165)
Diversity of TMT's Level of Experience	25.9831	25.2862	26.0893	26.0225	25.6383	26.1336	26.3280	26.1736	26.1615	26.0028
	(25.388)	(25.672)	(25.335)	(25.402)	(25.335)	(25.408)	(25.376)	(25.380)	(25.350)	(25.335)
Workers Average Level of Education	62.8997	68.6878	64.0009	64.4227	64.6680	59.9158	63.4294	63.3993	59.7516	60.6451
	(76.895)	(81.043)	(77.541)	(77.482)	(76.937)	(76.494)	(76.923)	(76.857)	(76.982)	(76.878)
Training	2.2e+03***	2.2e+03***	2.2e+03***	2.2e+03***	2.2e+03***	2.2e+03***	2.2e+03***	2.2e+03***	2.2e+03***	2.2e+03***
	(750.599)	(750.569)	(750.748)	(750.728)	(750.700)	(750.707)	(750.646)	(750.611)	(750.337)	(750.775)
TMT Size	12.3566	12.1661	12.7122	11.6465	10.2793	-2.3892	12.2900	12.4329	10.4410	12.0841
	(43.676)	(43.567)	(43.656)	(43.430)	(43.178)	(37.000)	(43.674)	(43.702)	(43.203)	(43.643)
Leverage	23.5833	23.5763	23.5865	23.5854	23.5954	23.5146	23.5873	23.5983	23.5452	23.5556
	(16.178)	(16.178)	(16.179)	(16.179)	(16.179)	(16.175)	(16.180)	(16.180)	(16.177)	(16.178)
Presence of R&D	1.8e+03	1.8e+03	1.8e+03	1.8e+03	1.8e+03	1.6e+03	1.8e+03	1.8e+03	1.8e+03	1.8e+03
	(1471.012)	(1466.915)	(1465.585)	(1464.543)	(1475.992)	(1491.129)	(1470.977)	(1470.831)	(1467.112)	(1472.034)
Firm Size	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Age	-13.8529	-13.7358	-13.9807	-14.0697	-13.2124	-7.2478	-13.5606	-13.8048	-13.5527	-13.8812
	(51.052)	(51.082)	(51.062)	(51.003)	(51.580)	(52.617)	(51.012)	(51.025)	(50.726)	(50.779)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Multinational	-2.1e+03	-2.1e+03	-2.1e+03	-2.1e+03	-2.1e+03	-2.3e+03	-2.1e+03	-2.1e+03	-2.1e+03	-2.1e+03
	(4266.451)	(4258.121)	(4266.018)	(4265.977)	(4267.150)	(4236.892)	(4266.415)	(4266.887)	(4269.297)	(4267.909)
Export	69.7099***	69.7021***	69.7007***	69.6985***	69.6477***	69.3285***	69.6870***	69.7109***	69.6744***	69.6951***
	(13.130)	(13.131)	(13.143)	(13.127)	(13.169)	(13.404)	(13.126)	(13.124)	(13.123)	(13.128)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1771427	1771427	1771427	1771427	1771427	1771427	1771427	1771427	1771427	1771427
Number of firms	297817	297817	297817	297817	297817	297817	297817	297817	297817	297817
OLS – VIF max [mean]	2.59 [1.36]	2.22 [1.35]	2.45 [1.37]	2.55 [1.36]	2.42 [1.38]	6.35 [1.50]	2.59 [1.36]	2.59 [1.36]	2.62 [1.36]	2.64 [1.36]
OLS – Breusch–Pagan (p-value)	1.75e+07 (0.0000)	1.79e+07 (0.0000)	1.66e+07 (0.0000)	1.76e+07 (0.0000)	1.69e+07 (0.0000)	1.74e+07 (0.0000)	1.75e+07 (0.0000)	1.75e+07 (0.0000)	1.74e+07 (0.0000)	1.75e+07 (0.0000)
Log likelihood	-2.2e+07	-2.2e+07	-2.2e+07	-2.2e+07	-2.2e+07	-2.2e+07	-2.2e+07	-2.2e+07	-2.2e+07	-2.2e+07
R-squared (within)	0.0008	0.0008	0.0008	0.0008	0.0009	0.0009	0.0008	0.0009	0.0009	0.0009
F statistic (overall)	45.6182 (0.0000)	43.2868 (0.0000)	45.9937 (0.0000)	45.8279 (0.0000)	48.1991 (0.0000)	45.8863 (0.0000)	45.4592 (0.0000)	45.5291 (0.0000)	46.8293 (0.0000)	45.4317 (0.0000)
Root MSE	7.2e+04	7.2e+04	7.2e+04	7.2e+04	7.2e+04	7.2e+04	7.2e+04	7.2e+04	7.2e+04	7.2e+04
Hausman Test	1845.58 (0.0000)	1647.95 (0.0000)	1825.10 (0.0000)	1841.45 (0.0000)	1817.89 (0.0000)	1841.20 (0.0000)	1835.24 (0.0000)	1847.44 (0.0000)	1882.53 (0.0000)	1866.86 (0.0000)

Notes: Robust standard errors in parentheses. Significance levels: *, 10%; **, 5%; ***, 1%. All models considered as the dependent variable the real gross value added, at factor prices, per employee, and conducted a panel data fixed effects estimation. In Model 1 the independent variables were AVG_EDU_YEARS, PERC_STEM_TMT, TMT_ EDU_IND, DIV_EDU_YEARS_TMT and DIV_EDU_YEARS_TMT (regarding formal education), and AVG_EXPERIENCE_TMT, TMT_SAME_INDUSTRY_EXP, DIV_EXP_YEARS_ TMT, and DIV_EXP_INDUSTRY_ TMT (regarding formal experience). The remaining models used the same variables with the exception of the following changes: Model 2, instead of AVG_EDU_YEARS considers PERC_DIPLOMADO_TMT; Model 3, 4 and 5, change PERC_STEM_TMT to PERC_BUSIN_TMT, TEM_STEM and TEM_BUSINESS, respectively; finally, Model 6 considers TOTAL_INDUSTRY_ EXPERIENCE instead of TMT_SAME_INDUSTRY_EXP. The final four models consider the following changes:

Model 7, instead of TMT_SAME_INDUSTRY_EXP considers PERC_TMT_SAME_INDUSTRY_EXP, while Model 8, changes TMT_SAME_INDUSTRY_EXP to MAJ_TMT_SAME_INDUSTRY_EXP; finally, Models 9 and 10 consider MAJ_ TMT_EDU_IND and PERC_TMT_EDU_IND, respectively, instead of TMT_ EDU_IND. The control variables remain unchanged throughout the models.
Source: Own elaboration.

