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Linking investments in intangible assets and global value chain participation with firm export performance

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Summary

This report presents a preliminary analysis on the main findings of the Globalinto large-scale pilot survey of intangible investments involving 1796 firms in seven European countries. The research objective is to explore the role of intangible assets as determinants of firm competitiveness in international markets, while considering the effects of participation in global value chains (GVCs). To achieve this, a three-stage methodological approach is followed. First, a set of indicators to capture the utilization of different types of intangible assets and export performance at the firm level was developed, drawing data from the Globalinto survey. In the second stage, the firm-level data were combined with sector-level (2-digit NACE Rev. 2) indicators on GVC participation, utilizing data from the newly released 2021 edition of OECD's Inter-Country Input-Output Tables (ICIOTs). In the third stage, these indicators and a set of control variables were modelled into simple regressions to study the contribution of different types of intangibles to export performance while considering the effects of GVC participation.

Our findings show that R&D investments appear to be essential contributors to export intensity while non-R&D intangibles have a negligible effect. This finding reflects the increased importance of R&D investments for firm growth and competitiveness compared to the other categories of intangible assets. Moreover, both in-house R&D investments and externally acquired knowledge seem to be important determining factors of export performance, suggesting the non-rivalrous and complementary nature of internally developed and purchased R&D knowledge.

When controlling for participation in GVCs, research results indicate that forward participation positively affects export performance while backward participation appears to be insignificant. Although these results should be interpreted with caution as they link firm and sector level evidence in a rather aggregate manner, they indicate that firms might target engaging in forward-oriented upstream activities, which are intangible-intensive, to secure significant competitiveness gains along GVCs. This finding is further supported when using additional control variables that capture the GVC dimension at the firm level, such as being part of a multinational group and engaging in FDI activities.

Keywords: export intensity; competitiveness; intangible assets; global value chains; R&D investments

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1. Introduction

Since the seminal work of Schumpeter, economic growth is considered to be driven by innovation through the process of creative destruction. His work paved the way for an ever-expanding literature on the ways his theory could be operationalized through the development of conceptual and empirical models that capture the effects of innovation and knowledge or technology (interchangeable terms in Schumpeterian, neo-Schumpeterian, evolutionary, and neoclassical traditions) on growth. In this sense, the academic interest on the determinants of growth and competitiveness in international markets has recently shifted away from exploring the effects of accumulating physical (tangible) capital, towards studying the accumulation of knowledge (Romer, 1990; Grossman and Helpman, 1991; Aghion and Howitt, 1992).. The role of knowledge here can be considered both direct and indirect. On the one hand, knowledge (or technology) is significantly different from physical capital as it is considered non-rivalrous in nature; utilization of specific knowledge for an application (e.g., the development of a product) by a firm does exclude other firms by simultaneously or subsequently utilizing the same knowledge in different applications (Grossman and Helpman, 2015). This non-rivalrous nature is associated with increasing returns to scale and direct growth and competitiveness gains. On the other hand, knowledge is also intertwined with the innovation process. In fact, as Crépon et al., (1998) suggested, it is knowledge assets that contribute to the production of innovation, which in turn can be utilized to provide growth and competitiveness gains at the firm level. However, in both cases, knowledge is quite ambiguous and difficult to be captured by specific metrics and statistics.

Until recently, investments in Research and Development (R&D) and all R&D related activities where ubiquitously accepted as the better proxies for knowledge and sometimes for innovation capacity as well. In fact, R&D expenditures, considered as productivity-enhancing innovation expenditures that enable firms to afford exporting costs, proved to be a significant tool in understanding the nexus between exports and innovation as enablers of the firm's ability to meet international demand in a profitable manner (Melitz and Redding, 2014). But R&D is not the only type of knowledge asset. In fact, Corrado et al. (2005; 2009) introduced a pioneering framework – which was latter on adopted by OECD's Oslo Manual (2018) – to identify and measure a set of knowledge-based assets, alternatively known as intangibles. These intangible assets provided significant insights on the EU's decreasing productivity puzzle as important drivers for growth (Corrado et al., 2009; Roth and Thum, 2013; Piekkola, 2018; Roth, 2020). More recent studies have also linked these assets with dominant positioning, higher value-added accumulation, and increased competitiveness in global value chains (GVCs) (Tsakanikas et al., 2022; Cadestin et al., 2021; WIPO, 2017; OECD, 2013).

Against this backdrop, this study aims to explore the role of intangible assets as determinants of firm competitiveness in international markets, while considering the effects of participation in GVCs. To achieve this, a three-stage methodological approach is followed. First, we develop a set of indicators to capture the utilization of different types of intangible assets and export performance at the firm level, drawing data from a large-scale survey on 1796 firms from seven EU economies that was implemented within the context of the H2020 Globalinto project (contract number: 822259). In the second stage, we combine firm-level data with sector-level (2-digit NACE Rev. 2) indicators on GVC participation, utilizing data from the newly released 2021 edition of OECD's Inter-Country Input-Output Tables (ICIOTs). In the third stage, we model these indicators and a set of control variables into simple regressions to study the contribution of different types of intangibles to export performance while considering the effects of GVC participation.

The rest of the paper is organized as follows. Section 2 provides the theoretical background on intangibles by reviewing quantification issues, various surveys conducted to measure them, and their importance for competitiveness in GVCs. Section 3 presents the methodological framework of the study, the data, and the variables. Section 4 presents and discusses the empirical results and, finally, section 5 concludes the paper.

2. Theoretical Background

2.1 Intangible Assets and Business Competitiveness

Intangible assets are becoming a critical tool for firms in building competitive advantages, and they are steadily gaining importance for the corporate value creation processes of all kinds of organizations. The main reason is the economies' transition from being industrial to knowledge-based, where competition is largely based on intangibles (Madhani, 2012). However, intangible assets are not always well defined (Marr and Chatzkel, 2004). According to Epstein and Mirza (2005), intangible assets are "*non-financial assets without physical substance that are held for use in the production or supply of goods or services or for rental to others, or for administrative purposes, which are identifiable and are controlled by the enterprise as a result of past events, and from which future economic benefits are expected to occur*". Johanson et al. (1998) have defined intangibles as knowledge, skills, and aptitudes at the individual level and as databases, technology, and routines at the organizational level. The terms intangibles, knowledge assets, and intellectual capitals are used interchangeably and refer to non-physical sources of value, i.e., claims to future benefits (Lev, 2001; Madhani, 2012).

Until the 1980s, the mainstream of business economics focused on the external environment (industry structure) as the ground for understanding competitive advantage. According to this theory, the role of management was to find a way to align the products of the firm and markets, given the bargaining power of customers and suppliers, entry barriers, and potential substitute products and technologies (Madhani, 2012). However, as the global business environment has become more competitive and dynamic, it requires firms to take an internal perspective, examine their intangible and tangible resources and capabilities, and identify how to integrate them to gain core competencies and competitive advantage (Hamel and Prahalad, 1990). This strategic management approach is based on the resource-based view (RBV) of the firm (Wernerfelt, 1984; Barney, 1991) and its refinement, i.e., the dynamic capabilities view (DCV) (Teece et al., 1997; Eisenhardt and Martin, 2000) which both emphasize matching any external opportunities with internal resources and capabilities (Madhani, 2012).

