ROMA TRE
UNIVERSITÀ DEGLI STUDI

PH.D. COURSE IN ECONOMICS
PRODUCTIVE SYSTEMS AND PUBLIC POLICY

XXXI CICLO

Global value chain participation and firms' performance during the Great Recession

Ph.D. student: Ilaria Salvati

Thesis committee: Prof. Anna Giunta, Prof. Silvia Nenci, Prof. Luca Salvatici

Coordinator: Prof. Luca Salvatici

ROMA TRE
UNIVERSITÀ DEGLI STUDI

Ph.D. in Economics
XXXI CICLO

Ph.D. Dissertation

GLOBAL VALUE CHAIN PARTICIPATION AND FIRMS' PERFORMANCE DURING THE GREAT RECESSION

Ph.D. student: Ilaria Salvati

Thesis committee: Prof. Anna Giunta, Prof. Silvia Nenci, Prof. Luca Salvatici

DOTTORATO IN ECONOMIA
UNIVERSITÀ DEGLI STUDI ROMA TRE

Table of contents

Introduction

Started at the end of 2008, the Great Recession has been the most severe economic crisis the world has experienced since World War II. In volume terms, world gross domestic product (GDP), exports and imports fell by 2.3%, 12.2% and 12.9% respectively, while the European Union (EU) countries were even more affected by the crisis, recording a reduction of 4.2% in GDP, 14.8% in exports and 14.5% in imports (WTO, 2010). Looking at Eurostat data, Landini *et al.* (Landini, Arrighetti, & Lasagni, 2015) signal that the number of active manufacturing companies in the Eurozone has decreased by 7% between 2008 and 2012. Countries located in the Eurozone periphery have been hit particularly hard by the crisis, with Italy and Spain recording a reduction in the number of active firms between 6% and 9%. The drop of manufacturing companies has been even bigger, concerning the 9% of Italian enterprises and the 17% of the Spanish ones.

In such context, the main purpose of this work is to investigate what happened to firms, taking into account their performance in relation to a crucial aspect of their internationalization and organizational strategies: their involvement in global value chains (GVCs).

The latter consists in a phenomenon acknowledged as being one of the most pervasive changes the world economy has experienced since the last decades of the 20th century (Krugman, 1995), fostered by the spread of the new Information and Communication Technologies (ICTs), which have led to globalization's second unbundling (R. Baldwin, 2011). Connecting technologies in transportation and communication, together with lower trade and investment barriers and liberalized domestic markets (Amador & Cabral, 2016) have allowed for production processes to be more and more fragmented, organized among various firms, belonging to the same group or independent from one another, not necessarily located in the same country. In other words, the value chains (Porter, 1985) – consisting in the series of tasks needed to bring a product or a service from its conception to its final use – have become global.

The development of international production networks has had several implications in macroeconomic terms, such as redefining national competitive advantages (Cheng, Rehman, Seneviratne, & Zhang, 2015) – since competition occurs more and more at the task level (R. Baldwin & Robert-Nicoud, 2014) – or intensifying the 2008-2009 big trade collapse (R. Baldwin, 2009). We hint at them in the introduction of the first chapter of this work (section 1.1), after which we try to highlight the absence of a unique framework of analysis for

investigating global value chains (section 1.2). Section 1.3. begins introducing the main theme of the first chapter, dedicated at carrying out a systematization of the literature analysing firms' participation to and positioning within global value chains and their implications for companies' performance. Such review appeared necessary in order to prepare for the empirical works carried out in chapters two and three, especially given the fact that the research studying GVCs at the firm level faces several challenges. These are mainly due to the lack of good quality micro data, which have led to a fragmented production of articles relying on a number of different data sources and applying various indicators in order to account for companies' engagement in international production networks. Thus, in section 1.4. we illustrate how firms' GVC participation and positioning have been measured so far in the literature, while section 1.5 tackles the issue of how to evaluate the governance of international production networks, that is to say the nature of the relationships linking the GVC players. Finally, section 1.6. represents the core of the first chapter of this work, trying to summarize the insights concerning firms' performance and growth in relation to their engagement in global value chains and to the mechanisms that govern them. The literature generally agrees on companies participating to international production networks as performing better than non-participants (e.g. J. Baldwin & Yan, 2014; Veugelers, Barbiero, & Blanga-Gubbay, 2013), while firms located in an intermediate position along the chain, i.e. selling to other companies, usually show a worse performance with respect to those producing for the final market (e.g. Accetturo & Giunta, 2017; Agostino, Giunta, Scalera, & Trivieri, 2016).

However, the performance indicators researchers commonly focus on are usually those referring to firms' productivity (both total factor productivity and labour productivity), with other variables sometimes taken into account, such as companies' sales growth or their intensive margin of trade. In the second and the third chapters of this work, we carry out two empirical investigations to assess whether and how GVC participation and positioning are related to companies' performance, looking at aspects that have not been much investigated so far. In fact, in chapter 2 we focus on firms' ability to survive the Great Recession and stay in the market, while chapter 3 takes into account those companies having endured the crisis and analyses the employment variation they have experienced.

More specifically, chapter 2 looks at the relation between companies' engagement in international production networks and their probability to survive during the Great Recession. Again, this has been the topic of few research, with literature on firms' survival mainly focusing on the role of age and size (e.g. Dunne, Roberts, & Samuelson, 1988; Jovanovic, 1982; Sutton,

1997) (section 2.1). In a recent work, Meliciani and Tchorek (2017) attempt at assessing whether firms involved in GVCs had higher or lower chances to exit the market during the recent economic crisis, but they do not do so by resorting to an indicator of GVC participation or positioning. We focus on the survival patterns of companies located in France, Germany, Italy and Spain, whose data are retrieved from the EFIGE database (section 2.2). We implement an empirical investigation strategy based on measures of GVC participation modes built by restricting the scope of those identified by Veugelers *et al.* (2013), while GVC positioning is accounted for by looking at the share of turnover originated from selling produced-to-order goods to other companies, as done, for instance, in Accetturo *et al.* (Accetturo, Giunta, & Rossi, 2011). Our investigation strategy is based first on probit models (section 2.2.1), then repeated relying on duration models, specifically on the Cox one (section 2.2.2). We find that engagement in international production networks did not play a role in increasing or decreasing firms' survival, as GVC participants appear to have no significant advantage or disadvantage with respect to exclusively domestic companies. However, in line with the literature signalling the performance gap of intermediate firms, we observe that the latter were actually more likely to fail during the crisis.

As anticipated, in chapter 3 we take into account those firms having managed to survive the Great Recession, investigating whether the employment variation they have experienced between 2008 and 2014 is related to their engagement into GVCs. To the best of our knowledge, there is almost no evidence linking enterprises' involvement in international production networks and employment growth at the company level. In fact, the literature on firms' growth (section 3.2) usually takes into account variables such as size and age (e.g. Barba Navaretti, Castellani, & Pieri, 2014; Grazzi & Moschella, 2017), while, for instance, another strand of research looks at the employment variation generated by companies' internationalization strategies linked to the development of international production networks, such as offshoring (e.g. Hijzen & Swaim, 2007). In our research, we rely again on EFIGE data for French, German, Italian and Spanish firms (3.3) and we resort to the same GVC participation and positioning measures applied in chapter 2. First, we estimate the relation between companies' involvement in international production networks and their employment growth by running OLS regressions (section 3.4.1) and quantile regressions (section 3.4.2). Results indicate a significant and positive association between GVC participation (one-way and two-way modes) and employment growth at the firm level, while three-mode engagement in international production networks appears relevant in terms of increase in labour force only for those firms having

recorded highest employment growth rates. In section 3.4.2, we try to single out the impact of GVC participation on firms' employment variation rates by borrowing from the impact evaluation analysis techniques and applying the propensity score matching. By doing so, we are able to compare companies that are very similar under several aspects, except for their involvement in global production networks. Our results confirm a positive impact of GVC participation on firms' employment growth.

References

Accetturo, A., & Giunta, A. (2017). Value chains and the great recession: Evidence from Italian and German firms. *International Economics*. https://doi.org/10.1016/j.inteco.2017.07.002

Accetturo, A., Giunta, A., & Rossi, S. (2011). *The Italian firms between crisis and the new globalization*. *Occasional Papers, Bank of Italy* (Vol. 86).

Agostino, M., Giunta, A., Scalera, D., & Trivieri, F. (2016). Italian Firms in Global Value Chains : Updating our Knowledge. *Rivista Di Politica Economica*, *VII–IX*.

Amador, J., & Cabral, S. (2016). Global value chains: A survey of drivers and measures. *Journal of Economic Surveys*, *30*(2), 278–301.

Baldwin, J., & Yan, B. (2014). *Global Value Chains and the Productivity of Canadian Manufacturing Firms*. *Economic Analysis Research Paper Series*.

Baldwin, R. (Ed.). (2009). *The great trade collapse: Causes, consequences and prospects*. Cepr.

Baldwin, R. (2011). *Trade And Industrialisation After Globalisation's 2nd Unbundling: How Building And Joining A Supply Chain Are Different And Why It Matters* (NBER Working Paper Series No. 17716). Cambridge, MA.

Baldwin, R., & Robert-Nicoud, F. (2014). Trade-in-goods and trade-in- tasks : An integrating framework. *Journal of International Economics*, *92*(1), 51–62.

Barba Navaretti, G., Castellani, D., & Pieri, F. (2014). Age and firm growth: evidence from three European countries. *Small Business Economics*, *43*, 823–837.

Cheng, K., Rehman, S., Seneviratne, D., & Zhang, S. (2015). *Reaping the Benefits from Global Value Chains*. *IMF Working Paper*.

Dunne, T., Roberts, M. J., & Samuelson, L. (1988). Patterns of Firm Entry and Exit in U . S . Manufacturing Industries. *The RAND Journal of Economics*, *19*(4), 495–515.

Grazzi, M., & Moschella, D. (2017). Small, young, and exporters: New evidence on the determinants of firm growth. *Journal of Evolutionary Economics*, *28*(1), 125–152.

Hijzen, A., & Swaim, P. (2007). Does offshoring reduce industry employment? *National Institute Economic Review*, *201*, 86–96.

Jovanovic, B. (1982). Selection and the Evolution of Industry. *Econometrica*, *50*(3), 649–670.

Krugman, P. (1995). Growing World Trade: Causes and Consequences. *Brookings Papers on Economic Activity*, *26*(1, 25th Anniversary Issue), 327–377.

Landini, F., Arrighetti, A., & Lasagni, A. (2015). *Economic Crisis and Firm Exit: Do*

Intangibles Matter? (LUISS Guido Carli / School of European Political Economy No. 10).

Meliciani, V., & Tchorek, G. (2017). *Global value chains, innovation and firms' performance during the crisis* (NBP Working Paper).

Porter, M. E. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. The Free Press.

Sutton, J. (1997). Gibrat ' s Legacy. *Journal of Economic Literature*, *35*(1), 40–59.

Veugelers, R., Barbiero, F., & Blanga-Gubbay, M. (2013). Meeting the manufacturing firms involved in GVCs. In R. Veugelers (Ed.), *Manufacturing Europe's future* (Bruegel Bl, pp. 107–138). Bruegel.

WTO. (2010). *World Trade Report 2010: Trade in natural resources*.

1. Firms in global value chains: a literature review

This chapter aims at attempting a systematization of the literature concerning firms and their engagement in international production networks. In particular, we are going to discuss the few data sources available to researchers investigating global value chains at the micro level and we are going to illustrate how the literature has dealt with the measurements issues of both GVC participation and positioning, also mentioning how GVC governance has been taken into account. We conclude by illustrating the main findings of the research, underlining how firms participating to GVCs are usually better performers, how intermediate firms often appear to suffer from a (bridgeable) performance gap with respect to the final ones, and how relationships linking companies involved in international production networks can be relevant in terms of their performance and growth.

1.
Firms in global value chains: a literature review

1.1 Introduction

First proposed by Michael E. Porter (1985), the expression 'value chain' (VC) refers to "the full range of activities required to bring a product or service from conception through the different phases of production, delivery to final consumers, and final disposal after use" (Kaplinsky & Morris, 2001, p. 4). Until the second half of the XIX century all these tasks had to be carried out close to the final market, in order to minimize the costs and the difficulties of reaching customers. Then, thanks to the technological innovation brought about by the steam engine, transportation costs began to lower, so that goods could be produced and later consumed in different places: the so-called globalisation's "1st unbundling" started, and international trade flourished. After roughly a century, around the mid-1980s, the Information and Communication Technology (ICT) revolution radically cut transmission costs by allowing for new, fast and cheap communication channels to be used; that triggered globalisation's 2nd unbundling (R. Baldwin, 2011). As noted by Baldwin (2006), the last wave of globalization differs from the first one in terms of "competitive fields". In fact, while dropping transportation costs allowed international competition to occur primarily at the sector-level, in terms of final goods, the second half of the 1980s started seeing international competition happening on a smaller scale, at the level of single production activities. Connecting technologies in transportation and communication, together with lower trade and investment barriers and liberalized domestic markets (Amador & Cabral, 2016a), have allowed firms to make new organizational choices, giving them the possibility to break down their production processes and source the inputs needed where and how they consider best, be it in their home country or abroad, be it from affiliates or external suppliers. The increased tradability of services[1], too, has favoured the implementation of these new organizational strategies by firms (Deardorff, 2001). Therefore, companies' value chains have become more and more articulated and internationally fragmented, because firms are now able to exploit differences in factor costs and expertise across countries, increasing the advantages of specialization. The "slicing up" of the value chain

[1] Blinder (2006) considers the ICT revolution as a "third industrial revolution", since it has greatly broadened the range of tradable services.

has been indicated by Krugman (1995) as one of the main changes having affected the global economy in the last decades of the past century, boosting trade especially in intermediate products. It might have even determined a switch in the object of trade itself, which concerns more and more "tasks" instead of goods, therefore significantly redefining the concept of national comparative advantages (R. Baldwin & Robert-Nicoud, 2014; G. M. Grossman & Rossi-Hansberg, 2006).

In fact, countries participating in 'global value chains' (GVCs) gain benefits beyond those traditionally associated with trade in final goods. Thanks to production fragmentation and task specialization, they can exploit finer comparative advantage niches and benefit more from economies of scale and scope (Cheng, Rehman, Seneviratne, & Zhang, 2015). Moreover, in order to grow, countries do not need to be internationally competitive on an industry level. In other words, it is now possible to join value chains without having to "build it" by setting up a deep and broad industrial base. Nevertheless, according to the so-called 'smile curve' (cf. section 2), the benefits of participating to global value chains are mainly dependent on the share of the total value produced that a firm (or a country, speaking in macro terms) is able to capture. That, in turn, depends on the position it occupies along the chain and on its ability to improve it, by moving towards higher value-producing tasks (the so-called process of 'upgrading'). Such mechanism is favoured by value chain relationships not only aiming at coordinating the various players involved, but also allowing for knowledge transmission among them. The nature of the relationships linking the different organizations participating to value chains, especially eventual power asymmetries – in one word, the 'governance' of the value chain – is therefore crucial in determining companies' ability to 'upgrade'.

The new paradigm represented by the international fragmentation of production has got to the point of being so pervasive that, according to several authors, it has played a significant role in the big trade collapse recorded during the years of the last great recession. Baldwin (2009) directly attributes the synchrony of the fall in world trade to the input-output linkages shaping global value chains. Several other studies show how national fluctuations of demand for final goods have been amplified by GVCs transmitting real and financial shocks through various channels (Alessandria, Kaboski, & Midrigan, 2011; Altomonte, Di Mauro, Ottaviano, Rungi, & Vicard, 2012; Yi, 2009). Moreover, after an initial recovery from the 2008-2009 collapse, international trade has kept on experiencing a slow growth, at rates lower than global

production[2]. What might be a "new normal" (Hoekman, 2015) could be due to structural changes, such as the evolution of the international production networks phenomenon. For instance, Constantinescu *et al.* (2015) investigate the long-run income elasticity of trade and they find that, after a boost in the 1990s, it started decreasing at the beginning of the 2000s, therefore before the Great Recession. They ascribe this downturn to the slowing down of the international fragmentation process of production chains.

Finally, the pertinence of the 'G' in the GVC acronym is a highly debated issue, too, since there is mixed evidence about the actual geographic scope of production networks. In the last decades, the regionalization of trade and investment has been fostered by several factors, such as regional trade agreements and the increasing economic importance of some emerging countries (R. Baldwin & Lopez-Gonzalez, 2013; Stephenson, 2014). Nevertheless, recent trends show how the global reach of VCs may be growing faster than their regional dimension. Los *et al.* (2015) show that value chains have become more internationally fragmented and that their growth has increasingly connected trade blocs between each other.

Hence, the phenomenon of global value chains appears to be reshaping international trade and national comparative advantages, redesigning production processes and foreign direct investments (FDIs) patterns, with implications at both the macro level (countries' growth, development, employment, welfare) and at the firm-level. In fact, companies find themselves competing in a new arena, with some of them benefitting of the new opportunities provided and some lagging behind or even suffering from the consequences of such structural change, with effects on countries' productive systems and employment. Such considerations are what makes global value chains so interesting from a research point of view, but also what makes them so challenging theoretically and analytically. International production networks can be considered and studied under multiple aspects and at multiple levels (macro, meso, micro), but getting the "whole picture" appears quite difficult. At the macro level, both the theoretical and the empirical literature are characterized by the absence of a unique framework of analysis to deal with GVCs. The former comprises the contributions of various strands, while the latter presents several investigation methods according to the data available. These are briefly presented in the second section on this work, which aims precisely at underlining how the study of GVCs lacks of a comprehensive (theoretical and empirical) framework of analysis. In the third section, we start getting to the heart of the matter of our interest. Indeed, the main contribution of this work

[2] Between 2011 and 2013, for the first time in almost half a century, international trade grew at annual rates lower than those of the global economy (Hoekman, 2015).

is to attempt a systematization of the GVC-related literature investigating international production networks at the micro level. It is a task not easy to accomplish since, if on one hand, the scarcity of good quality firm-level data has limited researchers in their studies (thus, GVC analysis at the macro level appears to be much more developed), on the other hand the same lack of information has pushed scholars to resort to (a few) different data sources, with consequences on the empirical methods applied each time. In fact, studies dealing with international production are highly dependent on data availability when building indices and measures to capture companies' participation to and positioning within global value chains, for instance. Moreover, some aspects of the GVC analysis, such as the typology of relations linking firms in the production networks, are better grasped relying on qualitative information, often unavailable for large samples of companies. Therefore, section 1.3 introduces the main issues related to firm-level GVC analysis and delineates the characteristics of the main data sources at hand. In section 1.4 and section 1.5, we move to illustrate respectively how companies' participation and positioning along international production networks has been investigated so far, and how the issue of GVC governance has been tackled empirically. Section 1.6 represents the core of this work, since it presents several contributions analyzing whether firms' performance and growth are related to their participation and positioning within GVCs and the type of relations linking them. Section 1.7 concludes.

1.2 Theoretical and empirical literature: the absence of a unique framework

International production networks are so widespread that, by now, even consumers are aware that the majority of the final goods they buy is the result of processes involving many actors located in many countries[3]. Nevertheless, despite being a relatively easy concept to grasp, global value chains represent a very challenging study subject for researchers, precisely given the variety of players, relationships and transactions concerned.

Two main strands of research have emerged, providing theoretical foundation to the investigation of the structure and the performance of global production networks. A first one focuses on the link between trade and organizations since, quoting Antràs and Rossi-Hansberg (2009, p. 5), "by affecting the location in which each part of the production process is done,

[3] Since the second half of the 1990s, several case studies provided evidence about the process of international fragmentation of production by investigating the making of products quite popular among consumers, such as the Barbie doll (Feenstra, 1998; Tempest, 1996) or Apple's iPad (Dedrick, Kraemer, & Linden, 2010) and iPhone (Xing, 2011).

trade determines organization, and by determining the way in which the production of these stages determines the 'reduced form' production function, organization determines trade flows". Therefore, this first strand of literature combines trade theories with organizational ones, incorporating the latter into general equilibrium trade model, either by relaxing traditional frictions from classical theories - the ability to fragment production or trade tasks, for instance (Arndt & Kierzkowski, 2001) - or by introducing non-traditional frictions – e.g. contractual frictions - to explain how organizations split into smaller entities such as firms. The former strategy yields richer and more flexible trade models and the related literature provides aggregate predictions investigating, for example, how the breaking down of production processes across countries impacts the pattern of comparative advantage and, as a consequence, the one of trade. The latter enriches organizational theories in terms of predictions and testable implications concerning how the organization of production is broken down into national and multinational firms (Antràs & Rossi-Hansberg, 2009). In their seminal work, Dixit and Grossman (1982) develop a model where goods are made through several steps according to a vertical production structure, where each activity adds some value to the final output. Recent contributions investigating global value chains focusing on firms' organizational choices on vertical specialization and fragmentation of their production processes are – among others - those of Markusen and Venables (2007), Antràs and Chor (2013), Costinot *et al.* (2013), and Baldwin and Robert-Nicoud (2014). When looking at firms' decision about insourcing vs. outsourcing, contract incompleteness has often been pointed out as being the main explanatory factor (Alfaro, Antràs, & Conconi, 2015; Antràs, 2015; S. J. Grossman & Hart, 1986). In extreme cases, international production processes can be entirely carried out by a multinational enterprise (MNE), deciding to internalize all those activities necessary to bring a product from its conception to delivery to final consumers, or by a network of independent firms, each one of them performing the tasks related to one or more specific production stages, dealing with one another through arm's length transactions. Between these two opposite organizational strategies lies Cantwell's (1995) 'double network' model, where affiliates of the same MNE are linked by intra-firm relationships and external partners are bound to them through outsourcing contracts.

The second strand of literature finds its roots in the so-called Global Value Chain Approach (GVCA) (Gereffi, 1994, 1999; Gereffi & Fernandez-Stark, 2016; Humphrey & Schmitz, 2002), developed around the mid-1990s thanks, in particular, to Gereffi's seminal works, where international production networks were initially referred to as 'global commodity

chains[4]'. This alternative perspective investigates, in particular, how the various activities comprising the value chain are coordinated, therefore looking at the different types of relationships linking the players of the network – be them firms belonging to the same company (intra-firm relationships) or independent actors (inter-firm relationships). The choice to focus on studying value chain relationships is motivated by the fundamental role they play in information and knowledge transmission. This, in turn, can stimulate processes of learning by firms, which could enhance their performance and eventually lead to an improvement of their position along the chain, the so-called 'upgrading'. As defined by Gereffi (1999, p. 51), "industrial upgrading is a process of improving the ability of a firm or an economy to move to more profitable and/or technologically sophisticated capital- and skill-intensive economic niches". It can operate on four levels: (i) within factories; (ii) within inter-firm enterprise networks; (iii) within local or national economies; (iv) within regions[5]. Humphrey and Schmitz (2002), in turn, single out four types of upgrading: (i) process upgrading; (ii) product upgrading; (iii) functional upgrading; (iv) inter-sectoral upgrading[6]. The main reason why companies upgrade is to increase the share of value added (VA) that they are able to capture out of the total generated by the production process split into the various activities comprising the VC. In fact, the VA produced along the chain varies according to the task(s) performed. Those carried out

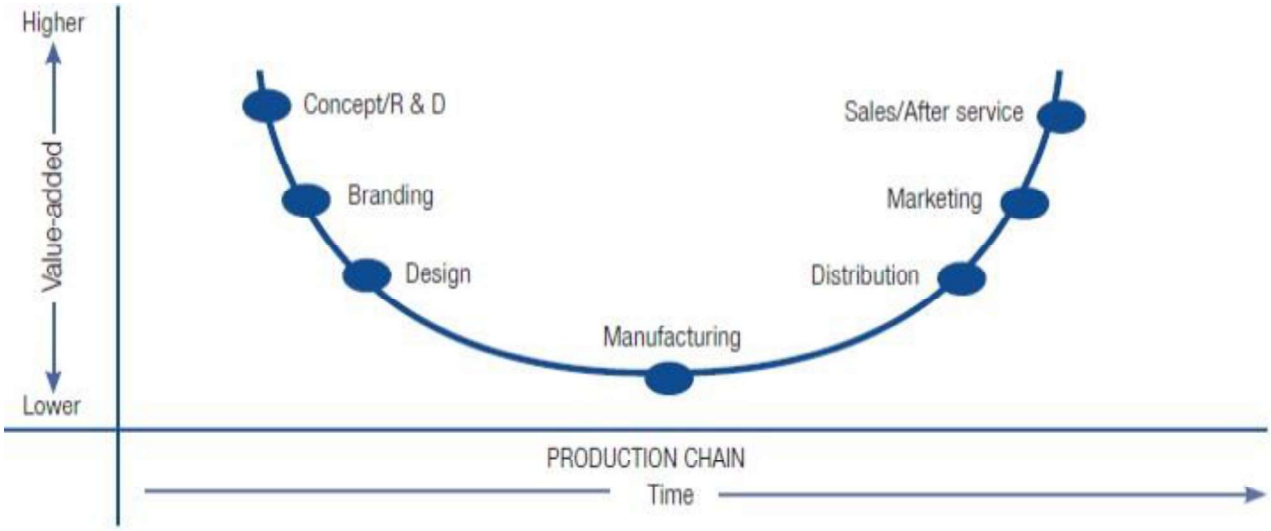
[4] Before Gereffi's 'global commodity chains', the concept of GVC can also be found in studies about 'commodity chains' appeared in the late 1970s (Bair, 2005), such as Hopkins and Wallerstein's (1977) programmatic article. In fact, the authors delineate their research intentions based on a particular view of the global economy's development. Instead of considering it as a sequential process where national markets, engaging more and more in foreign trade, expand towards a one international market, they start with a very different assumption. They conceive the idea of a 'commodity chain' made by all the inputs and transformations necessary to produce an 'ultimate consumable'. The term 'global value chain' appeared in the 2000s, aiming at broadening the simple concept of 'global commodity chain' by taking into account also the factors affecting the organization of global industries (Bair, 2005). Finally, some authors (e.g. Coe, Dicken, & Hess, 2008; Sturgeon, 2001) distinguish between 'chains' and 'networks'. They underline that the concept of GVC refers only to a linear sequence of productive activities carried out by different players on a global scale, while the idea of international production networks is broader since it encompasses the bundle of relationships linking the different organization contributing to the making of the final product and to its delivery to customers. Following a similar logic, Baldwin and Venables (2013) distinguish between 'spiders' and 'snakes'. In this work, however, the terms 'chain' and 'network' are used interchangeably.

[5] 'Within factories upgrading' happens when a plant moves towards the production of more expensive/complex products and satisfies lager orders. 'Within inter-firm enterprise networks upgrading' takes place when a firm shifts from mass-producing standardized goods to making differentiated products. When a company merely assembly imported components becomes an OEM or an OBM (for a definition, see note 39), it upgrades within its local or national economy. Finally, upgrading happens within regions when bilateral and asymmetrical inter-regional trade flows evolve into an advanced pattern of intra-region division of labor encompassing all the tasks comprised in a value chain.

