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How absorptive capacity enables new entrepreneurial ventures of high added value

Ioanna Kastelli^{1,2}, Georgios Siokas², Aggelos Tsakanikas²

ABSTRACT

Absorptive capacity as a set of organizational capabilities in the context of established firms has been heavily explored in the relevant literature. But when it comes to the business formation phase and especially to the creation of knowledge intensive entrepreneurial ventures, knowledge inheritance of new firms seems to be more related to individual attributes. Knowledge intensive entrepreneurship is very much dependent on founders' capability to understand new knowledge, combine their knowledge with external knowledge sources and exploit it in the context of opportunities they can recognize, namely the founders' absorptive capacity. This study gives new insights into the concept of absorptive capacity by studying it at the individual level enhancing the way of measuring it. At policy level this analysis reveals the importance of micro-determinants in fostering knowledge intensive entrepreneurial activities. Based on quantitative data from a large-scale survey, we conducted partial least squares structural equation modelling (PLS-SEM) verifying the role of the founding team characteristics and antecedents of absorptive capacity in triggering knowledge intensive entrepreneurship. Furthermore, the results imply a weaker but positive indirect effect of absorptive capacity to new ventures performance. There is also a statistically significant negative influence of the competition intensity and a positive influence of equity funding on the formation of knowledge intensive entrepreneurship.

Keywords: Absorptive Capacity; Knowledge intensive Entrepreneurship; Founding team; New Venture Performance

1 Introduction

Recent literature provides insights into the type of entrepreneurship having a positive impact on economic growth and social development, giving various definitions namely high potential entrepreneurship, dynamic entrepreneurship, knowledge intensive entrepreneurship (Audretsch et al. 2016; Audretsch and Keilbach 2007; Autio 2003; Hirsch-Kreinsen and Schwinge 2014; Franco Malerba and McKelvey 2016, 2019, 2020). Definitions vary but the basic attributes relate to a schumpeterian view of entrepreneurship and economic growth, emphasizing the decisive role of: i) entrepreneurial business formation (either resulting as spin-offs from other organisations or new start-ups) in shaping technological development and progress, ii) processes of knowledge generation and diffusion standing behind innovation, as main drivers of firm's competitive advantage, iii) the interactive processes in perceiving, assessing opportunities and transforming new ideas into practice.

In this paper, we adopt the definition of Malerba and McKelvey (2020, p. 508) for knowledge intensive entrepreneurship (KIE) occurring from "...a process of learning and problem-solving engaged by the entrepreneur (founder or founding team) and aiming to benefit from opportunity identification, creation and exploitation". Following this view, knowledge intensive firms are new ventures, innovative, having significant knowledge intensity in their activity, being embedded in innovation systems, and exploiting innovative opportunities in diverse evolving sectors and contexts (ibid). In this context, interactions play a significant role both at the level of knowledge creation and the level of knowledge transformation into

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innovative products, processes or services. Different types of actors are directly or indirectly involved either before the establishment of the KIE venture and/or during its development. From the ideation phase and opportunity recognition through the entrepreneurial life cycle to the successful commercialization there are learning mechanisms that result in transformation at different ontological levels: the individual, the group, the firm or the sector (Malerba and McKelvey 2020; Nonaka and Takeuchi 1995). Keeping that as a starting point, we argue that when it comes to the formation phase of KIE ventures, firm's resource attributes are not yet developed or not related to the organisation, and new firms do not have well-established routines. In this context, we argue that absorptive capability at an individual level, the founders' absorptive capability, becomes a precondition for access to and exploitation of external sources of knowledge and can be considered a critical element in the successful transformation of knowledge into viable new solutions, enabling the formation of KIE ventures.

In this paper, we study newly established firms in terms of their knowledge intensity, considering the founders' capabilities with specific emphasis on their absorptive capacity. In addition, we try to link firm's knowledge intensity with some early phase firm characteristics and the characteristics of the business environment in which those firms operate. We explore a) the influence of absorptive capacity on the type of newly established firms (whether they are knowledge intensive or non-knowledge intensive) and b) its impact on the business performance of those firms (sales, exports). We use data from AEGIS - a large-scale survey of 3804 newly established (in the 2000s) entrepreneurial ventures in nine European countries, namely the Czech Republic, Denmark, France, Germany, Greece, Italy, Portugal, Sweden, and the UK. This is the first collection of in-depth empirical data to identify typologies of newly established, knowledge intensive firms. The survey sample includes firms from different sectors. We constructed a set of variables for catching the effect of i) absorptive capacity as a founders' attribute, measuring it by their prior knowledge, and developed experiential skills, ii) early-stage firm characteristics and iii) the competition intensity, on the type of business created and the performance of these new firms. The new set of variables is analysed using an advanced statistical method, the Structural Equation Modelling – Partial Least Square (SEM-PLS). This method is suitable for the research questions and the nature of our data.

Our empirical results confirm that there is a positive relation between specific founders' characteristics representing their absorptive capacity and knowledge intensive entrepreneurship and its performance. There is also a significant negative influence of the competition intensity and a positive influence of specific early phase firm characteristics on the formation of knowledge intensive entrepreneurship (KIE).

The paper aims to give new insights into the concept of absorptive capacity in the context of the formation phase of KIE venture creation. Its contribution is threefold: a) it studies absorptive capacity conceptualised in the context of the formation phase of KIE ventures, extending the definition of absorptive capacity at the individual level and taking into consideration the founders' contribution, b) it opens the black box of founders' absorptive capacity, studying and measuring its antecedents and c) it gives insights into KIE performance and the effect of absorptive capacity of founders on business performance.

The remainder of the paper is organised as follows. The next section elaborates on the concept of absorptive capacity in the formation phase of knowledge intensive firms. The second section relates the formation of knowledge intensive firms to some early phase firm characteristics. The third section refers to the role of the business environment on the KIE formation process. The fourth section discusses specific aspects of knowledge intensive entrepreneurship in terms of their expected performance. The following two sections present the methodology and empirical results. The last section discusses the results and points to specific types of action that could boost activities of high added value.

1.1 Absorptive capacity and the formation of knowledge intensive entrepreneurial ventures

KIE new ventures occur within innovation systems, responding to opportunities which differ according to market conditions and sectoral systems' characteristics. Fundamental to the creation and growth of KIE is the successful exploitation of knowledge generated either by the founders or by third parties, and its transformation to innovation. Founders or founding teams develop their knowledge and the resources they commit to the new venture, to exploit opportunities, build upon existing knowledge and develop their venture leveraging their market and technological knowledge through learning and interacting with various actors of the innovation system (Caiazza et al. 2020; Malerba and McKelvey 2016, 2019, 2020; Amorós et al., 2019; Caiazza et al., 2015).

In such an interactive context, a critical element in fostering entrepreneurial activity is the capability to recognize the value of knowledge, assimilate it and transform it to respond to a commercial end. Since Cohen's and Levinthal's seminal work (1990), this capability has been defined as the *absorptive capacity*, conceptualised in the context of established firms. A number of colleagues have elaborated on its definition and many theoretical considerations as well as empirical studies have converged to the conclusion that absorptive capacity is a complex construct consisting of a set of discrete organisational routines and processes. They also present empirical evidence for the role of prior knowledge and intensity of efforts or commitment in problem solving and of interaction with external sources of knowledge in improving the effectiveness of learning and innovative processes (Avila, 2021; Caloghirou et al. 2004; Carayannis et al., 2006; Cockburn and Henderson 1998; Eisenhardt and Martin 2000; Jiménez-Barrionuevo et al. 2011; Kastelli et al. 2004; Lane et al. 2001; Lane and Lubatkin 1998; Laursen and Salter 2006; Makri et al. 2006; Mowery et al. 1996; Proeger, 2020; Zahra and George 2002). The capability of a firm to absorb knowledge and information from external sources is one of the pillars in the process of transformation of knowledge and information into new knowledge and its conversion into new value.