In these theoretical approaches, the role of intangibles as an array of different assets driving a firm's competitive advantage has emerged clearly. Extending the seminal idea by Penrose (1959) that resources should be appreciated for the 'services' they unfold and render, investments in multiple intangible assets enable the investing firm to embark successfully on the different activities of the innovation process (Montressor and Vezzani, 2016). For instance, R&D investments (Mansfield, 1984), software (Quintas, 1994), and training (Lynch and Black 1998; Bontis and Fitzenz, 2002; Bresnahan et al., 2002) provide firms with more research and education-based knowledge that can be used as a direct ingredient for new inventions. On the other hand, investments in design (Ravasi and Stigliani, 2012; D'Ippolito, 2014), reputation and branding (Aaker, 2007; Wong and Merrilees, 2008), and organization/business process improvements (Hsu and Fang, 2009; Carmona-Lavado et al., 2010; Squicciarini and Le Mouel, 2012) can enhance a firm's capability to utilize its inventions for producing more usable, appealing, and cost-effective products and services (Montressor and Vezzani, 2016).

It must be noted here that many authors have studied the effect of intangible assets or investments on firms' performance in the last decades. Most studies find a positive impact of intangible investment on firms' performance, measured by sales growth (Cucculelli and Bettinelli, 2015), total factor productivity (Dal Borgo et al. 2013), labor productivity (Roth and Thum, 2013) or innovativeness (Montresor and Vezzani, 2016; Ciriaci, 2011). A strand of these studies focuses on the effect of intangible investments on productivity, examining the mediating role of innovation (Crépon et al. 1998; Hall et al. 2013; Cincera et al. 2020). Crépon et al. (1998) developed and empirically validated a model [known as the Crépon-Duguet-Mairesse (CDM) model] according to which R&D investments positively affect productivity through the development of new products, services, or processes, or the improvement of existing ones. Hall et al. (2013) extended this model by including the intangible category of ICT. They found that R&D and ICT investments are both strongly associated with innovation and productivity, with R&D being more important for innovation and ICT investment being more critical for productivity. Cincera et al. (2020) further augmented the CDM model by investigating the impact of four intangible assets (R&D, ICT, new skills, and organizational improvement) on productivity both directly and indirectly through innovation enhancement. Their results suggest that all types of intangible investments positively affect labor productivity. However, ICT and the acquisition of new skills are more important for explaining productivity gains than R&D and organizational improvements. Moreover, Montressor and Vezzani (2016) found that firms' investments in developing intangibles using their own internal resources contributes much more to innovation performance than investments in acquiring intangibles externally. This finding seems reasonable as, from an RBV perspective, we could argue that creating and maintaining competitive advantage through VRIN (Valuable, Rare, Inimitable, Non-substitutable) resources is more intensely associated with the internal development of intangibles than intangibles purchased from external providers.

In addition, a significant body of literature points out that intangible assets contribute to business competitiveness by locating firms to higher value-added production stages in global value chains (GVCs). OECD (2013) and Baldwin and Evenett (2015) underlined that value accumulation had shifted away from the capital-intensive production (middle) stages to knowledge-intensive stages such as new concept development, R&D, and product design (upstream stages) or marketing, branding, and customer service (downstream stages). Therefore, the relationship between production activities (x) and value accumulation (y) forms a U-shaped curve known as the 'smiling curve' (Shih, 1992; Meng *et al.*, 2020).

Many studies support the 'smiling curve' concept arguing that advanced economies undertake knowledge-intensive tasks to retain their comparative advantage in global markets while outsourcing traditional large-scale manufacturing activities to developing economies (e.g., Dendrick et al., 2010; Mudambi, 2008). For instance, Rungi and Del Petre (2018), utilizing a large sample of EU firms, identified a U-shaped relationship between value-added accumulation and firms' positioning in the different stages of the supply chain. Therefore, an essential driver for a firm's upgrading in GVCs and, in turn, for competitiveness enhancement is investing in knowledge-based capital. Such investments drive productivity growth and determine the extent to which final products can be differentiated in consumer markets, determining the total value GVCs can create. For example, design features constitute a differentiation aspect and thus a competitive advantage of Apple's products, which, in turn, is protected against potential competitors through intellectual property rights (IPRs). The retainment of IPRs is a critical factor for multinational enterprises (MNEs) to secure dominant positioning and comparative advantage in global markets. They can prevent rivals from supplying imitable or substitutable inputs to GVCs. When a firm's input is easy to replicate, e.g., when it is not protected by IPRs or does not contain significant tacit knowledge, rival firms can easily develop substitutes for this input (OECD, 2013). As a result, the acquisition and control of crucial intangible assets are considered key elements for the activities of MNEs and the formulation of 'intellectual monopolies' in GVCs (Durand and Milberg, 2020; Cadestin et al., 2021).

2.2 Intangible Resources and Export Performance

A fundamental dimension of business competitiveness is export performance. Chen et al. (2016) reviewed 124 papers published between 2006 and 2014 to assess the determinants of export performance. They conclude that multiple theoretical approaches have been applied, new antecedents of export performance have been identified, and an increasing number of studies consider interaction and indirect relationships. Among these studies, the most widely used theoretical approach is the Resource-Based View (RBV) (50 papers), contingency theory (13 studies), Institutional-Based View (IBV) (12 studies), and Organizational Learning Theory (OLT) (11 studies). According to the RBV, a firm's valuable tangible and intangible resources and capabilities constitute pivotal elements in driving sustainable competitive advantage and shaping export performance (Barney et al., 2001; Katsikeas et al., 2000; Lages et al., 2009). Concerning firm capabilities, export market orientation (Sousa et al., 2008), as well as other strategic orientations (e.g., technology orientation), are found to significantly influence a firm's international behavior and its corresponding export performance (Hortinha et al., 2011). Some indicative studies about the influence of intangibles on export performance follow.

Pucar (2012) showed a positive influence of intellectual and human capital on the export growth in the food and beverages sectors and manufacturing of furniture and wood products in Bosnia and Herzegovina. Monteiro et al. (2019), through a survey of 265 Portuguese exporting companies, argue that intangible (i.e., financial, informational, and relational) resources have an indirect impact on export performance through dynamic capabilities and that entrepreneurial orientation directly impacts export performance. These results point to the critical role of dynamic capabilities by shedding light on how companies can use intangible resources to enhance export performance, also underlining the role of entrepreneurial orientation in leveraging business' export performance. In addition, Drenkovska and Redek (2015) point out that possessing intellectual capital is a necessary but not sufficient factor for manufacturing firms' global competitiveness, suggesting that adequate export orientation is needed to offer exposure to more advanced knowledge. Moreover, Rua (2018), by using survey data from 247 Portuguese SMEs from the textile industry, showed that innovation mediates the relationship between intangible resources and export performance.

3. Methodology

To achieve this study's research objectives, we devise a three-stage methodological approach. First, we develop a set of indicators to capture the utilization of different types of intangible assets and export performance at the firm level, drawing data from a large-scale survey on 1796 firms from seven EU economies that was implemented within the context of the H2020 Globalinto project (contract number: 822259). In the second stage, we combine firm-level data with sector-level (2-digit NACE Rev. 2) indicators on GVC participation, utilizing data from the newly released 2021 edition of OECD's Inter-Country Input-Output Tables (ICIOTs). In the third and final stage, we model these indicators and a set of control variables into simple regressions to study the contribution of different types of intangibles to export performance while considering the effects of GVC participation.