[6] Process upgrading relates to an improvement in the efficiency of production processes, while the product one entails the shift towards the production of more complex goods. Functional upgrading happens when functions are abandoned or acquired anew, to increase the total skill content of the tasks performed. Finally, inter-sectoral upgrading takes place when companies or clusters expand their production towards new activities.

at the beginning (upstream) or at the end (downstream) of the production (and distribution) process generate the highest value, while the mere manufacturing/assembly activities, central in the chain, creates the lowest amount of VA. This phenomenon is best illustrated by the so-called 'smile curve', first observed by Shih (1996) when observing the personal computer industry.

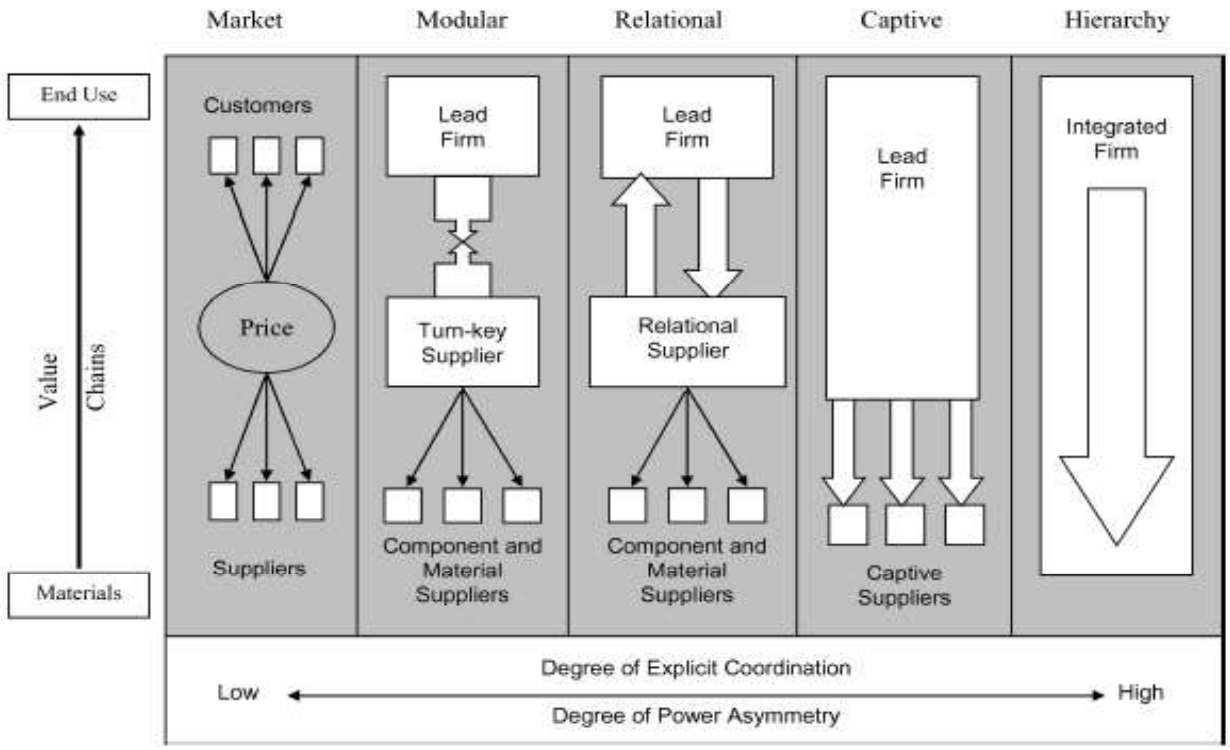
Figure 1.1 The 'smile curve'



Source: adapted from Unctad (2015, p.2).

The upgrading mechanism is highly influenced by the type of 'governance' characterizing the production network, defined by Gereffi (1994, p. 97) as the "authority and power relationships that determine how financial, material, and human resources are allocated and flow within a chain". In his first works, he distinguishes two kinds of value chains based on their type of governance: producer-driven and buyer driven. The first ones are common in industries such as electronics, automotive or pharmaceuticals, which rely on technology and R&D; therefore, lead firms are placed upstream in the chain and control the design of the products, as well as most of the assembly. The latter are typical among labour-intensive industries, such as textiles and shoes, where retailers and branded marketers control the production, which can even be entirely outsourced (De Backer & Miroudot, 2012).

Figure 1.2 GVC governance types[7]



Source: Gereffi *et al.* (2005, p. 89).

In a later contribution, Gereffi *et al.* (2005) look at power asymmetries among the various actors belonging to production networks and at their explicit degree of coordination and highlight three factors shaping GVC governance patterns: the complexity of transactions; the possibility to codify information; and the capability of the suppliers along the chain. The combination of these three elements can result in five types of GVC governance: market, modular, relational, captive and hierarchy, where the former and the latter represent the "extremes" of the taxonomy (figure 1.2).

The field of economic geography, too, offers a third theoretical approach to the study of GVC, worth mentioning. It transcends the idea - typical of international economics - of

[7] As anticipated, market and hierarchical value chains represent the extremes of the governance taxonomy. In the former, independent firms trade at arm's length, while in the latter, a fully vertically integrated group carries out all the activities necessary to produce the good and deliver it to the final customers. In modular value chains there is some sort of coordination between suppliers and buyers, with the former often producing according to the latter's specifications. Nevertheless, transaction-specific investments are very limited and the competences needed are fully provided by the suppliers. Relational value chains are characterized by complex relations linking sellers and customers, often entailing asset specificities and mutual dependence. They are managed through strong ties such as those built by trust, reputation or even family. Within captive value chains, finally, small suppliers are highly dependent on large lead firms, which often perform monitoring and control activities.

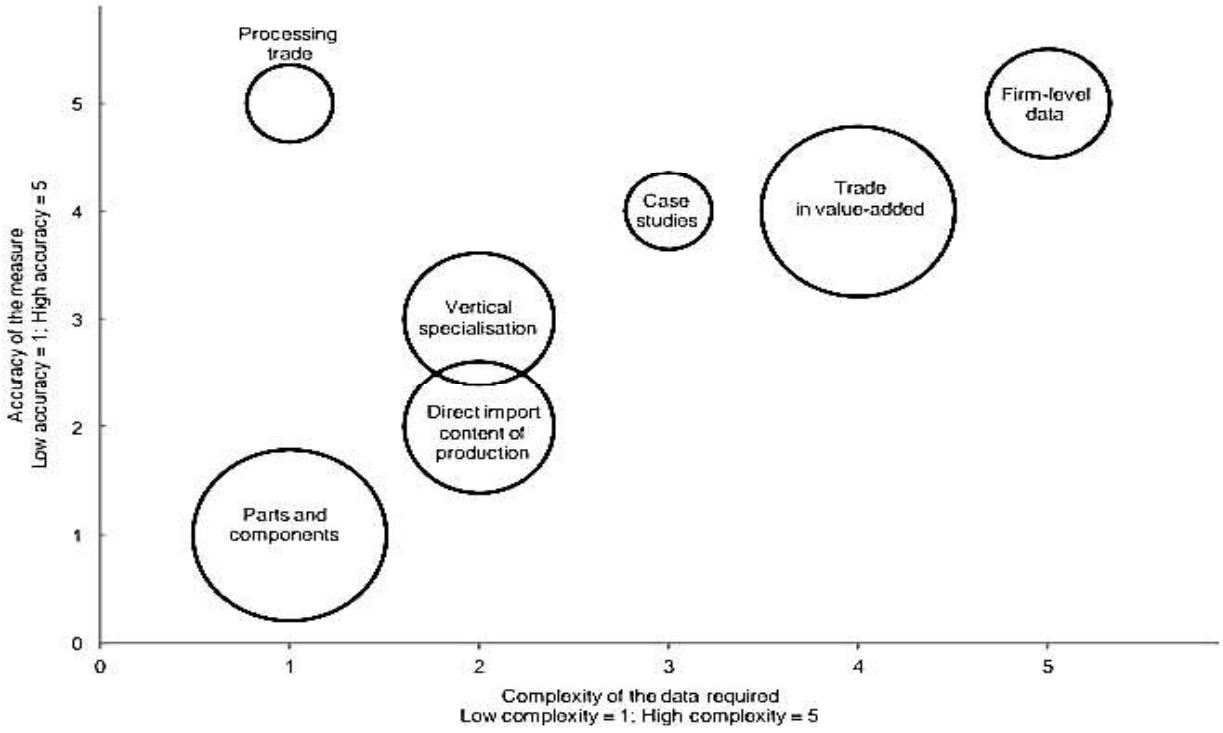
space as an ensemble of countries[8], and, when investigating the location choices referred to business functions, it takes into account two opposite forces. On the one hand, in fact, production activities need to be coordinated, and that is often easier when they are carried out in the same geographic area. On the other hand, each territory, given its characteristics, is more or less suitable to host a specific business function and that fosters their spatial dispersion (e.g. Iammarino & McCann, 2013).

The different strands of theoretical literature summarized so far, although providing a rich variety of insights, signal the absence of a comprehensive framework embracing all the specificities of global production networks. The same issue also affects the empirical literature concerning international fragmentation of value chains. As pointed out by Nielsen (2017), the latter represents one of the most intricate measurement challenges for economic, trade and business statistics. This is due to the multiplicity of aspects that must be taken into account when investigating the global organization of production processes. In fact, besides well-known problems, such as measuring intangible products like services, new issues arise, as the 'double counting'[9] in trade, or tracing firms' ownership structures and accounting for transfer pricing in business statistics. Moreover, a considerable amount of data is produced by national statistical institutes, which mainly focus on phenomena happening at the domestic level, while global value chains have an international dimension, being characterized by cross-border business linkages and transactions. As a result, several methods and data types and sources have been used so far to map and measure international production networks. Figure 1.3 (Amador & Cabral, 2016, p. 286) summarizes the main strands of empirical research on global value chains, which are categorized according to the complexity of the data required (measured on the x-axis), the accuracy of the measure (evaluated on the y-axis) and their coverage of the GVC phenomenon in the world economy (represented by the size of the circles).

[8] For example, Crescenzi *et al.* (2014) look at MNEs' location choices in relation to sub-national territorial characteristics. They find that, when referring to the most sophisticated knowledge intensive stages of the value chain, decisions are crucially influenced by European regions' socio-economic conditions.

[9] Since production processes are more and more fragmented, the making of a final good requires the use of intermediate inputs. Some of them can be imported and then incorporated into a final good that, in turn, might be exported. This implies that the same product can cross multiple borders before being finally consumed, and every time it does it is recorded in gross trade data.

Figure 1.3 Summary of the main strands of empirical research on GVCs



Source: Amador and Cabral (2016, p. 286).

Amador and Cabral (2016) illustrate that the main methodological approaches applied so far to investigate global production networks rely mostly on three types of data: international trade data combined with input-output (I-O) tables; international trade statistics on parts and components; customs statistics on processing trade[10]. Historically, the early empirical investigations about GVCs were mainly based on the first two kinds of information.

In the literature, generally two different indicators based on classical I-O data are used. The first one was introduced by Feenstra and Hanson (1996) and aims at evaluating the foreign content of national production by measuring the share of direct imported inputs in production or in total inputs. The second one is the "vertical specialization" indicator first computed by Hummels *et al.* (2001), which measures the direct and indirect content of exports. Moreover, recent studies rely on classical I-O tables to evaluate the average positioning of industries in

[10] Processing trade has been defined as "the process through which companies source intermediate inputs from various countries, assemble them in another for the final consumption in third markets" (Lucian & Pajot, 2012, p. 2). It is actually a trade regime, since it allows imports and exports of both intermediate and final goods to be traded duty free. Processing trade procedures are commonly distinguished between inward- and outward-processing procedures. Imports or exports under the former refer to intermediate goods imported, processed and then re-exported, while those under the latter concern intermediate goods exported to be processed abroad and then imported back in the home country.

value chains (e.g. Antràs & Chor, 2013; Antràs, Chor, Fally, & Hillberry, 2012). Nevertheless, given the spread of international production networks, gross trade data often result inadequate when aiming at investigating the competitiveness of industries and their role in GVCs[11], leading researchers to rely more and more (or, also) on trade in value added (VA) data. In order to retrieve them, world I-O table are needed. They are matrices showing, for several countries, inter-industrial flows of goods and services, both produced domestically and imported. Thanks to the recent availability of various global multi-regional I-O databases[12] and building especially on Hummels *et al.* (2001), new methodological approaches have been applied to study GVCs, among others Daudin *et al.* (2011), Johnson and Noguera (2012), and Koopman *et al.* (2014)[13].

The second approach, based on international trade data on parts and components, has the advantage of relying on information largely available and detailed, allowing for comparison across countries and over time. Nevertheless, it depends heavily on product classification[14]. The international fragmentation of production processes is measured by comparing trade in final goods with trade in parts and components. The seminal contributions in this field are those of Yeats (1998) and Ng and Yeats (1999). Athukorala (2005), for instance, looks at the dynamics of trade in parts and components (which he calls "fragmented trade") *vis-à-vis* to those of total trade in manufacturing. He illustrates that the former has increased faster than the latter and highlights how, with respect to Europe or North America, East Asia is more engaged[15] in this type of trade.

[11] Every time that a good (or a service) - be it intermediate or final - crosses the border of a nation, it is recorded in gross terms in trade statistics. Nevertheless, since production activities belonging to the same *filière* are more and more fragmented and carried out over multiple countries, the value a product embodies is usually not entirely produced in its country of origin. That is why information about the value-added actually created are crucial in order to have a clear and accurate picture of the performance and competitiveness of industries.

[12] The Economic Systems Research volume 25, issue 1, 2013 illustrates several of the I-O databases currently available.

[13] Daudin et al. (2011) look at the value added embodied in trade in final goods and distribute it to every country that has contributed to the production process accordingly. They calculate the share of imported inputs in exports (building on Hummels *et al.* (2001)), the domestic content of imports and the share of exports that are used as inputs for other countries' exports. Johnson and Noguera (2012) compute the ratio between value-added exports and gross exports. They calculate VA exports as the income a country produces, that is contained in final goods consumed abroad. Koopman et al. (2014) have formulated a unified framework that breaks down gross exports into their VA components. They distinguish between domestic and foreign content of exports, further disaggregating the former into domestic VA of exports and domestic content in intermediate exports that returns to its country of origin.

[14] The "parts and components" agglomerate is usually obtained relying on the most disaggregated version of the Standard International Trade Classification (SITC). The Broad Economic Categories (BEC) categorization by the United Nation is also often used, since it classifies products according to their main use, envisaging a section grouping specifically intermediate goods.

[15] Such dependency is illustrated by looking at the share of parts and components on the total exports in manufacturing, which is much higher in East Asia than in the other regions mentioned.

Being recorded by customs authorities, customs statistics on processing trade are very detailed, too. Besides supplying data on imported and exported goods, they also provide information linked to customs policies allowing for tariff exemptions or cuts based on the domestic content of imported goods. However, since processing trade data allow measuring international fragmentation of production by taking into account only the materials and components exported or imported for further processing (outward and inward processing trade, respectively), they offer a limited picture of the phenomenon. Feenstra *et al.* (2000), Görg (2000), Egger and Egger (2005), and Helg and Tajoli (2005) are among the studies using processing trade data to study the global slicing up of value chains.

Finally, in recent years, a new approach to dealing with the study of global value chains – and, more in general, of international trade – has emerged. It consists in applying the methodologies of network analysis (NA) on trade data, either in gross (e.g. De Benedictis & Tajoli, 2011) or in value added (e.g. Amador & Cabral, 2016b) terms. In fact, as production activities are scattered around the world, the making process of goods can be seen as the result of tasks carried out by individual 'nodes', i.e. industries or firms, connected through 'arcs', i.e. the bilateral relationships that link one node to another. The use of network analysis to analyze international trade and production chains can offer new and precious insights to enrich and complete researchers' understanding of such phenomena, since NA consists in the study of relations. More specifically, as pointed out by De Benedictis et al. (De Benedictis, Nenci, Santoni, Tajoli, & Vicarelli, 2013), it does not focus on relations *per sé*, considered individually and isolated from the others, but it takes into account their structural dimension, i.e. the interdependence between relations. This makes it particularly suitable for applications to the analysis of global value chains. For example, Cerina *et al.* (Cerina, Zhu, Chessa, & Riccaboni, 2015) use WIOD data to analyze the global, regional and national network characteristics of the world input-output system, where individual industries are considered as nodes. Working on the same data, Zhu *et al.* (Zhu, Morrison, Puliga, Chessa, & Riccaboni, 2015) construct both upstream and downstream global value networks, proposing a new network-based measure of node similarity allowing to compare GVCs across countries for each sector. Finally, Frohm and Gunnella (2017) investigate whether the network structure of global input-output linkages has a role in the transmission of economic disturbances in the international economy.

1.3 Firms in global value chains

It has been largely pointed out that it is firms that engage in international trade, not countries. Likewise, it must be noted that firms are the main actors in global value chains, not nations. Therefore, it is not surprising that empirical research based on firm-level data provides one of the most accurate measures of this phenomenon, as shown in figure 1.1. In fact, studies based on country-level information cannot account for firm heterogeneity. This has been much documented (e.g. Bernard, Jensen, Redding, & Schott, 2012; Greenaway & Kneller, 2007), leading to acknowledge that the aggregate performance of a country is determined by both macro conditions and firm-based decisions (such as import and export strategies or R&D investments). Thus, understanding the characteristics and the strategies of the actual players within international production networks appears not only crucial to have a clear picture of GVCs, but also necessary for policy makers in order to formulate programs and take measures able to deliver the expected results ("Data gaps lead to policy gaps" (Sturgeon, 2013, p.7)). Nevertheless, empirical studies on GVCs based on a firm-level analysis have appeared later than the ones presented so far. Moreover, they, too, lack of a unified methodological approach, greatly due to the lack of the information necessary. In fact, firm-level data are very scarce. Given the sensitivity of the information they supply, they are often unavailable for research due to statistical confidentiality. Moreover, even when micro data on firms are provided for study purposes, the structure of datasets is obviously dependent on the criteria – possibly different among statistical institutes or organizations - according to which information has been collected and recorded. Furthermore, data often refer to firms based in one country – generally the one where the institution in charge of the data collection is located – and they usually refer to one or a few specific years. These characteristics may limit the use of existing dataset in terms of cross-country comparison or dynamic analysis[16].

Given the scarcity of firm-level data – and the different structure of those datasets actually available – a unique framework to measure firms' engagement in global value chains has not been designed, yet. Empirical research dealing with international fragmentation of

[16] To overcome these limitations, Eurostat has launched the Micro Data Linking Project (MDL), aiming at constructing an internationally harmonized database containing variables from different statistical sources (Nielsen, 2017). More information available at http://ec.europa.eu/eurostat/statistics-explained/index.php/Microdata_linking_-_international_sourcing.

production processes from a firm-based perspective usually relies on three different sources of information[17]: case studies, firms' balance sheets and surveys (Table 1.1).

Table 1.1 Data sources for empirical firm-level GVC investigations: pros and cons

Data source	Pros	Cons
Case studies	• Both qualitative and quantitative data. • Rich and detailed information.	• Costly • Limited to firms operating in one or a few industries and/or located in a specific territory. • Not generalizable results.
Balance sheets	• Firms are required to draw them up. • Mostly quantitative data. • Large amount of information, usually covering multiple years.	• Availability constrained by statistical confidentiality issues. • Possible discrepancies among national accounting standards. • Lack of qualitative data.
Surveys	• Both qualitative and quantitative data. • Rich and detailed information. • Large amount of information.	• Costly. • Limited to one or a few years and to one or a few countries. • Not entirely comparable to other datasets.

The former are generally employed to investigate firms located in a limited territory and/or operating in the same industry. They are very rich and accurate in both qualitative and quantitative information, which is usually collected through detailed surveys and interviews. This, however, usually makes carrying out case studies quite costly. Moreover, given the particular object of analysis, results, although very precise, are too specific and cannot be generalized[18]. Balance sheets, on the contrary, are documents that the majority of firms is required to draw up. They normally offer both a picture of companies at a given time – by presenting the number of employees, for example – and a record of companies' activities during a certain period, usually a year. Therefore, they provide a wide range of information collected every year about a large number of firms, allowing for dynamic studies based on many

[17] As pointed out by Amador and Cabral (2016), some studies focus on multinational firms and on their offshoring strategies, looking at how production activities are distributed within the boundaries of such companies. Various analysis employ data on MNEs' workforce to compute the share of employment in affiliates over total employment and use it to assess the relative weight of affiliates in the whole production process, considering it a measure of offshoring. Given its nature, this indicator can assess only partially firms' offshoring activities, missing all those happening via outsourcing through arm's-length transactions.

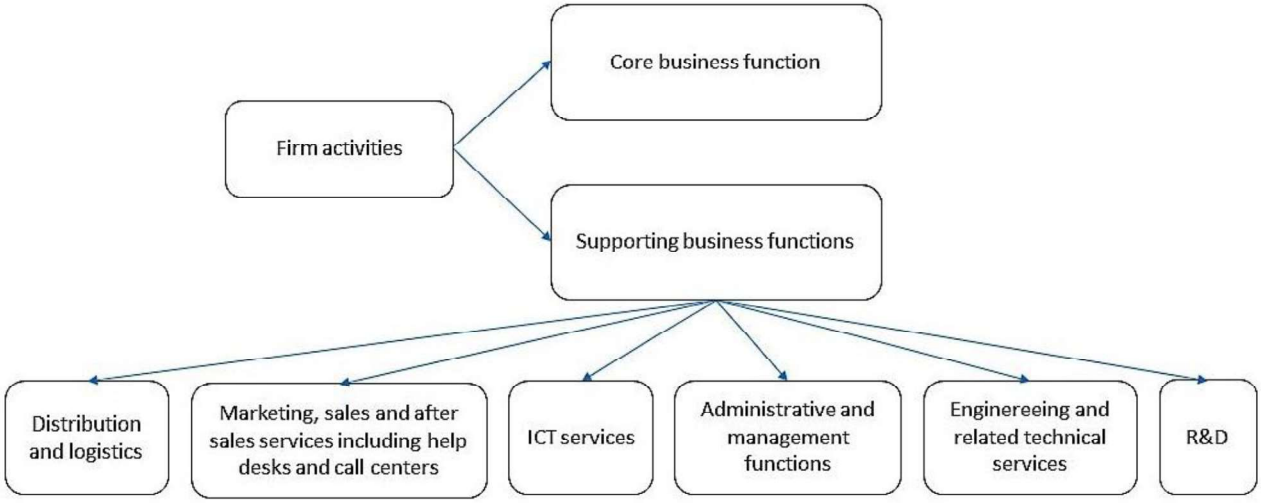
[18] Insights provided by case studies, often based on single industries, have been criticized for its selection bias (Milberg & Winkler, 2013). Dicken et al. (2001, p.89) advise to treat with caution "extrapolations from specific case studies and instances", since they are not generalizable and therefore not suitable for descriptive and causal inferences. Nevertheless, especially among international business scholars, the contribution and the importance of case studies is being reclaimed (e.g.Birkinshaw, Brannen, & Tung, 2011).

observations. Nevertheless, balance sheets data are not easily available due to statistical confidentiality and, if recorded according to different national principles, they could be not entirely suitable for cross-country investigations. Moreover, they provide mostly quantitative information, usually not documenting qualitative aspects such as strength and type of relations among firms or R&D collaborations. Finally, firm-level data based on specifically designed surveys can provide a large amount of both quantitative and qualitative data about several aspects of companies' structure, activities, relations and strategies. However, given the particular criteria according to which information is collected, it is often not comparable to that supplied by other datasets, so that dynamic and/or cross-country studies are possible only for those years and those nations covered by the survey. Unfortunately, since carrying out multiple surveys investigating firms located in different countries in a number sufficient to perform a proper analysis is usually very demanding in terms of resources to employ, surveys covering companies over multiple years and countries are very scarce.

However, since the mid-2000s, firm-based GVC studies have started to be performed also based on a new unit of analysis, which requires the collection of a new type of information, possible – for now – only through the employment of surveys. In fact, according to the framework developed by Sturgeon (2008), companies' involvement in global production networks can be best analyzed looking at their operations, decomposing them on the basis of 'business functions'. Indeed, as underlined also in Sturgeon *et al.* (Sturgeon, Nielsen, Linden, Gereffi, & Brown, 2013) and Nielsen (2017), even if product-level statistics - decomposing goods according to all the components needed for their production – would be the most direct way to measure the geography of value added, they would risk to miss the part of it generated by all those intangible activities (e.g. R&D, IT technologies or marketing and sales) necessary to the value chain, to bring the product or service from conception to delivery to consumers and final disposal after use. This gap would be bridged by collecting information about business functions through surveys aiming at capturing how and where they are sourced and quantifying their value. The concept of 'business functions' closely recalls the model of value chain theorized by Porter (1985) as a sequence of tasks. Indeed, they can be simply defined as the activities carried out by firms and they are commonly distinguished between 'core (or primary) business functions' and 'supporting business functions'. The latter group embraces all those tasks performed by a firm, which are necessary to accomplish its core activity or facilitate it, and whose output is not intended to be marketed for third parties. The European Union Survey on International Sourcing (Nielsen, 2008), for instance, has developed an exhaustive list of

business functions (figure 1.4), also adopted by the Statistics Canada for the Survey of Changing Business Practices in the Global Economy (Industry Canada, 2011) and in the 2010 United States for the National Organizations Survey (Brown *et al.*, 2014).

Figure 1.4 Firms' business functions as classified by the European Union Survey on International Sourcing



As underlined in Sturgeon *et al.* (2013), investigating GVC participation at the company-level relying on the business functions approach presents several advantages, extendible to firm-based studies in general. For instance, enterprises are usually categorized according to industry classifications (e.g. ISIC, NACE, NAICS) on the basis of their main output. Therefore, their products, employment and all the other firm-level information are attributed to a unique output category. On the contrary, the business functions approach allows to open companies' 'black-boxes' by allowing the collection of firm data disaggregated over specific tasks. Moreover, since this methodology mirrors companies' internal organization and firms' operations are often accounted on the basis of business functions, data collection yields high quality information (S. P. Brown, 2008). Nevertheless, the latter requires performing business surveys, possibly on globally harmonized basis, necessary for international and dynamic comparisons. That is challenging – to say the least – for national statistical institutes.

4. Firms' participation and positioning within GVCs

As already pointed out, data concerning firms' involvement in global production networks are scarce and based on a few, distinct sources. Consequently, empirical works analyzing GVCs at the micro level are not that widespread.

The majority of micro-founded GVC analysis consists of case studies, whose objects of analysis span over a wide range of industries and areas within countries, mostly developing ones. The Duke Global Value Chains Center (Duke CGGC), for example, has produced almost 250 works between research projects and publications, studying GVCs in industries like food and agriculture, energy and infrastructure, apparel, automotive and transportation[19]. The majority of them focus on Asian regions, followed by territories in Middle East and Africa and in Latin American and the Caribbean.