Nevertheless, when it comes to the process of formation of knowledge intensive entrepreneurial ventures, it is important to understand how knowledge contributes to knowledge-based entrepreneurial activity. Knowledge does not necessarily lead to knowledge intensive entrepreneurial activity. Qian and Acs (2013), introduced the notion of entrepreneurial absorptive capacity, conceptualised at the individual level. They defined it as the “ability of an entrepreneur to understand new knowledge, recognize its value, and subsequently commercialize it by creating a firm” (ibid, p. 191). They also linked entrepreneurial absorptive capacity to the ability to start a new business to exploit knowledge. In their study they measured indirectly entrepreneurial absorptive capacity using the direct effect of human capital on entrepreneurship. Their paper suggested future directions for research on the direct effect of entrepreneurial absorptive capacity on entrepreneurship and on measuring it at the individual level.

To empirically investigate the role of absorptive capacity on the creation of knowledge intensive entrepreneurial ventures, this paper tries to open the ‘black box’ of absorptive capacity and study its effect on knowledge intensive entrepreneurship by looking at the individual level of the founders with specific emphasis on its constituent elements. We assume that in the early phase of startup formation absorptive capacity is very much dependent on the founders’ prior knowledge, experiential skills and interactive involvement. There is relevant research studying the role of founders either in the context of established firms or during their first years of operation. Enkel et al. (2017) have examined the role of individuals in the absorption of external knowledge for innovating, linking the different dimensions of absorptive capacity to different types of innovation (exploratory or exploitative) in the context of an established firm. In the context of new venture creation the literature relates founders’ knowledge and capabilities, their experience from their previous professional career path and their knowledge of the market where they are launching their business to the success of entrepreneurial venturing and the ability to detect innovative opportunities (Reagans et al. 2005; Shane 2000). Larrañeta et al. (2017) have studied the efforts to develop the distinct dimensions of absorptive capacity, namely potential and realised, as an organisational construct that new ventures need to build during the first years of their operation. Their results distinguish implications for the development of absorptive capacity and its consequences on performance according to the origins of the new venture, whether being independent ventures or company spin offs. However, it is important to study absorptive capacity in the new venture’s formation phase.

It is important to notice that opportunities (either resulting from market needs or technological advances) meet the prior knowledge and experience of entrepreneurs to end up with a successful entrepreneurial venture. At the formation phase, management is mainly enacted by the founding team before being replaced by organizational routines (Kogut and Zander 2009).

The founders’ human capital has been usually proxied in similar empirical studies with educational background and past occupational activities. Formal education and pre-existing knowledge determine to some extent the seizing of new opportunities leveraged by its combination with external knowledge (Alvarez and Busenitz 2001; Colombo and Grilli 2005; Helfat and Lieberman 2002). The former is related to the generic human capital of the founders whereas previous professional experience is more specific and relates either to industry specific or to functions’ specific knowledge (Colombo and Grilli 2005). Highly educated and technically qualified people are more receptive to assimilating and transforming external knowledge (Lund Vinding 2006).

Absorptive capacity has also to be related to limits to cognition, as it is domain-limited and shaped by experience (Loasby 2006; Loasby 2005). If external sources of knowledge supplement our own limited cognitive abilities, new knowledge to be created depends on the connection between what is accessed and what is already possessed by the founders.

Additionally, previous experience from similar activities may enhance the interpretive skill of entrepreneurs vis-à-vis business opportunities and thus result to higher value-added ventures. In the case of KIE the founders build on their previous experience and knowledge of the market where KIE operates, and of specific functions implemented during their professional career. Furthermore, design capability appears to empower creative and innovative processes through interaction and learning from users, identification of problems, development of new concepts and implementation of new or enhanced services and products (Carlgren, Elmquist, et al. 2016; Carlgren, Rauth, et al. 2016; Roth et al. 2020).

As KIE is characterized by higher knowledge complexity, accessibility on various channels of information, feedback from external actors and provision of critical resources may prove very supportive and nurturing to the new entrepreneurial idea or venture (Birley, 1985; Greene & Brown, 1997; Uzzi, 1999). These experiential specific skills can prove beneficial for bringing new products successfully to the market. Accumulated experience and social capital of founders might be of greater importance in the formation phase because KIE might involve higher risk and thus might find difficulties in funding that could be overcome more or less due to trust built over the years and using community-based or other professional relationships over the years of their professional career.

The above can be considered as the most significant elements of what is usually conceptually captured under the term of absorptive capacity. It is important to analyse the specific effects of the antecedents of absorptive capacity and not the latter as an abstract concept. Hence, regarding founders' absorptive capacity we can assume the following hypotheses to be tested:

H1: Founders' educational attainment is an important attribute and enabler in the formation of KIE

H2: Experiential skills as determined by the previous work experience in the same field of activity, knowledge of the market, design and networking capability and technical and managerial expertise will positively determine the launch of a knowledge intensive entrepreneurial venture.

1.2 At the roots of the firm's foundation

During the process of KIE ventures formation, apart from the founders' attributes, there are some other dimensions that interplay and shape the opportunities for KIE development and its performance (Franco Malerba and McKelvey 2020). These early phase characteristics relate to the origins of KIE ventures, the funding mechanisms and the linkages developed with other actors of the innovation system.

Usually organisational and managerial processes are not yet fully operational (although probably designed), and any evolutionary path might be linked to the new venture's antecedent in case of existence of a parent organisation. A start up might be a spin off or a spin out. For both cases, the new venture represents a change in the configuration of existing resources and in the process through which knowledge and capabilities are acquired and accumulated. Accordingly, in both cases evolutionary paths might affect the way this new entrepreneurial activity will cope with uncertainty, with the business environment and with radical changes.

As it has been pointed out by a number of scholars (Boccardelli & Magnusson, 2006; Hill & Levenhagen, 1995; Nicholls-Nixon et al., 2000) strategic experimentation, improvisation and flexibility instead of rigidity could prove beneficial for entities entering a new environment and being more efficient in exploratory learning. This view of the firm formation process could be more apparent to spin offs or ventures that are not linked to a parent organisation because of two main reasons: a) they are less or not at all dominated of the 'designed-precedes-execution' view of management in established companies - especially big ones and b) in the case of an academic spin off the founding team is more open to research and experimentation.

In the literature there are conflicting views on the attractiveness of high-tech innovative firms to different forms of financing. The general assumption in entrepreneurial finance is that higher risk unambiguously means equity funding.

In the same vein we can suggest that KIE firms, as embedding more advanced and sophisticated knowledge and knowledge utilization, are more high risk (Audretsch and Lehmann 2004) although some other authors (Cowling et al. 2005) argue that they are more likely to survive than the generality of new firms in a rapidly changing environment. Investors could also expect higher levels of return investing in ventures using higher quality technologies, which is considered a signal of future profits. Furthermore, business advice or management support provided in the context of equity funding can be considered as a complementary asset to founders' skills that increases the new firm's capability to survive and grow. Although the relationship between funding mechanisms and KIE is quite complex, KIE firms might be more attractive to venture capitalists or business angels.