Table A18: The impact of TMT's formal education and professional experience on economic performance (Fixed effects estimation, dependent variable: real gross value added, at market prices)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
TMT's Level of Education	7.0e+03	448.3704	7.3e+03	7.0e+03	7.1e+03	**1.2e+04***	6.9e+03	7.0e+03	7.0e+03	7.1e+03
	(6413.452)	(387.332)	(6065.849)	(7166.996)	(6620.698)	**(6011.119)**	(6418.344)	(6414.294)	(5803.948)	(5935.554)
TMT's Field of Education	-30.5330	-83.6613	-4.0e+02	-1.4e+03	-2.5e+04	22.6767	-30.6355	-30.2594	-31.5809	-30.8218
	(398.936)	(404.962)	(718.286)	(5.9e+04)	(6.5e+04)	(394.138)	(398.941)	(398.945)	(425.551)	(413.767)
TMT's Formal Education Field of Study and Industry Match	-9.5e+03	-1.4e+04	4.6e+03	-9.5e+03	3.2e+03	-1.7e+04	-9.9e+03	-9.7e+03	-1.2e+04	-1.3e+02
	(4.6e+04)	(4.9e+04)	(6.6e+04)	(5.0e+04)	(5.0e+04)	(4.5e+04)	(4.6e+04)	(4.6e+04)	(5.0e+04)	(336.676)
Diversity of TMT's Field of Education	-1.2e+05	-1.2e+05	-1.3e+05	-1.2e+05	-1.1e+05	-2.1e+05*	-1.2e+05	-1.2e+05	-1.3e+05	-1.3e+05
	(1.3e+05)	(1.3e+05)	(1.2e+05)	(1.0e+05)	(1.1e+05)	(1.2e+05)	(1.3e+05)	(1.3e+05)	(1.4e+05)	(1.4e+05)
Diversity of TMT's Level of Education	-8.8e+03	-8.9e+03	-8.8e+03	-8.8e+03	-9.0e+03	-3.2e+03	-8.8e+03	-8.8e+03	-8.8e+03	-8.8e+03
	(7482.624)	(7477.906)	(7474.629)	(7789.131)	(7660.647)	(7839.558)	(7482.107)	(7482.540)	(7255.189)	(7331.688)
TMT's Level of Experience	2.8e+03	**2.1e+03***	2.8e+03	2.8e+03	2.8e+03	**3.8e+03****	2.7e+03	2.7e+03	2.8e+03	2.8e+03
	(1811.946)	**(1164.224)**	(1835.588)	(1838.372)	(1799.184)	**(1740.353)**	(1826.751)	(1815.529)	(1792.816)	(1800.867)
TMT's Type of Experience (Industry)	**-8.1e+04*****	**-8.1e+04*****	**-8.2e+04*****	**-8.1e+04*****	**-8.2e+04*****	**5.3e+05*****	**221.6558****	**-2.8e+04***	**-8.1e+04*****	**-8.1e+04*****
	(1.8e+04)	**(1.8e+04)**	**(1.8e+04)**	**(1.8e+04)**	**(1.8e+04)**	**(8.4e+04)**	**(87.610)**	**(1.7e+04)**	**(1.8e+04)**	**(1.8e+04)**
Diversity of TMT's Industry Experience	**1.7e+05*****	**1.7e+05*****	**1.7e+05*****	**1.7e+05*****	**1.7e+05*****	**-1.2e+06*****	**1.6e+05*****	**1.6e+05*****	**1.7e+05*****	**1.7e+05*****
	(3.4e+04)	**(3.5e+04)**	**(3.4e+04)**	**(3.4e+04)**	**(3.4e+04)**	**(1.9e+05)**	**(3.2e+04)**	**(3.4e+04)**	**(3.4e+04)**	**(3.4e+04)**
Diversity of TMT's Level of Experience	**-1.1e+04****	**-1.1e+04****	**-1.1e+04****	**-1.1e+04****	**-1.1e+04****	**-1.0e+04***	**-1.1e+04****	**-1.1e+04****	**-1.1e+04****	**-1.1e+04****
	(5211.485)	**(5252.051)**	**(5202.578)**	**(5210.486)**	**(5205.194)**	**(5318.524)**	**(5211.338)**	**(5210.870)**	**(5217.847)**	**(5215.844)**
Workers Average Level of Education	-4.1e+02	47.0295	-4.3e+02	-4.0e+02	-4.1e+02	-6.8e+02	-2.4e+02	-3.3e+02	-4.1e+02	-4.1e+02
	(1248.564)	(1176.090)	(1266.239)	(1261.750)	(1261.684)	(1248.183)	(1252.879)	(1249.912)	(1257.566)	(1248.880)
Training	-3.4e+04	-3.4e+04	-3.4e+04	-3.4e+04	-3.4e+04	-3.1e+04	-3.4e+04	-3.4e+04	-3.4e+04	-3.4e+04
	(3.0e+04)	(3.0e+04)	(3.0e+04)	(3.0e+04)	(3.0e+04)	(2.9e+04)	(3.0e+04)	(3.0e+04)	(3.0e+04)	(3.0e+04)
TMT Size	2.3e+05**	2.3e+05**	2.3e+05**	2.3e+05**	2.3e+05**	2.2e+05**	2.3e+05**	2.3e+05**	2.3e+05**	2.3e+05**
	(9.8e+04)	(9.8e+04)	(9.8e+04)	(9.8e+04)	(9.8e+04)	(1.0e+05)	(9.8e+04)	(9.8e+04)	(9.8e+04)	(9.8e+04)
Leverage	241.6703	241.0173	241.5629	241.6835	241.5591	227.2462	244.4785	242.9376	241.6777	241.6712
	(220.370)	(220.187)	(220.428)	(220.364)	(220.282)	(220.700)	(220.253)	(220.367)	(220.774)	(220.652)
Presence of R&D	5.4e+05***	5.4e+05***	5.4e+05***	5.4e+05***	5.4e+05***	4.3e+05***	5.4e+05***	5.4e+05***	5.4e+05***	5.4e+05***
	(7.0e+04)	(7.0e+04)	(7.0e+04)	(7.0e+04)	(7.0e+04)	(6.6e+04)	(7.0e+04)	(7.0e+04)	(7.0e+04)	(7.0e+04)
Firm Size	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Age	-6.1e+03	-6.1e+03	-6.1e+03	-6.1e+03	-6.1e+03	-2.4e+03	-6.1e+03	-6.1e+03	-6.1e+03	-6.1e+03
	(1.0e+04)	(1.0e+04)	(1.0e+04)	(1.0e+04)	(1.0e+04)	(1.1e+04)	(1.0e+04)	(1.0e+04)	(1.0e+04)	(1.0e+04)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Multinational	-2.2e+04	-2.3e+04	-2.2e+04	-2.2e+04	-2.2e+04	-1.7e+05	-2.2e+04	-2.1e+04	-2.2e+04	-2.2e+04
	(2.8e+05)	(2.8e+05)	(2.8e+05)	(2.8e+05)	(2.8e+05)	(2.7e+05)	(2.8e+05)	(2.8e+05)	(2.8e+05)	(2.8e+05)
Export	2.4e+03***	2.4e+03***	2.4e+03***	2.4e+03***	2.4e+03***	2.2e+03***	2.4e+03***	2.4e+03***	2.4e+03***	2.4e+03***
	(353.761)	(353.797)	(353.867)	(353.675)	(353.251)	(341.477)	(353.730)	(353.739)	(353.645)	(353.697)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1771427	1771427	1771427	1771427	1771427	1771427	1771427	1771427	1771427	1771427
Number of firms	297817	297817	297817	297817	297817	297817	297817	297817	297817	297817
OLS – VIF max [mean]	2.59 [1.36]	2.22 [1.35]	2.45 [1.37]	2.55 [1.36]	2.42 [1.38]	6.35 [1.50]	2.59 [1.36]	2.59 [1.36]	2.62 [1.36]	2.64 [1.36]
OLS – Breusch–Pagan (p-value)	3.21e+08 (0.0000)	3.21e+08 (0.0000)	3.21e+08 (0.0000)	3.21e+08 (0.0000)	3.21e+08 (0.0000)	3.45e+08 (0.0000)	3.21e+08 (0.0000)	3.21e+08 (0.0000)	3.22e+08 (0.0000)	3.22e+08 (0.0000)
Log likelihood	-2.8e+07	-2.8e+07	-2.8e+07	-2.8e+07	-2.8e+07	-2.8e+07	-2.8e+07	-2.8e+07	-2.8e+07	-2.8e+07
R-squared (within)	0.0515	0.0515	0.0515	0.0515	0.0515	0.0581	0.0514	0.0514	0.0515	0.0515
F statistic (overall)	68.8319 (0.0000)	69.2273 (0.0000)	68.8689 (0.0000)	68.7641 (0.0000)	68.8639 (0.0000)	74.9983 (0.0000)	69.1703 (0.0000)	69.0240 (0.0000)	67.9552 (0.0000)	67.9804 (0.0000)
Root MSE	2.0e+06	2.0e+06	2.0e+06	2.0e+06	2.0e+06	2.0e+06	2.0e+06	2.0e+06	2.0e+06	2.0e+06
Hausman Test	88457.71 (0.0000)	88408.21 (0.0000)	88538.54 (0.0000)	88473.55 (0.0000)	88499.15 (0.0000)	83662.11 (0.0000)	88432.62 (0.0000)	88442.56 (0.0000)	88491.24 (0.0000)	88461.92 (0.0000)