Historically, the apparel and footwear industry has been one of the most investigated in terms of international fragmentation of production. In one of his seminal works, Gereffi (1999) focuses on the evolution of the apparel commodity chain in Asia, while Schmitz (1999) looks at the Sinos Valley, a cluster producing leather footwear in Brazil, and illustrates how GVCs linkages have determined the success or the failure of firms operating in the area. Asia and its apparel industry have kept on being a topic of research even in more recent works (e.g. Azmeh & Nadvi, 2014; Goni & Kadarusman, 2015), but the segment of electronics and ICTs, too, has received much attention, both in Asia (e.g. Sun & Grimes, 2016; UNCTAD, 2015) and in other developing countries (Armando, Azevedo, Fischmann, & Pereira, 2016; Monge-Gonzalez & Zolezzi, 2012). Given their implications for economic development, especially in less industrialized countries, GVCs in the agrifood sector, too, have been the focus of several studies (Jespersen, Kelling, Ponte, & Kruijssen, 2014; Ponte, 2002). Being case studies, each of the above-mentioned works, as well as other similar articles, illustrate unique scenarios, very specific on both an industry and a country level. The magnitude and accuracy of the information collected usually allow to clearly identify firms' role in the value chain under investigation, their linkages with one another and with other actors (public and private), the evolution of the network along time, the impact on firms' performance of factors like stricter regulation or the introduction of new standards. This makes case studies particularly suitable to study the type of governance characterizing value chains and to investigate the mechanisms of companies' upgrading. Moreover, providing a detailed picture of a territory's production network operating in one specific sector, they can serve as a good informative tool for policymakers. Nevertheless, if the specificity of case studies represents their strength, it is also the main source of their weakness in terms of very low results generalizability and comparability with other studies.

[19] An overview about the methodological tools used by the Duke CGGC when conducting GVC projects can be found in Gereffi and Fernandez-Stark (2016).

These problems can be overcome by studying companies' involvement in global production networks using large datasets containing firm-level data. These are more and more available to researchers, but they are still scarce and present the flaws illustrated at the end of the previous section. As a result, a unique way to assess companies' participation to and role within GVCs has not been formalized, yet, since, in each investigation, indices measuring it can be different according to the type of information available.

As seen in Veugelers et al. (Veugelers, Barbiero, & Blanga-Gubbay, 2013), for example, one investigation strategy that can be applied consists in computing micro-versions of indicators originally designed to study global value chain participation at a country/industry-level. It is the case of the intermediate import ratio (IIR) proposed by Feenstra and Hanson (1996), measuring the share of imported intermediates over the total at the sector level. A similar index can be produced in relation to firms, looking at the percentage of imported intermediates over total inputs. Such measure has the advantage to easily proxy companies' involvement in global value chains, based on data that can be retrieved both from detailed balance sheets and from accurate surveys. Nevertheless, given its nature, it mostly looks at firms' backward linkages, being not entirely suitable to identify companies located upstream in the value chain. The proxy for (downstream) GVC participation used by Fauceglia *et al.* (Fauceglia, Lassmann, Shingal, & Wermelinger, 2018) present the same characteristic, but in this case the authors explicitly aim at investigating mostly backward GVC participation. Nevertheless, since it is computed as the ratio between intermediate inputs (sourced outside the firm's perimeter, both locally and abroad) and total sales, it does not take into account companies' international activities specifically, but it relies on the assumption that firms with a higher total input over sales ratio also have a higher imported inputs over sales ratio[20].

The core of the analysis carried out by Veugelers *et al.* (2013), however, is based on an approach identifying GVC participants by looking at companies' internationalization strategies. They work with data from the Efige survey (Altomonte & Aquilante, 2012) and construct seven categories pinpointing just as many internationalization strategies at the firm-level. After having identified "substantially internationally active" firms[21], they distinguish among three

[20] Fauceglia et al. (2018) test this hypothesis performing a series of robustness checks; they find strong support to their assumption.

[21] In order to do so, Veugelers *et al.* (2013) first pinpoint "internationally active firms" as those whose trade turnover (imports, exports or foreign production activities) is higher than the 25th percentile in their industry or whose share of trade turnover over their total is higher than the 25th percentile in their industry. Then, they combine both criteria to identify "substantially internationally active" firms.

"internationalization modes" (besides the "zero mode", associated with firms operating only domestically) based on three main international activities: imports, exports and international production, both through FDIs and global sourcing. Thus, companies pursuing a one-mode internationalization strategy are those classified as "pure importers" or "pure exporters" (since firms engaged only in global production, without importing or exporting, are very rare). Firms implementing a two-mode internationalization strategy are those carrying out two of the international activities, being them simultaneously (i) importers and exporters; (ii) importers and international producers; (iii) exporters and international producers. Finally, highly international companies are those following a three-mode internationalization strategy, being importers, exporters and international producers at the same time[22]. Veugelers et al. (2013) identify as GVC participant those firms carrying out multiple internationalization mode, with the ones implementing a three-mode strategy as the most involved in global production networks. Moreover, they consider as "intermediate firm" a company whose turnover is entirely generated by producing to order for other firms; if the latter are located abroad, the intermediate firm can be said to be part of a global value chain. Accetturo and Giunta (2017), too, proxy GVC participation using two variables, one referred to upstream participation and one accounting for downstream participation. The former is, indeed, computed looking at the sales from produced-to-order goods over total turnover[23]; the latter is a dummy, which equals to one if the firm imports customized intermediate goods. Labelling "intermediate firms" by looking at the source of their gross revenues is an investigation strategy already followed by Accetturo *et al.* (Accetturo, Giunta, & Rossi, 2011). Working on data collected through the Invid survey of the Bank of Italy, they consider "intermediate" those companies whose turnover originates from produced-to-order goods for other firms at least for a share equal to its 10%. On the contrary, firms generating more than the 90% of their gross revenues from sales to the final market are classified as "final".

Razzolini and Vannoni (2011) take into account only intermediate firms – subcontracting firms, specifically - to investigate the relationship between firms' performance and their internationalization strategies and internal organizational choices. They work with firm level data provided by the 8th and 9th Unicredit-Capitalia survey and they are able to distinguish

[22] Agostino et al. (2016) use the same classification to account for the possible internationalization strategies associated with firms' participation to GVCs.

[23] In the paper, Accetturo and Giunta use a discretized version of this variables, namely a dummy equal to one when a firm is fully intermediate (i.e. the ratio between sales from produced-to-order goods and total turnover is equal to one).

among six categories of companies, according to their international (exporters vs. non-exporters) and subcontracting (pure subcontractors vs. firms producing also for other purposes) activities: (i) manufacturers selling also (but not exclusively) via subcontracting in the domestic market and (ii) abroad; (iii) exporters, working as subcontractors only for the foreign market; (iv) domestic firms using the subcontracting channel only in the home market; (v) exporters that are subcontractors only domestically; (vi) exporters and subcontractors for both the foreign and the domestic market. Giunta *et al.* (Giunta, Nifo, & Scalera, 2012), too, focus on intermediate firms, investigating the impact of subcontracting on the growth of Italian companies operating in the manufacturing industry. Relying on the unique dataset built on the 7th and 8th waves of the Capitalia Survey on Manufacturing Firms, they distinguish companies in four categories, based on the share of total sales generated by subcontracting: (i) non-subcontractors, being firms selling directly to the final market; (ii) weak subcontractors, as companies owing up to 50% of their total sales to subcontracting; (iii) strong subcontractors, being firms whose majority of sales is due to subcontracting; (iv) absolute subcontractors, for companies producing exclusively for other firms. Agostino *et al.* (Agostino, Giunta, Nugent, Scalera, & Trivieri, 2015) investigate whether intermediate firms differ from final ones in terms of labor productivity and total factor productivity and whether this gap (if present) can be bridged by companies' capabilities and participation in GVCs. They work on data on Italian manufacturing companies collected through three waves of the Unicredit Survey on Manufacturing Firms and they assess companies' role along VCs looking at the source of their sales. In fact, the information provided by the survey allows distinguishing to what extent firms' revenues are generated by sales (to order) to other firms or by selling directly to the final market. Their empirical strategy consists of first considering only firms selling exclusively to either other companies or the final market, therefore excluding "hybrids". Afterwards, the latter are comprised in the analysis by resorting to an index measuring companies' dependence on sales to other firms, computed as the ratio of sales of intermediates to other companies over total revenues. Siedschlag and Murphy (2015), too, attempt to evaluate firms' engagement in global value chains using Efige data, but they do not define a GVC participation index. In fact, their work appears to be a study of the variables influencing companies' outward internationalization strategies (foreign sourcing, exports, FDIs or a combination of the three), which are, undoubtedly, typical activities carried out by firms operating in international production networks. A similar point can be raised about the recent work by Meliciani and Tchorek (2017), which aims at analyzing firms' performance during the crisis looking at their engagement

within global production networks. In fact, they do not attempt at measuring GVC participation, but they look at the various internationalization strategies that companies can implement (and that only in some cases signal an involvement in global production networks).

Table 1.2 GVC participation: how it is measured in the literature

Authors	Year	Data	GVC participation measure
Veugelers *et al.*	2013	Efige survey	Micro-adaptation of the IIR (Feenstra and Hanson, 1996): share of imported intermediates over total.
Veugelers *et al.*	2013	Efige survey	Firms carrying out at least two kinds of international activities.
Balwin and Yan	2014	Statistics Canada's Annual Survey of Manufactures (ASM) linked with the Importer Register	Firms who are both importers and exporters.
Giovannetti *et al.*	2015	2011 MET survey data merged with AIDA and Ice-Reprint	Firms declaring to be part of a VC
Giovannetti and Marvasi	2016	2011 MET survey	Firms declaring to be part of a VC since: 1. they are specialized in a particular production within a VC; 2. their involvement in the VC is continuous; 3. the majority of their turnover comes from VC production.
Accetturo *et al.*	2017	2011 9th Italian Census of Industry and Services	Firms supplying customized inputs to other firms
Brancati *et al.*	2017	MET survey	1. Exporters of semi-finished goods and components; 2. Exporters of final goods that import production inputs; 3. Importers of inputs or exporters of final goods having 'long and lasting significant relationship with foreign companies'.
Del Prete *et al.*	2017	WB Enterprise Survey	International traders having received an internationally recognized quality certification.
Montalbano *et al.*	2018	OECD-TiVA datasbase and WB Enterprise Survey	Match firm-level data with industry GVC participation index = IVA+FVA

Baldwin and Yan (2014) investigate Canadian manufacturing firms' participation to GVCs by looking at their internationalization strategies and consider as involved in global production networks those who engage simultaneously in importing and exporting activities. Studying the relationship between the quality of contract enforcement and firms' engagement in global production networks, Accetturo *et al.* (Accetturo, Linarello, & Petrella, 2017) rely on the information provided by the 2011 9th Italian Census of Industry and Services. They take into

account only manufacturing firms and consider as GVC participants those who have declared to be suppliers of customized inputs[24] to foreign independent companies. In fact, given the purpose of their work, they exclude from their sample those firms who provide inputs to affiliates belonging to their same group. Nevertheless, such measure of GVC participation appears to be more of an indication of GVC positioning, since it identifies only intermediate firms and does not consider companies located downstream in the value chain.

Using the same data but restricting the analysis to firms located in Tuscany, Giovannetti and Marvasi (2017) actually consider companies' positioning within GVCs – together with the type of governance of the chain they are active into (cf. section 5) – to investigate companies' performance and productivity. Giovannetti and Marvasi (2017) develop a taxonomy of GVC positioning encompassing three kinds of firms, taking into account whether or not they produce intermediate goods and their "input-output relations" with other firms. More specifically, the authors consider three characteristics: (i) the production of intermediate goods; (ii) the status of buyer and/or supplier; (iii) the source of firms' demand (other companies or households). As a result, they identify three kinds of firms: 1. upstream producers (or pure suppliers), which are companies making intermediate goods that then are sold to other firms; 2. midstream producers (or mid-suppliers), who make intermediate goods to be sold to other firms but they also buy inputs; 3. downstream producers (or pure buyers), which are firms making final goods and selling them to households.

Brancati *et al.* (Brancati, Brancati, & Maresca, 2017) formulate a more conservative approach to identify companies participating into global value chains. Relying on extensive quanti-qualitative firm-level information retrieved by the MET survey, they consider as being part of international production networks three kinds of firms: (i) exporters of semi-finished goods and components; (ii) exporters of final goods that import production inputs; (iii) either importers of inputs or exporters of final goods having 'long and lasting significant relationship with foreign companies'. The wide range of information provided by the MET survey about Italian firms' activities has allowed also other researchers to carry out investigations concerning such companies' involvement in production networks. Giovannetti *et al.* (Giovannetti, Marvasi, & Sanfilippo, 2015) and Giovannetti and Marvasi (2016), for instance, study the links between the probability to export and the value chain participation of firms, with the former work

[24] They refer to the "*contratto di subfornitura*", as envisaged by the Italian law (L. 192/1998). This indicates that, when making the requested good, the supplier must comply with the design and the production criteria established by the buyer.

focusing on SMEs while the latter investigates companies operating in the food industry. The authors are interested in mere VC participation, regardless its international dimension. Giovannetti *et al.* (2015) measure it directly, taking into account firms' self-assessments, while Giovannetti and Marvasi (2016), specifically, consider companies declaring to be involved in a VC which satisfy three requirements: (i) being specialized in a particular production within a VC; (ii) being involved in the VC continuatively; (iii) having the majority of their turnover coming from VC production. Giovannetti *et al.* (2015), however, also consider heterogeneity in firms' positioning along the value chain by distinguishing among three types of companies: (i) final good producers, whose revenues consist entirely of sales of final goods to the final market; (ii) subcontractors, working exclusively for other firms to which they are tied by a contract; (iii) 'own-branded' firms, whose products – final or intermediate - are self-designed (and industrial property is retained by the firms themselves).

Del Prete *et al.* (Del Prete, Giovannetti, & Marvasi, 2017) use data from the World Bank Enterprise Panel Survey to focus on North African firms and investigate to what extent they participate into GVCs and whether that has implications for their productivity. They rely on evidence showing how companies – especially those operating in developing countries – are likely to get a certification when they have to meet some specific requirements in terms of quality and reliability, and that is often the case when they belong to international production networks (e.g. Beghin, Maertens, & Swinnen, 2015). Therefore, Del Prete *et al.* (2017) identify companies participating into GVCs as international traders[25] that have received an internationally recognized quality certification.

Table 1.3 GVC positioning: how it is measured in the literature

Authors	Year	Data	GVC positioning measure
Accetturo *et. al.*	2011	Invid survey (Bank of Italy)	Intermediate firm: at least 10% of turnover generated by producing to order for other firms. Final firm: more than 90% of turnover generated by sales to the final market.
Razzolini and Vannoni	2011	Unicredit-Capitalia surveys	Focus on subcontracting firms, distinguished among: 1. manufacturers selling also (but not exclusively) via subcontracting in the domestic market; 2. manufacturers selling also (but not exclusively) via subcontracting abroad; 3. exporters, working as subcontractors only for the foreign market; 4. domestic firms, working as subcontractors only in the home market;

[25] They consider as "international traders" pure importers, pure exporters and two-way traders.

			5. exporters that are subcontractors only domestically; 6. exporters and subcontractors for both the foreign and the domestic market.
Giunta *et al.*	2012	Capitalia Survey on Manufactu-ring Firms	Firms distinguished between: 1. non-subcontractors = selling directly to the final market (final firms); 2. weak subcontractors = up to 50% of sales due to subcontracting; 3. strong subcontractors = more than 50% of sales due to subcontracting; 4. absolute subcontractors = producing exclusively for other firms.
Veugelers *et al.*	2013	Efige survey	Intermediate firm: total turnover entirely generated by producing to order for other firms located abroad.
Agostino *et al.*	2015	Unicredit Survey on Manufactur ing Firms	Two empirical strategies: 1. Distinguishing between (i) intermediate firms = selling exclusively to other companies and (ii) final firms = selling exclusively to the market. 2. Measuring companies' dependence on sales to other firms as the ratio of sales of intermediates to other companies over total revenues.
Giovannetti *et al.*	2015	2011 MET survey data merged with AIDA and Ice-Reprint	Firms distinguished in: 1. final producers = producing final goods for the final market; 2. subcontractors = bound to produce for other firms by a contract; 3. 'own-branded' firms = producing self-designed products.
Del Prete and Rungi	2017	Orbis and Zephyr databases	Matching firm-level activities on MNEs to industry-level GVC positioning measures: the 'downstreamness measures', as proposed by Antràs and Chor (2013), and the inversion of the 'Relative upstreamness measure', proposed by Alfaro *et al.* (2015).
Giovannetti and Marvasi	2017	2011 9th Italian Census of Industry and Services	1. Upstream producers: suppliers of intermediate goods to other firms; 2. midstream producers: buyers of inputs and suppliers of intermediate goods to other firms; 3. downstream producers: makers of final goods sold to households.
Rungi and Del Prete	2018	Orbis database	1. Matching firm-level activities with industry-level GVC positioning measures: the 'downstreamness measures', as proposed by Antràs and Chor (2013). 2. Firms classified according to the business function they carry out (Sturgeon, 2008).
Fauceglia *et al.*	2018	KOF innovation survey panel data.	Downstream participation measure: ratio of intermediate inputs bought over firms' total sales.
Montalba-no *et al.*	2018	OECD-TiVA datasbase and WB Enterprise Survey	Match firm-level data with industry GVC positioning index = IVA/FVA

Other studies match firm-level data with industries' GVC positioning indicators to assess companies' role in the value chains. It is the case, for example, of Montalbano *et al.* (Montalbano, Nenci, & Pietrobelli, 2018), who match firm-level data on companies located in Latin America and the Caribbean with OECD-TiVA data providing country-industry measures of GVC participation and positioning. They compute the former considering both the indirect domestic VA incorporated in intermediate exports (IVA, which proxies forward participation) and the foreign VA present in gross exports (FVA, proxying backward participation). The latter is measured through the IVA/FVA ratio: if higher (lower) than 1, it indicates that a country is positioned upstream (downstream) in the global value chain.

Del Prete and Rungi (2017) work on a database providing information about multinational enterprises, which are, by definition, undoubtedly part of an international production network. Therefore, knowing that the firms of their samples participate to global value chains, they try to determine their positioning along it by matching firm-level primary activities at the 6-digit of the NAICS classification with industrial metrics of positioning within supply chains, computed at the same disaggregation level. They measure the latter referring to both the downstreamness indices proposed by Antràs and Chor (2013) and to the inverse of the Relative Upstreamness indicator presented by Alfaro *et al.* (Alfaro et al., 2015). Rungi and Del Prete take into account the former approach even in a more recent work (2018), where they aim to test where the value added is produced along the value chain. They do so also applying a second methodology, consisting in classifying firms according to the business function they carry out in order to understand where they are located along the VC.

The latter strategy is in line with the framework developed by Sturgeon (2008), advocating, as anticipated (cf. section 3), the study of the value and the geographical distribution of companies' business functions (performed within or outside firms' boundaries) as the best way to assess GVC participation at the enterprise level. The first works applying this strategy dealt with investigating outsourcing and offshoring dynamics at a company-level, as in Huws *et al.* (Huws, Dahlmann, & Flecker, 2004), studying the outsourcing of ICT-related activities, or in Lewin et *al.* (Lewin, Massini, & Peeters, 2009), analysing the reasons behind companies' offshoring strategies regarding R&D tasks. In these cases, the lists of business functions employed to perform the surveys were not exhaustive, but included only commonly outsourced activities (e.g. call centres, IT services). Later on, studies became more comprehensive, such as the European Union Survey on International Sourcing (Nielsen, 2008; cf. section 3). Referring to the same framework, Brown *et al.* (C. Brown, Sturgeon, & Cole, 2014) investigate the

relationships between an organization's[26] international sourcing strategies and its domestic employment and job quality. They rely on the information provided by the 2010 National Organizations Survey (NOS), which is modelled similarly to the European one, envisaging a list of seven supporting functions and a core one. Ali-Yrkkö and Rouvinen (2015) analyze the distribution of value added along 45 GVCs, using detailed and company-confidential invoice data collected through in-depth case studies carried out in 2008-2014. They identify each GVC function, considered as a link in the value chain, and examine the VA produced looking at the performing companies and host location. They highlight how intangible tasks are able to capture a higher share of VA within international production networks.

1.5 The governance of firms in value chains

Undoubtedly, instruments and data to assess whether and how firms participate in global value chains are essential tools for researchers. Nevertheless, an additional dimension of analysis must be considered when aiming at getting the 'whole picture' about international production networks, i.e. their type of governance. As anticipated (cf. section 2), the governance of global value chains can be defined as the "authority and power relationships that determine how financial, material, and human resources are allocated and flow within a chain" (Gereffi, 1994, p. 97). It appears to be shaped by three determinants: the complexity of transactions within the value chain; the possibility to codify information; and the capability of the suppliers along the chain (Gereffi *et al.*, 2005).

The governance patterns characterizing international production networks are decisive in the construction of information – thus, of knowledge – transmission mechanisms, which, in turn, are crucial for the purposes of firms' growth and upgrading. Nevertheless, despite its importance, the governance of GVCs is not an easy object of study, since it's very case-specific; research aiming at its understanding requires information that goes beyond mere balance sheet data and it is often more qualitative. Hence, the majority of studies investigating GVC governance patterns are based on the analysis of one (or a few) case(s).

Drawing from several sources, Gereffi (1999), for instance, focus on the apparel industry in East Asia, characterized by buyer-driven commodity chains, to investigate the mechanisms and the organizational conditions that allow for learning and upgrading. Similarly, Dolan and

[26] The authors analyze a sample of organizations comprising for-profit firms, non-profit ones and public organizations.

Humphrey (2004) retrace the evolution of the governance patterns characterizing the trade in fresh vegetables between Africa (mostly Kenya) and the United Kingdom over twenty years. They underline how large retailers have become dominant in said market, signalling the emergence of a tendency towards production and processing concentration in Africa. Schmitz (1999) highlights the patterns of cooperation among companies located in the Sinos Valley (Brazil) and operating in the footwear industry, relying on quanti-qualitative information collected through surveys, interviews, participation to industrial meetings and local press. Sturgeon (2002) illustrate the emergence of a new model of industrial organization among firms in the electronics sector, the modular production network, whose design depends on the degree of knowledge codifiability at each stage of the VC. In fact, the modular production network is made by nodes – i.e. companies – functionally specialized, whose activities are integrated and based on tacit knowledge; 'breaks' in the value chains – i.e. linkages among companies – are based on flows of codified knowledge. Such relations are quick and flexible, since they are performed at arm's length, but they also allow for the exchange of a considerable amount of information among companies. Ivarssin and Alvstam (2010) investigate the relations between affiliates of Swedish transnational companies and their local suppliers in a number of developing countries (Brazil, China, India, Mexico, Thailand, Indonesia, Vietnam), collecting data through several interviews. Contrary to what usually assumed, they did not find 'captive' linkages between the international buyers and their domestic suppliers, but they observed what they have called 'developmental buyer-supplier relations'. In fact, the buyers actively pursued a strategy aimed to not becoming the main client of their suppliers, while fostering mechanisms of product and process technology transmission through both local and global business ties. In a more recent work, Magnani *et al.* (Magnani, Zucchella, & Strange, 2018) illustrate six case studies focusing on the dyadic outsourcing relationship between three lead firms and, for each one, two suppliers. The authors consider dependence and power asymmetries as crucial in shaping these relations and they assess that the former are determined by four factors: (i) heterogeneous capabilities and resources between lead firm and suppliers; (ii) 'isolating mechanisms[27]' implemented by both companies; (iii) number of alternative suppliers (buyers) for the lead firms (suppliers) and potential switching costs; (iv) investments in assets specific

[27] The 'isolating mechanisms' provide limits to the possibility of acquiring and/or imitating a firm's capabilities and resources by its potential competitors. Lawson *et al.* (2012) classify them into four categories: (i) forms of knowledge protection (either formal, e.g. property rights, or informal, e.g. measures to reduce knowledge leakage); (ii) firm-specific technological knowledge; (iii) market-based firm-specific assets (e.g. brand reputation); (iv) first mover advantages.

to the relation. Magnani *et al.* (2018) find that power dynamics are complex and not always asymmetric, exercised and in favour of the lead firm.

As already mentioned, research based on case studies suffers from several limitations, although being rich in details and, therefore, particularly suitable for investigations focusing on GVC governance. To overcome such drawbacks, recent works have been trying to identify GVC governance patterns resorting to firm-level datasets, often assembled through surveys.

Pietrobelli and Saliola (2008), for instance, investigate the governance patterns characterizing global and domestic value chain in Thailand's manufacturing sector. They use data from the Productivity and the Investment Climate Private Enterprise Survey (PICS), carried out by the World Bank from 2001 to 2003, providing both quantitative and qualitative plant-based information for each firm. Thus, they can formulate a measure of value chain governance based on four variables: (i) share of sales made only to tailor the buyer's specific requests; (ii) whether the buyer has imposed quality standards and has established specific product characteristics (e.g. design or quality); (iii) whether the buyer has involved the supplier in process or product R&D activities; (iv) whether personnel exchange has occurred from the buyer to the supplier, in order to bring new technologies into the production plant. Based on different degrees of these variables, the authors have singled out five types of VC governance, as illustrated in table 1.4.

Table 1.4 Classification of VC governance in Pietrobelli and Saliola (2008)

	Indicators		
Types of governance	*% of sales made according to buyer's specification*	*Product design/quality standards*	*Tech dissemination and R&D*
Low requirements	Less than 20%	No	No
Higher requirements	More than 20%	No	No
Higher requirements and D/Q standards	More than 20%	Yes	No
Higher requirements and Tech_R&D	More than 20%	No	Yes
Higher requirements and D/Q standards and Tech_R&D	More than 20%	Yes	Yes

Dallas (2015) uses standard trade data combined with those encompassing millions of lines of export transactions carried out by 439 of the largest Chinese exporting firms over 18 sub-industries belonging to the electronics and light industries sectors. He distinguishes three types

of inter-firm governance patterns: modular, relation-captive, and market[28]. In order to assess which type of governance characterizes the relations of each firm, he combines four indicators, two measured at the firm level and two computed at the product level (table 1.5). Among the former, 'export specialization' is calculated as the share of a firm' total export deriving from its primary HS code. A low export specialization is associated with pure market relations, since it is consistent with product and industry diversification strategies; a high export specialization is linked to relational-captive relations among firms, given that they entail deeper ties between companies and they require firms to concentrate resources on specialized products. The second firm-based indicator is the 'transactional stability' of a company's exports to its buyers and it is computed as the coefficient of variation of a firm's monthly transaction within its primary HS category. Transactional stability especially characterizes modular relations, since they are typical of companies having linkages with multiple buyers across multiple products, while market relations are, by definition, unstable under this point of view. Halfway between these two extremes lie relational-captive governance ties. As anticipated, these indicators are combined with other two measures computed at the product level, namely 'industry stability' and 'export entry'. The former is proxied using inflation-adjusted and trade weighted annual export data for China, considering only those years registering a real decline in Chinese exports in the HS code (thus, increasing the competitive pressure on suppliers); contrary to 'transaction stability', it is low 'industry stability' that is associated to modular governance linkages, and *vice versa* for relational-captive and market ones[29]. Finally, Dallas (2001, p. 891) argues that "GVC governance predicts heterogeneity in the barriers to export market entry". The latter is proxied as the share of total exports by HS code conducted by foreign-invested companies; a high level of export barriers is associated to modular relations and *vice versa* for relational-captive and especially market linkages[30].