Another characteristic of the formation phase is the type of their main client. Whether it is a consumer or another business or public organization, this may determine the nature of entrepreneurship and the level of knowledge intensity. The knowledge base of a company is directly related to the set of problems it faces and solutions it provides to its clients (López-Ortega et al. 2016). Thus, public organisations as clients (B2G) trigger innovation by placing an order for a product or a service that does not exist (Edquist and Zabala-Iturriagoitia 2012). In the same vein, newly established firms focusing to companies target group (B2B) may address more sophisticated needs, requirements, and problems to tackle with. Hence, we formulate the following hypothesis:

***H3:** Early phase characteristics affect the knowledge intensity of the new venture and more specifically new ventures a) coming from a university parent organisation or not related to a parent organisation, b) being funded by venture capital and/or c) responding to the demand of public or private organisations, are more likely to be knowledge intensive.*

1.3 The business environment

Firms are increasingly confronted with transformation pressure due to technological change, deregulation, and the entrance of new competitors at the global level. Organisations with capabilities to adapt to change and innovate are more likely to survive and grow (Geroski 1995; Lundvall and Nielsen 1999). The more is the transformation pressure that the firms are confronted with and the greater is the number of competitors, the more the firms innovate in order to survive (Lundvall and Nielsen 1999; Audretsch et al., 2006).

Hence, when it comes to new ventures, the relationship with competition and uncertainty is not straightforward. Several authors argue that the development of startups occurs in highly competitive environments. More specifically, it is argued that competition is an important factor in the decision of entrepreneurial venturing. Whether expressed on the basis of price or more sophisticated quality characteristics, it is expected that the higher the competition intensity the more the new ventures need to reveal unique and high potential characteristics in order to react to a more restricted range of opportunities and enter a field with important rivalry and they also exploit knowledge generated by incumbent firms (Ensley et al. 2002; Audretsch et al., 2006; Acs et al., 2009).

However, in more turbulent and changing environments firms are more difficult to enter, especially where barriers are high due to already important investments in knowledge. Furthermore, it has been buttressed that higher appropriation possibilities (and less competition) create better opportunities for high returns for a specific period before competition catches up (Lumpkin and Dess, 2001; Casson, 2003; Rothaermel et al., 2007, Mowery et al., 2001).

Plummer and Acs (2014) combined two elements in their research: i) one that relates to the supply side suggesting that rivalry results to knowledge investment that increases the amount of knowledge and the likelihood for knowledge-driven entrepreneurship, ii) second that a greater number of rivals reduces the propensity to launch a new knowledge intensive venture because entrepreneurial profits are more uncertain. They have shown that whereas higher competition in local contexts generates more knowledge and increases opportunities of exploitation by entrepreneurs, it also has adverse effects as it reduces the share of these opportunities per entrepreneur. They extended their analysis, looking at regional factors that counteract this negative effect of localised competition, giving new insights into the role of competition on knowledge-driven entrepreneurship.

By definition, KIE firms interact more with innovation systems than do other firms, thus accessing a rich pool of knowledge, they are innovative and bring change, and they face high uncertainty as introducing

novelty and change (Malerba, McKelvey, 2019; 2020). We thus assume that entrepreneurs will forgo launching a knowledge intensive venture when expectations for profits are eroded by intense competition.

H4: KIE tend to appear mostly where competition intensity is lower.

1.4 Performance of knowledge intensive firms

It is however important to link absorptive capacity to the performance of these knowledge intensive entrepreneurial ventures and look at their dynamics. It has been widely pointed out that firms facing increasing competitive pressure in globalized markets need to ensure their long-term competitive position in the global market by putting emphasis on innovative activities, creation of high added-value, exploitation of complementarities with technological advancements, as well as on the recognition and quick response to new market needs and market opportunities. At the firm's formation phase, the founders' perception of how to combine their endowments with market opportunities affects the success of the firm, at least in the short run (Grebel et al. 2003).

Protogerou et al. (2017) provided evidence that aspects of both internal factors, especially those encapsulated in the human capital, and external factors such as technology collaborations and networking with universities are important in explaining young firms' innovative activity.

Other research provides evidence of how different dimensions of absorptive capacity influence innovation (Crist et al. 2017; Fosfuri and Tribó 2008; Lane et al. 2001; Lane and Lubatkin 1998; Makri et al. 2006). Furthermore, accumulated knowledge in the context of newly established ventures is vital for their survival and performance (Adams et al. 2016; Agarwal and Shah 2014; Franco Malerba and McKelvey 2016). Larrañeta et al. (2017) have focused on the performance implications of the distinct dimensions of absorptive capacity, pointing to the need of investigating its direct effects on performance and not to intermediate outcomes such as innovation.

Following this line of research, we investigate whether KIE is linked to better business performance and competitiveness as we expect that high added value ventures possess a premium in comparison with firms that are less knowledge intensive. In addition, we investigate how absorptive capacity of founders at the formation phase affects performance of new ventures.

Linking absorptive capacity and KIE to business performance and internationalization, measured with objective measures such as sales and exports, contributes in our view to avoid tautology, as KIE by definition encapsulates innovation and thus is by definition linked to some type of innovativeness.

H5: KIE ventures are likely to demonstrate better business performance and competitive position.

Moreover, founders with a strong educational background and experience in the main sector of activity know better the market thus can make decisions with better effects in the sales performance of the company and its internationalization, a fact that is strengthened during their career path.

H6: Superior educational and experiential background of the founding team leads to better business performance and competitive position of the startup.

Under the conceptual framework, we constructed the pertinent research model for testing the hypotheses stated in this paper (Fig. 1). Furthermore, Fig. 2 shows the analytical research model (Measurement Model) enriched with the operationalisation of each construct.

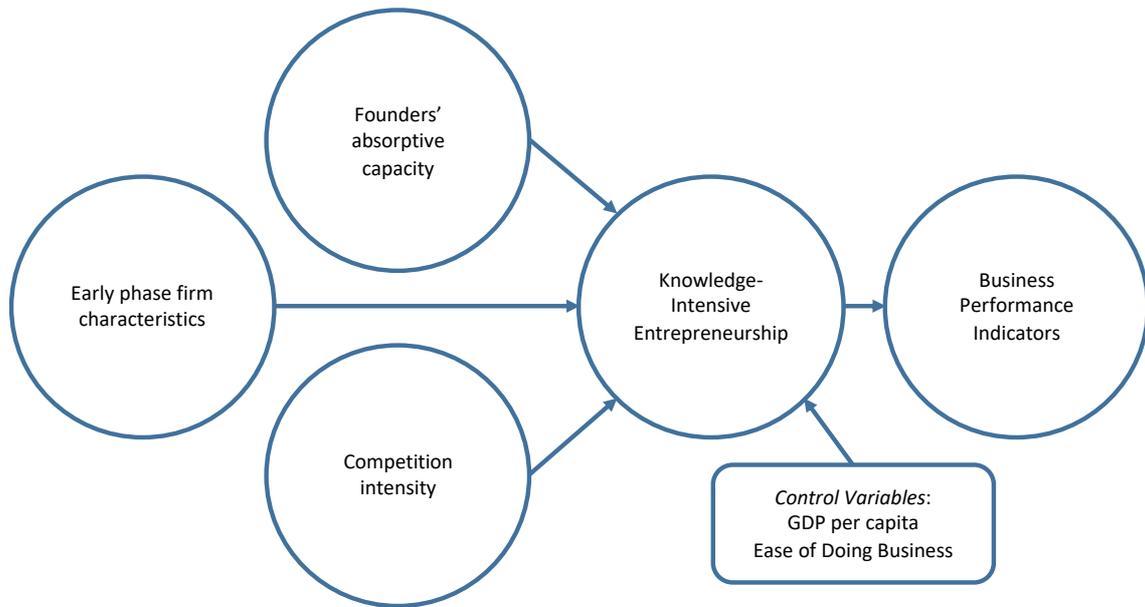


Fig. 1 The conceptual framework of the research model (Structural Model)