Notes: Robust standard errors in parentheses. Significance levels: *, 10%; **, 5%; ***, 1%. All models considered as the dependent variable the real gross value added, at market prices, and conducted a panel data fixed effects estimation. In Model 1 the independent variables were AVG_EDU_YEARS, PERC_STEM_TMT, TMT_EDU_IND, DIV_EDU_YEARS_TMT and DIV_EDU_YEARS_TMT (regarding formal education), and AVG_EXPERIENCE_TMT, TMT_SAME_INDUSTRY_EXP, DIV_EXP_YEARS_TMT, and DIV_EXP_INDUSTRY_TMT (regarding professional experience). The remaining models used the same variables with the exception of the following changes: Model 2, instead of AVG_EDU_YEARS considers PERC_DIPLOMADO_TMT; Model 3, 4 and 5, change PERC_STEM_TMT to PERC_BUSIN_TMT, TEM_STEM and TEM_BUSINESS, respectively; finally, Model 6 considers TOTAL_ INDUSTRY_EXPERIENCE instead of TMT_SAME_INDUSTRY_EXP. The final four models consider the following changes: Model 7, instead of TMT_SAME_INDUSTRY_EXP considers PERC_TMT_SAME_INDUSTRY_EXP, while Model 8, changes TMT_SAME_INDUSTRY_EXP to MAJ_TMT_SAME_INDUSTRY_EXP; finally, Models 9 and 10 consider MAJ_TMT_EDU_IND and PERC_TMT_EDU_IND, respectively, instead of TMT_EDU_IND. The control variables remain unchanged throughout the models.
Source: Own elaboration.