[28] 'Hierarchy' is not taken into account as form of governance since data refer to transactions between independent firms, therefore excluding intra-company trade relations. 'Captive' and 'relational' links are merged into a unique category, since Chinese trade data do not allow to distinguishing between the two.

[29] Several, mutually reinforcing factors can cause high industry volatility for goods whose production process is characterized by modular linkages among firms. In industries such as electronics, for instance, especially for final goods, demand is relatively more unstable, seasonally different and dependent on the launch of new products. Moreover, on the supply side, branded firms count on modular linkages with their suppliers to adjust production volumes by passing the volatility risk down the value chain. On the contrary, this is not the case for relational-captive and market VCs.

[30] Modular VC governance is expected to build the highest export barriers, since a considerable amount of resources, in terms of both capital and knowledge, is needed to achieve the necessary economies of scale and scope. Conversely, industries characterized by market linkages among firms should have the lowest level of entry barriers, given the low switching costs and simplicity of transactions.

Table 1.5 Governance types and indicators in Dallas (2001)

Governance type	Firm-level indicators		Product-level indicators	
	Export specialization	*Transaction stability*	*Industry stability*	*Export entry*
Modular	Unclear	High	Low	High
Relational-captive	High	Medium	High	Medium
Market	Low	Low	High	Low

Besides investigating firms' participation in value chains (section 4), Brancati *et al.* (2017) focus on the governance characterizing production networks. As already mentioned, they can rely on both qualitative and quantitative data collected through the MET survey. In accordance with GVC theory (Gereffi *et al.*, 2005), the authors are able to distinguish among four types of relationships in value chains: hierarchical, quasi-hierarchical, relational and market (table 1.6). The former and the latter represent the two extremes of the taxonomy: inter-firm relations characterized by market ties are simple arm's length transactions, while hierarchical ties are those linking companies belonging to the same group, identified through a legal requirement (i.e. being a subsidiary of corporate group). Both quasi-hierarchical and relational ties refer to 'long-lasting trade relations' among firms, but they differ by a fundamental feature. In fact, Brancati *et al.* (2017) use information about companies' involvement in the conception of the final good to proxy for their specific skills and their participation to the decisional process in the value chain. Thus, suppliers having stable relations with their main buyer and carrying out production activities merely following its specifications, with no active role in the definition of the good's characteristics, can be considered as being subjected to a quasi-hierarchical form of governance. On the contrary, suppliers that, thanks to their peculiar set of competences, contribute to the conception of the final good are considered to be involved in a relational VC.

Table 1.6 Governance types as identified in Brancati *et al.* (2017)

Governance type	Identification
Hierarchical	Suppliers being subsidiaries of a corporate group.

Quasi-hierarchical	Suppliers having long lasting, trade-oriented relations with foreign firms but not involvement in the conception of the final good.
Relational	Suppliers having long lasting, trade-oriented relations with foreign firms actively contributing to the definition of the product.
Market	Suppliers without any significant and stable relations with commercial partners.

Wynarczyk and Watson (2005) focus on SMEs located in the United Kingdom and engaged in subcontracting activities[31]. They differentiate companies into two groups, distinguishing between those that have developed inter-firm relations with their main buyer and those that have not. In order to belong to the former category, subcontractors should have established partnerships with their main customers having the following three characteristics: (i) representing the primary type of inter-firm links within the subcontractors' supply chain; (ii) being governed both by formal contracts and by mutual trust and interpersonal relationships; (iii) involving a high degree of knowledge transfer, resource sharing and cooperation. Altomonte *et al.* (2012), too, studying firm-level transactions, distinguish between two types of GVC organizational forms: one refers to the internalization of activities, where, therefore, transactions take place at the intra-group level; in the other one trade happens between unrelated firms tied by supply contracts, thus at arm's length.

Giovannetti and Marvasi (2017) are able to exploit information provided by the 2011 9th Italian Census of Industry and Services concerning firms' organizational structure and decisional power in order to distinguish among three types of governance: market, relational and hierarchy (table 1.7). As seen in Brancati *et al.* (2017), hierarchical ties are considered to be those linking companies belonging to the same corporate group. Among the rest of independent firms, market and relational types of governance are distinguished by looking at the degree of 'decisional centralization'. In fact, the dataset contains information about the entrepreneur's actual decisional power: in some cases, he truly is the subject in charge of strategic decisions (market governance), while in others, although formally holding decisional responsibilities, he is not the (only) one engaged in the definition of the firm's strategy, to which others concur, too (e.g. other internal and external managers and, sometimes, the employees).

Table 1.7 Governance types as identified by Giovannetti and Marvasi (2017)

Governance type	Identification

[31] The sample of firms used by Wynarczyk and Watson (2005) is made by companies whose output is related to subcontracting activities at least for a share equal to the 50%.

Hierarchical	Firms belonging to a corporate group, being either parent companies or affiliates.
Relational	Independent firms with relatively lower degree of decisional centralization.
Market	Independent firms with high degree of decisional centralization.

Looking at the power distribution along the value chain to determine its governance is a strategy also proposed by Kaplinsky e Morris (2001) and appears to be closer to the 'first approach' to GVC governance theorization – distinguishing between buyer-driven and producer-driven GVCs (e.g. Gereffi, 1994) –, while the 'second approach' tries to broaden the picture, taking into account additional elements such as information codifiability and transaction complexity (e.g. Gereffi *et al*., 2015). Nonetheless, Kaplinsky and Morris (2001, p.67) provide several useful indications regarding possible measures to evaluate the governance of production networks. However, although some indicators appear to be easily computable resorting to balance sheet data (e.g. 'share of chain sales', 'rate of profit'), they are also the weakest ones. The most suitable measures of GVC governance, such as 'share of chain buying power' or 'control over a key technology' require detailed and often confidential information, thus being obtainable almost exclusively through firm interviews. This bring us back to the issue of data availability at the firm level and their degree of detail. If case studies, the richest in terms of information collected, are useful but by definition provide a very specific analysis of the GVC governance phenomenon, investigations based on surveys, although stronger in terms of generalizable results, suffer from being highly dependent on the type of information available. In fact, as highlighted in this section, different indicators of GVC governance can be found in the literature, since researchers try to measure such phenomenon looking at the data they have access to through the lenses of GVC theory and finding, in every case, the best indices computable with the information at their disposal. Detailed and accessible firm-level databases, providing not only balance sheet data but also information about companies' internationalization strategies and inter- and intra-firm relations, would certainly facilitate GVC investigation and allow building a less diversified analytical framework.

1.6 Performance and upgrading of firms belonging to GVCs

The majority of research focusing on GVC participation, positioning and governance at the micro level is not limited to getting the 'whole picture' of such phenomena, describing in details

the organization and the mechanisms characterizing international production networks. It is known that only the most efficient and productive firms engage in international activities (Melitz, 2003). Thus, empirically, several works investigate whether playing a role in a global value chain is related to firms' performance and can stimulate or facilitate their upgrading process along the chain (cf. section 2).

Giovannetti *et al.* (2015) and Giovannetti and Marvasi (2016), for example, focus on the link between being part of a value chain and being able to implement internationalization strategies. They find that there is a positive and significant association between participation into VCs and both the probability of export and the intensive margin of trade, especially for downstream firms.

Siedschleg and Murphy (2015) illustrate how the propensity of firms to implement internationalization strategies is positively related to their age, size, productivity and product innovation. Agostino *et al*. (Agostino, Giunta, Scalera, & Trivieri, 2015) find a positive association between firms' importing activities and their productivity, measured in total factor productivity (TFP) terms. In particular, they illustrate how firms' TFP is positively and significantly related to importing intermediate goods. Results are stronger for companies considered 'best performers'[32], for exporters and for firms with higher absorptive capacity sourcing customized inputs from advanced countries. These latter findings suggest the presence of learning-by-importing mechanisms, activated by technology transfers embedded in the intermediate goods imported. Montalbano *et al.* (2018), on the other hand, first focus on exporting firms, showing that they are more productive than those not selling abroad. Then they take into account GVC participation, which also appear to be positively associated with companies' productivity. Moreover, relying on industry-level GVC positioning indicators, they find that firms operating in sectors located upstream in international production networks (i.e. mostly supplying intermediates used in other countries' exports) appear to be more productive than those belonging to downstream industries.

Badwin and Yan (2014) not only find a positive association between GVC participation and a number of firms' characteristics such as labor productivity, size, wages and sales per worker, but they are also able to single out the impact of entering into an international production network on companies' productivity. In fact, they control for the self-selection problem[33] and they find that not only becoming part of a GVC increases companies' productivity, but also this

[32] With 'best performers', the authors refer to firms having a TFP higher than the median value.
[33] This is necessary since firms that are more productive may self-select into being part of a GVC.

positive effect cumulates over time. The strength of this 'GVC effect' depends on the industry considered, the type of internationalization strategies and the import sourcing and export destination areas[34]. Del Prete *et al.* (2017), too, are able to single out the impact of GVC participation. They exploit a longitudinal set of data and, by carrying out an impact evaluation analysis, they are able to show that firms entering into global value chains show both higher productivity levels ex-ante and extra productivity gains afterwards.

Veugelers *et al.* (2013) find that firms involved in GVCs are large, intensively active in trade, more innovative and more productive. In particular, although representing only the 5% of the study sample, companies involved the most in international production networks (i.e. 'triple-mode' firms) account for about the 27% of total value added, 24% of total employment and 30% of total trade of the group. These companies also have a higher total factor productivity, whose positive relation with complex internationalization strategies has been proven econometrically significant. Higher levels of TFP are especially associated with being downstream in value chains, while, when considering intermediate firms, the picture is harder to interpret. Generally, companies producing for other firms are less productive than final firms, but this is true mostly for companies operating only in the domestic market; in fact, even in the case of intermediate firms, more complex internationalization strategies are associated with higher productivity levels. When considering firms' innovativeness, results have a similar pattern: not only higher GVC involvement is associated with better innovation performance, but triple-mode firms are less likely to introduce (usually cost-cutting) process innovation only; on the contrary, they appear to be more inclined to innovate both at the product and at the process level. When taking into account intermediate firms, it is necessary to distinguish again between those operating only domestically and those supplying foreign companies. The former appear to be less inclined to implement innovation strategies and, if they do, they are mostly process innovators exclusively; the latter, in contrast, are more likely to introduce innovations and, in doing so, to implement product ones. Agostino *et al.* (2016) also find similar results in terms of relations between companies' GVC participation and labor productivity. They rely on an updated version of the Efige database and focus in particular on Italian firms, showing that there is a positive association between the degree of GVC involvement (e.g. single, dual or triple mode internationalization strategies) and firms' productivity: the stronger the former, the

[34] The 'GVC effect' is higher for firms starting exporting after having already engaged in import activities. In addition, it is stronger in the technology sector and for companies importing from or exporting to high-wage countries.

higher the latter. Moreover, they show once again that positioning matters, since suppliers appear to be characterized by lower productivity levels. This confirms what Accetturo *et al.* (2011) find studying the performance of Italian firms participating in GVCs during the first years of the recent economic crisis. In fact, they observe that intermediate firms, on average, tend to be smaller (in terms of labor force), to have a lower export propensity and lower productivity levels (proxied by the share of turnover per employee)[35]. This intermediate firms' 'disadvantage' with respect to final ones is what Razzolini and Vannoni (2011) call "subcontracting discount". In fact, the authors find that subcontractors are smaller and characterized by lower productivity (measured as TFP, both in absolute and relative terms[36]) when compared to firms not engaged in production-to-order activities. Even among exporters, those supplying only foreign companies (i.e. not selling to other firms domestically) are less productive than exporters not involved in subcontracting activities at all (either at home or abroad). Agostino *et al.* (2015) shed more light on the matter by looking at subcontractors' characteristics. Indeed, they find non-exporting and non-innovative subcontractors to be less productive (in terms of both labor productivity and TFP) than final firms having the same features, but such gap can be reduced for intermediate firms that have acquired greater competences. In fact, results show no significant differences in productivity between final firms and subcontractors when the latter are capable to both export and innovate. Positioning within value chains (specifically, being an intermediate or a final firm) has also been proved relevant when evaluating the impact of the recent crisis on companies' performance. Accetturo and Giunta (2017) investigate whether companies' sales dynamics during the 2008-2009 crisis is related to their role within VCs. They find that intermediate firms tend to be smaller and they appear to have experienced a greater decrease in sales during the 2008-2009 crisis. Also, they privilege process rather than product innovation and have less human capital. Nevertheless, once again such picture is different according to companies' degree of internationalization. In fact, suppliers whose main customer is located abroad engage also in product innovation and their export share over total sales is similar to the one of downstream firms. Moreover, comparing Italian and German firms, Accetturo and Giunta (2017) underline how the former have been characterized by much lower growth in sales with respect to the latter and, among them, there is a larger presence of small, fully intermediate companies. The authors find that

[35] It should be noted, however, that such picture is marked by a high degree of heterogeneity.

[36] Besides measuring TFP in absolute terms, Razzolini and Vannoni (2011) also compute a relative measure of it, in order to remove industry and year effect. The relative TFP of a firm is calculated as the ratio between its productivity and the industry mean for the year.

such difference in the positioning within GVC explains on fifth of the performance gap between Italy and Germany in terms of firm performance.

Giunta *et al.* (2012), too, focus on subcontracting activities of Italian manufacturing firms, carrying out, however, a dynamic analysis. In fact, the authors investigate the impact of such activities on companies' growth in the second half of the 1990s. They find that, in innovating firms, a rise in the subcontracting activities entails higher growth and that innovation is fundamental for the growth of subcontracting companies.

The performance of intermediate firms is also at the center of the investigation conducted by Wynarczyk and Watson (2005). In this case, the performance of a sample of 211 subcontractors located in the United Kingdom is studied in association with the type of relations they have established with the other players in their supply chain. In particular, the authors look at the growth rates of sales and employment of firms distinguishing between those having established 'partnerships' (relations entailing resource sharing strategies and mutual trust) with other members of their production networks and those that have not. Results show that companies having established inter-firm partnerships grow at higher rates than the others do. This conclusion is similar to the one reached by Pietrobelli and Saliola (2008), who analyze whether the productivity (measured as TFP) of Thai suppliers is related to the type of relations linking them to their buyers, i.e. to the governance characterizing the value chain they are involved in. The authors find that intermediate firms show higher levels of productivity when they are deeply connected to their buyers. In particular, this happens when the final firm is highly involved with its main suppliers in a relation that is not limited to cooperation and co-design in the making of the final products, but that entails knowledge sharing in terms of technology dissemination and R&D activities. Moreover, they find that the relevance of the types of linkages connecting the players of a value chain is higher in domestic production networks, as GVC governance affects less the productivity of suppliers that export or sell to MNEs.

Giovannetti and Marvasi (2017) take into account both GVC positioning and governance and investigate how they influence firms' performance[37]. According to companies' role within international production networks, final firms appear to be the most productive, followed by the midstream ones and, lastly, by those located upstream in the chain. This is somehow surprising, since, according to the "smile curve" thesis, the companies that are able to capture the largest part of the value added produced along fragmented production processes are those

[37] The authors look at firms' productivity, measuring it as sales per employee.

located at the extremes of the chain, namely those upstream and downstream. Looking at the type of relations linking the players within the VCs, Giovannetti and Marvasi (2017) find that market relations, although representing the way most firms operate, entail lower productivity level with respect to relational and especially hierarchical links. When considering the two dimensions – GVC positioning and governance – together, the most productive firms appear to be those located midstream in the production processes and engaged in hierarchical relations.

Investigating companies' upgrading in global value chains poses a real challenge to researchers, mostly because, if (as often pointed out so far) firm-level data are scarcely available, even fewer datasets provide longitudinal information allowing to retrace how companies' performance has evolved and what has influenced it. Therefore, not surprisingly, most of the literature covering the subject consists in case studies.

For instance, in one of his seminal works, Gereffi (1999) investigates the evolution of the apparel industry especially focusing on East Asia. Relations between international buyers and local sellers have been crucial in fostering the industrial upgrading of the apparel sector in the region, since they allow for knowledge transmission. The type of information acquired by local suppliers depends on the typology (i.e. the GVC positioning) of their local buyers: the higher the complexity of activities carried out by the buyer (e.g. manufacturers vis-à-vis retailers and marketers), the more sophisticated are the requirements they ask to local suppliers. Therefore, the latter not only have the opportunity to enhance their organizational skills - since they often have to subcontract part of their orders to other local firms – but they also learn about the marketing side of the industry. These learning mechanisms, together with other factors[38], favored an upgrading of the apparel East Asian companies, from original equipment manufacturers (OEMs) to original brand name manufacturers (OBMs)[39]. Investigating how leather footwear producers located in the export-oriented Sinos Valley (Brazil) have responded to the new challenges posed by the increasing global competition, Schmitz (1999), too, highlights how relations among firm have proved to play an essential role in the evolution of the cluster. The author underlines how cooperation among companies has allowed them to upgrade in the production activities, but no advancements have been made in tasks with a higher

[38] Such as the pattern by which different types of international buyers follow one another in new (usually, lowest-cost) areas, domestic supply-side constraints (e.g. increasing wages, labor scarcity), external determinants (e.g. tariffs, quotas, currency re-evaluations).

[39] OEMs are suppliers that produce goods based on the instruction received by their buyers and have no control over the distribution activities; the products are sold under the buyers' brand. OBMs design, produce and sell their own merchandise, sometimes also acting as OEMs for other firms.

value added content (e.g. design, marketing), despite the efforts planned in a mutual cooperation pact. In fact, conflicts have arisen between different associations, the state proved incapable to mediate, and some major companies of the cluster preferred collaborating with foreign large players rather than cooperating with local firms.

Brancati *et al.* (2017) are among the few that can exploit a large firm-level dataset, covering several years and providing both qualitative and quantitative information. They look at upgrading trajectories of Italian firms between 2008 and 2013, taking into account not only standard measures, such as productivity and sales dynamics, but they also consider ex-ante strategies directed to increase firms' chances to upgrade, namely those related to innovation and R&D. Investigating how companies participating to global production chains have fared during the recent global crisis, they obtain heterogeneous results. In fact, they illustrate that, after the 2009 trade collapse, merely being part of an international production network is not enough to be successful for a firm. Specifically, they find that skilled firms involved in relational GVCs do have a higher probability of engaging in innovation and R&D activities, showing a higher propensity to upgrade as signaled also by their higher productivity (measured as the ratio between value added and the number of employees) and sales growth. Nevertheless, companies involved in GVCs characterized by other forms of governance do not appear to have any significant advantage compared to exclusively domestic ones. Moreover, in 2008-2009, firms involved in GVCs do not show a decrease in productivity, although experiencing a reduction in sales growth that has affected mostly suppliers with low skills, while 'sparing' firms in relational GVCs.

1.7 Concluding remarks

The international fragmentation of production processes is one of the strongest and most pervasive phenomena having impacted on the global economy in the last decades. Its effects can be noted (and, therefore, studied) at the macro, meso and micro level. Having a clear understanding of whether and how companies participate into global production networks appears imperative, since they are the actual players within GVCs and policies addressing firm-level issues must take into account how they move in this new competitive arena. More importantly, it appears crucial to identify what are the consequences of GVC participation for companies and understand whether different type of GVC involvement, in terms of both positioning and governance, can entail different effects on firms.

In this work, we have tried to systematize a large body of literature investigating companies within international production networks. We have shown how GVC participation, positioning and governance have been studied so far at the micro level and what their impact appears to be on firms' performance. Enterprises belonging to a global production networks generally show higher levels of productivity, especially when located downstream in the chain. Nevertheless, intermediate firms, too, seems to benefit from GVC participation, particularly when they are able to export and innovate. Moreover, the presence of inter-firm linkages allowing for mechanisms of knowledge transmission has positive implication in terms of companies' performance.

This evidence, although precious, leaves ample room for further research. In fact, investigating GVCs at the micro level is a complex task due to the lack of good quality data at the firm level. As shown in this work, scholars usually resort to a few information sources, each one having pros and cons which influence the quality of their research. More data are needed, both quantitative and qualitative, ideally covering several countries and years. That would allow for longitudinal, cross-country comparisons, yielding generalizable results.

References

Accetturo, A., Giunta, A., & Rossi, S. (2011). *The Italian firms between crisis and the new globalization*. *Occasional Papers, Bank of Italy* (Vol. 86).

Accetturo, A., Linarello, A., & Petrella, A. (2017). *Legal enforcement and Global Value Chains: micro-evidence from Italian manufacturing firms*. *Occasional Papers, Bank of Italy* (Vol. 397).

Agostino, M., Giunta, A., Nugent, J. B., Scalera, D., & Trivieri, F. (2015). The importance of being a capable supplier: Italian industrial firms in global value chains. *International Small Business Journal*, *33*(7), 708–730.

Agostino, M., Giunta, A., Scalera, D., & Trivieri, F. (2015). Imports, productivity and Global Value Chains: a European firm-level analysis. In *Paper presented at the Workshop: Global Value Chains. Firms, Trade and Policy Implications. Roma Tre University, 10-11 December 2015*.

Alessandria, G., Kaboski, J. P., & Midrigan, V. (2011). US Trade and Inventory Dynamics. *The American Economic Review*, *101*(3), 303–307.

Alfaro, L., Antràs, P., & Conconi, P. (2015). Internalizing Global Value Chains: A Firm-level Analysis. *NBER Working Paper*, *41*(December), 1–5.

Ali-Yrkkö, J., & Rouvinen, P. (2015). Slicing Up Global Value Chains: a Micro View. *Journal of Industry, Competition and Trade*, *15*, 69–85.

Altomonte, C., & Aquilante, T. (2012). *The EU-EFIGE/Bruegel-UniCredit dataset* (No. 13).

Altomonte, C., Di Mauro, F., Ottaviano, G., Rungi, A., & Vicard, V. (2012). *Global Value Chains During the Great Trade Collapse: A Bullwhip Effect? European Central Bank Working Paper Series*.

Amador, J., & Cabral, S. (2016a). Global value chains: A survey of drivers and measures. *Journal of Economic Surveys*, *30*(2), 278–301.

Amador, J., & Cabral, S. (2016b). Networks of Value-added Trade. *The World Economy*, 1–23.

Antràs, P. (2015). *Global Production : Firms , Contracts , and Trade Structure*. Princeton University Press.

Antràs, P., & Chor, D. (2013). Organizing the Global Value Chain. *Econometrica*, *81*(6), 2127–2204.

Antràs, P., Chor, D., Fally, T., & Hillberry, R. (2012). Measuring the Upstreamness of Production and Trade Flows. *The American Economic Review*, *102*(3), 412–416.

Antràs, P., & Rossi-Hansberg, E. (2009). Organizations and Trade. *Annual Review of Economics*, *1*(1), 43–64.

Armando, E., Azevedo, A. C., Fischmann, A. A., & Pereira, C. E. C. (2016). Business strategy and upgrading in global value chains: a multiple case study in Information Technology firms of Brazilian origin. *RAI Revista de Administração e Inovação*, *13*(1), 39–47.

Arndt, S. W., & Kierzkowski, H. (Eds.). (2001). *Fragmentation. New production patterns in the world economy*. Oxford: Oxford University Press.

Athukorala, P. (2005). Product Fragmentation and Trade Patterns in East Asia. *Asian Economic Papers*, *4*(February 2005), 1–27.

Azmeh, S., & Nadvi, K. (2014). Asian firms and the restructuring of global value chains. *International Business Review*, *23*(4), 708–717.

Bair, J. (2005). Global Capitalism and Commodity Chains: Looking Back, Going Forward. *Competition & Change*, *9*(2), 153–180.

Baldwin, J., & Yan, B. (2014). *Global Value Chains and the Productivity of Canadian Manufacturing Firms*. *Economic Analysis Research Paper Series*.

Baldwin, R. (2006). Globalisation: the great unbundling(s). *Economic Council of Finland*, *20*(September), 51.

Baldwin, R. (Ed.). (2009). *The great trade collapse: Causes, consequences and prospects*. Cepr.

Baldwin, R. (2011). *Trade And Industrialisation After Globalisation's 2nd Unbundling: How Building And Joining A Supply Chain Are Different And Why It Matters* (NBER Working Paper Series No. 17716). Cambridge, MA.

Baldwin, R., & Lopez-Gonzalez, J. (2013). *Supply Chain Trade: a Portrait of Global Patterns and Several Testable Hypothesis* (No. 18957). *NBER Working Paper Series*.

Baldwin, R., & Robert-Nicoud, F. (2014). Trade-in-goods and trade-in- tasks : An integrating framework. *Journal of International Economics*, *92*(1), 51–62.

Baldwin, R., & Venables, A. J. (2013). Spiders and snakes: Offshoring and agglomeration in the global economy. *Journal of International Economics*, *90*(2), 245–254.

Beghin, J. C., Maertens, M., & Swinnen, J. F. M. (2015). *Non-tariff measures and standards in trade and global value chains* (LICOS Discussion Paper Series No. 363).

Bernard, A. B., Jensen, J. B., Redding, S. J., & Schott, P. K. (2012). The Empirics of Firm Heterogeneity and International Trade. *Annual Review of Economics*, *4*, 283–313.

Birkinshaw, J., Brannen, M. Y., & Tung, R. L. (2011). From a distance and generalizable to up close and grounded: Reclaiming a place for qualitative methods in international business research. *Journal of International Business Studies*, *42*(5), 573–581.

Brancati, E., Brancati, R., & Maresca, A. (2017). Global value chains, innovation and performance: Firm-level evidence from the Great Recession. *Journal of Economic Geography*, *17*(5), 1039–1073.

Brown, C., Sturgeon, T. J., & Cole, C. (2014). *The 2010 National Organizations Survey: Examining the Relationships Between Job Quality and the Domestic and International Sourcing of Business Functions by United States Organizations* (IRLE Working Paper No. 156–13).

Brown, S. P. (2008). Business Processes and Business Functions: a new way of looking at employment. *Monthly Labor Review*, (December), 51–70.

Cantwell, J. (1995). The globalisation of technology: what remains of the product cycle model? *Cambridge Journal of Economics*, *19*(1), 155–174.

Cerina, F., Zhu, Z., Chessa, A., & Riccaboni, M. (2015). World input-output network. *PLoS ONE*, *10*(7), 1–21.

Cheng, K., Rehman, S., Seneviratne, D., & Zhang, S. (2015). *Reaping the Benefits from Global Value Chains*. *IMF Working Paper*.

Coe, N. M., Dicken, P., & Hess, M. (2008). Global production networks: Realizing the potential. *Journal of Economic Geography*, *8*(3), 271–295.

Constantinescu, C., Mattoo, A., & Ruta, M. (2015). *The Global Trade Slowdown: Cyclical or Structural?* (No. 7158). *Policy Research Working Papers*.

Costinot, A., Vogel, J., & Wang, S. (2013). An elementary theory of global supply Chains. *Review of Economic Studies*, *80*(1), 109–144.

Crescenzi, R., Pietrobelli, C., & Rabellotti, R. (2014). Innovation Drivers, Value Chains and the Geography of Multinational Corporations in Europe. *Journal of Economic Geography*, *14*(6), 1053–1086.

Dallas, M. P. (2015). 'Governed' trade: global value chains, firms, and the heterogeneity of trade in an era of fragmented production. *Review of International Political Economy*, *22*(5), 875–909.