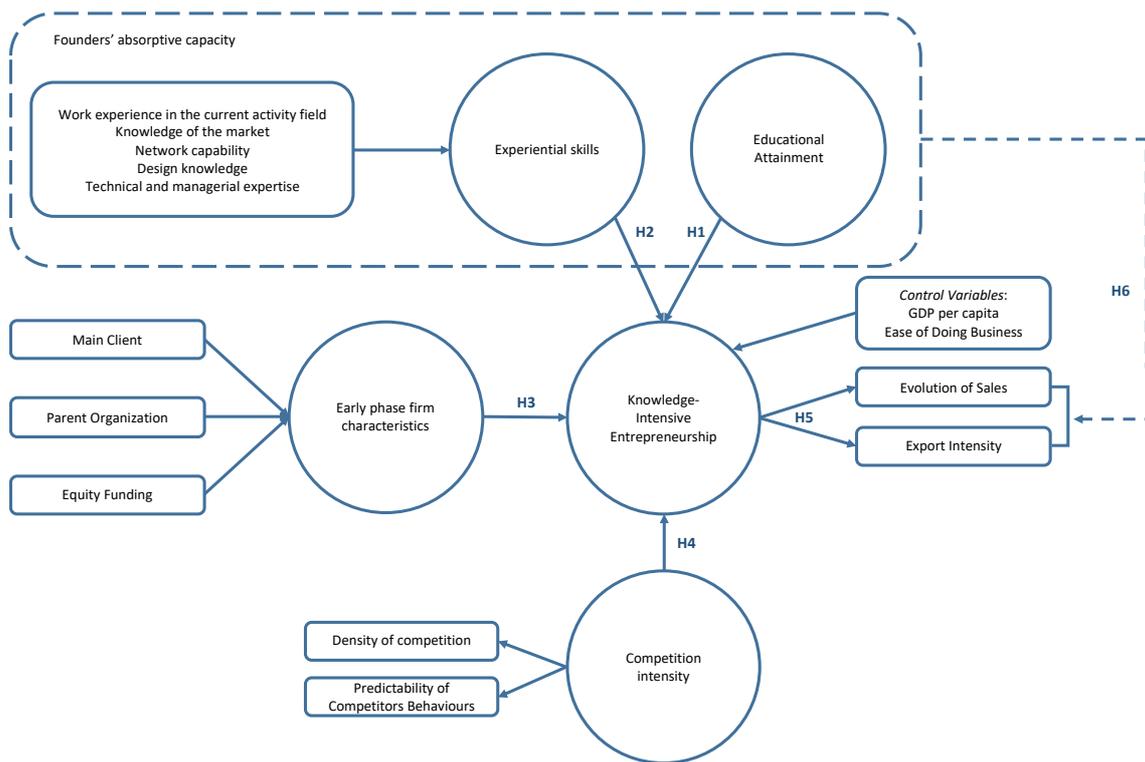


Fig. 2 The hypothesized research model showing the paths of the under-study constructs in this research (Measurement Model)

2 Research Design and Methodology

2.1 Data collection and sampling procedures

The paper is inspired by the project AEGIS³. For the purpose of the paper, the data originates from a large-scale survey conducted in late Fall 2010 and early Spring 2011, a pioneer attempt in collecting in-depth empirical data to identify typologies⁴ of newly established (in the 2000s), knowledge intensive firms. Thus, the research uses the generated dataset by the previously mentioned project, which is compiled by 3804 matching entrepreneurial ventures, newly established firms from a variety of economic sectors with activities in the industry and in services, from 9 European countries, namely the Czech Republic, Denmark, France, Germany, Greece, Italy, Portugal, Sweden, and the United Kingdom⁵. Information used in this study relates exclusively to the formation phase of entrepreneurial ventures.

2.2 Measurement of the model's variables

Following the collected data, an adaptation process of the dataset started. Firstly, a set of variables were operationalized for testing the effect of the research model. All the variables relevant to the hypotheses were grouped and tested using Exploratory (EFA) and Confirmatory Factor Analysis (CFA), creating a set of multiple variables-items fitted for the conceptual constructs. Consequently, only a selective set of variables showed satisfying results for being included in the empirical model. Therefore, the final set of variables and constructs⁶ with their description, conceptual structure and appropriate descriptive statistics is shown in Table 1.

2.2.1 Dependent variables (exogenous variables)

- *Knowledge Intensive Entrepreneurship* (labelled as KIE): We defined as knowledge intensive entrepreneurial ventures the cases satisfying both criteria: (1) having more than 10 per cent of employees⁷ with a university degree, and (2) introducing a product or process innovation during the period 2008–11. The variable is considered as dummy variable, taking the value of 2 if the firm meets the criteria and 1, otherwise.
- *Export Intensity (labelled as Exports)*: For business performance, the variable used information on exports over time as collected from the survey. The variable refers to the average percentage (%) of the firm's sales directed in the international market during a three-year period, 2007 to 2009. The score ranges from 0% to 100% with the 0% being the lowest (non-existence export intensity) and 100% being the highest score (high export intensity). Exports can also be considered a proxy for competitiveness.
- *Evolution of Sales* (labelled as Sales): For business performance, the variable used information on sales over time as collected from the survey. The variable refers to the average percentage (%) of increase/decrease in the firm's sales during a three-year period, 2007 to 2009. The score ranges from -100% to 100% with the -100% being the lowest and 100% being the highest score.

2.2.2 Independent variables (endogenous variables)

The explanatory variables were subdivided in three groups, namely: (1) the founders' absorptive capacity, (2) the early phase firm characteristics during the formation process, and (3) business environment which refers to competition intensity.

³ The survey was conducted in the context of the EU-funded research project "Advancing Knowledge intensive Entrepreneurship and Innovation for Economic Growth and Social Well-Being in Europe" (AEGIS), 7th Framework Programme for RTD, European Commission, (contract number: 225134). The aim of the project is to study the interactions between knowledge, innovation, economic growth and social well-being in Europe focusing on knowledge intensive entrepreneurship (KIE), which work as a mechanism of change mediating between the creation of knowledge and its transformation into economic activity.

⁴ The typologies are characteristics and patterns in the creation, growth, and motives of the firms.

⁵ Firms were contacted by telephone to complete a questionnaire online. The person contacted was a member of the founding team (giving information about the other founders as well). The questionnaire included six sections collecting general information about the firm, the founders, the formation process, the market environment, enablers and constraints in the operation of the firm, the strategy of the firm and its innovation and business performance.

⁶ The constructs used to test the hypotheses of the paper are formatted by multiple items of first order dimensions.

⁷ The cut-off point of 10 per cent was chosen as it is remarkably close to the median (6.7 per cent) of the sample and there were no firms in the range from 6.7 to 10 per cent.