Table A19: The impact of TMT's formal education and professional experience on economic performance (Fixed effects estimation, dependent variable: real gross value added, at factor prices)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
TMT's Level of Education	7.0e+03	467.6524	7.4e+03	7.0e+03	7.2e+03	**1.2e+04***	7.0e+03	7.0e+03	7.2e+03	7.1e+03
	(6670.221)	(391.612)	(6301.227)	(7391.508)	(6852.093)	**(6257.764)**	(6675.393)	(6671.129)	(6137.785)	(6218.444)
TMT's Field of Education	-22.0432	-81.5607	-3.9e+02	-4.3e+02	-3.2e+04	32.2628	-22.1261	-21.7705	-27.0631	-22.0996
	(400.541)	(405.942)	(717.007)	(5.9e+04)	(6.4e+04)	(395.582)	(400.552)	(400.552)	(427.493)	(415.154)
TMT's Formal Education Field of Study and Industry Match	-1.2e+04	-1.6e+04	2.3e+03	-1.2e+04	4.4e+03	-1.9e+04	-1.2e+04	-1.2e+04	-1.9e+04	-1.5e+02
	(4.5e+04)	(4.8e+04)	(6.5e+04)	(5.0e+04)	(4.9e+04)	(4.4e+04)	(4.5e+04)	(4.5e+04)	(5.1e+04)	(336.113)
Diversity of TMT's Field of Education	-1.3e+05	-1.3e+05	-1.3e+05	-1.3e+05	-1.1e+05	**-2.2e+05***	-1.3e+05	-1.3e+05	-1.3e+05	-1.3e+05
	(1.3e+05)	(1.3e+05)	(1.2e+05)	(1.0e+05)	(1.1e+05)	**(1.2e+05)**	(1.3e+05)	(1.3e+05)	(1.4e+05)	(1.4e+05)
Diversity of TMT's Level of Education	-8.6e+03	-8.7e+03	-8.6e+03	-8.6e+03	-8.8e+03	-2.9e+03	-8.6e+03	-8.6e+03	-8.6e+03	-8.6e+03
	(7584.610)	(7571.062)	(7578.687)	(7879.493)	(7758.362)	(7922.955)	(7584.004)	(7584.439)	(7358.961)	(7438.809)
TMT's Level of Experience	2.7e+03	**2.1e+03***	2.7e+03	2.7e+03	2.7e+03	**3.7e+03****	2.6e+03	2.7e+03	2.8e+03	2.7e+03
	(1872.653)	**(1189.479)**	(1895.393)	(1897.885)	(1858.956)	**(1799.413)**	(1888.267)	(1876.461)	(1856.008)	(1862.098)
TMT's Type of Experience (Industry)	**-8.5e+04*****	**-8.5e+04*****	**-8.5e+04*****	**-8.5e+04*****	**-8.5e+04*****	**5.4e+05*****	**221.3871****	**-3.2e+04***	**-8.5e+04*****	**-8.5e+04*****
	(1.8e+04)	**(1.9e+04)**	**(1.8e+04)**	**(1.8e+04)**	**(1.8e+04)**	**(8.5e+04)**	**(85.953)**	**(1.6e+04)**	**(1.8e+04)**	**(1.8e+04)**
Diversity of TMT's Industry Experience	**1.7e+05*****	**1.7e+05*****	**1.7e+05*****	**1.7e+05*****	**1.7e+05*****	**-1.2e+06*****	**1.6e+05*****	**1.7e+05*****	**1.7e+05*****	**1.7e+05*****
	(3.5e+04)	**(3.6e+04)**	**(3.5e+04)**	**(3.5e+04)**	**(3.5e+04)**	**(1.9e+05)**	**(3.3e+04)**	**(3.5e+04)**	**(3.5e+04)**	**(3.5e+04)**
Diversity of TMT's Level of Experience	**-1.1e+04****	**-1.1e+04****	**-1.1e+04****	**-1.1e+04****	**-1.1e+04****	**-1.1e+04****	**-1.1e+04****	**-1.1e+04****	**-1.1e+04****	**-1.1e+04****
	(5230.075)	**(5272.096)**	**(5221.100)**	**(5229.055)**	**(5223.758)**	**(5337.913)**	**(5229.954)**	**(5229.442)**	**(5236.490)**	**(5234.470)**
Workers Average Level of Education	-1.3e+02	326.7069	-1.6e+02	-1.3e+02	-1.4e+02	-4.0e+02	43.9058	-50.4248	-1.4e+02	-1.3e+02
	(1269.111)	(1177.134)	(1283.542)	(1281.524)	(1280.391)	(1267.549)	(1274.350)	(1270.659)	(1279.851)	(1269.606)
Training	-3.2e+04	-3.2e+04	-3.2e+04	-3.2e+04	-3.2e+04	-2.8e+04	-3.1e+04	-3.2e+04	-3.2e+04	-3.2e+04
	(2.9e+04)	(2.9e+04)	(2.9e+04)	(2.9e+04)	(2.9e+04)	(2.9e+04)	(2.9e+04)	(2.9e+04)	(2.9e+04)	(2.9e+04)
TMT Size	2.3e+05**	2.3e+05**	2.3e+05**	2.3e+05**	2.3e+05**	2.2e+05**	2.3e+05**	2.3e+05**	2.3e+05**	2.3e+05**
	(9.7e+04)	(9.7e+04)	(9.8e+04)	(9.8e+04)	(9.7e+04)	(1.0e+05)	(9.7e+04)	(9.7e+04)	(9.7e+04)	(9.7e+04)
Leverage	233.7773	233.1053	233.6665	233.7866	233.6288	219.1143	236.6832	235.0186	233.7393	233.7827
	(218.238)	(218.062)	(218.293)	(218.232)	(218.154)	(218.534)	(218.121)	(218.235)	(218.628)	(218.510)
Presence of R&D	5.6e+05***	5.6e+05***	5.6e+05***	5.6e+05***	5.6e+05***	4.4e+05***	5.6e+05***	5.6e+05***	5.6e+05***	5.6e+05***
	(6.8e+04)	(6.9e+04)	(6.9e+04)	(6.8e+04)	(6.8e+04)	(6.4e+04)	(6.8e+04)	(6.8e+04)	(6.8e+04)	(6.8e+04)
Firm Size	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Age	-8.8e+03	-8.8e+03	-8.8e+03	-8.8e+03	-8.8e+03	-5.1e+03	-8.8e+03	-8.8e+03	-8.8e+03	-8.8e+03
	(9967.278)	(9968.468)	(9962.568)	(9966.895)	(9957.014)	(9517.156)	(9969.589)	(9968.181)	(9966.493)	(9966.501)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Multinational	-2.0e+04	-2.1e+04	-1.9e+04	-2.0e+04	-1.9e+04	-1.7e+05	-1.9e+04	-1.9e+04	-2.0e+04	-2.0e+04
	(2.8e+05)	(2.8e+05)	(2.8e+05)	(2.8e+05)	(2.8e+05)	(2.7e+05)	(2.8e+05)	(2.8e+05)	(2.8e+05)	(2.8e+05)
Export	2.4e+03***	2.4e+03***	2.4e+03***	2.4e+03***	2.4e+03***	2.2e+03***	2.4e+03***	2.4e+03***	2.4e+03***	2.4e+03***
	(352.244)	(352.278)	(352.348)	(352.159)	(351.739)	(339.801)	(352.215)	(352.224)	(352.127)	(352.180)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1771427	1771427	1771427	1771427	1771427	1771427	1771427	1771427	1771427	1771427
Number of firms	297817	297817	297817	297817	297817	297817	297817	297817	297817	297817
OLS — VIF max [mean]	2.59 [1.36]	2.22 [1.35]	2.45 [1.37]	2.55 [1.36]	2.42 [1.38]	6.35 [1.50]	2.59 [1.36]	2.59 [1.36]	2.62 [1.36]	2.64 [1.36]
OLS — Breusch–Pagan (p-value)	3.13e+08 (0.0000)	3.13e+08 (0.0000)	3.13e+08 (0.0000)	3.13e+08 (0.0000)	3.13e+08 (0.0000)	3.37e+08 (0.0000)	3.13e+08 (0.0000)	3.13e+08 (0.0000)	3.14e+08 (0.0000)	3.14e+08 (0.0000)
Log likelihood	-2.8e+07	-2.8e+07	-2.8e+07	-2.8e+07	-2.8e+07	-2.8e+07	-2.8e+07	-2.8e+07	-2.8e+07	-2.8e+07
R-squared (within)	0.0518	0.0518	0.0518	0.0518	0.0518	0.0587	0.0518	0.0518	0.0518	0.0518
F statistic (overall)	73.2024 (0.0000)	73.5778 (0.0000)	73.2681 (0.0000)	73.1273 (0.0000)	73.2730 (0.0000)	80.4616 (0.0000)	73.5488 (0.0000)	73.3029 (0.0000)	72.5181 (0.0000)	72.5181 (0.0000)
Root MSE	2.0e+06	2.0e+06	2.0e+06	2.0e+06	2.0e+06	2.0e+06	2.0e+06	2.0e+06	2.0e+06	2.0e+06
Hausman Test	85130.88 (0.0000)	85108.78 (0.0000)	85208.64 (0.0000)	85136.71 (0.0000)	85175.17 (0.0000)	79917.94 (0.0000)	85095.13 (0.0000)	85121.81 (0.0000)	85190.41 (0.0000)	85150.87 (0.0000)

Notes: Robust standard errors in parentheses. Significance levels: *, 10%; **, 5%; ***, 1%. All models considered as the dependent variable the real gross value added, at factor prices, and conducted a panel data fixed effects estimation. In Model 1 the independent variables were AVG_EDU_YEARS, PERC_STEM_TMT, TMT_EDU_IND, DIV_EDU_ YEARS_TMT and DIV_EDU_YEARS_TMT (regarding formal education), and AVG_EXPERIENCE_TMT, TMT_ SAME_INDUSTRY_EXP, DIV_EXP_YEARS_TMT, and DIV_EXP_INDUSTRY_TMT (regarding professional experience). The remaining models used the same variables with the exception of the following changes: Model 2, instead of AVG_EDU_YEARS considers PERC_DIPLOMADO_TMT; Model 3, 4 and 5, change PERC_STEM_TMT to PERC_BUSIN_TMT, TEM_STEM and TEM_BUSINESS, respectively; finally, Model 6 considers TOTAL_ INDUSTRY_EXPERIENCE instead of TMT_SAME_INDUSTRY_EXP. The final four models consider the following changes: Model 7, instead of TMT_SAME_INDUSTRY_EXP considers PERC_TMT_SAME_INDUSTRY_EXP, while Model 8, changes TMT_SAME_INDUSTRY_EXP to

MAJ_TMT_SAME_INDUSTRY_EXP; finally, Models 9 and 10 consider MAJ_TMT_EDU_IND and PERC_TMT_EDU_IND, respectively, instead of TMT_EDU_IND. The control variables remain unchanged throughout the models.
Source: Own elaboration.