Daudin, G., Rifflart, C., & Schweisguth, D. (2011). Who produces for whom in the world economy?, *44*(4), 1403–1437.

De Backer, K., & Miroudot, S. (2012). Mapping Global Value Chains. *OECD Trade Policy*

Papers, (159), 1–44.

De Benedictis, L., Nenci, S., Santoni, G., Tajoli, L., & Vicarelli, C. (2013). *Network Analysis of World Trade using the BACI-CEPII dataset* (No. 24).

De Benedictis, L., & Tajoli, L. (2011). The World Trade Network. *The World Economy*, *34*(8), 1417–1454.

Deardorff, A. V. (2001). International Provision of Trade Services , Trade , and Fragmentation. *Review of International Economics*, *9*(2), 233–248.

Dedrick, J., Kraemer, K. L., & Linden, G. (2010). Who Profits from Innovation in Global Value Chains? A Study of the iPod and Notebook PCs. *Industrial and Corporate Change*, *19*(1), 81–116.

Del Prete, D., Giovannetti, G., & Marvasi, E. (2017). Global value chains participation and productivity gains for North African firms. *Review of World Economics*, *153*(4), 675–701.

Del Prete, D., & Rungi, A. (2017). Organizing the global value chain: A firm-level test. *Journal of International Economics*, *109*, 16–30.

Dicken, P., Kelly, P. F., Olds, K., & Wai-Chung Yeung, H. (2001). Chains and networks, territories and scales: towards a relational framework for analysing the global economy. *Global Networks*, *1*(2), 89–112.

Dixit, A. K., & Grossman, G. M. (1982). Trade and Protection With Multistage Production. *The Review of Economic Studies*, *49*(4), 583.

Dolan, C. S., & Humphrey, J. (2004). Changing governance patterns en the trade in fresh vegetables betwen Africa and the United Kingdom. *Environment and Planning A*, *36*(3), 491–509.

Egger, P., & Egger, H. (2005). The determinants of EU processing trade. *The World Economy*, *28*, 147–168.

Fauceglia, D., Lassmann, A., Shingal, A., & Wermelinger, M. (2018). Backward Participation in Global Value Chains and Exchange Rate Driven Adjustments of Swiss Exports. *Review of World Economics*.

Feenstra, R. C. (1998). Integration of Trade and Disintegration of Production in the Global Economy, *12*(4), 31–50.

Feenstra, R. C., & Hanson, G. H. (1996). Globalization, Outsourcing, and Wage Inequality. *American Economic Review*, *86*(2), 240–245.

Feenstra, R. C., Hanson, G. H., & Swenson, D. L. (2000). Offshore Assembly from the

United States : Production Characteristics of the 9802 Program. In R. C. Feenstra (Ed.), *The Impact of International Trade on Wages* (pp. 85–125). Chicago, IL: University of Chicago Press.

Frohm, E., & Gunnella, V. (2017). *Sectoral interlinkages in global value chains: Spillovers and network effects*. *ECB Working Paper Series* (Vol. May).

Gereffi, G. (1994). The Organization of Buyer-Driven Global Commodity Chains: How U.S. Retailers Shape Overseas Production Networks. In G. Gereffi & M. Korzeniewicz (Eds.), *Commodity Chains and Global Capitalism* (pp. 95–122).

Gereffi, G. (1999). International trade and industrial upgrading in the apparel commodity chain. *Journal of International Economics*, *48*(1), 37–70.

Gereffi, G., & Fernandez-Stark, K. (2016). *Global Value Chain Analysis: A Primer (2nd edition)*. *Duke CGGC (Center on Globalization, Governance & Competitiveness)*. Retrieved from https://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/12488/2016-07-28_GVC Primer 2016_2nd edition.pdf?sequence=1%0Ahttp://hdl.handle.net/10161/12488

Gereffi, G., Humphrey, J., & Sturgeon, T. J. (2005). The governance of global value chains. *Review of International Political Economy*, *12*(1), 78–104.

Giovannetti, G., & Marvasi, E. (2016). Food exporters in global value chains: Evidence from Italy. *Food Policy*, *59*, 110–125.

Giovannetti, G., Marvasi, E., & Sanfilippo, M. (2015). Supply chains and the internationalization of small firms. *Small Business Economics*, *44*(4), 845–865.

Giunta, A., Nifo, A., & Scalera, D. (2012). Subcontracting in Italian Industry: Labour Division, Firm Growth and the North-South Divide. *Regional Studies*, *46*(8), 1067–1083.

Goni, J., & Kadarusman, Y. (2015). Local Company Contribution within Global Value Chain: A Case Study in the Indonesian Footwear Industry. *Mediterranean Journal of Social Sciences*, *6*(6), 444–453.

Görg, H. (2000). Fragmentation and Trade: US Inward Processing Trade in the EU. *Weltwirtschaftliches Archiv*, *136*(3), 403–422.

Greenaway, D., & Kneller, R. (2007). Firm heterogeneity, exporting and foreign direct investment. *Economic Journal*, *117*, 134–161.

Grossman, G. M., & Rossi-Hansberg, E. (2006). The Rise of Offshoring: It's Not Wine for Cloth Anymore. *The New Economic Geography: Effects and Policy Implications*, 59–102.

Grossman, S. J., & Hart, O. D. (1986). The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration. *Journal of Political Economy*, *94*(4), 691–719.

Helg, R., & Tajoli, L. (2005). Patterns of international fragmentation of production and the relative demand for labor. *North American Journal of Economics and Finance*, *16*(2), 233–254.

Hoekman, B. (Ed.). (2015). *The Global Trade Slowdown: A New Normal? VoxEU.org eBook*. CEPR Press.

Hopkins, T. K., & Wallerstein, I. (1977). Patterns of development of the modern world-system. *Review*, *1*, 11–145.

Hummels, D., Ishii, J., & Yi, K.-M. (2001). The nature and growth of vertical specialisation in world trade. *Journal of International Economics*, *54*, 75–96.

Humphrey, J., & Schmitz, H. (2002). How does insertion in global value chains affect upgrading in industrial clusters ? *Regional Studies*, *36*(9), 1017–1027.

Huws, U., Dahlmann, S., & Flecker, J. (2004). *Outsourcing of ICT and related services in the EU*.

Iammarino, S., & McCann, P. (2013). *Multinationals and economic geography. Location, technology and innovation*. Cheltenham: Edward Elgar.

Industry Canada. (2011). *Business Innovation and Strategy: A Canadian Perspective*. *REPORT BASED ON THE RESULTS OF THE SURVEY OF INNOVATION AND BUSINESS STRATEGY (SIBS)*.

Ivarsson, I., & Alvstam, C. G. (2010). Upstream Control and Downstream Liberty of Action?: Interdependence Patterns in Global Value Chains, with Examples from Producer-driven and Buyer-driven Industries. *Review of Market Integration*, *2*(1), 43–60.

Jespersen, K. S., Kelling, I., Ponte, S., & Kruijssen, F. (2014). What shapes food value chains? Lessons from aquaculture in Asia. *Food Policy*, *49*(P1), 228–240.

Johnson, R. C., & Noguera, G. (2012). Accounting for intermediates: Production sharing and trade in value added. *Journal of International Economics*, *86*(2), 224–236.

Kaplinsky, R., & Morris, M. (2001). *A Handbook for Value Chain Research*. *Institute for Development Studies: Brighton, UK*.

Koopman, R., Wang, Z., & Wei, S. (2014). Tracing Value-Added and Double Counting in Gross Exports, *104*(2), 459–494.

Krugman, P. (1995). Growing World Trade: Causes and Consequences. *Brookings Papers on Economic Activity*, *26*(1, 25th Anniversary Issue), 327–377.

Lewin, A. Y., Massini, S., & Peeters, C. (2009). Why are companies off shoring innovation? The emerging global race for talent? *Journal of International Business Studies*, *40*(6), 901–920.

Los, B., Timmer, M. P., & de Vries, G. J. (2015). How global are global value chains? A new approach to measure international fragmentation. *Journal of Regional Science*, *55*(1), 66–92.

Lucian, C., & Pajot, M. (2012). *"Assembled in Europe" - The role of processing trade in EU export performance* (Trade - Chief Economist Note No. 3).

Magnani, G., Zucchella, A., & Strange, R. (2018). The dynamics of outsourcing relationships in global value chains: Perspectives from MNEs and their suppliers. *Journal of Business Research*, (January), 0–1.

Markusen, J. R., & Venables, A. J. (2007). Interacting factor endowments and trade costs: A multi-country, multi-good approach to trade theory. *Journal of International Economics*, *73*(2), 333–354.

Meliciani, V., & Tchorek, G. (2017). *Global value chains, innovation and firms' performance during the crisis* (NBP Working Paper).

Melitz, M. J. (2003). The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica*, *71*(6), 1695–1725.

Milberg, W., & Winkler, D. (2013). *Outsourcing Economics: Global Value Chains in Capitalist Development*. Cambridge, MA: Cambridge University Press.

Monge-Gonzalez, R., & Zolezzi, S. (2012). *Insertion of Costa Rica in Global Value Chains* (IDB-WP).

Montalbano, P., Nenci, S., & Pietrobelli, C. (2018). Opening and linking up: firms, GVCs, and productivity in Latin America. *Small Business Economics*, *50*(4), 917–935.

Ng, F., & Yeats, A. (1999). *Production Sharing in East Asia. Who Does WHat for Whom, and Why?* (Policy Research Working Paper Series No. 2197).

Nielsen, P. B. (Ed.). (2008). *International Sourcing. Moving Business Functions Abroad*. Statistics Denmark.

Nielsen, P. B. (2017). The puzzle of measuring global value chains – The business statistics perspective. *International Economics*.

Pietrobelli, C., & Saliola, F. (2008). Power relationships along the value chain : multinational firms , global buyers and performance of local suppliers. *Cambridge Journal of Economics*, (32), 947–962.

Ponte, S. (2002). The “Latte Revolution”? Regulation, markets and consumption in the global coffee chain. *World Development*, *30*(7), 1099–1122.

Porter, M. E. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. The Free Press.

Razzolini, T., & Vannoni, D. (2011). Export premia and subcontracting discount: Passive strategies and performance in domestic and foreign markets. *World Economy*, *34*(6), 984–1013.

Rungi, A., & Del Prete, D. (2018). The smile curve at the firm level: Where value is added along supply chains. *Economics Letters*, *164*, 38–42.

Schmitz, H. (1999). Global competition and local cooperation: Success and failure in the Sinos Valley, Brazil. *World Development*, *27*(9), 1627–1650.

Shih, S. (1996). *Me-Too is Not My Style: Challenge Difficulties, Break through Bottlenecks, Create Values*. Taipei.

Siedschlag, I., & Murphy, G. (2015). Firms’ engagement in global value chains. In J. Amador & F. Di Mauro (Eds.), *The Age of Global Value Chains. Maps and Policy Issues* (pp. 175–186). CEPR Press.

Stephenson, S. (2014). *Global Value Chains: The New Reality of International Trade*. *E15 Expert Group on Globl Value Chains: Development Challenges and Policy Options*. Geneva.

Sturgeon, T. J. (2001). How Do We Define Value Chains and Production Networks? *IDS Bulletin*, *32*(3), 9–18.

Sturgeon, T. J. (2002). Modular Production Networks: a new American model of industrial organization. *Industrial and Corporate Change*, *11*(3), 451–496.

Sturgeon, T. J. (2008). Mapping integrative trade: conceptualising and measuring global value chains. *International Journal of Technological Learning, Innovation and Development*, *1*(3), 237–257.

Sturgeon, T. J. (2013). *Global Value Chains and Economic Globalization - Towards a New Measurement Framework*.

Sturgeon, T. J., Nielsen, P. B., Linden, G., Gereffi, G., & Brown, C. (2013). Direct Measurement of Global Value Chains: Collecting Product- and Firm-Level Statistics on Value Added and Business Function Outsourcing and Offshoring. In A. Mattoo, Z. Wang, & S. Wei (Eds.), *Trade in Value Added: Developing New Measures of Cross-Border Trade* (pp. 291–321).

Sun, Y., & Grimes, S. (2016). China's increasing participation in ICT's global value chain: A firm level analysis. *Telecommunications Policy*, *40*(2–3), 210–224.

Tempest, R. (1996). Barbie and the World Economy. *Los Angeles Times*.

UNCTAD. (2015). *Tracing the Value Added in Global Value Chains : Product-Level Case Studies in China*.

Veugelers, R., Barbiero, F., & Blanga-Gubbay, M. (2013). Meeting the manufacturing firms involved in GVCs. In R. Veugelers (Ed.), *Manufacturing Europe's future* (Bruegel Bl, pp. 107–138). Bruegel.

Wynarczyk, P., & Watson, R. (2005). Firm growth and supply chain partnerships: An empirical analysis of UKSME subcontractors. *Small Business Economics*, *24*(1), 39–51.

Xing, Y. (2011). How the iPhone widens the US trade deficit with China. *VoxEU.Org*.

Yeats, A. (1998). *Just how Big is Global Production Sharing?* (Policy Research Working Paper No. 1871).

Yi, K.-M. (2009). The collapse of global trade: the role of vertical specialization. In R. Baldwin & S. Evenett (Eds.), *The collapse of global trade, murky protectionism, and the crisis. Recommendations for the G20* (pp. 45–48). Cepr.

Zhu, Z., Morrison, G., Puliga, M., Chessa, A., & Riccaboni, M. (2015). *The Similarity of Global Value Chains: A Network-Based Measure* (IMT Lucca EIC Working Paper Series No. 09).

2. Global value chains participation and positioning and firms' survival to the Great Recession

The aim of this analysis is to empirically investigate whether and how GVC participation and positioning have influenced firms' probability to survive the last economic crisis. We work on EFIGE data providing information about companies located in France, Germany, Italy and Spain. We run two kinds of models: a probit model and a Cox duration model. Both techniques provide results denying any significant advantage or disadvantage for companies engaged in international production networks in terms of survival. Nevertheless, VC positioning proves to matter. In fact, intermediate companies show a higher risk of failure compared to final ones. We perform robustness checks that confirm our results.

2.

Global value chains participation and positioning and firms' survival to the Great Recession

2.1 Introduction

The recent economic recession has had a huge impact of the productive fabric of European countries. Looking at Eurostat data, Landini *et al.* (Landini, Arrighetti, & Lasagni, 2015) signal that the number of active manufacturing companies in the Eurozone has decreased by 7% between 2008 and 2012. Countries located in the Eurozone periphery have been hit particularly hard, with Italy and Spain recording a reduction in the number of active firms between 6% and 9%. The drop of manufacturing companies was even bigger, concerning the 9% of Italian firms and the 17% of the Spanish ones.

When investigating why companies fail, the dominant literature looks at a number of firms' characteristics that might influence their survival, such as size or age. Nevertheless, few contributions take into account companies' international activities, which could be significantly related with firms' resilience, since they should be carried out only by the most efficient and productive enterprises (Melitz, 2003).

However, globalization's second unbundling (R. Baldwin, 2011), by fostering a process of fragmentation of production activities, has provided firms with the possibility to implement new internationalization strategies. In fact, the "value chain" (VC) of a product, i.e. the series of tasks necessary to bring it from conception to final use (Kaplinsky & Morris, 2001; Porter, 1985), nowadays can be split among companies (not necessarily located in the same country), which in turn can carry out their production activities choosing among several organizational structures; they can produce in-house or outsource, upon their affiliates or external suppliers, in their home country or abroad. This has lead value chains to being more and more *global*. Given the pervasiveness of its economic (but also social and environmental) impact, the global value chain[1] (GVC) phenomenon has much drawn researchers' attention in recent years. At the

[1] In the literature, several expressions are used to refer to the same concept indicating production processes internationally fragmented, such as "global value chains" or "international production networks". As previously underlined, we use all these terms interchangeably to indicate such phenomenon. For further insight about the evolution of the terminology used, see Bair (2005) and the first article of this work. In the latter, the development of the GVC phenomenon, its implications in terms of trade and countries and firms' competitiveness and the measurement challenges it represents for statisticians are illustrated in detail.

firm level, despite the lack of good quality data, studies have found that GVC participation is usually associated with higher productivity (e.g. Veugelers, Barbiero, & Blanga-Gubbay, 2013), although differences emerge depending on companies' position within production networks, since intermediate firms appear to perform worse than the final ones (e.g. Agostino, Giunta, Scalera, & Trivieri, 2016). Considering all this information, it would seem reasonable to assume that companies participating to GVCs tend to be more resilient, therefore to have a higher chance to survive periods of economic downturn, with respect to those not engaged into international production networks. This hypothesis could be reinforced considering that at least part of the transactions happening within GVCs occurs on the basis of contracts, such as the outsourcing one, thus being more "stable" than mere arm's length exchanges.

Nevertheless, when investigating firms' survival during the recent recession, engagement into global production networks could have played a negative role. In fact, for various reasons, global value chains are believed to have acted as propagation agents of economic disturbances, contributing to the so-called "big trade collapse" (e.g. Altomonte, Di Mauro, Ottaviano, Rungi, & Vicard, 2012).

Working on EFIGE data, Meliciani and Tchorek (2017) attempt at assessing whether modes of international operations and positioning within GVCs have contributed to determine firms' exit from the market. However, they do not rely on some GVC participation and positioning indicator[2]; they rather take into account firms' various internationalization strategies (e.g. exporting, being a passive outsourcer) separately.

Our investigation aims at evaluating whether companies' engagement in international production networks and their position within them has influenced their probability to survive the Great Recession. We do so relying on EFIGE data, too, but we exploit a new measure of GVC participation built on Veugelers et al. (2013), applying both a probit model and duration models. Results show that being an intermediate firm has affected negatively companies' resilience to the crisis, while mere GVC participation did not matter for firms' survival.

The rest of the paper is structured as follows. Section 2.2 deepens the study of the relevant literature to our investigation. Section 2.3 presents the data we use and provides some descriptive analysis. Section 2.4 illustrates our empirical strategies and their results (2.4.1 probit model, 2.4.2 duration models). Section 2.5 concludes.

[2] This has been already pointed out in the first paper of this work, where the measurement issues related to evaluating GVC participation and positioning are discussed at length.

2.2 Literature review

When investigating firms' survival, a very large body of research focuses on the role of size and age. To quote one of the stylized facts singled out by Geroski about firms' entry, "both size and age are correlated to the survival of entrants" (Geroski, 1995, p. 434). There is general agreement on the fact that such correlation is positive: the larger and/or the older a company, the higher its chances to survive (e.g. Agarwal & Gort, 1996; Dunne, Roberts, & Samuelson, 1988; Sutton, 1997). The seminal work by Jovanovic (1982) also belongs to this strand of literature. The author provides a theory of selection with incomplete information consistent with the fact that smaller firms are more likely to fail than bigger ones. In fact, new firms learn by producing, so they acquire experience and grow. Therefore, in presence of market selection, the chances of surviving increase along the life cycle of a company (thus, with its age), as the company itself gets larger and larger. This thesis has been empirically tested in several works. In some cases, the authors focus on the firms' size at the moment they entry the market (e.g. Audretsch, 1995), in others they focus on the current companies' size, as in Doms *et al.* (Doms, Dunne, & Roberts, 1995) or as in Hall (1987), who finds that companies' probability to survive does grow with their size, but at a decreasing rate. However, the significance and the sign of the relation between firms' survival and size and age can vary depending on a number of factor, for instance according to the phase of their products' life cycles (e.g. Agarwal & Audretsch, 2001).

Other firms' characteristics have been investigated to understand whether they play a role in determining companies' likelihood to stay in the market. The already cited Hall (1987), for example, finds that firms' probability to survive increases with the share of accumulated R&D expenditures over their total capital. In more recent years, Cefis and Marsili (2005) and Buddelmeyer *et al.* (Buddelmeyer, Jensen, & Webster, 2010) both identify a positive impact of firms' innovative capacity on their probability to stay in the market.

Another feature characterizing firms has drawn much attention recently, due to the financial nature of the origins of the last economic crisis. In fact, several researchers have been investigating the role of financial constraints in relation to firms' failure. Claessens *et al.* (Claessens, Tong, & Wei, 2012), for instance, single out two main channels through which the 2008-2009 crisis has affected firms' performance: a real channel, consisting in a reduction of trade and the internal demand, and a financial one, linked to higher difficulties for companies to access credit. Clarke *et al.* (Clarke, Cull, & Kisunko, 2012), focusing on companies located in Eastern Europe and Central Asia, observe that, during the crisis, financial constraints were

less strong for firms located in countries characterized by the presence of well-established foreign banks. Moreover, they find that firms' risk of failure during the crisis was reduced if they had access to external credit. Similarly, working on Portuguese firms and comparing a pre-crisis (2004-2007) versus a crisis (2008-2012) period, Carreira and Teixteira (2016) underline that strictness of credit markets is associated with higher firms' failure.

For the purposes of our analysis, we are interested in understanding whether there is a relation between firms' survival and their participation to and positioning within (global) value chains. The latter is a phenomenon emerged during the last decades of the 20th century, when a number of factors – among which a prominent role is played by the diffusion of the Information and Communication Technologies (ICTs) – allowed for the so-called globalization's second unbundling (R. Baldwin, 2011), with production processes – or, as Porter (1985) referred to them, value chains – becoming more and more fragmented among firms and countries, thus assuming a *global* dimension (e.g. Gereffi, 1994).

Given the relevance of such phenomenon[3], researchers have been very interested in understanding its mechanisms and implication, at both the macro and the micro level. Investigating the latter poses several challenges, exacerbated by the lack of good quality data at the firm level[4].

Meliciani and Tchorek (2017) are the only authors that – to the best of our knowledge – have tried to look at the relation between GVC participation and firms' survival to the crisis. Nevertheless, as already briefly mentioned, they do not identify a measure to assess whether a firm is engaged in an international production network, nor they evaluate companies' positioning within GVCs. In fact, looking at EFIGE data for French, German, Italian and Spanish firms, they take into account the various internationalization activities companies can carry out (e.g. exporting, being a passive outsourcers) individually. They find that merely being an exporter or an active outsourcer is not statistically significant in relation to firms' exit from the market, while companies that have carried out foreign direct investments, those being global exporters and those belonging to foreign groups have a lower chance to fail. The opposite is observed for passive outsourcers.

Attempting to formulate a hypothesis about whether and how GVC participation can be linked to firms' survival during the recent economic crisis is not easy, since two opposite considerations must be contemplated. On one hand, researchers usually agree on companies

[3] According to UNCTAD (2013), "GVC trade" represented around 80% of the world trade.
[4] See Nielsen (2017) and the first article of this work for further insights.

belonging to international production networks as performing better than the non-participants under several aspects, such as productivity[5] (e.g. Agostino, Giunta, Nugent, Scalera, & Trivieri, 2015; J. Baldwin & Yan, 2014; Giovannetti & Marvasi, 2017), probability of exporting (Giovannetti & Marvasi, 2016), intensive margin of trade (Giovannetti, Marvasi, & Sanfilippo, 2015). These investigations, however, are necessarily designed to take into account only active firms, that is to say those that already have managed to stay in the market, at least at the time covered by the research. On the other hand, several articles underline how the mechanisms linking firms within international production networks have intensified the shock transmission during the Great Recession, contributing to the so-called trade collapse (R. Baldwin, 2009). To explain this, a few reasons have been proposed, such as the increase in exchanges of components – very sensitive to variations in the final demand - enhanced by the development of GVCs (e.g Bems, Johnson, & Yi, 2009), or inventory adjustments carried out by final firms (to the detriment of the intermediate ones) in response to the crisis (Alessandria, Kaboski, & Midrigan, 2011). These mechanisms could have strengthened the negative impact of the great recession on companies engaged in international production networks, while non-GVC participants could have been more shielded by international disturbances. Formulating assumption on whether firms' position along the production network has influenced their likelihood to survive the crisis is relatively more easy. In fact, researchers agree on final firms enjoying an advantage in terms of performance with respect to suppliers (Accetturo, Giunta, & Rossi, 2011; Razzolini & Vannoni, 2011), even if results might be dependent on the type of relations linking them to their clients (Wynarczyk & Watson, 2005). Moreover, intermediate firms appear to be the ones affected by the inventory adjustments carried out by final firms, more strongly the more they are specialized in production tasks far from the final market (Alessandria *et al.*, 2011). Generally, intermediate firms have performed worse than the final ones during the recent economic crisis (Accetturo & Giunta, 2017; Békés, Halpern, Koren, & Muraközy, 2011). Thus, can it be assumed that suppliers have had a higher probability to fail during the crisis? If such hypothesis seems reasonable when comparing intermediate firms to the final ones, we do not have strong evidence to understand how the former fared with respect to exclusively domestic companies, not involved in global value chains.

A few contribution investigating firms' survival take into account their international dimension, comparing those that are internationalized to the ones that are only domestic.

[5] Researchers have been relying on different measures of productivity, mostly total factor productivity and labour productivity. Results do not differ.

Giovannetti *et al.* (Giovannetti, Ricchiuti, & Velucchi, 2011), for instance, working on Italian firms, find that exporting firms have a higher chance to fail, given the increased competition they face in the global markets. Therefore, in order to survive and be successful, they should also be large and innovative. Wagner (2013) focuses on German companies to signal that, while exporting activities are not significantly linked to firms' chances of survival, importing and two-way trade (exporting and importing together) do increase companies' likelihood to stay in the market. In another contribution together with Weche Gelübcke (Wagner & Weche Gelübcke, 2013), studying German manufacturing firms having more than 20 employees, the author observes that, while exporting is associated with higher risk of failure for firms, the opposite is true for importing, thus explaining why two-way trading is not significantly linked to firms' survival, as the negative effect of selling abroad might be counterbalanced by importing. Moreover, they do not find significant results for foreign multinationals. Godart *et al.* (Godart, Görg, & Hanley, 2012) also take into account firms' ownership. Looking at the period between 2006 and 2009 they find a relevant difference between manufacturing and service companies in Ireland; among the former, there is no significant divergence in terms of probability to exit the market between foreign and domestic firms, while among the latter the resilience advantage owned by foreign firms before the crisis disappears with the start of it.

2.3 Data and descriptive analysis

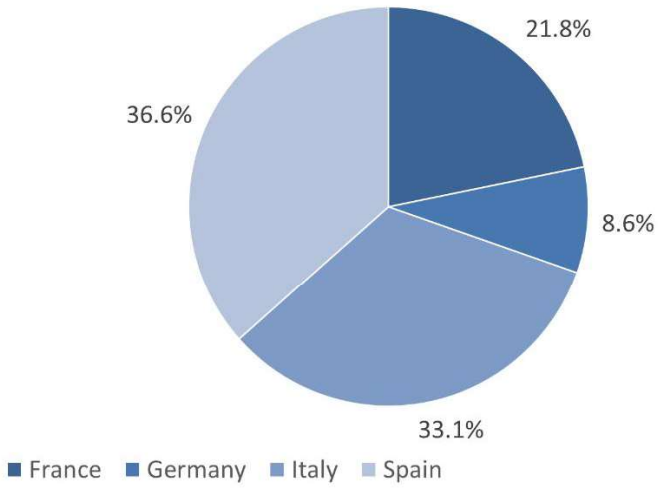
Our research has been performed relying on data provided by the EU-EFIGE/Bruegel-UniCredit dataset (in short, the EFIGE dataset), a database recently collected within the EFIGE project (*European Firms in a Global Economy: internal policies for external competitiveness*) supported by the Directorate General Research of the European Commission through its 7th Framework Program and coordinated by Bruegel. It provides information on almost 15,000 manufacturing companies having at least 10 employees and located in Austria, France, Germany, Hungary, Italy, Spain and United Kingdom. Such sampling is stratified by sector and firm size, with an over-sampling for large companies. Data were collected in 2010, refer to years 2007-2009 and provide both qualitative and quantitative information on around 150 items related to: structure of the firms, workforce, investment, technological innovation and R&D, export and internationalization processes, market structure and competition, financial structure

and bank-firm relationship[6]. Moreover, balance sheet information was recently updated up to 2014.