3.1 Datasets

The Globalinto large-scale survey conducted through the CATI[1] method between November 2020 and March 2021 involved 1796 firms in seven European countries (Denmark, Finland, France, Germany, Greece, Slovenia, and the United Kingdom)[2] and provided intangibles-related data. It aimed to a) develop a more comprehensive view of business' spending on intangible assets contributing to the improvement of the micro-level measurement approach, b) identify the factors influencing these investments, c) assess their impact on enterprise (economic and innovation) performance, and d) investigate the role of relevant policies and impact of Covid-19 pandemic on the level of these investments. Most of the firms are Small and Medium-sized Enterprises (20-249 full-time employees) (76.8%), whereas large firms (250+ full-time employees) account for 23.2% of the sample. In addition, 60% of firms are in manufacturing whereas 40% belong to services. Regarding sectors' technology and knowledge intensity, firms belonging to High & Medium-high technology (H&MHT) manufacturing sectors account for 30% of the total sample. Another 30% of the sample are knowledge-intensive services (KIS) firms. Medium-low-tech (MLT) and low-tech (LT) manufacturing firms account for 13.5% and 16.1% of the sample respectively. Moreover, 1 out of 10 firms belongs to less knowledge-intensive services (less KIS) and, more specifically, wholesale and retail trade.

In addition, this study draws data from the 2021 edition of OECD's ICIOTs, which provide I-O data for 45 2-digit NACE Rev. 2 sectors from 66 countries covering the period 1995-2018. We utilize these data

[1] Computer-Assisted Telephone Interviewing.
[2] More specifically, the sample allocation per country is as follows: 314 firms from France, 310 firms from Germany, 312 firms from UK and 215 from each smaller country (Denmark, Finland, Greece, and Slovenia).

to develop sector-level indicators of GVC participation for our sample firms, assuming that each firm will follow its parent-sector pattern of GVC participation.[3] The underpinnings of the computational procedure are presented below.

3.2 Development of indicators

This section presents the development of our models' variables. We use the Globalinto survey dataset to measure all variables except for the indicators of GVC participation, which derive from OECD's ICIOTs. **Table A1** in the Appendix provides a summary of the variables employed.

3.2.1 Intangible Assets

In general, three approaches seem to prevail regarding the measurement of intangible assets: a) The expenditures-based approach that uses aggregate estimates derived from firm expenditures on intangibles (e.g., Corrado et al., 2005), b) the labor-based approach that uses measures of labor input of workers in high skilled R&D, ICT, and Organisational Capital related occupations (Piekkola et al., 2011), and c) the stocks-based approach that uses direct measures based on stocks reported initially as assets on companies' balance sheets (e.g., Marrocu et al., 2012). Regarding the expenditures-based approach, Corrado et al. (2005, 2009) provided a coherent conceptualization of intangible assets and a quantification framework that directly corresponds to the products of selected innovative activities formulating the knowledge-based capital, as described in OECD's Oslo Manual for the measurement of innovation (OECD and Eurostat 2018). Building on preexisting literature, Corrado et al. (2005, 2009) grouped intangibles into three broad categories that include: i) Computerized information, ii) Innovative property, and iii) Economic competencies. Disaggregation of these categories leads to the identification of a large variety of assets that cover a) Computer software, databases, and related activities as parts of Computerized Information, b) R&D output, IPP assets, and overall Innovative Property and c) Entertainment, design, branding and marketing, and organizational capital as parts of Economic Competencies.

The hitherto limited business surveys on intangible assets use the expenditures-based approach; namely, they measure a firm's investments in diverse intangible types. Most of them [ONS, Imperial College London and NESTA (UK), 2009 & 2011; INAPP and ISTAT (Italy), 2013; Innobarometer survey, 2013 & 2015][4] focus on the following six intangible types: a) R&D, b) Training, c) Organization and Business Process Improvement, d) Software & Databases, e) Design, and f) Reputation & Branding. These surveys also differentiate between in-house spending and the purchase of intangible assets. The Globalinto Survey adopted this approach focusing on these six intangibles. Their definition follows:

1. **Research and experimental development (R&D)** comprise creative and systematic work undertaken (in-house or provided by external providers) in order to increase the stock of knowledge and to devise new applications of available knowledge [Oslo Manual, 2018, §

[3] Each firm allocated itself into its corresponding 2-digit NACE Rev. 2 activity code during the survey.
[4] The European Investment Bank Investment Survey (EIBIS) that is conducted annually since 2016, focus on four intangibles: R&D, ICT, new skills, and organizational improvements.

According to the *Frascati Manual 2015* definition (OECD, 2015: § 2.5 to 2.7)]. R&D activities must meet five criteria: (i) novel; (ii) creative; (iii) address an uncertain outcome; (iv) systematic; and (v) transferable and/or reproducible. R&D comprises basic research, applied research, and experimental development. This intangible category also includes the investment in **external knowledge acquisition** that includes purchasing patents and non-patented inventions, know-how, process blueprints, and other types of knowledge.

2. **Training activities** include all activities paid for or subsidized by the enterprise to develop knowledge and skills required for the specific trade, occupation, or tasks of a firm's employees (Oslo manual, 2018).
3. **Organization or business process improvement** involves work targeted at improving the efficiency and effectiveness of the enterprise, such as quality improvement programmes, business transformation projects, changes in management systems, and changes in the organization structure. This work can be undertaken through purchased consultancy services and/or in-house investment of managerial time.
4. **Software and Databases:** The in-house development and/or purchase of computer software, programme descriptions, and supporting materials for both systems and applications software (including standard software packages and customized software solutions). The design, creation, or acquisition of databases in electronic format and cloud services related to software and databases, use and/or development are also included.
5. **Design** includes a wide range of activities to develop a new or modified function, form, or appearance for goods, services, or processes, including business processes to be used by the firm itself. Product and service design aims to improve the attractiveness (aesthetics) or ease of use (functionality) of products and services. Process design, which can be closely linked to engineering, improves the efficiency of processes (OECD and Eurostat, 2018).
6. **Reputation and Branding** activities include market research and market testing, methods for product promotion, product advertising, and the promotion of products at trade fairs or exhibitions. They also include advertising for trademarks that are not directly related to a specific product, such as advertising linked to the firm's name and public relations activities that contribute to a firm's reputation and brand equity.

For each intangible category, the survey questionnaire first examined whether the firm made an investment in 2019 and secondly the level of this investment as a percentage of the same year's turnover. Our regression models used a series of variables related to investment intensity as a percentage of turnover. Firstly, we applied the investment intensity indicator for each intangible type, both for in-house (internal) and purchased (external) intangibles.[5] In addition, using these indicators, we calculated the intensity of a) the overall (in-house and purchased) non-R&D investments, b) the overall in-house investments, c) the overall investments in purchased intangibles, as well as d,) the total sum of investments (see more details in Table A1 in Appendix).

[5] In cases where the firm reported no investment in the specific intangible category, the specific variable equals to zero.

3.2.2 Export performance measurement

Early and more recent literature reviews revealed a low degree of consensus regarding the measurement of export performance (Katsikeas et al., 2000; Sousa, 2004; Beleska-Spasova, 2014; Chen et al., 2016). Katsikeas et al. (2000) reviewed more than 100 academic articles and identified 42 different performance indicators, including economic, non-economic and more generic measures. The economic indicators are sales-related (e.g., export sales ratio-intensity, export sales growth, export sales volume, export sales ratio-intensity growth), profit-related (e.g., export profitability, export profitability growth, export profit ratio), and market share-related (export market share, export market share growth). The non-economic measures include product-related (e.g., new products exported), market-related (e.g., export country/market number, new market(s) exports) and various indicators (e.g., contribution of exporting to scale economies or to company reputation, years of exporting). Instances of generic measures are the perceived export success and the degree to which export objectives have been fulfilled. Economic measures are most frequently used, including export sales intensity, export sales growth, export profitability, export sales volume, and export sales intensity growth.