The founders' absorptive capacity is described by two latent variables, "*Prior Educational Attainment of founder(s)*" and "Experiential skills", which are a result of CFA and model specifications. In more detail, the latent variable regarding the experiential skills is described by the variables type of expertise attained through education, the market knowledge, the work experience in the current activity field, the design knowledge and the network ties formed and built by the founders during their previous career. The latent variable regarding prior education is a single structure construct defined by the prior Educational Attainment of founder(s), which is presented as follows:

- *Prior Educational Attainment of founder(s)* (labelled as Educational Attainment): The variable is a single-item latent variable and refers to the educational background of the founders of the founding team. For each founder, the educational attainment is measured by taking the values: 1- elementary education; 2-secondary education; 3-bachelor's degree; 4-postgraduate degree; 5-Ph.D. degree. The initial variable of the founding team's education is based on the average score across the founding members. Thus, the value of 5 corresponds to a team with PhD degree(s) and 1 for a founding team with only elementary education.

Below are the five indicators forming the latent variable regarding the experiential skills:

- *Expertise attained through education (labelled as Expertise)*: The variable constructed is ordinal and reflects whether the founder(s) have a technical expertise, economic expertise, or both. The results are based on the factor analysis of the main areas of expertise relevant to the operations of the firm. Thus, it is measured by taking the value of 3 for a founding team that has both technical and economic experts, the value of 2 for a founding team that has either technical or economical experts and 1 for a founding team that has none.
- *Knowledge of the market (labelled as Market Knowledge)*: The variable refers to the importance of the founders' knowledge regarding the operating market.
- *Work experience in the current activity field (labelled as Work Experience)*: The variable refers to the importance of the founders' work experience.
- *Design Knowledge (labelled as Design Knowledge)*: The variable refers to the importance of the design knowledge possessed by the founders.
- *Networks built during previous career (labelled as Network)⁸*: The variable refers to the networking capability of the founders.

Early phase firm's characteristics

The following variables formulated the latent variable describing the firm's characteristics during the early phase of the formation process and labelled as Early Phase Firm Characteristics.

- *Main Client (labelled as B2B, B2G and B2C)*: The variable refers to the most important type of customer for the firm. The main customer of the firm can be another business firm (other large or SMEs Companies), the public sector (a government organization) or the final customer. For the measurement model and because of the nature of the variable, it is broken down in 3 different variables, B2B (business to business), B2G (business to government) and B2C (business to consumer). Each variable is a dummy variable taking the values of 1 if the client is not the main one and 2 otherwise. In the model, the variables that will be used are B2B and B2G.
- *Parent Organisation (labelled as PO_Uni, PO_Com and PO_Non)*: The variable refers to the parent organisation from which the firm originates. The parent organisation can be another company, a university or none. For the purpose of the measurement model and because of the nature of the variable, it is broken down in 3 different variables, PO_Uni (University as parent organisation), PO_Com (company as parent organisation) and PO_None (No parent organisation). Each variable

⁸ Market knowledge, Work experience, Design Knowledge and Network are measured at a Likert scale taking the value of 5 for high importance and 1 otherwise.

is a dummy variable taking the values of 2 if the parent is the corresponded one and 1 otherwise. The use of this variable will be focused on the variables PO_Uni and PO_None.

- *Equity funding* (labelled as Equity): The variable is binary and refers to the source of funding during the formation process. It is measured by taking the value of 2 if the source of funding is a venture capital or business angel and 1 otherwise.

Competition intensity

The following two variables formulate the latent variable describing intensity of competition:

- *Density of competition* (labelled as Density): As an ordinal variable, it refers to the intensity of competition. It shows the number of businesses offering the same products and/or services to the same potential customers. Greater number of firms corresponds to higher competition. It is measured by taking the value of 3 for many competitors, the value of 2 for only a few business competitors and 1 for no competition.
- *Predictability of Competitors Behaviours* (labelled as *Predictability*): The variable is based on a Likert - scale and refers to the assessment of the business environment in which the firm operates. Higher predictability corresponds to less uncertainty. In the principal industry in which the firm operates the activities of the major competitors range from highly unpredictable (value of 5) to highly predictable (value of 1).

Control Variable

In our effort to mitigate for the confounding effect from other independent variables and reducing characteristics which collide with the variables of the sample (Atinc et al. 2012; Cheung and Lau 2008), we included two control variables trying to capture economic and institutional aspects of the business environment, namely GDP per capita and Ease of Doing Business⁹.

- *GDP per capita* (labelled as GDPpc): The variable is numeric and refers to the Gross Domestic Product (GDP) per capita for each country. The year of reference is 2011 and it is counted in the international standard of US Dollars (\$). The data was extracted by the database of World Development Indicators of the World Data Bank (The World Bank Group 2020).
- *Ease of Doing Business* (labelled as Frontier): This variable is scale and refers to the ranking made by the World Bank in the Annual Report of Doing Business. More specifically, the variable is based on the Distance to the Frontier, thus the ranking scale is from 100: lowest performance (greatest distance) to 0: highest performance (being the frontier and the leading country) in this category (The World Bank Group 2019).

The relation of early-phase entrepreneurship and income levels is rather ambiguous. On the one hand in wealthier economies, individuals are more likely to have access to the necessary resources for starting and developing a new venture, although motivation to create a startup might be higher in lower-income economies as they might not have alternative income sources. On the other hand, in lower income countries there might be less intensive competition in high-added value new products and services and growing demand for such products (Bosma et al. 2020, p. 38). Of course, our survey includes high income countries but at different levels. This means that in higher-income economies KIE ventures tend to be a smaller part of the overall early-stage entrepreneurship activity than in lower-income economies. Early-stage entrepreneurial activity is also influenced by the ease of starting and developing businesses in each economy as different institutional and regulatory frameworks (legal, fiscal and tax regulations, property rights, organizational arrangements for small firms support or promotion of inter-organisational linkages, etc.) are enabling or constraining the choice of a person to become an entrepreneur and/or the probabilities to scale up. Weak public institutions raise the effective cost of doing business, and in particular, the cost of engaging in higher risk activities such as innovative and cutting-edge ventures.

Following the analytical description of the variables, table 1 shows the distinctive characteristics of the variables used in the model for the groups (1) knowledge intensive entrepreneurial ventures (52,2%) and (2) non-KIE ventures (47,8%).

⁹ The size of the company was excluded as a control variable, since 90% of the sample has less than 20 full-time employees.

Table 1: Summary of the characteristics of the construct items in the dataset¹⁰

<i>Variables Name</i>	<i>non-KIE</i>	<i>KIE</i>
Knowledge Intensive Entrepreneurship ¹¹	47.8% (1789)	52.2% (1956)
Export intensity (Average)	12.4%	16.2%
Evolution of sales (Average)	22.0%	36.7%
Main Client ^{12**}		
• Large firms are those that employ >250 persons	26.2% (468)	32.3% (632)
• Small and medium sized firms SME with	46.5% (832)	42.5% (832)
• Final consumers (e.g., private households & consumption)	14.6% (261)	9.9% (194)
• Public sector public sector should be treated with a wider	7.5% (135)	10.3% (201)
• Other	5.2% (93)	5.0% (97)
Parent Organisation**		
• University	0.2% (2)	0.6% (12)
• Company	16.5% (296)	11.9% (233)
• None	83.3% (1491)	87.5% (1711)
Equity funding**		
• Lower Risk	24.8% (436)	18.5% (355)
• Higher Risk	75.2% (1322)	81.5% (1559)
Predictability of competitors behaviour (Average)	3.34 (1789)	3.18 (1956)
Density of Competition **		
• No other business competitors	7.4% (133)	6.5% (128)
• Only a few business competitors	32.3% (578)	36.3% (710)
• Yes, many business competitors	60.3% (1078)	57.2% (1118)
Educational attainment of founder(s)	2.74 (1766)	3.47 (1930)
Expertise attained through education		
• No Expertise	7.6% (136)	5.5% (107)
• Technical Experts or Economical Experts	37.3% (667)	39.4% (770)
• Both Expertise	55.1% (986)	55.1% (1079)
Knowledge of the market (Average)	4.04 (1786)	4.05 (1951)
Work experience in the current activity field (Average)	4.33 (1784)	4.34 (1950)
Design knowledge (Average)	2.99 (781)	3.05 (1943)
Network built during previous career (Average)	3.71 (1780)	3.77 (1945)
Total Observations (N)		3804
Total Observations (N) after casewise deletion¹³		3136