In this study, we focus on French, German, Italian and Spanish firms. For the majority of them, EFIGE provides information about their "status" in 2014, distinguishing among active and inactive ones. Out of a total of 11,312 observations, however, obtained by cleaning the original database from "basic" missing data (i.e. information about firms' industry, size, or their activity status in 2014), we are forced to further reduce our sample, mostly because of lack of information concerning firms' productivity. Moreover, following Meliciani and Tchorek (2017), we exclude from our sample also those companies having been declared as "inactive" in 2014 following a merger or an acquisition process. In fact, their activity status appears ambiguous, since they might have been closed, but they might also be still operating owned by a different group.

Such data cleansing leaves us working on a sub-sample of 6,385 firms. Figure 2.1 and table 2.1 provide an overview of our data, showing firms' distribution across countries and size. German firms appear to be under-represented in our sample, consisting only of the 8.6% of the total. The majority of the companies taken into account are located in Italy (33.1%) and Spain (36.6%).

Figure 2.1 Sample composition based on firms' location
Percentages over total.



Source: author's elaborations based on EFIGE data.

[6] See Altomonte and Aquilante (2012) for further information about the EFIGE database.

Table 2.1. Firms' distribution based on country and size
Percentages over total in the same country.

	France		Germany		Italy		Spain		Total	
	N.	%	N.	%	N.	%	N.	%	N.	%
Micro	358	25.7%	29	5.3%	580	27.5%	961	41.2%	1,928	30.2%
Small	663	47.7%	96	17.5%	1,009	47.8%	1,012	43.3%	2,780	43.5%
Medium	261	18.8%	296	54.0%	395	18.7%	246	10.5%	1,198	18.8%
Large	109	7.8%	127	23.2%	127	6.0%	116	5.0%	479	7.5%
Total	1,391	100.0%	548	100.0%	2,111	100.0%	2,335	100.0%	6,385	100.0%

Source: author's elaborations based on EFIGE data.

Looking at companies' size[7], measured in terms of total turnover, France and Italy show more or less the same composition, while more than half of German firms are medium companies (54%) and more than 80% of Spanish enterprises are micro or small ones. Table 2.1A, in the appendix, provides a more accurate picture of firms' distribution over countries, size and industries.

As anticipated, our research investigates firms' exit from the market in relation to their participation and positioning within (global) value chains. In order to evaluate whether a company is part of an international production network, we build on Veugelers *et al.* (2013), since, by doing so, we are able to distinguish among three degrees of GVC participation. Nevertheless, the measure proposed by the authors might single out as GVC participants companies that, although internationalized, cannot be considered as part of an international production network. Therefore, we apply a stricter definition of firm-level GVC participation with respect to Veugelers *et al.* (2013), while still looking at the various international activities companies can carry out.

(1) Importing: we view as GVC participants those firms importing intermediate goods or services.

[7] In this first part of this paper, which aims at providing descriptive statistics, we refer to firm size by relying on four classes (built on those provided by the EFIGE database) which are based on companies' turnover; specifically: micro < 2 million euro; small ≥ 2 million euro but < 10 million euro; medium ≥ 10 million euro but < 50 million euro; large > than 50 million euro. Measuring firm size looking at the number of employees would have forced us to lower even more the number of the observations, since it is a missing information for several of the companies in our sample.

(2) Exporting: we consider as GVC participants companies exporting intermediate goods (thus, selling to other firms) or final goods produced as passive outsources for foreign clients. In fact, firms exporting exclusively final goods produced at home to sell them to foreign final customers cannot be viewed as part of an international production network.

(3) Producing abroad: we single out as GVC participants firms producing abroad (through either FDIs or outsourcing contracts) intermediate goods or final goods not destined to the local market. By doing so, we exclude from our taxonomy companies making their products entirely abroad and selling them to local customers, as this does not indicate the existence of a global value chain.

The EFIGE dataset allows to retrieve the information needed to distinguish companies participating to international production networks according to our classification. Since in the EFIGE survey firms were requested to indicate the type of goods imported, it is possible to easily identify those belonging to the first category. Among exporters, it is possible to distinguish the passive outsourcers, which are undoubtedly part of a GVC. Concerning the rest of them, we do not have information about the type of goods sold abroad, but we have data indicating the share of their turnover resorting from sales to other firms[8]. Therefore, relying on a proportionality hypothesis, we assume that exporting companies selling intermediate goods (i.e. selling entirely or partly to other firms) do so also abroad, thus engaging in an international production network.

Finally, in order to single out companies belonging to category (3), we look at the destination of the goods produced abroad, either by firms' affiliates or by their foreign passive outsourcers. Companies are considered as part of a GVC when the products made abroad are:

1. intermediate goods imported in their home country to be used in their production processes;
2. final goods imported in their home country to be sold in the domestic market;
3. goods imported in their home country to be then exported to third countries.

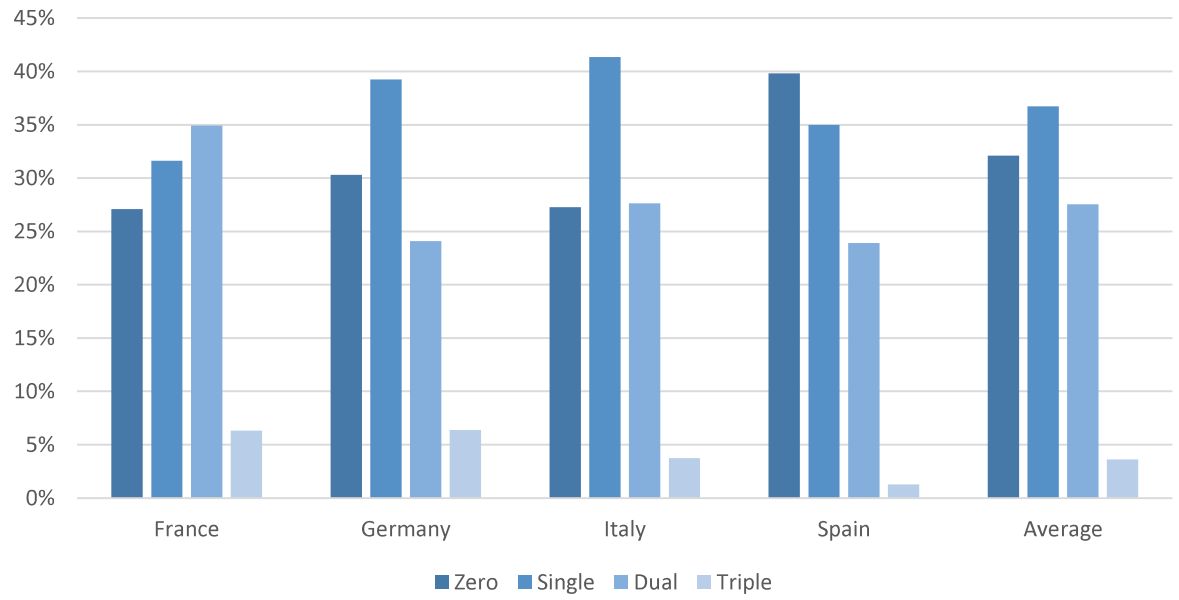
According to the number of GVC-related international activities companies engage in, we distinguish among single, dual and triple mode GVC participation, with the zero mode indicating non-participants. Also, as long as companies are involved in international production networks through one of the three modes, we consider them as GVC participants.

[8] The EFIGE survey, in question E1, asks firms to indicate the average percentage of their turnover made by sales of produced-to-order goods.

To assess firms' position within international production networks, as seen in Accetturo and Giunta (2017), we look again at their turnover, taking into account the share generated by selling produced-to-order goods. When such portion is equal to 100%, we identify companies as being pure suppliers (PS); on the contrary, when firms' turnover is not generated by sales of produced-to-order goods to other companies, it is possible to state that the former are exclusively final firms, i.e. selling to final customers.

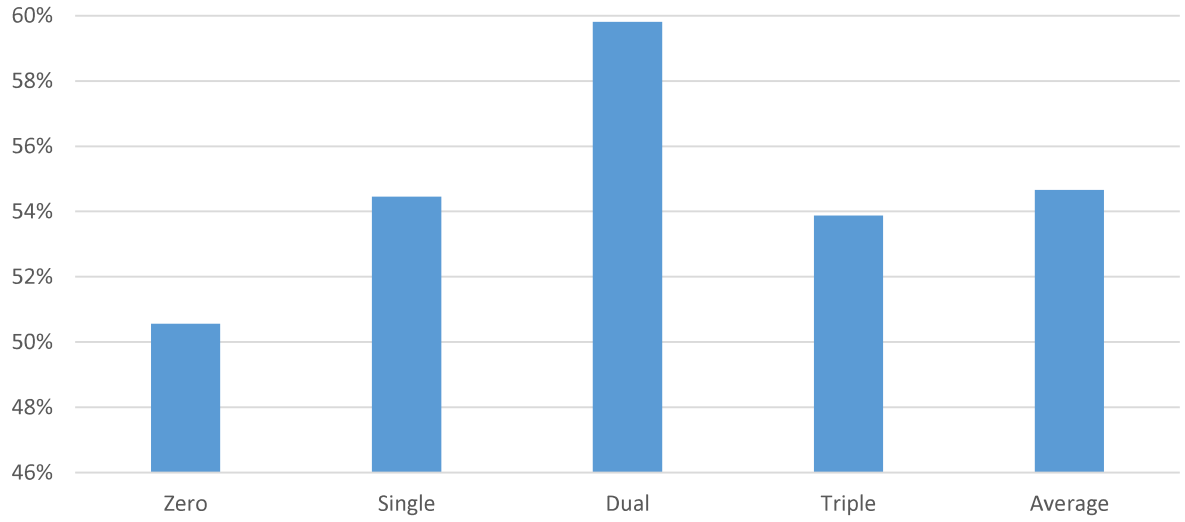
Figures 2.2 gives some insight about the firms of our sample and their engagement within international production networks. Almost one-third (32%) of the companies we take into account does not participate in a global value chain, with Spanish firms particularly absent from international production networks (the 40% fall into the zero-mode category). French and Italian firms show the same degree of GVC participation (more than 70%); the former, however, privilege a dual engagement, while the latter mainly favour a one-way engagement (41%). This is true for German firms, too, which also present the highest triple GVC participation engagement (6.4%), together with their French counterparts (6.3%). Such involvement, however, characterizes the lowest share of companies, being the one implying commitment in three different international activities.

Figure 2.2 GVC participation modes at the country level and sample average
Percentages over total in each country and on average in the whole sample.



Source: author's elaborations based on EFIGE data.

Figure 2.3 Pure suppliers and GVC participation modes
Percentages over each GVC participation category and over total, calculated over the whole sample.



Source: author's elaborations based on EFIGE data.

The 54.7% of the firms in our sample are pure suppliers (figure 2.3). Their concentration is especially high among companies dually engaged in international production networks (59.8%); however, they represent always more than half of the companies, even among non-GVC participants (50.6%). Table 2.2 allows for a more detailed analysis of firms' participation to and positioning within GVC, taking also their size into account. Moreover, an industry-based picture of the phenomenon is provided by figure 2.2A in the Appendix.

Table 2.2 Firms' distribution over countries, size, GVC participation modes and GVC positioning
Percentages over same country-size category.

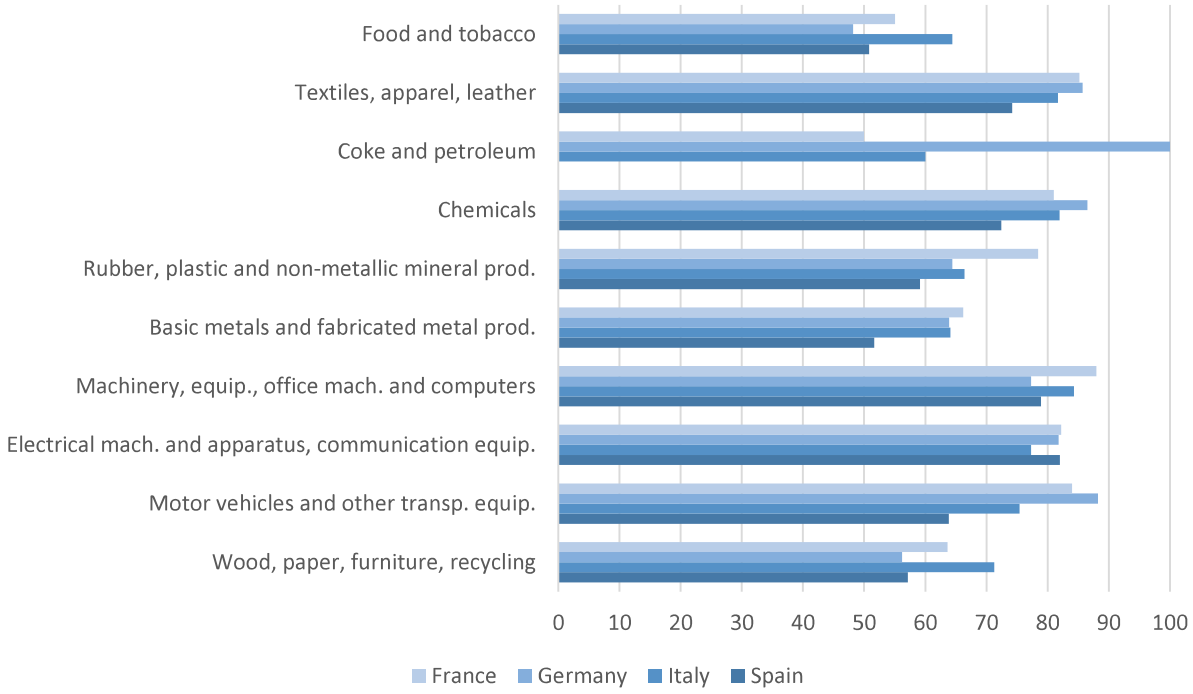
		Zero	Single	Dual	Triple	Total
France	Micro	47.5%	34.6%	17.0%	0.8%	100.0%
	of which, PS	*59.4%*	*72.6%*	*68.9%*	*66.7%*	*65.6%*
	Small	25.0%	32.7%	36.3%	5.9%	100.0%
	of which, PS	*71.7%*	*75.6%*	*77.2%*	*79.5%*	*75.4%*
	Medium	12.3%	28.0%	49.0%	10.7%	100.0%
	of which, PS	*50.0%*	*65.8%*	*68.0%*	*64.3%*	*64.8%*
	Large	8.3%	23.9%	51.4%	16.5%	100.0%
	of which, PS	*77.8%*	*50.0%*	*78.6%*	*55.6%*	*67.9%*
	Total	27.1%	31.6%	34.9%	6.3%	100.0%
	of which, PS	*64.5%*	*71.6%*	*73.9%*	*69.3%*	*70.3%*
Germany	Micro	75.9%	24.1%	0.0%	0.0%	100.0%
	of which, PS	*27.3%*	*57.1%*			*34.5%*
	Small	37.5%	38.5%	21.9%	2.1%	100.0%
	of which, PS	*33.3%*	*29.7%*	*52.4%*	*50.0%*	*36.5%*
	Medium	28.4%	40.2%	24.7%	6.8%	100.0%
	of which, PS	*25.0%*	*42.9%*	*43.8%*	*40.0%*	*37.8%*
	Large	18.9%	40.9%	29.9%	10.2%	100.0%
	of which, PS	*12.5%*	*36.5%*	*44.7%*	*46.2%*	*35.4%*
	Total	30.3%	39.2%	24.1%	6.4%	100.0%
	of which, PS	*25.3%*	*39.5%*	*45.5%*	*42.9%*	*36.9%*
Italy	Micro	46.4%	42.4%	10.7%	0.5%	100.0%
	of which, PS	*72.1%*	*69.1%*	*77.4%*	*0.0%*	*71.0%*
	Small	24.1%	44.1%	28.9%	2.9%	100.0%
	of which, PS	*59.3%*	*66.3%*	*63.4%*	*44.8%*	*63.1%*
	Medium	14.4%	36.5%	41.3%	7.8%	100.0%
	of which, PS	*52.6%*	*63.2%*	*62.6%*	*48.4%*	*60.3%*
	Large	5.5%	29.9%	52.0%	12.6%	100.0%
	of which, PS	*42.9%*	*36.8%*	*53.0%*	*37.5%*	*45.7%*
	Total	27.3%	41.4%	27.6%	3.7%	100.0%
	of which, PS	*64.4%*	*65.3%*	*63.5%*	*43.0%*	*63.7%*
Spain	Micro	54.7%	31.9%	13.1%	0.2%	100.0%
	of which, PS	*43.3%*	*41.4%*	*43.7%*	*50.0%*	*42.8%*
	Small	33.9%	37.1%	27.9%	1.2%	100.0%
	of which, PS	*39.9%*	*41.1%*	*47.9%*	*58.3%*	*42.8%*
	Medium	19.5%	37.0%	41.5%	2.0%	100.0%
	of which, PS	*27.1%*	*19.8%*	*47.1%*	*60.0%*	*33.3%*
	Large	11.2%	37.9%	41.4%	9.5%	100.0%
	of which, PS	*15.4%*	*18.2%*	*52.1%*	*36.4%*	*33.6%*
	Total	39.8%	35.0%	23.9%	1.3%	100.0%
	of which, PS	*40.9%*	*37.6%*	*47.1%*	*50.0%*	*41.3%*

Source: author's elaborations based on EFIGE data.

Regardless of firms' location, the share of non-GVC participants over total decreases as we move from a smaller size class to a bigger one, with very few large companies absent from international production networks (less than 10% in France and Italy). The exact opposite can be observed with regard to the triple mode involvement in GVCs, with the highest shares recorded among the biggest companies, from the 9.5% of the Spanish ones to the 16.5% of their French counterparts. Medium and large firms, however, mainly implement a two-way engagement strategy when participating to international production networks, except for German firms that favour a single mode involvement in GVCs. Pure suppliers represent a considerable share of firms everywhere, especially in France (70.3%) and Italy (63.7%). In Germany and Spain, they are mostly present among companies carrying out more sophisticated participation strategies to international production networks.

Among industries, some of those recording a higher involvement in international production networks are chemicals and textiles, apparel and leather, where firms' GVC participation rates are above 80% in all the countries considered except for Spain (figure 2.4). Spanish firms are engaged in global production networks especially in the electrical machinery and apparatus industry (82%).

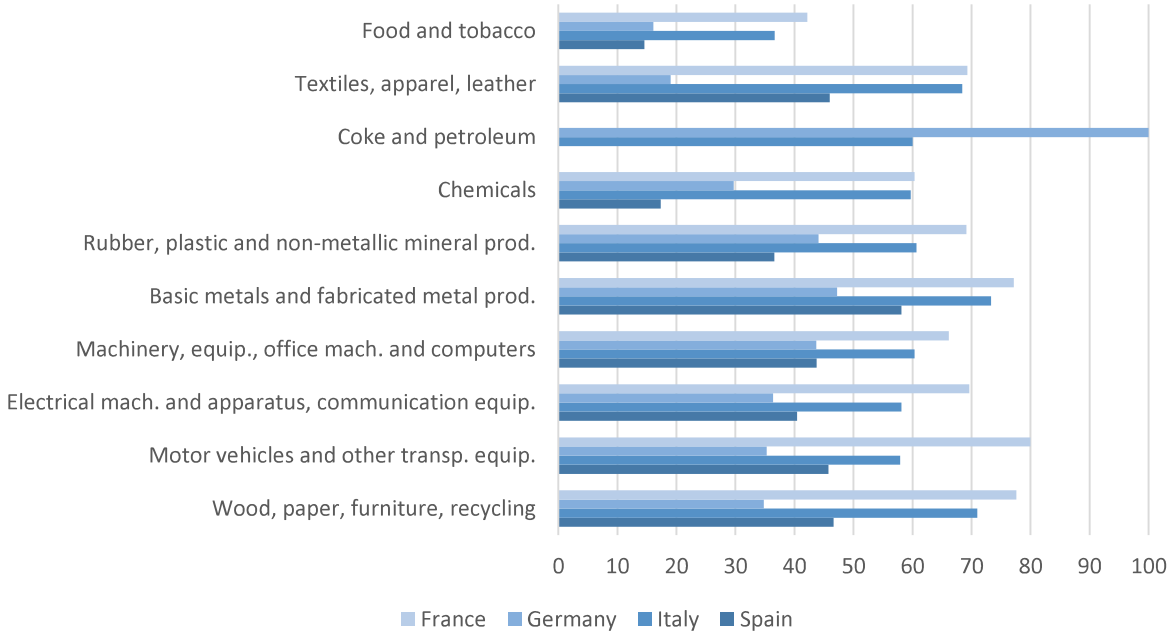
Figure 2.4 GVC participation rates in industries
Percentages over same industry-country category.



Source: author's elaborations based on EFIGE data.

Figure 2.5 confirms that among French and Italian firms there is a largest share of pure suppliers in almost all industries. Germany is the country where companies tend to be located downstream in global value chains in the majority of the sectors, except for some of them such as chemicals and rubber, plastic and non-metallic mineral products, where Spanish firms record the lowest percentages of pure suppliers.

Figure 2.5 Pure suppliers
Percentages over same country-industry category.

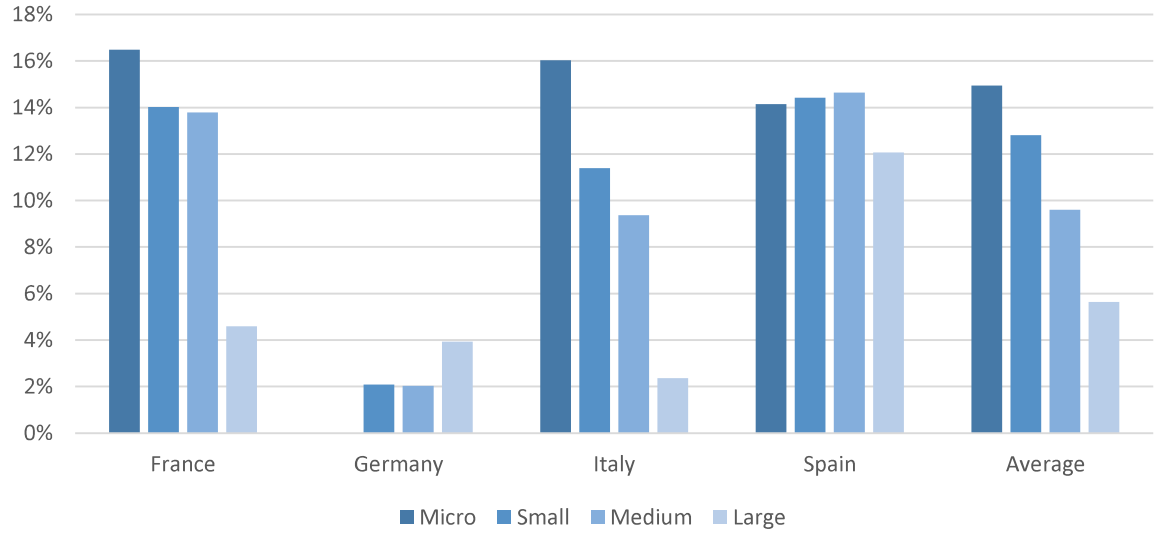


Source: author's elaborations based on EFIGE data.

Besides taking into account firms' GVC participation and positioning, our research looks at how they have fared during the crisis, specifically considering if they have been able to "survive" it. As anticipated, thanks to a recent update, the EFIGE dataset provides companies' balance sheet data up to 2014 together with information concerning their "status", by stating whether they are still active or, on the contrary, that they have become inactive during the years following 2008-2009. As a result, we know that 786 companies in our sample, around the 12.3% of the total, appear not to be active anymore. There is a striking difference between the performances of German firms with respect to those of the rest of the company in the sample, as shown in figure 2.6. While the percentage of French, Italian and Spanish firms that have not been able to survive the crisis is around 13-14%, in Germany only the 2.4% of the firms in our sample has exited the market in the same period (2010-2014). Again, French and Italian companies show similar patterns, with exit rates declining as firms' size increases (large

enterprises in France show exit rates much closer to their German counterparts). In Spain, however, the recent economic crisis seems to have affected companies with more or less the same intensity, with the medium-sized ones recording the highest inactivity rate of our sample (17%). Looking at what happened inside each industry (table 2.3), it appears that, in all the countries considered, one of the most affected in terms of firm exit is the one producing machinery and equipment, together with the sector of wood, paper, furniture and recycling. Another industry hit very hard by the Great Recession is the one of basic metals and fabricated metal products, recording inactivity rates higher than 4% among French and Spanish companies (corresponding to around 30% among inactive firms) and around 2.4% among Italian ones (20.2% of the inactive enterprises), with the German firms not affected. A similar scenario, with slightly lower exit rates, concerns the rubber, plastic and non-metallic products industry, where, again, German companies appear to have been sheltered by the crisis.

Figure 2.6 Inactive firms
Percentages over same country-size category.



Source: author's elaborations based on EFIGE data.

Table 2.3 Inactive firms' distribution over countries and industries

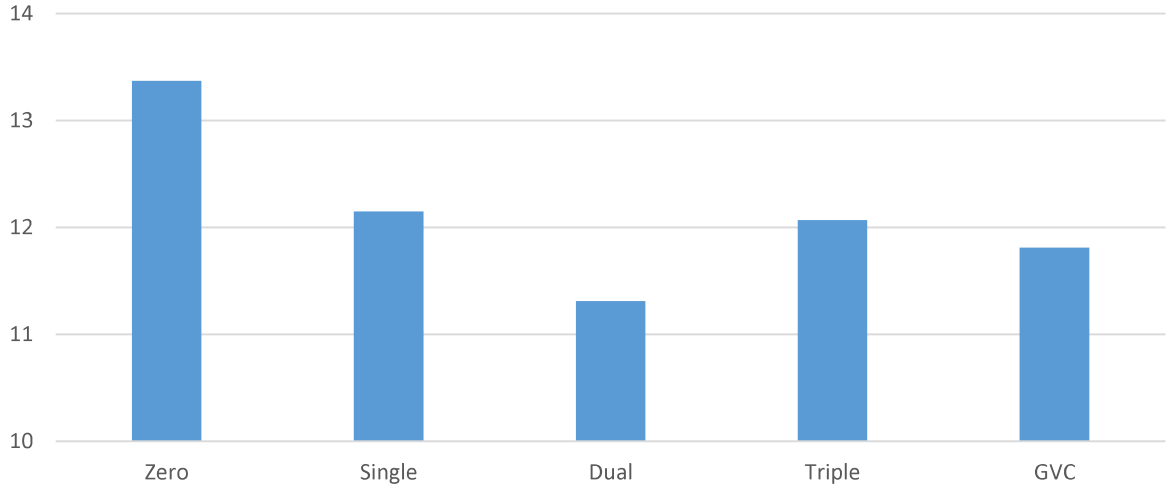
Percentages over same country-industry category, calculated over the total of firms in each country and over the inactive ones in each country alternatively.