Chen et al. (2016) show that export performance is captured in 53 different ways (23 different indicators used only once or twice). Although several broad taxonomies have been developed (e.g., EXPERF scale, Zou et al., 1998), no uniformly accepted export performance conceptualization and measurement still exist. Economic measures are most frequently utilized, especially export profitability, export sales growth, and export intensity. Among non-economic measures, satisfaction with export performance and export goal achievement are used relatively often. Moreover, the authors point out that as export performance is a multi-faceted phenomenon, multiple indicators are essential to capture the different aspects of the export performance construct (Chen et al., 2016).

Our study uses export intensity, i.e., the ratio of export sales to total turnover, to measure export performance. This indicator is calculated by summing up the percentages of the enterprise's turnover from exports in the European and international markets (outside Europe) (see more details in Table A1 in Appendix).

3.2.3 Controling for firm-specific characteristics

First, we introduce a control variable to capture each firm's size through the logarithm of the number of employees. Firm size is expected to have a positive impact on export performance. Given the relevant sunk costs required to enter foreign markets, larger firms might benefit from economies of scale in production, they may also appear less risk averse and more capable to obtain credit at lower costs (Melitz and Redding, 2014). We also introduce a control variable regarding the firm's ownership structure. Specifically, we examine whether it is a part of a multinational enterprise (MNE) or not, to account for the fact that firms belonging to a multinational group might be more capable of competing in international markets as they might have a larger international network. Furthermore, a binary variable indicating whether the enterprise made any Foreign Direct Investments (FDI) (i.e., by buying, starting or expanding a firm in another country) in the previous 3-year activity is also included. Indeed, FDI and export activity might be correlated since FDI investments might improve the knowledge of foreign markets (Benfratello et al., 2022). 1 out of 4 firms (25.2%) are part of a multinational group, and only 12.8% of firms made Foreign Direct Investments (FDI) during the period 2017-2019.

The last two control variables (being part of an MNE and engaging in FDI activities) further enable us to control for each firm's participation in GVCs. However, these variables do not capture nor quantify the orientation of this participation. To resolve this issue, we resort to more aggregate measures of GVC participation, which are described in the following section.

Lastly, we further introduce country and parent sector tech-level controls through dedicated dummy variables, i.e., the value 1 corresponds to the firm belonging to a specific country or sector and 0 otherwise.

3.2.4 Controling for GVC participation

The quantification of GVC participation goes hand-in-hand with significant measurement implications, as simple trade statistics (such as gross exports) become redundant when challenged to capture complex transactions that cross borders for production purposes (Johnson and Noguera, 2012; Koopman et al., 2014; Borin and Mancini, 2019). The development of various multinational input-output tables (such as OECD's ICIOTs) presented a promising solution to these caveats, as they provide the proper setting for the calculation of value-added (VA) based indicators that better depict GVC activities and global production linkages. Most of the GVC metrics and indicators available in relevant literature originate from the work of Hummels et al. (2001), where they developed indicators to capture vertical specialization at the country level, alternatively known as the 'import content of exports'. Building on their work, more recent studies developed accounting frameworks to trace the VA-content of international trade (Johnson and Noguera, 2012), and monitor trade and competitiveness in global markets under a GVC perspective.

In a seminal study, Koopman et al. (2014) combined and extended several earlier studies to provide a framework for decomposing gross exports at the country and the sector level into two components: embodied domestic VA (DVA) and embodied foreign VA (FVA). These two components were later utilized for the development of GVC participation indicators that depict each country's/sector's backward (related to FVA) and forward (related to DVA) participation as shares of its gross exports. Specifically, the originally proposed backward participation indicator measures the FVA embodied in gross exports as a share of the aggregate gross exports, and forward participation measures the share of DVA embodied in gross exports, which is exported to a partner country for production purposes and then re-exported into a third partner.

This framework was further extended by Wang et al. (2017) under a production (i.e., VA) based decomposition approach that refined the calculation of both backward and forward participation. We utilize this framework to develop indicators that measure backward and forward participation for each firm's parent sector as a share of its total output, drawing data from OECD's ICIOTs.[6] Furthermore, we use this refinement to better align our GVC participation indicators with the other variables deployed in the

[6] Details regarding the computational procedure of both indicators can be found in Wang et al., (2017).

models, which are expressed as shares of each firm's turnover. These two indicators are presented in the following equations:

$$gvc\_b_{i,c} = \frac{FVAinGX_{i,c}}{TO_{i,c}}$$

$$gvc\_f_i = \frac{DVAinGXp_{i,c}}{TO_{i,c}}$$

Where the term $FVAinGX_i$ represents the embodied FVA in the gross exports of sector i in country c, $DVAinGXp_{i,c}$ depicts the DVA from sector i in country c in the gross exports of a partner country and $TO_{i,c}$ refers to the total output of sector i in country c.

3.3 Model specification

The variables described in the previous section are modeled in the simple specification where export performance, proxied by the ratio of exports to turnover at the firm level, is the dependent variable and the independent variables include the different types of intangible assets (as investment shares to turnover) and a set of control variables for size, tech intensity and GVC activities. All continuous variables are included in the model as turnover shares (%) for interpretation purposes.[7] The year of reference for our data is 2019, and the model is presented in the following equation:

$$x\_to_i = a + \sum_{j=1}^{n} \beta_j \boldsymbol{X}_{j,i} + \boldsymbol{C}_i + \lambda_c + \varepsilon_i$$

Where x_to_i refers to the ratio of exports to turnover and the independent variables' vector $\boldsymbol{X}_{j,i}$ contains the intangibles' investment intensity as a percentage of turnover per type of asset and per origin (internally produced, externally purchased, and total intangibles). Vector $\boldsymbol{C}_i$ comprises the set of control variables. These include firm size (log of no. of employees), firm's ownership status (part of an MNE) and FDI activities, and the tech level of each firm's parent sector, i.e., high and medium-high tech (H&MHT), medium-low tech (MLT) and low tech (LT) for manufacturing firms, and knowledge-intensive (KIS) and non-knowledge-intensive (nonKIS) for business service firms. Given the unavailability of data at the firm level, the introduction of sector-level variables in our specification enables us to account for the impact of GVC activities in our model and specifically their link with export performance. We further refine these variables by introducing them lagged by one period, assuming that competitiveness benefits from GVC participation are not instantaneously gained (Tsakanikas et al., 2022; Constantinescu et al., 2019).[8] However, even in this case, the results should be interpreted with a grain of salt as the assumption that each firm follows the patterns of GVC participation (both backward and forward) of its parent sector omits

[7] Backward and forward participation indicators are an exception to this rule as they correspond to aggregate sector level data. However, we mildly attempted to remedy this issue by including both indicators as shares to total output rather than shares to gross exports.
[8] The introduction of lagged GVC participation indicators further provides a remedy against possible double counting (in the case of forward participation and export performance) and reverse causality implications in the model.

individual firm characteristics. Therefore, the GVC participation variables are introduced as control variables in the model to provide insights into the general effect of GVC orientation on competitiveness at the firm level rather than actual independent variables. Taken together with the firms' ownership status and FDI activities, they enable us to integrate the GVC dimension into our specifications and consider its impact on export performance. Lastly, λ_c corresponds to country fixed effects and ε_i depicts the error term.

Our estimation method includes the deployment of simple OLS estimators with robust standard errors. A summary list of the model variables, including definition (calculation), status (dependent, independent and control), and the data sources, is provided in **Table A1** in the Appendix.

4. Results and discussion

The empirical results of this study are structured into two different sections. The first section (4.1) presents several key descriptive statistics that lead to some salient facts regarding the utilization of different types of intangible assets and the export performance of the firms in our sample. In addition, we present some correlation statistics between the different types of intangible assets to preliminary explore their interlinkages. In section 4.2, we present and discuss the econometric results.