3 Model specification and data analysis

3.1 Estimation Method and data analysis

Due to the nature and characteristics of the hypothesized model, the paper adopts an advanced quantitative analytical statistical method, partial least square structural equation modelling (PLS - SEM), to analyse the dataset sample and test the hypotheses (Fornell and Cha 1994; Hair et al. 2011; Lohmöller, 1989). This technique is preferred for estimating causal relationships between variables¹⁴, in comparison to the covariance-based approach (CB-SEM), a stricter technique. PLS-SEM is variance-based and has advantages which allow our model to focus on maximizing the variance of its dependent variables explained by the independent ones (Henseler et al. 2009, 2012) and to estimate the maximum likelihood or multivariate normality (Chin and Newsted 1999; Hair et al. 2011; Hair et al. 2012).

¹⁰ The percentages (apart the variable KIE) refer on each KIE category.

¹¹ The total number adds up to 3745 instead of 3804 because we have a total of 59 missing cases in the sample.

¹² **Each category is used as a separate variable as mentioned in the variable description.

¹³ For the calculation of the latent variables via the PLS Algorithm, we used for the missing values the option “casewise deletion”, thus leading to a new total of cases. This selection is a very conservative missing value strategy allowing precision and power of the estimates (Hair et al. 2012; Wong 2013).

¹⁴ The model includes binary variables, thus requiring a less strict model (Hair et al. 2011).

Before running the PLS-SEM¹⁵ model, a series of tests were conducted, showing that the sample is adequate (Barclay et al. 1995; Hair Jr. et al. 2016) with no multicollinearity constrains (Farrar and Glauber 1967; Grewal et al. 2004; Mansfield and Helms 1982). Additionally, all latent variables satisfy two conditions: (1) the conceptual meaning is similar and (2) the statistical tests approve the combination, which can be either reflective or formative¹⁶.

The analysis and evaluation of the model follows two main procedures: The analysis of (1) the outer model (measurement model), examining the relationship of the indicators and the constructs, and (2) the analysis of the inner model (structural model), evaluating the paths between the latent variables (Hair et al. 2011; Rasoolimanesh et al. 2014).

3.2 Research Results: Validation of the measurement and structural model

The reliability of the statistically significant indicators is ensured through the outer loadings and weights of both reflective and formative latent variables (Barclay et al. 1995; Chin 1998; Duarte and Raposo 2010; Hair et al. 2011), which most of them surpass the value of 0.5 (see Appendix Table A1). Furthermore, the composite reliability value (0.720) and the corresponding value of Average Variance Extracted (AVE) (0.592) of the reflective variable “Competition Intensity” indicate a relatively high reliability and a linear homogeneity between the reflective construct and its independent variables. Additionally, using the technic Heterotrait - Monotrait Ratio (HTMT), we evaluated the discriminant validity of the constructs (Garson 2012; Hair et al. 2011), and according to the limitations suggested by Henseler et al. (2014), we see a clear distinction between the variables (see Appendix Table A2).

Table 2 shows the criteria assessing the predictive quality of the structural model’s capability to predict. For KIE, the adjusted R² and the Stone–Geisser’s Q² are considered satisfactory (Chin 1998; Höck and Ringle 2010) ensuring that the predictive validity of the model is adequate for each endogenous latent construct (Chin, 1998; Geisser, 1975; Ruiz et al., 2008; Stone, 1974; Jugend et al., 2018). Furthermore, by using the bootstrapping technique, we tested the significance of the PLS estimates via the inner variance inflation factor (VIF) (Chin 1998; Hair et al. 2012; Ringle et al. 2015)¹⁷ indicating no serious multicollinearity problems (Table 2) (Diamantopoulos and Siguaw 2006; Garson 2012).

Table 2: Results of the latent variables of the structural model (N=3136)

	<i>R Square (R²)</i>	<i>Adj. (R²)</i>	<i>Effect size (f²) on KIE</i>	<i>Q²</i>	<i>Inner VIF on KIE</i>	<i>SRMR</i>
KIE	0.129	0.127		0.122		0.113
Exports	0.004	0.004		0.004		
Sales	0.003	0.003		0.003		
Experiential Skills			0.001	0.170	1,046	
Competition Intensity			0.002		1.022	
Firm Characteristics			0.007		1.038	
Educational Attainment			0.114		1.053	
GDPpc			0.010		1.745	
Frontier			0.001		1.781	

Ultimately, Fig. 3 summarizes a visualization of the results of the outer (A) and inner (B) model, allowing for a better understanding of the role and the relevant effect of the different constructs and variables in the model. More precisely, the outer model shows the standardized path coefficients (direct effect) and the desirable level of significance (0.05) of the p-values of the formulated relations (Chin 1998; Efron 1988; Hayes 2009). Additionally, all the occurred direct and indirect effects in the model and the significance of each variable are shown in Table A3 in the Appendix.

¹⁵ For the needs of this study, the software used is SmartPLS 3.0 (Hair et al. 2012).

¹⁶ When the changes in the construct are projected in the variables, reflective constructs are formulated and when the changes in the indicators cause changes in the construct, formative constructs are formulated. The direction of changes is presented in arrows (Diamantopoulos and Siguaw 2006; Joe F. Hair et al. 2011; Jarvis et al. 2003).

¹⁷ We use 5000 bootstrap samples for the final model as recommended by Hair et al. (2011).

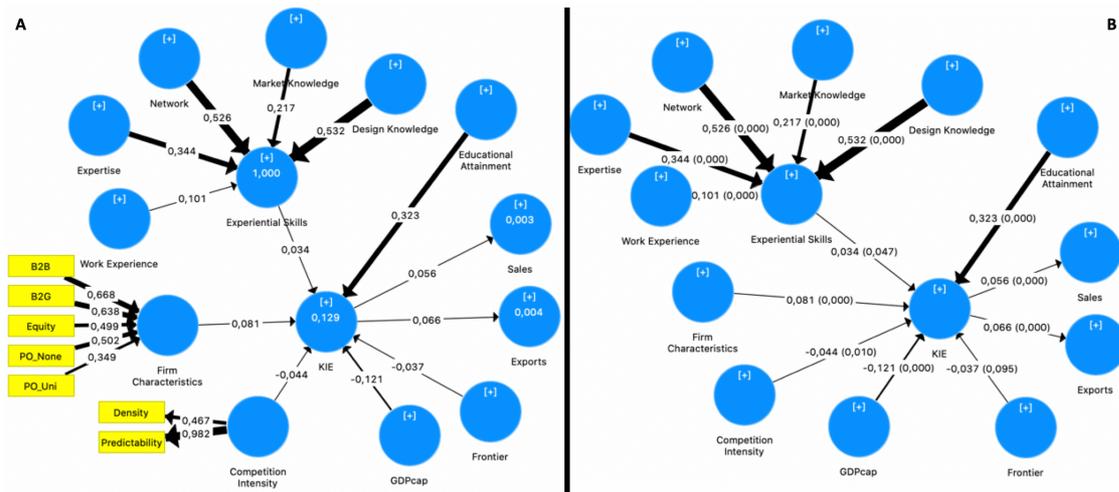


Fig. 3: The measurement (outer) model (A) and the structural (inner) model (B) with their standardized path coefficients and p-values (in parenthesis) (N=3136)¹⁸