	France		Germany		Italy		Spain	
	% over total	% over inactive	% over total	% over inactive	% over total	% over inactive	% over total	% over inactive
Food and tobacco	0.7%	5.2%	0.2%	7.7%	0.5%	4.0%	1.1%	7.5%
Textiles, apparel, leather	1.2%	8.8%	0.0%	0.0%	2.1%	18.1%	0.6%	4.2%
Coke and petroleum	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Chemicals	0.2%	1.6%	0.4%	15.4%	0.2%	1.6%	0.3%	1.8%
Rubber, plastic and non-metallic mineral prod.	2.0%	14.5%	0.0%	0.0%	1.5%	12.5%	1.7%	11.7%
Basic metals and fabricated metal prod.	4.7%	33.7%	0.0%	0.0%	2.4%	20.2%	4.2%	29.8%
Machinery, equip., office mach. and computers	1.2%	8.3%	0.4%	15.4%	1.5%	12.5%	1.4%	9.6%
Electrical mach. and apparatus, communication equip.	1.1%	7.8%	0.5%	23.1%	0.6%	4.8%	0.3%	2.4%
Motor vehicles and other transp. equip.	0.7%	5.2%	0.2%	7.7%	0.2%	2.0%	0.7%	4.8%
Wood, paper, furniture, recycling	2.1%	15.0%	0.7%	30.8%	2.8%	24.2%	4.0%	28.0%

Source: author's elaborations based on EFIGE data.

In figure 2.7 we start investigating the presence of a relation between firms' GVC participation and their ability to survive to the economic crisis. In our sample, the highest rate of failure is recorded among companies not involved in international production networks (13.4%). Nevertheless, the difference with GVC participants is not that pronounced, given that the latter, too, have recorder almost a 12% rate of exit from the market. Taking into account GVC participation modes, the dual one is related to a higher chance of survival, while firms implementing a one-way or a three-way engagement strategy in GVCs both show failure rates around 12%.

Figure 2.7 Inactivity rates and GVC participation
Percentages of exited firms over same category, calculated over the whole sample.



Source: author's elaborations based on EFIGE data.

Further insights can be gained by table 2.4, showing the percentage of inactive firms over those in the same industry-GVC participation category. In some cases, such as in the electrical machinery sector or in that of wood, paper, furniture and recycling, being involved in an international production network is related to higher failure rates. Overall, the picture is very heterogeneous, with higher engagement in GVCs being associated to lower failure rates in some industry (e.g. chemicals), while the opposite is recorded for others (e.g. textiles, apparel and leather). Hence, the relation between GVC participation and firms' survival to the crisis needs to be further investigated. In figure 2.8, moreover, we account for firms' positioning within VC. In this respect, we distinguish among final firms (share of turnover generated from produced-to-order goods = 0) and pure suppliers (firms whose share turnover originated from sales to

other companies is 100%)[9]. In each category, we measure the percentage of firms exited from the market.

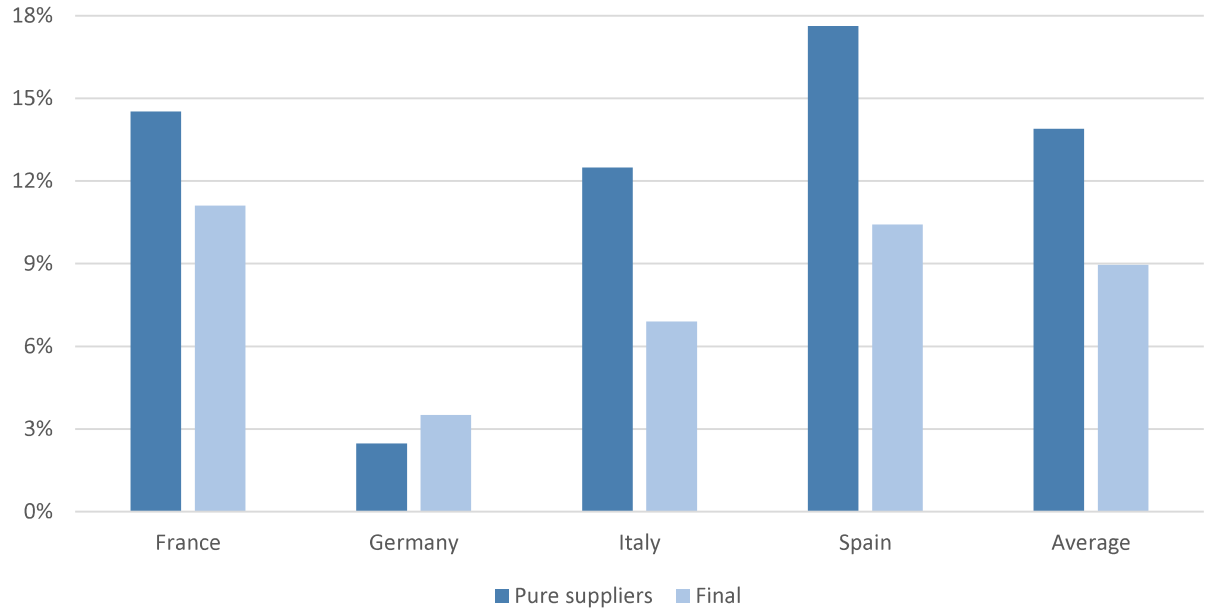
Table 2.4 Inactive firms and GVC participation modes at the industry level
Percentages of inactive firms over total in the same industry-GVC participation mode category.

	Zero	Single	Dual	Triple	GVC
Food and tobacco	6.5%	5.9%	7.9%	0.0%	6.4%
Textiles, apparel, leather	16.0%	16.3%	12.2%	23.1%	14.8%
Coke and petroleum	0.0%	0.0%	0.0%		0.0%
Chemicals	10.2%	11.0%	6.2%	0.0%	5.7%
Rubber, plastic and non-metallic mineral prod.	15.8%	7.0%	12.5%	27.3%	11.7%
Basic metals and fabricated metal prod.	16.8%	11.7%	12.6%	8.0%	12.0%
Machinery, equip., office mach. and computers	10.4%	11.6%	9.1%	0.0%	9.9%
Electrical mach. and apparatus, communication equip.	7.5%	7.1%	9.1%	8.3%	8.2%
Motor vehicles and other transp. equip.	16.7%	18.0%	15.0%	0.0%	15.0%
Wood, paper, furniture, recycling	15.3%	19.0%	16.1%	20.7%	18.1%

Source: author's elaborations based on EFIGE data.

[9] We consider these two categories of firms since they represent the extreme roles companies can play in international production networks. However, in the sample there is a share of "hybrid" firms – i.e. those selling only in part to other companies – that is not taken into account in figure 2.8.

Figure 2.8 Inactive firms and GVC positioning
Percentages over total country-GVC positioning category

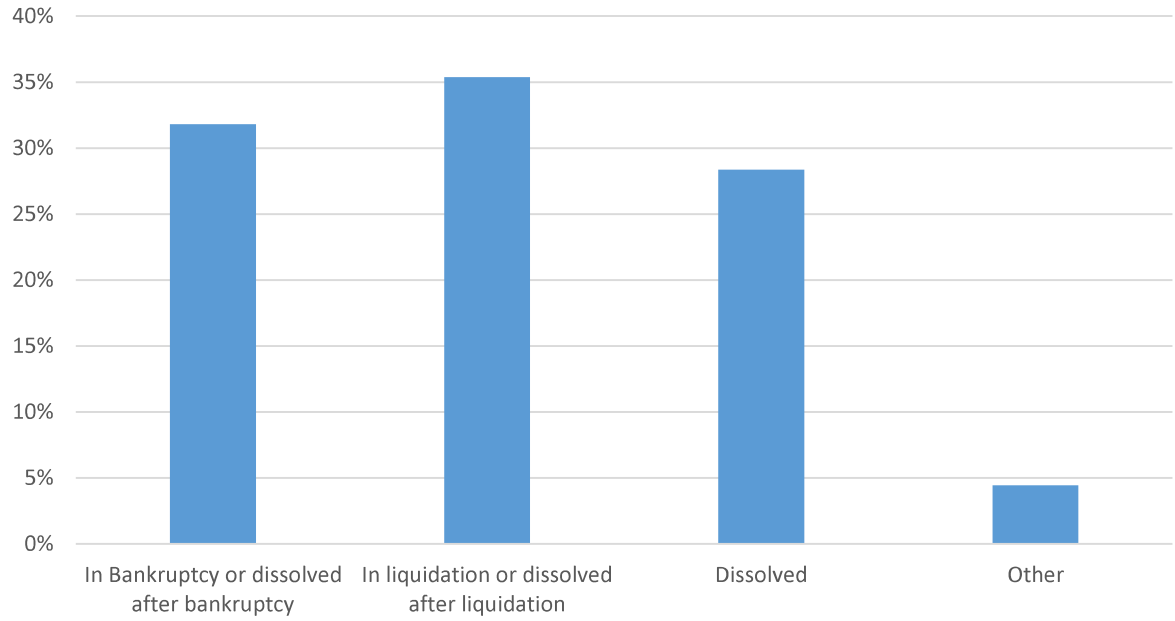


Source: author's elaborations based on EFIGE data.

In all the countries taken into account except for Germany, suppliers have been the most affected by the crisis, registering an average failure rate of 14%. The gap with the other firms involved in value chains is considerable in Italy and most of all in Spain. On the contrary, final firms appear to have been more sheltered by the disturbances brought about by the Great Recession.

As anticipated, the EFIGE database also provides some information about what lead to firms' exit from the market, as shown in figure 2.9. More than one-third of the inactive companies underwent a liquidation process, while another considerable share (31.8%) failed following bankruptcy. Further details about firms' inactivity are presented in tables 2.3A and 2.4A in the Appendix.

Figure 2.9 Firms' modes of exit from the market
Percentages over total inactive firms.



Source: author's elaborations based on EFIGE data.

2.4 Empirical analysis and main results

2.4.1 Probit model

The first part of our empirical analysis consists in a binary response model. As such, we focus on the probability of firms' survival to the crisis and we model it as a function of several variables, relying on a probit model[10] estimated using the standard maximum likelihood procedure. The first specification of our model considers the main characteristics of companies, together with industry and country dummies to control for sectoral and geographical effects.

Formally, the baseline model we estimate is the following:

$$\Pr(SURVIVAL = 1)_{i,t+6} = \phi(\beta_0 + \beta_1 GVC_{it} + \beta_2 tfp_{it} + \beta_3 size_{it} + \beta_4 age_{it} + \beta_5 INNO_{it} + \delta_1 \eta_c + \delta_2 \gamma_s + \varepsilon_i) \quad (1)$$

[10] Probit models were first introduced by Bliss (1934).

where SURVIVAL takes the value 1 if firm *i* is still active after the crisis (in 2014, equal to *t* + *6*) and ϕ indicates the cumulative distribution function for the standard normal.

The explanatory variables we rely on are the following:

- GVC_{it} is a dummy = 1 if firm *i* belongs to an international production networks (as defined in section 2.3) in 2008 (= *t*);
- tfp_{it} measures total factor productivity (tfp) for firm *i* in 2008;
- $size_{it}$ accounts for the size of firm *i* in 2008, measured as the log of total assets[11];
- age_{it} refers to the age of firm *i* in 2008, measured in logs;
- $INNO_{it}$ is a dummy = if firm *i* has implemented product, process or market innovation in 2008;
- η_c is the set of country dummies;
- γ_s is the set of industry dummies.

We enrich our analysis by adding further explanatory variables, in order to assess whether some characteristics of the labour force and additional aspects of companies can increase their resilience, boosting their probability to survive. Such variables are the additional ones presented in equation (2), specifically:

- $training_{it}$ is a dummy = 1 if workers in firm *i* got trained in 2008;
- HK_{it} is a dummy = 1 if the share of the workers with a graduate degree in firm *i* was higher than the national average in its industry in 2008;
- $labour\_flex_{it}$ is a dummy = 1 if firm *i* has used part-time or fixed term employment contracts in 2008;
- $GROUP_{it}$ is a dummy = 1 if firm *i* belonged to a group (either domestic or foreign) in 2008;
- $qual\_cert_{it}$ is a dummy = 1 if firm *i* has obtained any quality certification in 2008;
- $foreign\_comp_{it,t+1}$ is a dummy = 1 if (in 2008-2009) the firm *i* has declared of having competitors abroad;
- $EXTERNAL\_FINANCING_{it,t+1}$ is a dummy = 1 if the firm *i* has recurred to external financing in the period 2008-2009

[11] Contrary to what has been done during the descriptive analysis, here we control for size relying on total assets, since it is a more precise measure compared to size classes based on turnover. However, as a robustness check, we have also repeated the estimations presented here controlling for the latter. Results are confirmed.

$$\Pr(SURVIVAL = 1)_{i,t+6} = \phi(\beta_0 + \beta_1 GVC_{it} + \beta_2 tfp_{it} + \beta_3 size_{it} + \beta_4 age_{it} + \beta_5 INNO_{it} + \beta_6 training_{it} + \beta_7 HK_{it} + \beta_8 labour\_flex_{it} + \beta_9 GROUP_{it} + \beta_{10} qual\_cert_{it} + \beta_{11} foreign\_comp_{it,t+1} + \beta_{12} EXTERNAL\_FINANCING_{it,t+1} + \delta_1 \eta_c + \delta_2 \gamma_s + \varepsilon_i) \quad (2)$$

Table 2.5A in the Appendix presents the correlation matrix among the independent variables, while table 2.5 shows the results of our estimations for equations (1) and (2).

Table 2.5 GVC participation and firms' survival

	(1)	(2)
GVC	-0.010	-0.017
	(0.048)	(0.049)
tfp2008	0.281***	0.274***
	(0.044)	(0.044)
size	0.064***	0.084***
	(0.017)	(0.020)
age	0.089**	0.080**
	(0.038)	(0.038)
INNO	0.131***	0.128***
	(0.045)	(0.046)
training		0.077*
		(0.045)
HK		0.078*
		(0.047)
labour_flex		0.024
		(0.064)
GROUP		-0.160***
		(0.058)
qual_cert		-0.013
		(0.045)
foreign_comp		0.020
		(0.045)
EXTERNAL_FINANCING		-0.141***
		(0.044)
FRA	-0.768***	-0.747***
	(0.129)	(0.131)
ITA	-0.640***	-0.606***
	(0.126)	(0.125)
SPA	-0.762***	-0.736***
	(0.127)	(0.126)
Industry dummies	Yes	Yes
Observations	6,385	6,385

Notes: calculations based on EFIGE dataset. Maximum likelihood estimates. White-robust standard errors in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%.

Our analysis shows that GVC participation has had no statistically significant influence on firms' chances to survive the great recession (table 2.5, first row). This is striking, considering that the literature agrees on companies involved in international production networks as generally performing better than non-GVC participants (e.g. J. Baldwin & Yan, 2014; Veugelers et al., 2013). However, such findings can be consistent with the role played by global value chains in the 2008-2009 big trade collapse (e.g. Altomonte et al., 2012). In fact, as already underlined (cf. Section 2.2), the mechanisms linking companies within GVCs might have acted as transmitters of economic disturbances during the recent crisis. Therefore, although usually characterized by better performances, GVC participants might have been more exposed to the international shocks brought about by the Great Recession; these considerations, together, might explain why companies involved in international production networks show no significant advantage – in terms of probability to survive – with respect to the non-GVC participants. This is also in line with what Meliciani and Tchorek (2017) find about firms that are "active abroad", whose international engagement appears to have had no significant influence on their chances to survive the crisis. Looking at the rest of our estimation, we can see that both age and size increase companies' resilience to the crisis:. A positive influence on companies' resilience is also exercised by firms' innovation strategies, by the presence of skilled labour (HK) and, most of all, by their productivity (second row). Thus, less productive firms had a bigger probability to fail during the years of the crisis. This confirms what Casacurberta and Gandelman (2015) observe among Portuguese manufacturing and service companies: even an economic crisis originated in the financial sector seems to have produced what they call a "cleansing effect", by hitting less productive firms harder and determining their exit from the market. Table 2.5 also provides insights about how the impact of the crisis has been much harder for French, Italian and Spanish firms with respect to the German ones. In fact, the coefficients relative to the three country dummies are very significant and negative. Another two variables significantly and negatively impacting on companies' chances to survive are EXTERNAL_FINANCING and GROUP. Since these characteristics, as the others, are referred to the early years of the crisis, we can assume that firms having recurred to external financing right then have found themselves facing a period of economic downturn with a certain amount of liabilities in their accounts, which might have represented a burden and, thus, decreased companies' chances to survive. Concerning being part of a group, a further analysis has been carried out. First, we have looked at the group nationality, distinguishing between domestic and foreign groups: only being part of the former significantly increase firms'

probability to fail. Furthermore, we have taken into account the role that companies play within groups (both domestic and foreign), singling out purely controlling firms, purely controlled ones and hybrids (i.e. both controlling firms and controlled by others). It appears that the former have no significant advantage in terms of survival, while the latter and especially the exclusively controlled companies suffer from a higher chance of exiting the market.

In order to deepen our investigation about GVC participation and firms' survival to the crisis, by taking into account the various modes through which companies can be engaged into international production networks, we estimate again our model – presented in equations (1) and (2) – substituting the single dummy GVC with the three ones controlling for as much GVC participation modes, as illustrated in equations (3) and (4). Results are shown in table 2.6.

$$\Pr(SURVIVAL = 1)_{i,t+6} = \phi(\beta_0 + \beta_1 SINGLE\_GVC_{it} + \beta_2 DUAL\_GVC_{it} + \beta_3 TRIPLE\_GVC_{it} + \beta_4 tfp_{it} + \beta_5 size_{it} + \beta_6 age_{it} + \beta_7 INNO_{it} + \delta_1 \eta_c + \delta_2 \gamma_s + \varepsilon_i) \quad (3)$$

$$\Pr(SURVIVAL = 1)_{i,t+6} = \phi(\beta_0 + \beta_1 SINGLE\_GVC_{it} + \beta_2 DUAL\_GVC_{it} + \beta_3 TRIPLE\_GVC_{it} + \beta_4 tfp_{it} + \beta_5 size_{it} + \beta_6 age_{it} + \beta_7 INNO_{it} + \beta_8 training_{it} + \beta_9 HK_{it} + \beta_{10} labour\_flex_{it} + \beta_{11} GROUP_{it} + \beta_{12} qual\_cert_{it} + \beta_{13} foreign\_comp_{it,t+1} + \beta_{14} EXTERNAL\_FINANCING_{it,t+1} + \delta_1 \eta_c + \delta_2 \gamma_s + \varepsilon_i) \quad (4)$$

Table 2.6 GVC participation modes and firms' survival

	(3)	(4)
SINGLE_GVC	-0.016	-0.025
	(0.052)	(0.053)
DUAL_GVC	0.006	0.004
	(0.060)	(0.062)
TRIPLE_GVC	-0.092	-0.083
	(0.124)	(0.126)
tfp2008	0.280***	0.274***
	(0.044)	(0.044)
size	0.064***	0.084***
	(0.018)	(0.021)
age	0.090**	0.080**
	(0.038)	(0.038)
INNO	0.131***	0.128***
	(0.045)	(0.046)
training		0.078*
		(0.045)
HK		0.077*
		(0.046)
labour_flex		0.024
		(0.064)
GROUP		-0.160***
		(0.058)
qual_cert		-0.025
		(0.046)
foreign_comp		0.018
		(0.046)
EXTERNAL_FINANCING		-0.141***
		(0.044)
FRA	-0.770***	-0.750***
	(0.130)	(0.131)
ITA	-0.643***	-0.610***
	(0.126)	(0.125)
SPA	-0.766***	-0.741***
	(0.127)	(0.126)
Industry dummies	Yes	Yes
Observations	6,385	6,385

Notes: calculations based on EFIGE dataset. Maximum likelihood estimates. White-robust standard errors in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%.

The estimations of equation (3) and (4) confirm that being engaged in a global production network does not influence firms' chances to survive the crisis, notwithstanding the degree of involvement. The other results, as expected, are confirmed. Larger firms, older ones,

those recording higher productivity, implementing innovation strategies or employing more skilled human capital have had a greater probability to stay in the market during the great recession. On the contrary, being part of a group and having resorted to external financing right when the crisis hit (2008-2009) are associated with lower chance of firms' survival.

Aiming at investigating also whether VC positioning has played a role in influencing firms' survival to the Great Recession, we repeat our probit estimations adding alternatively the two variables we have identified as signalling companies location within production networks: PTO_turnover and PURE_SUPPLIER (equation (5), (6), (7) and (8)). As already mentioned, the former indicates the share of firms' turnover originated from sales of goods produced to satisfy other companies' orders, while the latter is a dummy = 1 when said share is 100%, singling out enterprises that sell exclusively to their counterparts. Results are shown in table 2.7.

$$\Pr(SURVIVAL = 1)_{i,t+6} = \phi(\beta_0 + \beta_1 GVC_{it} + \beta_2 PTO\_turnover_{it} + \beta_3 tfp_{it} + \beta_4 size_{it} + \beta_5 age_{it} + \beta_6 INNO_{it} + \beta_7 training_{it} + \beta_8 HK_{it} + \beta_9 labour\_flex_{it} + \beta_{10} GROUP_{it} + \beta_{11} qual\_cert_{it} + \beta_{12} foreign\_comp_{it,t+1} + \beta_{13} EXTERNAL\_FINANCING_{it,t+1} + \delta_1 \eta_c + \delta_2 \gamma_s + \varepsilon_i) \quad (5)$$

$$\Pr(SURVIVAL = 1)_{i,t+6} = \phi(\beta_0 + \beta_1 GVC_{it} + \beta_2 PTO\_turnover_{it} + \beta_3 tfp_{it} + \beta_4 size_{it} + \beta_5 age_{it} + \beta_6 INNO_{it} + \beta_7 training_{it} + \beta_8 HK_{it} + \beta_9 labour\_flex_{it} + \beta_{10} GROUP_{it} + \beta_{11} qual\_cert_{it} + \beta_{12} foreign\_comp_{it,t+1} + \beta_{13} EXTERNAL\_FINANCING_{it,t+1} + \delta_1 \eta_c + \delta_2 \gamma_s + \varepsilon_i) \quad (6)$$

$$\Pr(SURVIVAL = 1)_{i,t+6} = \phi(\beta_0 + \beta_1 SINGLE_{GVC_{it}} + \beta_2 DUAL_{GVC\,it} + \beta_3 TRIPLE_{GVC\,it} + \beta_4 PTO\_turnover_{it} + \beta_5 tfp_{it} + \beta_6 size_{it} + \beta_7 age_{it} + \beta_8 INNO_{it} + \beta_9 training_{it} + \beta_{10} HK_{it} + \beta_{11} labour\_flex_{it} + \beta_{12} GROUP_{it} + \beta_{13} qual\_cert_{it} + \beta_{14} foreign\_comp_{it,t+1} + \beta_{15} EXTERNAL\_FINANCING_{it,t+1} + \delta_1 \eta_c + \delta_2 \gamma_s + \varepsilon_i) \quad (7)$$

$$\Pr(SURVIVAL = 1)_{i,t+6} = \phi(\beta_0 + \beta_1 SINGLE_{GVC_{it}} + \beta_2 DUAL_{GVC\,it} + \beta_3 TRIPLE_{GVC\,it} + \beta_4 PURE\_SUPPLIER_{it} + \beta_5 tfp_{it} + \beta_6 size_{it} + \beta_7 age_{it} + \beta_8 INNO_{it} + \beta_9 training_{it} + \beta_{10} HK_{it} + \beta_{11} labour\_flex_{it} + \beta_{12} GROUP_{it} + \beta_{13} qual\_cert_{it} +$$

$$\beta_{14} foreign\_comp_{it,t+1} + \beta_{15} EXTERNAL\_FINANCING_{it,t+1} + \delta_1 \eta_c + \delta_2 \gamma_s + \varepsilon_i) \quad (8)$$

Table 2.7 GVC participation and positioning and firms' survival.

	(5)	(6)	(7)	(8)
GVC	-0.003	-0.014		
	(0.050)	(0.050)		
SINGLE_GVC			-0.015	-0.023
			(0.053)	(0.053)
DUAL_GVC			0.025	0.010
			(0.063)	(0.062)
TRIPLE_GVC			-0.066	-0.084
			(0.127)	(0.127)
PTO_turnover	-0.001**		-0.002**	
	(0.001)		(0.001)	
PURE_SUPPLIER		-0.101**		-0.103**
		(0.045)		(0.045)
tfp2008	0.278***	0.278***	0.278***	0.278***
	(0.044)	(0.044)	(0.044)	(0.044)
size	0.081***	0.082***	0.080***	0.082***
	(0.020)	(0.020)	(0.021)	(0.021)
age	0.074*	0.076**	0.074*	0.076**
	(0.038)	(0.038)	(0.038)	(0.038)
INNO	0.124***	0.124***	0.123***	0.124***
	(0.046)	(0.046)	(0.046)	(0.046)
training	0.082*	0.078*	0.081*	0.078*
	(0.045)	(0.046)	(0.045)	(0.045)
HK	0.073	0.074	0.073	0.074
	(0.047)	(0.047)	(0.047)	(0.047)
labour_flex	0.023	0.023	0.023	0.023
	(0.064)	(0.064)	(0.064)	(0.064)
GROUP	-0.163***	-0.161***	-0.164***	-0.161***
	(0.058)	(0.058)	(0.058)	(0.058)
qual_cert	-0.018	-0.019	-0.019	-0.020
	(0.046)	(0.046)	(0.046)	(0.046)
foreign_comp	0.020	0.024	0.016	0.021
	(0.046)	(0.046)	(0.046)	(0.047)
EXTERNAL_FINANCING	-0.141***	-0.143***	-0.142***	-0.143***
	(0.044)	(0.044)	(0.044)	(0.044)
Country dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Observations	6,385	6,385	6,385	6,385

Notes: calculations based on EFIGE dataset. Maximum likelihood estimates. White-robust standard errors in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%.

These last estimations provide interesting results. As acknowledged in the literature, intermediate firms tend to perform worse than final ones (cf. section 2.2). Here, we find that

this is true also with respect to firms' chances to survive the recent economic crisis. Pure suppliers have a lower chance to stay in the market compared to companies selling at least partly to final customers (table 2.7, row 6).

2.4.1.1 Robustness checks

In order to check for the robustness of our model, we have repeated our estimations on three sub-samples of our original data, selected in different ways. Specifically, we focus on:

- sub-sample A, obtained by excluding German firms from our original sample; it consists of 5,837 observations;
- sub-sample B, obtained by excluding from our sample those firms that, albeit identified as GVC participants, are not "substantially internationally active"; it is made of 5,611 observations;
- sub-sample C, obtained by combining the two previous criteria, that is to say by excluding from our original set of firms both the German ones and those involved in international production networks but not identifiable as "substantially internationally active".