4.1 Descriptive analysis

4.1.1 Investment in Intangible Assets

Figure 4.1 shows the percentage of firms that make expenditures in each category of intangible assets, whereas **Table 4.1** depicts the intensity of this spending as a percentage of turnover (i.e., the mean and median values of spending in the relevant category) both for in-house and purchased activities.

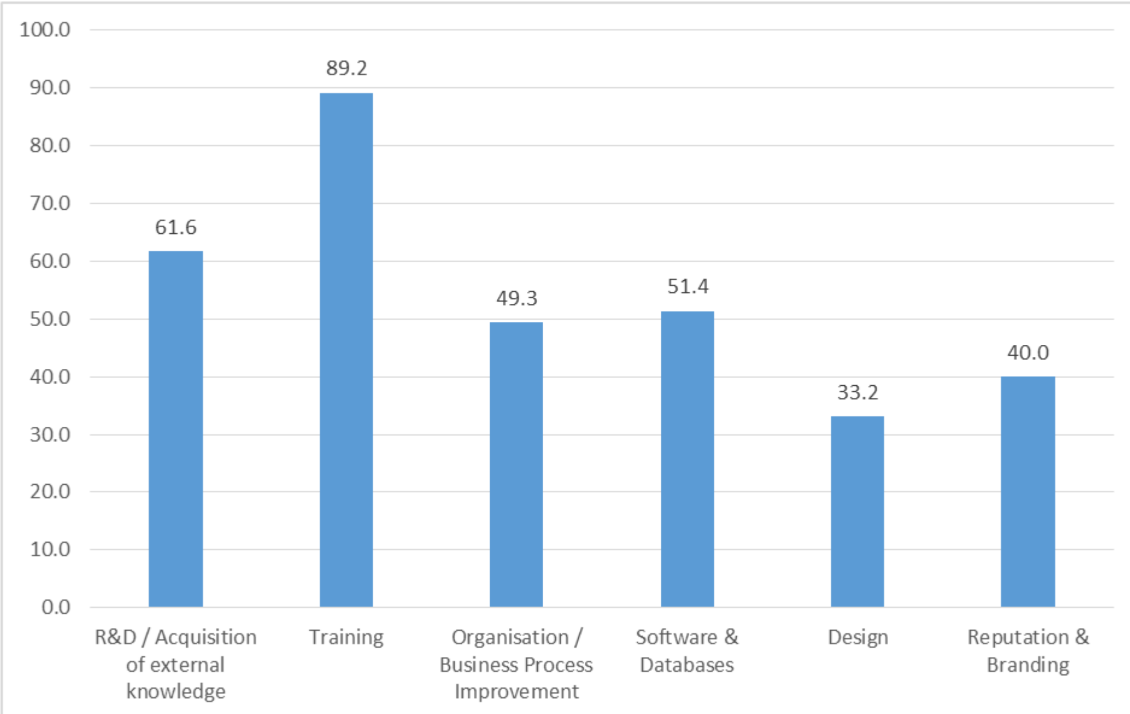

Figure 4.1 % of firms conducting intangible activity by asset type [N = 1792]

Figure 4.1 shows that most firms report some training activity (9 out of 10). A large part of them (over 61%) have R&D expenditures (and/or acquire external knowledge such as patents, process blueprints, or non-patented inventions). About half of the firms report expenditures on software/databases and organization/business process (OBP) improvement activities. Lower is the percentage of firms with reputation and branding expenditures (40%), whereas design exhibits the lowest incidence (1 out of 3 firms). Only 65 firms (3.6%) have no intangible activity.

Table 4.1 illustrates the average spending (in-house and purchased) by asset category as a percentage of turnover conditional on reporting some spending. R&D exhibits the largest average expenditure level followed by design and software and databases, while average spending on OBP improvement, reputation & branding, and training is relatively smaller. Furthermore, in-house investment is an important component in all asset categories, especially for R&D, design, and OBP improvement. Only for software and databases, external investment outweighs in-house spending.

Table 4.1 Average spending (in-house and purchased) by asset type (for firms reporting intangible activity)

Type of Intangible Asset	In-house			Purchased		
	Number of Firms	Mean	Median	Number of Firms	Mean	Median
R&D[9]	894	6.61	3	386	1.92	1
Training	996	1.21	0.5	1255	1.06	0.5
Organisation / Business Process Improvement	706	1.53	0.5	749	1.15	0.4
Software & Databases	777	1.59	0.18	804	1.69	0.9
Design	499	3.22	0.5	518	1.42	0.3
Reputation & Branding	612	1.28	0.5	641	1.21	0.5

Table 4.2 Average spending (in-house and purchased) by asset type (for all firms)

	Number of Firms	In-house (mean)	Purchased (mean)	Total
R&D[10]	1669	3.46	0.44	3.90
Training	1526	0.78	0.83	1.61
Organisation / Business Process Improvement	1597	0.67	0.50	1.17
Software & Databases	1627	0.73	0.79	1.53
Design	1687	0.95	0.42	1.37
Reputation & Branding	1682	0.46	0.43	0.90
TOTAL	**1351**	**6.88**	**3.85**	**10.73**

Table 4.2 further depicts the average expenditures intensity by asset category but for all firms (that could estimate it) and not only for firms reporting some activity in the relevant intangible. Again, R&D (particularly in-house) exhibits the highest percentage, but now it is followed by training because 9 out of 10 firms conduct this type of activity. Software & databases, design, and OBP improvement hold the third, fourth, and fifth place, respectively, whereas the lowest spending characterizes reputation & branding.

[9] The mean and median values regarding the expenditures in acquisition of external knowledge as % of turnover are 1.84% and 0.5% respectively (N=288).
[10] The mean value of the expenditures in acquisition of external knowledge is 0.3% (N = 1740).

Taking all six types of spending together, **Table 4.2** indicates that in-house activities outweigh purchased activities[11].

Figure 4.2 depicts the distribution of firms regarding their total investment as % of turnover[12]. The right-skewed distribution indicates a large share of firms with relatively low expenditures in intangible activities and a smaller share of firms with high expenditure intensity[13].