3.3 Empirical Results

Following the above statistical analysis of the research model and the measurement and structural model, we can evaluate our results. Hypotheses H1 and H2 refer to the role of founders' absorptive capacity in terms of its antecedents and constituent elements. We evaluated the impact of the prior education of the founding team indicated by the empirical results ($\beta_1=0.323$, $t= 18.854$, $p=0.000$) and found a significant and positive relationship between the variable and KIE, thus H1 is supported. Additionally, results related to the knowledge of the market ($\beta_{2a}=0.007$, $t=1.987$, $p=0.047$), the work experience in the current activity field ($\beta_{2b}=0.003$, $t=1.988$, $p=0.047$), the design Knowledge ($\beta_{2c}=0.018$, $t=1.987$, $p=0.047$), the network built during previous career ($\beta_{2d}=0.018$, $t=1.986$, $p=0.047$), and expertise attained through education ($\beta_{2e}=0.012$, $t=1.986$, $p=0.047$) of the founding team prove a significant positive relationship with KIE, thus H2 is supported as well.

Furthermore, H3, referring to the role of early-phase firm characteristics depicted by equity funding, the type of parent organisation and the type of client, are supported as the impact of the latent variable 'Early phase firm characteristics' on KIE is significantly positive ($\beta_3=0.081$, $t=4.772$, $p=0.000$). Hypothesis H4 expects KIE to appear mostly where competition intensity is lower. The empirical results indicate a significant and negative relationship between KIE formation and competition intensity ($\beta_4= -0.044$, $t=2.633$, $p=0.008$). Therefore, H4 is supported. Regarding H5, it is expected that knowledge intensive entrepreneurial ventures are likely to demonstrate better business performance and competitive position, which is evaluated through the evolution of sales and export intensity. The impact of KIE on sales ($\beta_{5a}=0.056$, $t=4.652$, $p=0.000$) and exports ($\beta_{5b}=0.066$, $t=3.701$, $p=0.000$), indicates a positive and significant relationship, thus, confirming H5.

Finally, regarding the indirect effect of the antecedents of founders' absorptive capacity on business performance and competitive position of the new ventures, our results show that superior educational attainment ($\beta_{6a1}=0.018$ and $\beta_{6a2}=0.021$, $p_{a1,2}=0.000$) and experiential skills ($\beta_{6b1}=0.002$ and $\beta_{6b2}=0.002$, $p_{6b1}=0.083$ and $p_{6b2}=0.093$), have a positive and relatively significant indirect effect on sales and exports respectively, confirming H6.

4 Discussion of results and conclusions

Following our analysis, we can highlight the most important results:

- The most important hypothesis which refers to the absorptive capacity of the founders is supported. More precisely, there is a statistically significant positive relationship of the educational level of the founders with the formation of knowledge intensive entrepreneurship. In addition, there are some distinctive specific skills of the founders that influence positively KIE such as the previous work experience, the market knowledge and design capability, networking capability of the founding

¹⁸ The density of the arrows shows the intensity of the relative values of each item of the constructs.

partners as well as technical and managerial expertise. Particularly, there are synergistic gains from the combination of technical and managerial skills. These results are consistent with findings of other empirical research (Colombo and Grilli 2005; Protojerou et al. 2017).

- Regarding early phase characteristics of the formation of the company the relevant hypotheses is confirmed. Equity funding is more related to higher value-added entrepreneurship. New ventures having no parent organization or resulting as spinoffs of a university are more likely to be knowledge intensive. Finally, new ventures targeting mostly private or public firms (B2B or B2G) are more likely to be knowledge intensive.
- Competition intensity has a significant negative impact on KIE, as expected. The intensity of competition approximated by the predictability of the competitors' actions and the number of competitors does not seem to favour the development of KIE.
- Regarding firm performance, our results show a positive effect of KIE ventures and a clear indirect positive effect of formal education of the founders on sales and exports. Furthermore, specific skills such as design and engineering knowledge as well as the combination of technical and management expertise have a weaker positive indirect effect on business performance. This result points to the importance of human capital as enabling factor of market success, as measured at least with some hard indicators such as sales and exports.
- The country's income level as measured by GDP per capita is negatively related to KIE. This result follows the general trend as found in the Global Entrepreneurship Monitor survey, where out of the 33 economies which belong to the high-income group, 26 have a lower total early-stage entrepreneurial activity rate compared to other income levels (less than 15%) (Bosma et al. 2020). As our sample is including high income countries, our finding suggests that such trend could be anticipated within specific groups of countries as well and could be explained by the fact that in higher income levels people are more in their comfortable zone and do not take high risks related to technological change and innovation. As far as the ease of doing business is concerned, results are not surprising: countries which are closer to the frontier are more likely to have higher levels of knowledge intensive entrepreneurial ventures.

Based on the above results, we could claim that founders' characteristics related to absorptive capacity are important in the formation process of knowledge intensive entrepreneurship. During this early phase, organizational procedures, routines, and attributes are not fully developed yet and thus founders' attributes such as the level of education, prior experience and technical and managerial skills can build an interface with external knowledge sources to monitor, assimilate and transform this into new economic value. Our results indicate that founders' educational level and specific skills positively relate to the formation of knowledge intensive entrepreneurship and to higher performance entrepreneurship. These findings imply that a strong pool of highly educated people with complementary skills could enhance the market potential of high added value ventures and reshape the basis of new firms' competitive advantage. Investment in education, training and lifelong learning could boost exploitation of research outcomes from students and academics and result in reshaping the landscape of entrepreneurial ventures and changing its characteristics. They also imply that the combination of technical and managerial skills might prove beneficial in raising the quality of entrepreneurial venturing and the successful exploitation of business opportunities. This is particularly relevant for engineers that need to combine their technical skills with understanding business environment and the internal environment of the firm.

Our results are particularly important as they reveal the positive effect of absorptive capacity's antecedents to business and competitive performance of newly established firms, measured with objective measures such as sales and exports. Overall, founders' absorptive capacity might reduce the cost and risk of innovation development through exploitation of external knowledge sources, increasing the possibility for viable KIE ventures. This finding corroborates with results of other studies (Lane et al. 2001; Tsai 2001; Wales et al. 2013). It also complements the results of Larrañeta et al. (2017) as it reflects in more details the role played by venture founder's education and prior experience. It also strengthens expectations about the contribution of micro-structural characteristics to developing a competitive business ecosystem. Entrepreneurs should constantly develop their knowledge but at the same time search and interact with external sources of knowledge to widen the opportunities for viable KIE ventures. The indirect effect of absorptive capacity on business performance infers that for developing successful KIE, technology and industrial policy should shape the appropriate environment for absorbing and further developing external

knowledge at the individual level, which extends similar considerations that have been shown at the country level (Chung et al., 2021).

Furthermore, 47% of our sample is characterized as non-KIE group. Firms included in this group are related to specific founders' characteristics and demonstrate lower business performance. From a policy perspective this finding could interestingly point to specific criteria when evaluating new projects and entrepreneurial teams.

The same goes for early phase firm characteristics that according to our findings significantly and positively influence the performance of KIE ventures. This result should be considered when evaluating entrepreneurial ideas and projects to be funded.