Table A20: The impact of TMT's formal education and professional experience on financial performance (Fixed effects estimation, dependent variable: return on assets, when measured as net results over total assets)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
TMT's Level of Education	0.1495 (0.120)	-0.0034 (0.003)	0.1476 (0.117)	0.1463 (0.118)	0.1444 (0.116)	0.1497 (0.120)	0.1494 (0.120)	0.1495 (0.120)	0.1519 (0.120)	0.1528 (0.121)
TMT's Field of Education	-0.0016 (0.003)	0.0022 (0.002)	-0.0008 (0.003)	0.0317 (0.237)	0.3498 (0.380)	-0.0016 (0.003)	-0.0016 (0.003)	-0.0016 (0.003)	-0.0016 (0.003)	-0.0016 (0.003)
TMT's Formal Education Field of Study and Industry Match	-0.3170 (0.348)	-0.1168 (0.327)	-0.2779 (0.414)	-0.3032 (0.348)	-0.4843 (0.473)	-0.3188 (0.348)	-0.3176 (0.348)	-0.3174 (0.348)	-0.4275 (0.371)	-0.0050 (0.004)
Diversity of TMT's Field of Education	-1.0511 (0.745)	-1.0182 (0.744)	-1.0669 (0.741)	-1.0784 (0.837)	-1.1935 (0.824)	-1.0539 (0.744)	-1.0498 (0.745)	-1.0509 (0.745)	-1.1085 (0.720)	-1.1817 (0.731)
Diversity of TMT's Level of Education	-0.0434 (0.045)	-0.0494 (0.045)	-0.0433 (0.046)	-0.0430 (0.045)	-0.0410 (0.046)	-0.0430 (0.045)	-0.0434 (0.045)	-0.0434 (0.045)	-0.0423 (0.047)	-0.0419 (0.047)
TMT's Level of Experience	0.0082 (0.007)	-0.0182 (0.016)	0.0080 (0.007)	0.0081 (0.007)	0.0084 (0.007)	0.0078 (0.007)	0.0080 (0.007)	0.0081 (0.007)	0.0084 (0.007)	0.0083 (0.007)
TMT's Type of Experience (Industry)	**-0.3406*** **(0.192)**	**-0.3379*** **(0.192)**	**-0.3410*** **(0.192)**	**-0.3405*** **(0.191)**	**-0.3379*** **(0.191)**	0.0353 (0.036)	-0.0017 (0.001)	**-0.2758*** **(0.162)**	**-0.3389*** **(0.192)**	**-0.3391*** **(0.192)**
Diversity of TMT's Industry Experience	**0.2582***** **(0.097)**	**0.2582***** **(0.098)**	**0.2585***** **(0.097)**	**0.2578***** **(0.096)**	**0.2548***** **(0.096)**	0.1247 (0.132)	**0.2138**** **(0.095)**	**0.2457***** **(0.095)**	**0.2558***** **(0.096)**	**0.2568***** **(0.096)**
Diversity of TMT's Level of Experience	0.0154 (0.024)	0.0143 (0.024)	0.0154 (0.024)	0.0154 (0.024)	0.0154 (0.024)	0.0155 (0.024)	0.0154 (0.024)	0.0154 (0.024)	0.0154 (0.024)	0.0154 (0.024)
Workers Average Level of Education	-0.1285* (0.073)	-0.1172* (0.068)	-0.1283* (0.073)	-0.1282* (0.073)	-0.1281* (0.073)	-0.1280* (0.073)	-0.1284* (0.073)	-0.1284* (0.073)	-0.1287* (0.073)	-0.1287* (0.073)
Training	-0.6283 (0.629)	-0.6276 (0.629)	-0.6285 (0.629)	-0.6285 (0.629)	-0.6289 (0.629)	-0.6268 (0.628)	-0.6280 (0.629)	-0.6282 (0.629)	-0.6280 (0.629)	-0.6274 (0.629)
TMT Size	0.0002 (0.002)	-0.0014 (0.002)	0.0002 (0.002)	0.0002 (0.002)	-0.0001 (0.002)	-0.0003 (0.002)	0.0003 (0.002)	0.0003 (0.002)	-0.0004 (0.002)	-0.0002 (0.002)
Leverage	0.0018** (0.001)	0.0018** (0.001)	0.0018** (0.001)	0.0018** (0.001)	0.0018** (0.001)	0.0018** (0.001)	0.0018** (0.001)	0.0018** (0.001)	0.0018** (0.001)	0.0018** (0.001)
Presence of R&D	-0.0018 (0.058)	-0.0021 (0.058)	-0.0028 (0.057)	-0.0036 (0.058)	-0.0059 (0.057)	-0.0066 (0.064)	0.0024 (0.058)	-0.0001 (0.058)	-0.0026 (0.058)	-0.0009 (0.059)
Firm Size	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Age	-0.0040 (0.003)	-0.0029 (0.003)	-0.0041 (0.003)	-0.0040 (0.003)	-0.0039 (0.003)	-0.0038 (0.003)	-0.0040 (0.003)	-0.0040 (0.003)	-0.0040 (0.003)	-0.0040 (0.003)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Multinational	-0.1452 (0.246)	-0.1543 (0.244)	-0.1451 (0.246)	-0.1453 (0.246)	-0.1469 (0.246)	-0.1522 (0.247)	-0.1406 (0.246)	-0.1440 (0.246)	-0.1457 (0.246)	-0.1458 (0.246)
Export	0.0066* (0.004)	0.0066* (0.004)	0.0066* (0.004)	0.0066* (0.004)	0.0066* (0.004)	0.0066* (0.004)	0.0066* (0.004)	0.0066* (0.004)	0.0066* (0.004)	0.0066* (0.004)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1770984	1770984	1770984	1770984	1770984	1770984	1770984	1770984	1770984	1770984
Number of firms	297711	297711	297711	297711	297711	297711	297711	297711	297711	297711
OLS — VIF max [mean]	2.59 [1.36]	2.22 [1.35]	2.45 [1.37]	2.55 [1.36]	2.42 [1.38]	6.35 [1.50]	2.59 [1.36]	2.59 [1.36]	2.62 [1.36]	2.64 [1.36]
OLS — Breusch–Pagan (p-value)	4.73e+06 (0.0000)	4.31e+06 (0.0000)	4.75e+06 (0.0000)	4.73e+06 (0.0000)	4.74e+06 (0.0000)	4.76e+06 (0.0000)	4.73e+06 (0.0000)	4.73e+06 (0.0000)	4.73e+06 (0.0000)	4.72e+06 (0.0000)
Log likelihood	-9.5e+06	-9.5e+06	-9.5e+06	-9.5e+06	-9.5e+06	-9.5e+06	-9.5e+06	-9.5e+06	-9.5e+06	-9.5e+06
R-squared (within)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
F statistic (overall)	2.4629 (0.0000)	2.5920 (0.0000)	2.4918 (0.0000)	2.4399 (0.0000)	2.4657 (0.0000)	2.4160 (0.0000)	2.4458 (0.0000)	2.4648 (0.0000)	2.4550 (0.0000)	2.4739 (0.0000)
Root MSE	50.4576	50.4578	50.4576	50.4576	50.4576	50.4577	50.4577	50.4577	50.4576	50.4576
Hausman Test	51.20 (0.9237)	52.55 (0.9018)	50.99 (0.9269)	51.05 (0.9259)	51.34 (0.9217)	50.49 (0.9339)	50.24 (0.9250)	51.01 (0.9266)	51.41 (0.9207)	51.55 (0.9186)