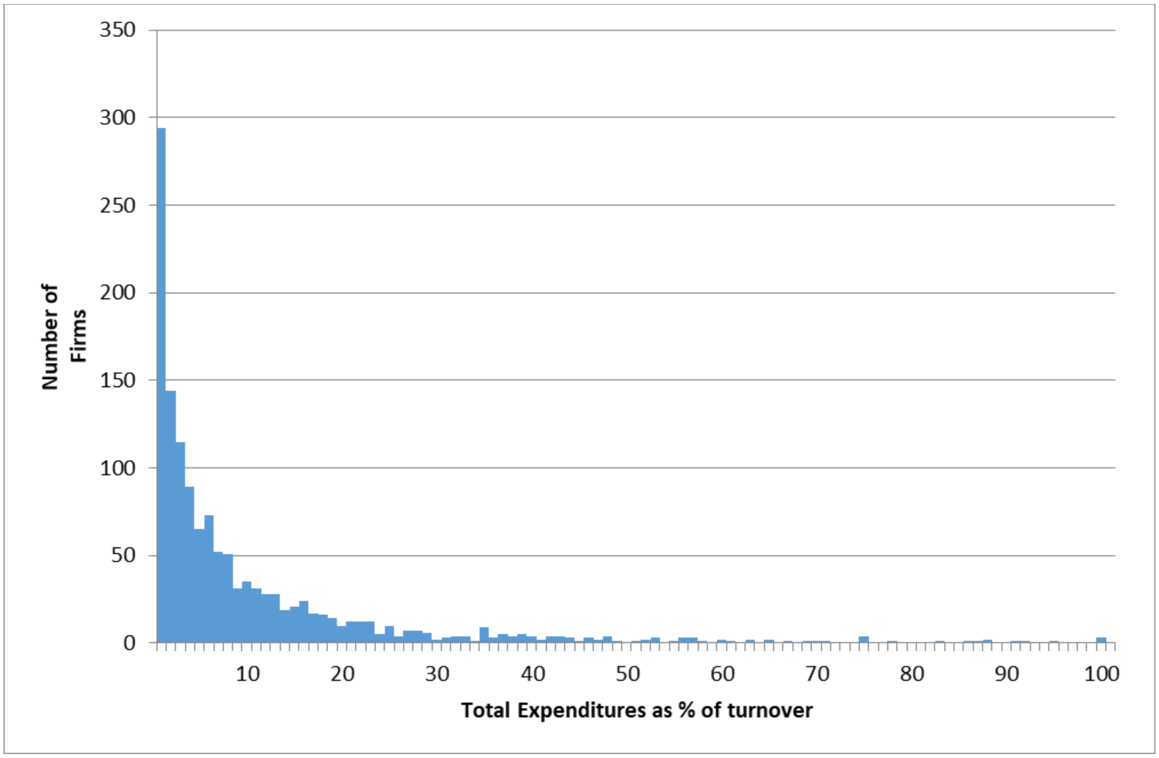

Figure 4.2 Total spending on intangible activities as % of turnover (N = 1351)

52.3% of firms spend less than or equal to 5% of their turnover in intangible assets, with 21.8% spending just up to 1% of their turnover. 1 out of 4 firms (27.3%) spends between 5% and 15% of turnover, while only 20.4% of firms invest more than 15% of their turnover in intangible assets (**Table 4.3**).

[11] We omitted from this calculation the firms that could not estimate their expenditures as % of turnover in at least one of the intangible asset categories, i.e., 445 firms. Therefore, the distribution refers to 1351 sample firms.
[12] The figure refers again to 1351 sample firms which could estimate their expenditures in all types of intangible assets.
[13] The median is 4.6 whereas the mean is 10.73.

Table 4.3 Total spending on intangible activities as % of turnover (N = 1351)

Spending (as % of turnover)	% of Firms
0 < ≤ 1%	21.8
1 < ≤ 5%	30.5
5 < ≤ 15%	27.3
15 < ≤ 25%	9.8
25 < ≤ 50%	6.8
> 50%	3.8

Regarding sectors' technology/knowledge intensity, KIS presents the highest expenditures, followed by H&MHT manufacturing. However, firms in MLT and LT manufacturing demonstrate relatively lower expenditures (these two sectors have similar mean and median values regarding in-house and purchased expenditures), whereas less KIS firms make the lowest investment in intangible assets. Therefore, sectors with high technology/knowledge intensity invest more in intangible activities and particularly conduct much higher in-house investments (**Table 4.4**).

Table 4.4 Average total spending (in-house and purchased) on intangible activities as % of turnover by sectoral group (technology/knowledge intensity) [N = 1351]

Sector	In-house		Purchased	
	Mean	Median	Mean	Median
H&MHT	7.03	3.80	3.28	1.68
MLT	2.88	1.00	3.13	1.00
LT	2.91	1.00	3.04	1.10
KIS	12.48	3.70	5.78	3.00
Less KIS	2.04	0.50	2.20	1.00

Table 4.5 illustrates that in-house investment prevails over purchased intangibles investment at the country level as well. In general, large countries except France[14] seem to make higher expenditures, especially for the development of in-house intangibles. On the other hand, Denmark and Finland display the highest in-house investments among small countries, as indicated by the relative mean and median values.

[14] The low mean and median values for France, particularly regarding in-house investments, can be partly attributed to the characteristics of the sample of French firms and specifically the relatively high representation of less KIS.

Table 4.5 Average total spending (in-house and purchased) on intangible activities as % of turnover by country [N = 1351]

Country	In-house		Purchased	
	Mean	Median	Mean	Median
Denmark	6.08	2.5	3.32	1.8
Finland	6.42	2.3	3.51	1.5
France	4.87	1	3.69	1.25
Germany	9.00	3	3.79	1.8
Greece	6.18	1.5	4.09	1.5
Slovenia	5.44	2	3.71	1.6
UK	9.05	3	4.62	1.6

4.1.2 Export Performance

There is significant heterogeneity in firms' export activity. Over 1 out of 4 firms (26.8%) are oriented exclusively towards their national market, and approximately 3 out of 10 firms have exports accounting for up to 25% of their turnover. In contrast, a significant number of firms (17.4%) report a very high export intensity exceeding 75% of their turnover (**Table 4.6**).

Table 4.6 Exports as % of the enterprise turnover (N = 1708)

	Number of Firms	% of Firms
0%	458	26.8
0 < ≤ 25%	523	30.6
25 < ≤ 50%	248	14.6
50 < ≤ 75%	182	10.6
75 < ≤ 100%	297	17.4

Regarding enterprise size classes, as expected, small firm exhibit a lower export intensity than medium and large firms (**Table 4.7**).

Table 4.7 Exports as % of turnover by firm size

Size category	Number of Firms	Mean	Median	ANOVA Sig.	Eta squared
Small firms (20-49 Employees)	737	27.4%	10%	0.000	0.011
Medium firms (50-249 Employees)	569	34.6%	20%		
Large firms (250+ Employees)	402	34.5%	20%		

Moreover, the sector appears to be a significant source of heterogeneity in enterprises' export orientation—firms in manufacturing display a much higher export activity than firms in services (**Table 4.8**). Furthermore, the manufacturing sectors that are more technology/knowledge-intensive exhibit higher export intensity, and a similar pattern is observed in services. Moreover, within less technology/knowledge-intensive manufacturing sectors, the export intensity variation is higher as in H&MHT the mean and median values are almost equal. In contrast, in LT, the mean value is almost two times higher. In addition, within KIS and less KIS, the difference between mean and median values is much higher, indicating an even higher firm heterogeneity within these sectors (**Table 4.9**). This fact implies that apart from the sector, additional factors may significantly influence the export performance of firms.

Table 4.8 Exports as % turnover by sectoral group (manufacturing vs. services)

Sectoral group	Number of Firms	Mean	Median	T-test Sig.	Eta squared
Manufacturing	1028	41.5%	35%	0.000	0.141
Services	680	16.3%	2%		

Table 4.9 Exports as % of turnover by sectoral group (technology/knowledge intensity)

Sectoral group	Number of Firms	Mean	Median	ANOVA Sig.	Eta squared
High & Medium-high-technology	515	50.3%	50%	0.000	0.175
Medium-low-technology	235	37.3%	30%		
Low-technology	278	28.6%	10%		
Knowledge-intensive services	504	17.8%	2%		
Less knowledge-intensive services	176	11.9%	1.9%		

4.1.3 Correlations

Table 4.10 provides (Pearson) correlation statistics among total (internal and external) expenditures in the various categories of intangible assets. The goal here is to explore the linkages between different types of intangibles by correlating their respective investments.

Table 4.10 Pearson correlation statistics for the investments in intangible assets (IA) per asset type.