The positive relationship of equity funding with KIE points to the important role that new funding mechanisms can play in seizing opportunities. The fact that new entrepreneurs might have limited access to financial resources could be counterbalanced by the development of new funding mechanisms resulting from specific technology policy objectives. Furthermore, the fact that KIE ventures are more related to B2B and B2G clients, suggests that demand pull explanations in the creation of high added value ventures are valid. Sophisticated demand can be at the origins of transforming the entrepreneurial landscape and to this respect, policy initiatives should a) support collaborative interfirm relationships where users lead the development of innovative solutions in cooperation with the potential developer(s) and b) use public procurement as a tool for raising demand of innovative solutions, fostering the development of specific activities and capabilities helping to move down quickly the learning curve and reap dynamic economies of scale. Our results also verify that independent new ventures or spinoffs can become game-changers in industries where incumbent firms have already established evolutionary paths. Incumbent companies are less able or not willing to commercialize the fruits of their research launching new ventures because of established routines and commitment to existent technological paths.

Finally, competition intensity appears to be negatively related to KIE. This could be explained by the fact that our sample refers to new ventures at their very early phase. During the formation process KIE firms, as embedding more advanced and sophisticated knowledge with more uncertain outcomes, might need a more protected environment to flourish and succeed. Intense competition, restricts appropriation opportunities and signals to potential entrepreneurs that they do not have a long-term horizon to invest in the specific market, making them less willing to invest in activities with long delay between investment and payback. This finding is not in contradiction with findings of other research (Plummer and Acs, 2014). Another comment of policy relevance is that as competition intensity has a negative effect on KIE, someone might not expect any particular trade-off between competition policy and technical progress. Our results indicate that there is justification in promoting more synergistic mechanisms that would allow the increase of knowledge stock on the one hand but shape less rivalry on the other. These results could be differentiated when taking into consideration the amount of investment initially needed, as they might depend on the level of capital intensity of the new ventures. Further research could distinguish between ventures requiring higher and those requiring lower initial capital investment and link it to competition intensity.

However, when industrial transformation is in play with emergence of new sectors and high uncertainty in the decision-making process, policy initiatives should take into consideration leveraging human capital qualifications, supporting the development of well-connected actors to financial and knowledge sources, using criteria for boosting entrepreneurial ventures that meet sophisticated demand and develop what Fagerberg et al. (2007) define as demand competitiveness.

5 Limitations and future research questions

Our study's limitations refer mostly to the fact that we have only a snapshot of the reality omitting the dynamic effects of the different factors studied.

Furthermore, the issue of competition in relation with innovation activity has been studied through different lens but is indeed a complex issue. Our measure for competition intensity lying on the number and behaviour of rival firms catches some of the aspects. Further research should take into consideration i) the type of activity of incumbent firms in the sector where new ventures are launched, and whether it is complementary or similar to the incumbents, ii) a distinction of fields of activity in terms of required initial capital investment.

An interesting path for future research could also refer to the attributes of the founders and how they relate to the distinct dimensions of absorptive capacity, namely potential and realised. Furthermore, as absorptive capacity is domain-limited and related to limits to cognition, it is important to look at how and under which conditions the new venture enters a development phase depending less on the founders' attributes and more on the organisational capabilities built over time.

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Appendix

Table A1: Summary of results relating to the main characteristics of the model's latent measurements (N = 3136)

<i>Latent variables (type)</i>	<i>Items/Indicators</i>	<i>Outer loadings/weights</i>	<i>p-values</i>	<i>AVE</i>	<i>Composite Reliability</i>
Competition Intensity (Reflective)	Density	0.467	0.021	0.592	0.720
	Predictability	0.982	0.000		
Early Phase Firm Characteristics (Formative)	B2B	0.668	0.000	-	-
	B2G	0.638	0.000		
	PO_None	0.499	0.000		
	PO_Uni	0.502	0.000		
	Equity	0.349	0.001		

Table A2: Discriminant validity of constructs using the technic HTMT (N=3136)

	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>	<i>11</i>	<i>12</i>
1 Competition Intensity												
2 Design Knowledge	0.088											
3 Educational Attainment	0.151	0.000										
4 Expertise	0.098	0.168	0.017									
5 Exports	0.122	0.060	0.080	0.023								
6 Frontier	0.049	0.155	0.083	0.117	0.024							
7 GDPpc	0.085	0.130	0.117	0.029	0.019	0.646						
8 KIE	0.078	0.034	0.331	0.016	0.066	0.013	0.06					
9 Market Knowledge	0.129	0.118	0.039	0.064	0.040	0.042	0.021	0.007				
10 Network	0.081	0.073	0.042	0.005	0.012	0.093	0.045	0.029	0.311			
11 Sales	0.034	0.002	0.085	0.010	0.007	0.058	0.055	0.056	0.034	0.036		
12 Work Experience	0.081	0.122	0.035	0.019	0.030	0.005	0.003	0.005	0.217	0.268	0.081	

Table A3: Indirect and direct effect of the relationship of the variables (the p-values are shown in the parentheses) (N = 3136)

<i>A/A</i>	<i>Relationships</i>	<i>Direct</i>	<i>Indirect</i>
1	Competition Intensity -> Exports		-0.003 (0.039)
2	Competition Intensity -> KIE	-0.044 (0.008)	
3	Competition Intensity -> Sales		-0.002 (0.03)
4	Design Knowledge -> Experiential Skills	0.532 (0.000)	
5	Design Knowledge -> Exports		0.001 (0.093)
6	Design Knowledge -> KIE		0.018 (0.047)
7	Design Knowledge -> Sales		0.001 (0.083)
8	Educational Attainment -> Exports		0.021 (0.000)
9	Educational Attainment -> KIE	0.323 (0.000)	
10	Educational Attainment -> Sales		0.018 (0.000)
11	Experiential Skills -> Exports		0.002 (0.093)
12	Experiential Skills -> KIE	0.034 (0.047)	
13	Experiential Skills -> Sales		0.002 (0.083)
14	Expertise -> Experiential Skills	0.344 (0.000)	
15	Expertise -> Exports		0.001 (0.093)
16	Expertise -> KIE		0.012 (0.047)
17	Expertise -> Sales		0.001 (0.083)
18	Firm Characteristics -> Exports		0.005 (0.004)
19	Firm Characteristics -> KIE	0.081 (0.000)	

20	Firm Characteristics -> Sales		0.005 (0.002)
21	Frontier -> Exports		-0.002 (0.156)
22	Frontier -> KIE	-0.037 (0.104)	
23	Frontier -> Sales		-0.002 (0.154)
24	GDPcap -> Exports		-0.008 (0.003)
25	GDPcap -> KIE	-0.121 (0.000)	
26	GDPcap -> Sales		-0.007 (0.001)
27	KIE -> Exports	0.066 (0.000)	
28	KIE -> Sales	0.056 (0.000)	
29	Market Knowledge -> Experiential Skills	0.217 (0.000)	
30	Market Knowledge -> Exports		0.000 (0.093)
31	Market Knowledge -> KIE		0.007 (0.047)
32	Market Knowledge -> Sales		0.000 (0.083)
33	Network -> Experiential Skills	0.526 (0.000)	
34	Network -> Exports		0.001 (0.093)
35	Network -> KIE		0.018 (0.047)
36	Network -> Sales		0.001 (0.083)
37	Work Experience -> Experiential Skills	0.101 (0.000)	
38	Work Experience -> Exports		0.000 (0.093)
39	Work Experience -> KIE		0.003 (0.047)
40	Work Experience -> Sales		0.000 (0.083)