Notes: Robust standard errors in parentheses. Significance levels: *, 10%; **, 5%; ***, 1%. All models considered as the dependent variable the return on assets, when measured as net results over total assets, and conducted a panel data fixed effects estimation. In Model 1 the independent variables were AVG_EDU_YEARS, PERC_STEM_TMT, TMT_EDU_IND, DIV_EDU_YEARS_TMT and DIV_EDU_YEARS_TMT (regarding formal education), and AVG_ EXPERIENCE_TMT, TMT_SAME_INDUSTRY_EXP, DIV_EXP_YEARS_TMT, and DIV_EXP_INDUSTRY_ TMT (regarding professional experience). The remaining models used the same variables with the exception of the following changes: Model 2, instead of AVG_EDU_YEARS considers PERC_DIPLOMADO_TMT; Model 3, 4 and 5, change PERC_STEM_TMT to PERC_BUSIN_TMT, TEM_STEM and

TEM_BUSINESS, respectively; finally, Model 6 considers TOTAL_INDUSTRY_EXPERIENCE instead of TMT_SAME_INDUSTRY_EXP. The final four models consider the following changes: Model 7, instead of TMT_SAME_INDUSTRY_EXP considers PERC_TMT_SAME_ INDUSTRY_EXP, while Model 8, changes TMT_SAME_INDUSTRY_EXP to MAJ_TMT_SAME_INDUSTRY_EXP; finally, Models 9 and 10 consider MAJ_TMT_EDU_IND and PERC_TMT_EDU_IND, respectively, instead of TMT_ EDU_IND. The control variables remain unchanged throughout the models.
Source: Own elaboration.

Table A21: The impact of TMT's formal education and professional experience on financial performance (Fixed effects estimation, dependent variable: return on assets, when measured as EBIT over total assets)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
TMT's Level of Education	0.1467 (0.118)	-0.0029 (0.003)	0.1446 (0.115)	0.1439 (0.116)	0.1417 (0.114)	0.1469 (0.118)	0.1466 (0.118)	0.1467 (0.118)	0.1489 (0.118)	0.1496 (0.119)
TMT's Field of Education	-0.0016 (0.003)	0.0019 (0.002)	-0.0007 (0.003)	0.0029 (0.212)	0.3260 (0.371)	-0.0016 (0.003)	-0.0016 (0.003)	-0.0016 (0.003)	-0.0016 (0.003)	-0.0017 (0.003)
TMT's Formal Education Field of Study and Industry Match	-0.3385 (0.338)	-0.1521 (0.309)	-0.3037 (0.405)	-0.3279 (0.335)	-0.4936 (0.471)	-0.3404 (0.338)	-0.3392 (0.338)	-0.3389 (0.338)	-0.4358 (0.368)	-0.0050 (0.003)
Diversity of TMT's Field of Education	-0.9100 (0.615)	-0.8780 (0.613)	-0.9250 (0.611)	-0.9214 (0.689)	-1.0436 (0.690)	-0.9134 (0.615)	-0.9087 (0.615)	-0.9098 (0.615)	-0.9754 (0.603)	-1.0502* (0.621)
Diversity of TMT's Level of Education	-0.0368 (0.040)	-0.0425 (0.040)	-0.0367 (0.041)	-0.0366 (0.040)	-0.0345 (0.041)	-0.0364 (0.040)	-0.0368 (0.040)	-0.0368 (0.040)	-0.0356 (0.041)	-0.0351 (0.042)
TMT's Level of Experience	0.0076 (0.006)	-0.0179 (0.016)	0.0074 (0.006)	0.0074 (0.006)	0.0077 (0.006)	0.0071 (0.006)	0.0073 (0.006)	0.0075 (0.006)	0.0077 (0.006)	0.0076 (0.006)
TMT's Type of Experience (Industry)	-0.3331* (0.189)	-0.3302* (0.189)	-0.3334* (0.189)	-0.3330* (0.189)	-0.3305* (0.189)	0.0381 (0.035)	-0.0017 (0.001)	-0.2699* (0.160)	-0.3314* (0.189)	-0.3317* (0.189)
Diversity of TMT's Industry Experience	0.2432*** (0.090)	0.2427*** (0.091)	0.2434*** (0.090)	0.2430*** (0.090)	0.2400*** (0.089)	0.1037 (0.121)	0.1998** (0.089)	0.2311*** (0.089)	0.2408*** (0.090)	0.2419*** (0.090)
Diversity of TMT's Level of Experience	0.0113 (0.020)	0.0102 (0.020)	0.0113 (0.020)	0.0113 (0.020)	0.0112 (0.020)	0.0113 (0.020)	0.0113 (0.020)	0.0113 (0.020)	0.0113 (0.020)	0.0112 (0.020)
Workers Average Level of Education	-0.1250* (0.072)	-0.1140* (0.067)	-0.1248* (0.072)	-0.1248* (0.072)	-0.1246* (0.072)	-0.1246* (0.072)	-0.1249* (0.072)	-0.1250* (0.072)	-0.1252* (0.072)	-0.1252* (0.072)
Training	-0.6287 (0.629)	-0.6279 (0.629)	-0.6288 (0.629)	-0.6288 (0.629)	-0.6292 (0.629)	-0.6272 (0.628)	-0.6284 (0.629)	-0.6286 (0.629)	-0.6284 (0.629)	-0.6278 (0.629)
TMT Size	0.0002 (0.002)	-0.0013 (0.002)	0.0002 (0.002)	0.0002 (0.002)	-0.0001 (0.002)	-0.0003 (0.002)	0.0003 (0.002)	0.0002 (0.002)	-0.0005 (0.002)	-0.0003 (0.002)
Leverage	0.0018** (0.001)	0.0018** (0.001)	0.0018** (0.001)	0.0018** (0.001)	0.0018** (0.001)	0.0018** (0.001)	0.0018** (0.001)	0.0018** (0.001)	0.0018** (0.001)	0.0018** (0.001)
Presence of R&D	-0.0048 (0.058)	-0.0055 (0.058)	-0.0058 (0.057)	-0.0061 (0.058)	-0.0087 (0.057)	-0.0102 (0.064)	-0.0007 (0.058)	-0.0032 (0.058)	-0.0056 (0.058)	-0.0039 (0.059)
Firm Size	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Age	-0.0038 (0.003)	-0.0028 (0.003)	-0.0039 (0.003)	-0.0039 (0.003)	-0.0038 (0.003)	-0.0036 (0.003)	-0.0039 (0.003)	-0.0039 (0.003)	-0.0038 (0.003)	-0.0039 (0.003)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Multinational	-0.1367 (0.238)	-0.1463 (0.237)	-0.1366 (0.238)	-0.1368 (0.238)	-0.1383 (0.238)	-0.1445 (0.240)	-0.1321 (0.238)	-0.1355 (0.238)	-0.1372 (0.238)	-0.1372 (0.238)
Export	0.0066* (0.004)	0.0066* (0.004)	0.0066* (0.004)	0.0066* (0.004)	0.0066* (0.004)	0.0066* (0.004)	0.0066* (0.004)	0.0066* (0.004)	0.0066* (0.004)	0.0066* (0.004)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1770984	1770984	1770984	1770984	1770984	1770984	1770984	1770984	1770984	1770984
Number of firms	297711	297711	297711	297711	297711	297711	297711	297711	297711	297711
OLS – VIF max [mean]	2.59 [1.36]	2.22 [1.35]	2.45 [1.37]	2.55 [1.36]	2.42 [1.38]	6.35 [1.50]	2.59 [1.36]	2.59 [1.36]	2.62 [1.36]	2.64 [1.36]
OLS – Breusch–Pagan (p-value)	4.77e+06 (0.0000)	4.34e+06 (0.0000)	4.80e+06 (0.0000)	4.78e+06 (0.0000)	4.79e+06 (0.0000)	4.81e+06 (0.0000)	4.78e+06 (0.0000)	4.78e+06 (0.0000)	4.77e+06 (0.0000)	4.77e+06 (0.0000)
Log likelihood	-9.4e+06	-9.4e+06	-9.4e+06	-9.4e+06	-9.4e+06	-9.4e+06	-9.4e+06	-9.4e+06	-9.4e+06	-9.4e+06
R-squared (within)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
F statistic (overall)	2.4707 (0.0000)	2.6001 (0.0000)	2.5005 (0.0000)	2.4466 (0.0000)	2.4784 (0.0000)	2.4345 (0.0000)	2.4568 (0.0000)	2.4723 (0.0000)	2.4569 (0.0000)	2.4825 (0.0000)
Root MSE	49.5186	49.5187	49.5186	49.5186	49.5186	49.5186	49.5186	49.5186	49.5186	49.5186
Hausman Test	51.57 (0.9182)	52.75 (0.8984)	51.37 (0.9213)	51.44 (0.9201)	51.70 (0.9161)	50.84 (0.9289)	50.57 (0.9201)	51.38 (0.9212)	51.73 (0.9156)	51.85 (0.9138)