IA Type	R&D_tot	train_tot	OC_tot	SD_tot	brand_tot	dsg_tot
R&D_tot	1.000					
train_tot	.165***	1.000				
OC_tot	.156***	.265***	1.000			
SD_tot	.212***	.185***	.247***	1.000		
brand_tot	.136***	.187***	.098***	.194***	1.000	
dsg_tot	.053	.079***	.041	.021	.124***	1.000

Note: *** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.

It shows that investments in almost all intangible assets are positively and significantly correlated with each other. Total R&D investments are mainly correlated with the corresponding investments in software and databases, followed by investments in training, organizational capital, and branding. On the other hand, R&D appears to be not correlated with design. The same holds for organizational capital and software and databases. Training is moderately correlated with organizational capital and, to a lesser extent, with software and databases and branding. Although weak, there is a positive correlation between training and design. In fact, design further presents a stronger correlation with branding. Organizational capital is moderately correlated with software and databases and, to a smaller extent, with branding. Lastly, branding and software and databases also present a positive and statistically significant correlation.

These positive correlations among the different types of intangibles may hint at possible multicollinearity issues when these assets (i.e., investments) are considered together in the same specification. However, their magnitude is below 0.3 (i.e., imply at best moderate correlations) in every case, and the mean VIF test score is 2.44, indicating no multicollinearity issues are present. The same holds when these assets are disaggregated to internal (in-house developed) and externally purchased assets (mean VIF test score at 2.00). From this disaggregation, two key results derive. First, the origin of resources used for intangibles development appears to matter as internally developed intangibles present higher degrees of pair-wise correlations between them. Therefore, when a firm is engaged in the in-house production of one type of intangible asset, it is more likely to be engaged in the internal production of other types. The same holds for external intangibles, hinting that firms that purchase a certain type of intangible asset are also more likely to purchase other types. Second, internal, and external investments for the same intangible asset are strongly correlated, presenting a non-rivalrous relationship between in-house and purchased intangibles, which can be translated as a sign of complementarity between them. The corresponding Pearson correlation statistics for the disaggregated assets per type and origin are provided in Table (4.11).

Table 4.11 Pearson correlation statistics for the investments in intangible assets (IA) per asset type and per origin (internal and external).

IA Type	R&D_int	R&D_ext	train_int	train_ext	OC_int	OC_ext	SD_int	SD_ext	brand_int	brand_ext	dsg_int	dsg_ext
R&D_int	1.000											
R&D_ext	.216***	1.000										
train_int	.171***	.188***	1.000									
train_ext	.040	.239***	.208***	1.000								
OC_int	.143***	.130***	.180***	.147***	1.000							
OC_ext	.072***	.207***	.116***	.231***	.354***	1.000						
SD_int	.205***	.097***	.143***	.058**	.261***	.099***	1.000					
SD_ext	.133***	.128***	.172***	.115***	.151***	.160***	.389***	1.000				
brand_int	.148***	.153***	.195***	.137***	.118***	.041	.181***	.189***	1.000			
brand_ext	.041	.053*	.044	.083***	.041	.058**	.027	.112***	.361***	1.000		
dsg_int	.051*	.006	.073***	.027	.031	.003	.029	.019	.142***	.024	1.000	
dsg_ext	.017	0.043	0.057**	.040	.033	.052*	-.004	-.005	.098***	.024	.182***	1.000

Note: *** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.

4.2 Econometric results

We present three different panels to provide a structured interpretation of our econometric results. First, in panel 1 (Table 4.12), we introduce intangibles' variables in the specification aggregated to total intangibles in column (1) and disaggregated to internal and external intangibles in column (2).

Table 4.12 Model results for aggregate intangibles (total, internal, and external)

Dep. Variable: x_to	(1)	(2)
intan_tot	.174***	
intan_int		.172***
intan_ext		.177
gvc_b	.332	.332
gvc_f	.523**	.523**
FDI	.116***	.116***
MNE_group	.180***	.180***
lempe	.005	.005
H&MHT	.324***	.324***
MLT	.242***	.242***
LT	.185***	.185***
KIS	0.68**	0.68**
constant	0.089	0.089
Country Fixed Effects	Yes	Yes
Observations	1348	1348
F-test	44.85***	42.23***
R^2	.319	.319

Note: *** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.

According to column (1), investment in intangible assets provides a positive and statistically significant contribution to export performance, suggesting that the acquisition and control of intangibles are key elements for firm competitiveness in global markets (Mudambi, 2008; OECD, 2013; 2021; Durand and Milberg, 2020). When these assets are disaggregated into internally developed and externally purchased intangibles in column (2), we find that the origin of intangibles indeed matters for firm competitiveness, as it is the share of investments in the in-house intangibles that provides the competitiveness gains. On the other hand, externally purchased intangibles do not provide any statistically significant contribution to firm export performance. These findings suggest that investing more in intangibles does not necessarily boost export performance and, in turn, competitiveness, while their choice to dedicate internal resources to the development of intangible assets appears to do so. Internal development of intangibles is related to the strategic choice of 'making' rather than 'buying' intangibles. External development of IAs could pose problems of knowledge fragmentation and issues of coordination and control, which could negatively affect competitive advantage (Montressor and Vezzani, 2016).

Therefore, firms should be cautious in leaving the expansion and improvement of intangibles to external providers, as their innovative development mostly depends on specific capabilities that are different and not easily replicable by the market.

When examining the control variables that capture the GVC dimension of firms' activities, we find that forward participation in GVCs positively contributes to export performance while backward participation is insignificant. These results should be interpreted with caution as they link firm with sector level evidence. On the other hand, they provide helpful information regarding the orientation of GVC activities that each firm should undertake to secure competitiveness gains based on its parent-sector GVC participation patterns. In this sense, our results lead to the conjecture that our sample firms should target the engagement in forward-oriented upstream activities, which are intangible-intensive and secure significant competitiveness gains along GVCs (Mudambi, 2008; OECD, 2013; Meng et al., 2020). This conjecture is further supported by the positive effects of intangible investments on firm export performance and the positive contribution of the additional control variables that capture the GVC dimension. In detail, being part of an MNE appears to be a significant factor that boosts export performance as a likely consequence of the fact that many trade transactions that cross borders are actually in-house activities implemented by the same MNE. Another reason relates to the significant market power concentrated in MNEs and the ease of access to multiple markets across the world. Accordingly, engagement in FDI activities boosts export performance as it further reflects an openness to international trade transactions.

Another set of results reflects the effects of the tech intensity of the firms according to their parent sector classification. In detail, we find that being a high- and medium-high tech manufacturing firm can be translated into higher export gains than medium- and low-tech. This finding also presents initial evidence on the role of R&D for firm competitiveness, as the high-tech classification of manufacturing activities is based on the relationship between R&D investments and VA. We further find that service firms experience limited export gains compared to manufacturing firms and that knowledge-intensive service firms exhibit higher export activity than non-knowledge intensive ones.

In the second panel (Table 4.13), we disaggregate intangibles both per type of intangibles (by distinguishing between investments in R&D and non-R&D assets), and per origin, by providing results for total intangibles in column (1) and external and internal intangibles in column (2).

Table 4.13 Model results for intangibles per origin (total, internal, and external) and per type (R&D, non-R&D).

Dep. Variable: x_to	(1)	(2)
R&D_tot	.314***	
R&D_int		.248***
R&D_ext		1.80***
nonR&D_tot	.066	
nonR&D_int		.014

nonR&D_ext		.066
gvc_b	.345	.359
gvc_f	.518**	.544**
FDI	.116***	.114***
MNE_group	.180***	.180***
lempe	.003	.003
H&MHT	.321***	.315***
MLT	.243***	.239***
LT	.184***	.181***
KIS	.068**	.066**
constant	.094	.086
Country Fixed Effects	Yes	Yes
Observations	1348	1348
F-test	42.96***	39.11***
R^2	.321	.324

Note: *** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.