Notes: Robust standard errors in parentheses. Significance levels: *, 10%; **, 5%; ***, 1%. All models considered as the dependent variable the return on assets, when measured as EBIT over total assets, and conducted a panel data fixed effects estimation. In Model 1 the independent variables were AVG_EDU_YEARS, PERC_STEM_TMT, TMT_ EDU_IND, DIV_EDU_YEARS_TMT and DIV_EDU_YEARS_TMT (regarding formal education), and AVG_ EXPERIENCE_TMT, TMT_SAME_INDUSTRY_EXP, DIV_EXP_YEARS_TMT, and DIV_EXP_INDUSTRY_ TMT (regarding professional experience). The remaining models used the same variables with the exception of the following changes: Model 2, instead of AVG_EDU_YEARS considers PERC_DIPLOMADO_TMT; Model 3, 4 and 5, change PERC_STEM_TMT to PERC_BUSIN_TMT, TEM_STEM and

TEM_BUSINESS, respectively; finally, Model 6 considers TOTAL_INDUSTRY_EXPERIENCE instead of TMT_SAME_INDUSTRY_EXP. The final four models consider the following changes: Model 7, instead of TMT_SAME_INDUSTRY_EXP considers PERC_TMT_SAME_ INDUSTRY_EXP, while Model 8, changes TMT_SAME_INDUSTRY_EXP to MAJ_TMT_SAME_INDUSTRY_EXP; finally, Models 9 and 10 consider MAJ_TMT_EDU_IND and PERC_TMT_EDU_IND, respectively, instead of TMT_ EDU_IND. The control variables remain unchanged throughout the models.
Source: Own elaboration.