We observe that the contribution of intangible assets to export performance is attributed to investments in R&D, while non-R&D assets appear to provide insignificant effects. First, this finding is consistent with previous literature indicating that R&D is a critical factor for firm growth and international competitiveness (e.g., Benfrattelo et al., 2022; Orts and Marti, 2018, Wagner, 2006). This may be attributed to the fact that R&D activity may positively affect a firm's export intensity by creating a higher probability of introducing product/process innovations and/or by increasing firm absorptive capacity (Benfratello et al., 2022). In turn, introducing new products and/or cost savings generated by innovative activities may foster firms' competitiveness, allowing them to enter new foreign markets and/or export new products, thus enlarging export baskets and the number of destination markets (Benfratello et al., 2022). Second, it further reflects the increased importance of R&D compared to the rest of the intangible assets, irrespective of whether the firm engages in manufacturing or service activities. Furthermore, when accounting for the origin dimension of resources used for intangibles development, we find that both internal and external R&D investments enhance export performance. This finding indicates the non-rivalrous and complementary nature of internally developed and purchased R&D knowledge.[15]

The control variables' contribution to firm export performance mirror the findings presented and discussed in Table 4.12. In short, forward participation in GVCs is acknowledged as the preferable type of GVC participation orientation for our sample firms. Firms that participate in MNE groups and engage in FDI activities benefit in terms of export performance, while high tech manufacturing firms and knowledge-

[15] The extreme coefficient of investments in externally purchased R&D in column (2) of Table 4.12 is a likely consequence of specific outliers of our sample which correspond to firms engaged in disproportionated external investments in R&D assets. We select to retain these outliers in our sample at this early stage to provide a full and coherent picture of the survey results and aim to investigate in-depth this issue in future research efforts.

intensive service firms present higher export gains compared to firms in lower-tech and knowledge classes.

However, the panel in Table 4.13 presents an aggregate classification of non-R&D intangibles and prevents the reader from identifying individual intangibles that may contribute to firm export performance. Therefore, we disaggregate non-R&D intangibles into different asset types, both internal and external, in the third panel presented in Table 4.14.

Table 4.14 Model results for intangibles per investment (total, internal, and external) and asset type

Dep. Variable: x_to	(1)	(2)
R&D_tot	.327***	
R&D_int		.265***
R&D_ext		1.85***
train_tot	.287	
train_int		-.030
train_ext		.259
OC_tot	-.410	
OC_int		-.387
OC_ext		-.585
SD_tot	-.051	
SD_int		-.384
SD_ext		.262
brand_tot	.240	
brand_int		.616
brand_ext		-.404
dsg_tot	.117	
dsg_int		.071
dsg_ext		.209
gvc_b	.345	.363
gvc_f	.517**	.552**
FDI	.115***	.113***
MNE_group	.180***	.181***
lempe	.004	.004
H&MTC	.323***	.319***
MLT	.247***	.243***
LT	.187***	.188***
KIS	.069**	.068**
constant	.094	.082

Country Fixed Effects	Yes	Yes
Observations	1348	1348
F-test	35.54***	28.65***
R^2	.323	.328

Note: *** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.

It is evident from Table 4.13 that the contribution of different types of intangible assets to export performance is aligned with those of the aggregate non-R&D category, as no individual asset other than R&D – internal or external – provides any meaningful contribution to export performance.

A common finding across all three panels is that firm size is not identified as a driving factor for export performance. This is a rather intriguing finding, as size is widely acknowledged as a significant factor for firm growth and competitiveness. We conjecture that our finding is related to the presence of the MNE dummy in the specifications and the fact that firms which participate in MNE business groups are – in most cases – large. In this case, the positive and statistically significant coefficient of the MNE variable across all three panels further depicts the positive effects of firms' size to export performance.

5. Concluding remarks

This paper explores a firm's export performance determinants, focusing on the role of intangible investments also controlling for participation in global value chains. Our findings suggest that total investment in intangible assets positively impacts export performance, suggesting that acquiring and controlling intangibles are critical for firm competitiveness in global markets. When disaggregating intangible assets investment in in-house development (i.e., using own resources and staff) and acquisition from external providers, it appears that the share of investments in the in-house intangibles matters for promoting export intensity and, therefore, boosting competitiveness. This implies that the internal development of intangibles is related to the strategic choice of 'making' rather than 'buying' intangibles. On the other hand, external acquisition of intangibles may pose knowledge fragmentation and control issues, negatively affecting competitive advantage.

To further examine the role of intangibles on export performance, we distinguish between investments in R&D and non-R&D intangible assets (both in aggregated and disaggregated forms) to identify individual intangibles that may contribute to firm export performance. Our findings show that R&D investments appear to be essential contributors to export intensity while non-R&D intangibles have a negligible effect. This finding reflects the increased importance of R&D investments for firm growth and competitiveness compared to the other categories of intangible assets. Moreover, both in-house R&D investments and externally acquired knowledge seem to be important determining factors of export performance, suggesting the non-rivalrous and complementary nature of internally developed and purchased R&D knowledge.

When controlling for participation in global value chains, research results indicate that forward participation in GVCs positively affects export performance while backward participation appears to be insignificant. Although these results should be interpreted with caution as they link firm and sector level evidence in a rather aggregate manner, they indicate that firms might target engaging in forward-oriented upstream activities, which are intangible-intensive, to secure significant competitiveness gains along GVCs. This finding is further supported when using additional control variables that capture the GVC dimension at the firm level, such as being part of a multinational group and engaging in FDI activities.

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Appendix

Table A1: Summary list of variables included in the model

Variable	Type	Definition	Source
intan	Continuous	Aggregate investments in intangibles (all assets) as % of firm turnover	Globalinto Survey
R&D	Continuous	R&D investments as % of firm turnover	Globalinto Survey
nonR&D	Continuous	Investments in non R&D intangible assets (aggregate) as % of firm turnover	Globalinto Survey
train	Continuous	Investments in training activities as % of firm turnover	Globalinto Survey
OC	Continuous	Investments in organization or business process improvement as % of firm turnover	Globalinto Survey
SD	Continuous	Investments in software and databases as % of firm turnover	Globalinto Survey
brand	Continuous	Investments in reputation and branding as % of firm turnover	Globalinto Survey
dsg	Continuous	Investments in design as % of firm turnover	Globalinto Survey
gvc_b	Continuous	Foreign value added embodied in gross exports as % of total output (parent-sector level)	OECD's ICIOTs
gvc_f	Continuous	Domestic value added embodied in the gross exports of a partner as % of total output (parent-sector level)	OECD's ICIOTs
FDI	Binary	**1:** The firm made any Foreign Direct Investments (FDI) in the last three-year period **0:** Otherwise	Globalinto Survey

MNE	Binary	**1:** Firm being part of a multinational enterprise group **0:** Otherwise	Globalinto Survey
lempe	Continuous	Natural logarithm of the firm's no. of employees	Globalinto Survey
H&MHT	Binary	**1:** Firm belongs to a high or medium-high tech parent-sector **0:** Otherwise	Globalinto Survey
MLT	Binary	**1:** Firm belongs to a medium-low tech parent-sector **0:** Otherwise	Globalinto Survey
LT	Binary	**1:** Firm belongs to a low tech parent-sector **0:** Otherwise	Globalinto Survey
KIS	Binary	**1:** Firm belongs to a knowledge intensive parent-sector **0:** Otherwise	Globalinto Survey