Table A22: The impact of TMT's formal education and professional experience on financial performance (Fixed effects estimation, dependent variable: return on equity)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
TMT's Level of Education	-0.3826	-0.0390	0.0116	-0.3172	-0.1242	-0.3791	-0.3834	-0.3817	-0.4041	-0.4360
	(0.374)	(0.046)	(0.119)	(0.329)	(0.152)	(0.370)	(0.375)	(0.374)	(0.391)	(0.410)
TMT's Field of Education	0.1260	0.1343	-0.1847	8.6934	-5.9994	0.1261	0.1260	0.1260	0.1277	0.1295
	(0.121)	(0.132)	(0.185)	(9.330)	(7.057)	(0.121)	(0.121)	(0.121)	(0.123)	(0.124)
TMT's Formal Education Field of Study and Industry Match	-1.9162	-1.3676	3.7868	-1.7022	0.3214	-1.9260	-1.9230	-1.9112	-0.4868	0.0144
	(1.646)	(1.139)	(4.369)	(1.368)	(1.958)	(1.655)	(1.653)	(1.646)	(0.483)	(0.011)
Diversity of TMT's Field of Education	12.5134	12.4614	11.9192	8.4582	15.5670	12.4457	12.5302	12.4938	11.7554	11.6300
	(11.197)	(11.153)	(10.618)	(6.995)	(14.346)	(11.131)	(11.217)	(11.195)	(10.558)	(10.464)
Diversity of TMT's Level of Education	-0.2109	-0.2079	-0.2402	-0.1593	-0.2674	-0.2060	-0.2106	-0.2108	-0.1981	-0.1944
	(0.406)	(0.407)	(0.431)	(0.358)	(0.463)	(0.403)	(0.406)	(0.406)	(0.399)	(0.397)
TMT's Level of Experience	-0.0578	-0.0354*	-0.0588	-0.0542	-0.0527	-0.0583	-0.0602	-0.0553	-0.0582	-0.0591
	(0.037)	(0.019)	(0.037)	(0.035)	(0.033)	(0.037)	(0.038)	(0.035)	(0.037)	(0.037)
TMT's Type of Experience (Industry)	-1.0115	-1.0437	-1.0994	-0.9888	-1.0623	0.4493	0.0065	-2.6155	-1.0165	-1.0285
	(1.237)	(1.266)	(1.310)	(1.217)	(1.284)	(0.463)	(0.016)	(2.100)	(1.241)	(1.247)
Diversity of TMT's Industry Experience	0.7613	0.8158	0.8715	0.7220	0.8316	-0.5135	0.6353	0.9266	0.7597	0.7674
	(0.518)	(0.569)	(0.612)	(0.482)	(0.580)	(0.910)	(0.405)	(0.569)	(0.517)	(0.521)
Diversity of TMT's Level of Experience	-0.0302	-0.0270	-0.0346	-0.0316	-0.0301	-0.0299	-0.0299	-0.0305	-0.0305	-0.0305
	(0.043)	(0.043)	(0.042)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)
Workers Average Level of Education	-0.0600	-0.0831	-0.0945	-0.0651	-0.0828	-0.0588	-0.0572	-0.0626	-0.0586	-0.0566
	(0.088)	(0.101)	(0.112)	(0.089)	(0.103)	(0.087)	(0.085)	(0.086)	(0.087)	(0.086)
Training	-0.6098	-0.6165	-0.6023	-0.5998	-0.5916	-0.6034	-0.6023	-0.6172	-0.6125	-0.6181
	(0.546)	(0.545)	(0.547)	(0.547)	(0.548)	(0.546)	(0.547)	(0.546)	(0.545)	(0.545)
TMT Size	0.0694	0.0679	0.0502	0.0525	0.0751	0.0626	0.0696	0.0692	0.0671	0.0679
	(0.067)	(0.065)	(0.048)	(0.049)	(0.073)	(0.060)	(0.067)	(0.067)	(0.065)	(0.066)
Leverage	-0.2613	-0.2613	-0.2614	-0.2614	-0.2614	-0.2613	-0.2613	-0.2614	-0.2613	-0.2613
	(0.161)	(0.161)	(0.161)	(0.161)	(0.161)	(0.161)	(0.161)	(0.161)	(0.161)	(0.161)
Presence of R&D	-0.7481*	-0.7091*	-0.6001*	-0.8090	-0.6003*	-0.8394	-0.7426*	-0.7528*	-0.7475*	-0.7475*
	(0.442)	(0.410)	(0.341)	(0.502)	(0.341)	(0.520)	(0.438)	(0.440)	(0.441)	(0.441)
Firm Size	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Age	0.2231	0.2242	0.2241	0.2271	0.2251	0.2261	0.2231	0.2232	0.2230	0.2230
	(0.261)	(0.263)	(0.262)	(0.265)	(0.263)	(0.264)	(0.262)	(0.261)	(0.261)	(0.261)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Multinational	-0.4743	-0.3814	-0.4181	-0.4731	-0.4423	-0.5901	-0.4729	-0.4808	-0.4688	-0.4618
	(1.035)	(0.953)	(0.989)	(1.035)	(1.004)	(1.130)	(1.039)	(1.031)	(1.032)	(1.028)
Export	0.0694	0.0695	0.0699	0.0693	0.0697	0.0693	0.0694	0.0694	0.0694	0.0695
	(0.062)	(0.062)	(0.062)	(0.062)	(0.062)	(0.062)	(0.062)	(0.062)	(0.062)	(0.062)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1771427	1771427	1771427	1771427	1771427	1771427	1771427	1771427	1771427	1771427
Number of firms	297817	297817	297817	297817	297817	297817	297817	297817	297817	297817
OLS – VIF max [mean]	2.59 [1.36]	2.22 [1.35]	2.45 [1.37]	2.55 [1.36]	2.42 [1.38]	6.35 [1.50]	2.59 [1.36]	2.59 [1.36]	2.62 [1.36]	2.64 [1.36]
OLS – Breusch–Pagan (p-value)	9.91e+07 (0.0000)	9.90e+07 (0.0000)	1.01e+08 (0.0000)	9.91e+07 (0.0000)	1.00e+08 (0.0000)	9.90e+07 (0.0000)	9.90e+07 (0.0000)	9.91e+07 (0.0000)	9.91e+07 (0.0000)	9.92e+07 (0.0000)
Log likelihood	-1.2e+07	-1.2e+07	-1.2e+07	-1.2e+07	-1.2e+07	-1.2e+07	-1.2e+07	-1.2e+07	-1.2e+07	-1.2e+07
R-squared (within)	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
F statistic (overall)	1.9331 (0.0000)	1.9448 (0.0000)	2.0208 (0.0000)	1.9080 (0.0000)	1.9781 (0.0000)	1.9178 (0.0000)	1.9444 (0.0000)	1.9714 (0.0000)	1.9299 (0.0000)	1.9448 (0.0000)
Root MSE	254.2325	254.2324	254.2311	254.2329	254.2338	254.2325	254.2325	254.2324	254.2326	254.2326
Hausman Test	424.04 (0.0000)	426.64 (0.0000)	424.84 (0.0000)	418.81 (0.0000)	405.70 (0.0000)	424.18 (0.0000)	424.04 (0.0000)	424.57 (0.0000)	422.93 (0.0000)	422.43 (0.0000)

Notes: Robust standard errors in parentheses. Significance levels: *, 10%; **, 5%; ***, 1%. All models considered as the dependent variable the return on equity, and conducted a panel data fixed effects estimation. In Model 1 the independent variables were AVG_EDU_YEARS, PERC_STEM_TMT, TMT_EDU_IND, DIV_EDU_YEARS_TMT and DIV_EDU_YEARS_TMT (regarding formal education), and AVG_EXPERIENCE_TMT, TMT_SAME_INDUSTRY_EXP, DIV_EXP_YEARS_TMT, and DIV_EXP_ INDUSTRY_TMT (regarding professional experience). The remaining models used the same variables with the exception of the following changes: Model 2, instead of AVG_EDU_ YEARS considers PERC_DIPLOMADO_TMT; Model 3, 4 and 5, change PERC_STEM_TMT to PERC_BUSIN_ TMT, TEM_STEM and TEM_BUSINESS, respectively; finally, model 6 considers TOTAL_INDUSTRY_ EXPERIENCE instead of TMT_SAME_INDUSTRY_EXP. The final four models consider the following changes: Model 7, instead of TMT_SAME_INDUSTRY_EXP considers PERC_TMT_SAME_INDUSTRY_EXP, while Model 8, changes TMT_SAME_INDUSTRY_EXP to MAJ_TMT_SAME_INDUSTRY_

EXP; finally, Models 9 and 10 consider MAJ_ TMT_EDU_IND and PERC_TMT_EDU_IND, respectively, instead of TMT_EDU_IND. The control variables remain unchanged throughout the models.
Source: Own elaboration.