We borrow the latter criterion again from Veugelers *et al.* (2013). In fact, the authors label as internationally active those companies (i) whose trade turnover (i.e. turnover generated from imports, exports or international production activities) is above the 25th percentile in their sector, and (ii) whose share of trade turnover over total turnover is above the 25th percentile in their sector. Due to data availability, we can apply only the second criterion. Since we aim at identifying substantially internationalized companies in each sector, we measure the 25th threshold by considering the whole set of information available in EFIGE.

The results of our additional estimations are showed in tables 2.6A, 2.7A and 2.8A in the Appendix. Again, our initial findings hold. While engagement in international production networks did not appear to have made a difference in terms of companies' resilience to the crisis, intermediate firms and especially pure suppliers had a lower probability to stay in the market with respect to the rest of the companies.

2.4.2 Duration models

In this second part of our empirical analysis we look at the relation between GVC participation and positioning and firms' survival to the great recession by relying on duration (or survival) models[12].

These models investigate how long it takes for a certain event to happen. Usually, a group of subjects presenting some characteristics is observed over time, until the "event" occurs. Such event is conventionally referred to as "failure", even if it can represent a positive change of status (e.g. an unemployed person finding a job). Duration models can tell us whether the subjects' characteristics have any influence in increasing or decreasing the risk of the event happening and, by splitting the subjects who failed into two groups according to a dychotomic variable, they can also assess whether for the group of subjects presenting a specific characteristic the event is more likely to happen.

In our case, the sample is made by the 6,385 firms, which are the subjects of our analysis. We know that, at time t_0 (=2008) they were all active in the market, while at time t_1 (=2014), some of them failed, i.e. exited the market. We do not have "censored" observations; that is to say that, at time t_1, we know the status (active or inactive) of all the firms in the sample. The event under investigation – contrary to section 2.4.1 – is firms' exit from the market, given that we must take into account an occurrence that implies a change of status (therefore, in this case, an active company becomes inactive).

Since, after the start of the observation period, we have only one point in time in which we look at the firms of the sample and check whether they are still active or not, building the hazard function (and, consequently, the survival function) is pretty straightforward (table 2.8). As already underlined, around the 12.3% of the companies considered failed to survive the crisis, exiting the market by 2014.

Table 2.8 Firms' survival to the great recession. Hazard function and survival function

Time	N° at risk	N° of failures	Hazard function	Survival Function
0 (2009)	6,385	0	-	-
1 (2014)	6,385	786	861/6,385 = 0.1231	1-0.1231 = 0.8769

Source: author's calculations based on EFIGE dataset.

[12] See Genc (Genc, 2004) for an overview.

As anticipated, the group of companies that has exited the market can be divided into two parts according to a specific characteristic that must be indicated by a dychotomic variable, taking values 0 or 1. By doing so, we can carry out a log-rank test for equality of survivor function, to verify whether the presence of such feature has significantly increased or decreased the probability of failing. We have performed this test twice, taking into account our GVC participation dummy (GVC) and our GVC positioning dummy (PURE_SUPPLIER) alternatively. Results are shown in table 2.9.

Table 2.9 Log-rank tests for equality of survivor function: GVC participants vs non-GVC participants; pure suppliers vs. other firms.

		Events observed	Events expected	*chi2(1)*	*Pr>chi2*
GVC	0	274	252.23		
	1	512	533.77		
	Total	786	786	*3.14*	*0.0758*
PURE_ SUPPLIER	0	301	356.38		
	1	485	429.62		
	Total	786	786	*17.95*	*0.0000*

Among both non-GVC participants (table 2.9, 1st row, GVC=0) and pure suppliers (table 2.9, 5th row, PURE_SUPPLIER=1), the number of events (that is, the number of companies exited from the market) is higher than the one expected. However, concerning exclusively intermediate firms, the difference between the number of failures observed and expected is statistically significant (Pr>chi2 = 0.0000), therefore signalling that VC positioning, contrary to GVC participation, did play a role in determining companies' risk of failure during the crisis, since those purely intermediate failed statistically more than expected

After having performed this check, we run a Cox duration model. The event analysed, as already specified, is firms' failure, while the explanatory variables taken into account are the same presented (and used) in the previous section (cf. 2.4.1). The model chosen is different with respect to the probit or logit approach – as well as from other standard parametric models, such as log-normal or log-logistic) because the form of the baseline hazard rate is not specified. Therefore, the hazard rate can take the form suggested by the data[13] (Jones & Branton, 2005). The Cox model is run four times. During the first two of them, we aim at singling out whether

[13] Given this characteristic, the Cox model is considered a semi-parametric model, because the hazard rate is parametrized as a function of covariates, but there is no specification of its distributional form. For further insight, see Box-Steffensmeier and Jones (2004).

GVC participation and GVC positioning (measured, alternatively, through the variable PTO_turnover and the dummy PURE_SUPPLIER) have played any role in influencing companies' risk of exiting the market (similarly to what has been done in equations (5) and (6)); during the other two, we aim at doing the same, while accounting for the various GVC participation modes (same investigation strategy implemented in equations (7) and (8)).

Table 2.10 GVC participation and positioning and firms' exit from the market

	(1)	(2)	(3)	(4)
GVC	1.009	1.024		
	(0.086)	(0.086)		
SINGLE_GVC			1.027	1.039
			(0.093)	(0.093)
DUAL_GVC			0.967	0.991
			(0.104)	(0.105)
TRIPLE_GVC			1.106	1.134
			(0.239)	(0.245)
PTO_turnover	1.002**		1.002**	
	(0.001)		(0.001)	
PURE_SUPPLIER		1.165**		1.167**
		(0.090)		(0.091)
tfp2008	0.670***	0.671***	0.671***	0.672***
	(0.043)	(0.043)	(0.043)	(0.043)
size	0.882***	0.879***	0.882**	0.979***
	(0.031)	(0.031)	(0.032)	(0.032)
age	0.879**	0.878**	0.879**	0.877**
	(0.056)	(0.056)	(0.057)	(0.056)
INNO	0.824**	0.825**	0.825**	0.825**
	(0.064)	(0.064)	(0.064)	(0.064)
training	0.877*	0.882	0.876*	0.882
	(0.069)	(0.069)	(0.066)	(0.069)
HK	0.889	0.872*	0.890*	0.888
	(0.073)	(0.069)	(0.074)	(0.073)
labour_flex	0.991	0.991	0.993	0.991
	(0.108)	(0.108)	(0.108)	(0.108)
GROUP	1.268**	1.263**	1.269***	1.264**
	(0.125)	(0.124)	(0.125)	(0.125)
qual_cert	1.027	1.027	1.029	1.029
	(0.082)	(0.082)	(0.082)	(0.082)
foreign_comp	0.969	0.964	0.973	0.967
	(0.077)	(0.077)	(0.078)	(0.077)
EXTERNAL_FINANCING	1.258***	1.261***	1.258***	1.260***
	(0.096)	(0.096)	(0.096)	(0.096)
Country dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Observations	6,385	6,385	6,385	6,385

Notes: calculations based on EFIGE dataset. Cox duration models estimations. Standard errors in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 2.10 presents our results, not reporting the coefficient of our estimations but showing the hazard ratios provided by the model. In fact, together with the former, duration models provide also the latter that, when statistically significant and higher than 1, indicate that the corresponding variables increase the risk of failure. This is the case, for example, of the variable indicating the share of turnover generated by selling produced-to-order goods, whose corresponding hazard ratio appears statistically significant and higher than one. The same can be observed for the dummy PURE_SUPPLIER, signalling the disadvantage of exclusively intermediate firms in terms of increased risk of failure (table 2.11, row 6). The other results confirm what we have observed running the probit model. Higher productivity, bigger size and age, innovation capabilities and hiring skilled workers all decrease firms' risk to fail, while having recurred to external financing or belonging to a group increase companies' likelihood to exit the market. Furthermore, as robustness checks, we have performed the same estimations relying on the exponential and Weibull specification of the duration model, and they both provide the same findings.

2.5. Concluding remarks

Considering the generalized strong negative impact the recent economic crisis has had on firms' performance, in several cases pushing companies out of the market, it is important to investigate whether firms' characteristics have played a role in influencing their resilience. Together with taking into account the features of companies usually examined in the literature, such as size, age or innovative capabilities, we focus on firms' participation to global value chains and on their positioning along production networks. So far, very few contributions have looked at the role of companies' international activities in influencing their chances to survive in the market, and even fewer have considered GVCs. The literature agrees on recognizing a positive relation between engagement in international production networks and firms' performance, measured in various terms such as productivity, innovativeness and intensive margin of trade. Nevertheless, it has been underlined how the GVC mechanisms have contributed to the transmission of the economic turbulences associated to the crisis, contributing to the big trade collapse occurred in 2008-2009. Moreover, intermediate companies are recognized, on one hand, as performing worse than final firms and, on the other hand, has having suffered the most from the adjustments strategies implemented by final companies after the great recession hit.

Relying on EFIGE data on French, German, Italian and Spanish firms, we have analysed whether GVC participation and positioning have affected companies' probability to survive the Great Recession. By performing a probit model we note how being involved in an international production network is not statistically significant for the purposes of our analysis, while being an intermediate firm matters, with pure suppliers particularly being at higher risk of failing. In the second part of our empirical analysis, we have repeated our investigation by relying on duration models, specifically on the Cox duration model. Results confirm that higher share of turnover originated from produced-to-order goods appear significantly related to higher hazard ratios. Being a pure supplier statistically implies lower probability for firms to survive during periods of economic downturn.

References

Accetturo, A., & Giunta, A. (2017). Value chains and the great recession: Evidence from Italian and German firms. *International Economics*.

Accetturo, A., Giunta, A., & Rossi, S. (2011). *The Italian firms between crisis and the new globalization*. *Occasional Papers, Bank of Italy* (Vol. 86).

Agarwal, R., & Audretsch, D. B. (2001). Does entry size matter? The impact of the life cycle and technology on firm survival. *The Journal of Industrial Economcis*, *XLIX*(1), 21–43.

Agarwal, R., & Gort, M. (1996). The Evolution of Markets and Entry , Exit and Survival of Firms, *78*(3), 489–498.

Agostino, M., Giunta, A., Nugent, J. B., Scalera, D., & Trivieri, F. (2015). The importance of being a capable supplier: Italian industrial firms in global value chains. *International Small Business Journal*, *33*(7), 708–730.

Agostino, M., Giunta, A., Scalera, D., & Trivieri, F. (2016). Italian Firms in Global Value Chains : Updating our Knowledge. *Rivista Di Politica Economica*, *VII–IX*.

Alessandria, G., Kaboski, J. P., & Midrigan, V. (2011). US Trade and Inventory Dynamics. *The American Economic Review*, *101*(3), 303–307.

Altomonte, C., & Aquilante, T. (2012). *The EU-EFIGE/Bruegel-UniCredit dataset* (No. 13).

Altomonte, C., Di Mauro, F., Ottaviano, G., Rungi, A., & Vicard, V. (2012). *Global Value Chains During the Great Trade Collapse: A Bullwhip Effect? European Central Bank Working Paper Series*.

Audretsch, D. B. (1995). Innovation, growth and survival. *International Journal of Industrial Organization*, *13*, 441–457.

Bair, J. (2005). Global Capitalism and Commodity Chains: Looking Back, Going Forward. *Competition & Change*, *9*(2), 153–180.

Baldwin, J., & Yan, B. (2014). *Global Value Chains and the Productivity of Canadian Manufacturing Firms*. *Economic Analysis Research Paper Series*.

Baldwin, R. (Ed.). (2009). *The great trade collapse: Causes, consequences and prospects*. Cepr.

Baldwin, R. (2011). *Trade And Industrialisation After Globalisation's 2nd Unbundling: How Building And Joining A Supply Chain Are Different And Why It Matters* (NBER Working Paper Series No. 17716). Cambridge, MA.

Békés, G., Halpern, L., Koren, M., & Muraközy, B. (2011). *Still standing: how European firms weathered the crisis: The third EFIGE policy report* (Bruegel Blueprint Series No.

15).

Bems, R., Johnson, R. C., & Yi, K.-M. (2009). The collpase of global trade: update on the role of vertical linkages. In R. Baldwin (Ed.), *The Great Trade Collapse: Causes, Consequences and Prospects*. CEPR.

Bliss, C. I. (1934). The method of probits. *Science*, *79*(2037), 38–39.

Box-Steffensmeier, J. M., & Jones, B. S. (2004). *Event History Modeling*. *Cambridge University Press*.

Buddelmeyer, H., Jensen, P. H., & Webster, E. (2010). Innovation and the determinants of company survival. *Oxford Economic Papers*, *62*(2), 261–285.

Carreira, C., & Teixeira, P. (2016). Entry and exit in severe recessions: lessons from the 2008–2013 Portuguese economic crisis. *Small Business Economics*, *46*(4), 591–617.

Casacuberta, C., & Gandelman, N. (2015). Productivity, exit, and crisis in the manufacturing and service sectors. *The Developing Economies*, *53*(1), 27–43.

Cefis, E., & Marsili, O. (2005). A matter of Life and Death: Innovation and Firm Survival. *Industrial and Corporate Change*, *14*(6), 1167–1192.

Claessens, S., Tong, H., & Wei, S.-J. (2012). From the financial crisis to the real economy: using firm-level data to identify transmission channels. *Journal of International Economics*, *2*(88), 375–387.

Clarke, G. R. G., Cull, R., & Kisunko, G. (2012). External finance and firm survival in the aftermath of the crisis: Evidence from Eastern Europe and Central Asia. *Journal of Comparative Economics*, *40*(3), 372–392.

Doms, M., Dunne, T., & Roberts, M. J. (1995). The role of technology use in the survival and growth of manufacturing plants. *International Journal of Industrial Organization*, *13*, 523–542.

Dunne, T., Roberts, M. J., & Samuelson, L. (1988). Patterns of Firm Entry and Exit in U . S . Manufacturing Industries. *The RAND Journal of Economics*, *19*(4), 495–515.

Genc, I. H. (2004). Duration modeling in undergraduate econometrics curriculum via Excel. *American Journal of Applied Science*, *1*(4), 266–272.

Gereffi, G. (1994). The Organization of Buyer-Driven Global Commodity Chains: How U.S. Retailers Shape Overseas Production Networks. In G. Gereffi & M. Korzeniewicz (Eds.), *Commodity Chains and Global Capitalism* (pp. 95–122).

Geroski, P. A. (1995). What do we know about entry? *International Journal of Industrial Organization*, *13*(4), 421–440.

Giovannetti, G., & Marvasi, E. (2016). Food exporters in global value chains: Evidence from Italy. *Food Policy*, *59*, 110–125.

Giovannetti, G., & Marvasi, E. (2017). Governance, value chain positioning and firms' heterogeneous performance: The case of Tuscany. *International Economics*, (November), 1–22.

Giovannetti, G., Marvasi, E., & Sanfilippo, M. (2015). Supply chains and the internationalization of small firms. *Small Business Economics*, *44*(4), 845–865.

Giovannetti, G., Ricchiuti, G., & Velucchi, M. (2011). Size, innovation and internationalization: a survival analysis of italian firms. *Applied Economics*, *43*(12), 1511–1520.

Godart, O., Görg, H., & Hanley, A. (2012). Surviving the Crisis: Foreign Multinationals versus Domestic Firms. *World Economy*, *35*(10), 1305–1321.

Hall, B. H. (1987). The relationship between firm size and firm growth in the U.S. manufacturing center. *The Journal of Industrial Economics*, *35*, 583–606.

Jones, B. S., & Branton, R. P. (2005). Beyond Logit and Probit: Cox Durtion Models of Single, Repeating, and Competing Events for State Policy Adoption. *State Politics and Policy Quarterly*, *5*(4), 420–443.

Jovanovic, B. (1982). Selection and the Evolution of Industry. *Econometrica*, *50*(3), 649–670.

Kaplinsky, R., & Morris, M. (2001). *A Handbook for Value Chain Research*. *Institute for Development Studies: Brighton, UK*.

Landini, F., Arrighetti, A., & Lasagni, A. (2015). *Economic Crisis and Firm Exit: Do Intangibles Matter?* (LUISS Guido Carli / School of European Political Economy No. 10).

Meliciani, V., & Tchorek, G. (2017). *Global value chains, innovation and firms' performance during the crisis* (NBP Working Paper).

Melitz, M. J. (2003). The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica*, *71*(6), 1695–1725.

Nielsen, P. B. (2017). The puzzle of measuring global value chains – The business statistics perspective. *International Economics*.

Porter, M. E. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. The Free Press.

Razzolini, T., & Vannoni, D. (2011). Export premia and subcontracting discount: Passive strategies and performance in domestic and foreign markets. *World Economy*, *34*(6),

984–1013.

Sutton, J. (1997). Gibrat ' s Legacy. *Journal of Economic Literature*, *35*(1), 40–59.

UNCTAD. (2013). Global Value Chains and Development: Investment and value added trade in the global economy. *Unctad*, 32.

Veugelers, R., Barbiero, F., & Blanga-Gubbay, M. (2013). Meeting the manufacturing firms involved in GVCs. In R. Veugelers (Ed.), *Manufacturing Europe's future* (Bruegel Bl, pp. 107–138). Bruegel.

Wagner, J. (2013). Exports, imports and firm survival: first evidence for manufacturing enterprises in Germany. *Review of World Economics*, *149*, 113–130. https://doi.org/10.1007/s10290-012-0141-2

Wagner, J., & Weche Gelübcke, J. P. (2013). *Risk or Resilience? The role of trade integration and foreign ownership for the survival of German enterprises during the crisis 2008-2010*. *CESIS Electronic Working Paper Series*.

Wynarczyk, P., & Watson, R. (2005). Firm growth and supply chain partnerships: An empirical analysis of UKSME subcontractors. *Small Business Economics*, *24*(1), 39–51.

Appendix 2 – Additional tables and figures

Table 2.1A Firms' distribution according to country, size and industry

Percentages over same size class and over total firms.

		Food and tobacco	Textiles, apparel, leather	Coke and petroleum	Chemicals	Rubber, plastic and non-metallic mineral prod.	Basic metals and fabricated metal prod.	Machinery, equip., office mach. and computers	Electrical mach. and apparatus, communication equip.	Motor vehicles and other transp. equip.	Wood, paper, furniture, recycling
France	Micro	8.7%	9.2%	0.0%	1.7%	13.4%	40.8%	4.7%	4.7%	2.5%	14.2%
	Small	4.7%	5.6%	0.2%	2.3%	15.7%	34.8%	10.9%	10.4%	2.4%	13.1%
	Medium	11.9%	6.5%	0.4%	8.4%	16.5%	20.3%	13.0%	13.0%	2.3%	7.7%
	Large	14.7%	0.9%	0.0%	13.8%	8.3%	15.6%	9.2%	13.8%	17.4%	6.4%
	Over total	7.8%	6.3%	0.1%	4.2%	14.7%	32.1%	9.6%	9.7%	3.6%	11.9%
Germany	Micro	10.3%	6.9%	0.0%	6.9%	6.9%	20.7%	20.7%	0.0%	0.0%	27.6%
	Small	12.5%	5.2%	0.0%	5.2%	9.4%	16.7%	16.7%	15.6%	5.2%	13.5%
	Medium	9.5%	3.7%	0.0%	4.1%	12.2%	13.2%	24.7%	13.5%	2.0%	17.2%
	Large	10.2%	2.4%	0.8%	14.2%	9.4%	8.7%	18.9%	17.3%	4.7%	13.4%
	Over total	10.2%	3.8%	0.2%	6.8%	10.8%	13.1%	21.7%	14.1%	3.1%	16.2%
Italy	Micro	4.0%	15.7%	0.0%	0.9%	10.7%	26.2%	12.1%	8.3%	2.2%	20.0%
	Small	9.2%	13.0%	0.1%	3.8%	12.2%	22.0%	14.4%	8.8%	2.3%	14.3%
	Medium	13.2%	12.2%	0.5%	4.3%	12.2%	19.0%	14.9%	5.6%	3.3%	14.9%
	Large	9.4%	7.1%	1.6%	9.4%	8.7%	15.0%	20.5%	10.2%	6.3%	11.8%
	Over total	8.5%	13.2%	0.2%	3.4%	11.6%	22.2%	14.2%	8.1%	2.7%	15.8%
Spain	Micro	14.2%	7.0%	0.0%	2.9%	7.9%	26.0%	10.0%	2.7%	3.2%	26.1%
	Small	15.8%	5.1%	0.0%	3.9%	12.7%	23.6%	12.8%	3.8%	2.5%	19.8%
	Medium	21.5%	2.0%	0.0%	7.3%	16.3%	17.5%	9.3%	6.1%	5.7%	14.2%
	Large	18.1%	0.0%	0.0%	11.2%	10.3%	19.0%	6.0%	8.6%	11.2%	15.5%
	Over total	15.8%	5.3%	0.0%	4.2%	11.0%	23.7%	11.0%	3.8%	3.6%	21.6%

Source: author's elaborations based on EFIGE dataset.

Table 2.2A Firms' distribution according to country, industry, GVC participation modes and GVC positioning

Percentages over same country-industry class.

	France						Germany						Italy						Spain					
	Zero	Sing	Dual	Trip	% GVC over tot	% PS over total	Zero	Sing	Dual	Trip	% GVC over tot	% PS over total	Zero	Sing	Dual	Trip	% GVC over tot	% PS over total	Zero	Sing	Dual	Trip	% GVC over tot	% PS over total
Food and tobacco	45.0	34.9	17.4	2.8	55.0	42.2	51.8	37.5	8.9	1.8	48.2	16.1	35.6	41.1	22.8	0.6	64.4	36.7	49.2	37.0	13.2	0.5	50.8	14.6
Textiles, apparel, leather	14.8	30.7	37.5	17.0	85.2	69.3	14.3	33.3	42.9	9.5	85.7	19.0	18.3	35.5	35.5	10.8	81.7	68.5	25.8	40.3	30.6	3.2	74.2	46.0
Coke and petroleum	50.0	50.0	0.0	0.0	50.0	0.0	0.0	100.0	0.0	0.0	100.0	100.0	40.0	20.0	40.0	0.0	60.0	60.0	0.0	0.0	0.0	0.0	0.0	0.0
Chemicals	19.0	32.8	44.8	3.4	81.0	60.3	13.5	56.8	27.0	2.7	86.5	29.7	18.1	23.6	54.2	4.2	81.9	59.7	27.6	32.7	35.7	4.1	72.4	17.3
Rubber, plastic and non-metallic mineral prod.	21.6	34.8	36.3	7.4	78.4	69.1	35.6	32.2	27.1	5.1	64.4	44.1	33.6	34.0	31.6	0.8	66.4	60.7	40.9	33.1	25.3	0.8	59.1	36.6
Basic metals and fabricated metal prod.	33.8	31.3	32.2	2.7	66.2	77.2	36.1	43.1	18.1	2.8	63.9	47.2	35.9	41.0	21.6	1.5	64.1	73.3	48.4	30.0	20.9	0.7	51.6	58.1
Machinery, equip., office mach. and computers	12.0	27.1	52.6	8.3	88.0	66.2	22.7	40.3	26.1	10.9	77.3	43.7	15.7	53.7	26.0	4.7	84.3	60.3	21.1	45.3	32.8	0.8	78.9	43.8
Electrical mach. and apparatus, communication equip.	17.8	23.7	45.2	13.3	82.2	69.6	18.2	46.8	28.6	6.5	81.8	36.4	22.7	42.4	29.7	5.2	77.3	58.1	18.0	31.5	46.1	4.5	82.0	40.4
Motor vehicles and other transp. equip.	16.0	30.0	44.0	10.0	84.0	80.0	11.8	17.6	52.9	17.6	88.2	35.3	24.6	35.1	33.3	7.0	75.4	57.9	36.1	27.7	36.1	0.0	63.9	45.8
Wood, paper, furniture, recycling	36.4	37.0	22.4	4.2	63.6	77.6	43.8	31.5	19.1	5.6	56.2	34.8	28.7	45.8	22.8	2.7	71.3	71.0	42.9	35.7	19.8	1.6	57.1	46.6

Source: author's elaborations based on EFIGE dataset.

Table 2.3A Inactive firms' distribution over countries according to inactivity reason
Percentages over the total of firms in each country and over the inactive ones in each country alternatively.

	France		Germany		Italy		Spain	
	% over tot	% over inactive	% over tot	% over inactive	% over tot	% over inactive	% over tot	% over inactive
In Bankruptcy or dissolved after bankruptcy	7.9%	57.0%	0.0%	0.0%	6.6%	56.5%	0.0%	0.0%
In liquidation or dissolved after liquidation	0.0%	0.0%	0.4%	15.4%	4.6%	39.1%	7.7%	53.9%
Dissolved	6.0%	43.0%	2.0%	84.6%	0.5%	4.0%	5.1%	35.8%
Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	1.5%	10.2%

Source: author's elaborations based on EFIGE dataset.

Table 2.4A Inactive firms' distribution over countries, GVC participation modes, GVC positioning and modes of exit from the market

Percentages over same country-GVC participation mode category.

		Bankruptcy	Liquidation	Dissolved	Other	Total inactive
France	Zero	63.0%	0.0%	37.0%	0.0%	100.0%
	of which, PS	61.8%	-	75.0%	-	66.7%
	Single	53.6%	0.0%	46.4%	0.0%	100.0%
	of which, PS	80.0%	-	76.9%	-	78.6%
	Dual	49.3%	0.0%	50.7%	0.0%	100.0%
	of which, PS	75.8%	-	73.5%	-	74.6%
	Triple	81.3%	0.0%	18.8%	0.0%	100.0%
	of which, PS	76.9%	-	66.7%	-	75.0%
	Total	57.0%	0.0%	43.0%	0.0%	100.0%
	of which, PS	72.7%	-	74.7%	-	73.6%
Germany	Zero	0.0%	0.0%	100.0%	0.0%	100.0%
	of which, PS	-	-	50.0%	-	50.0%
	Single	0.0%	20.0%	80.0%	0.0%	100.0%
	of which, PS	-	0.0%	50.0%	-	40.0%
	Dual	0.0%	25.0%	75.0%	0.0%	100.0%
	of which, PS	-	100.0%	33.3%	-	50.0%
	Triple	0.0%	0.0%	100.0%	0.0%	100.0%
	of which, PS	-	-	0.0%	-	0.0%
	Total	0.0%	15.4%	84.6%	0.0%	100.0%
	of which, PS	-	50.0%	36.4%	-	38.5%
Italy	Zero	57.7%	38.0%	4.2%	0.0%	100.0%
	of which, PS	68.3%	81.5%	66.7%	-	73.2%
	Single	54.2%	40.7%	4.2%	0.8%	100.0%
	of which, PS	67.2%	68.8%	40.0%	0.0%	66.1%
	Dual	58.5%	37.7%	3.8%	0.0%	100.0%
	of which, PS	74.2%	60.0%	0.0%	-	66.0%
	Triple	66.7%	33.3%	0.0%	0.0%	100.0%
	of which, PS	50.0%	50.0%	-	-	50.0%
	Total	56.5%	39.1%	4.0%	0.4%	100.0%
	of which, PS	68.6%	70.1%	40.0%	0.0%	67.7%
Spain	Zero	0.0%	49.7%	38.1%	12.2%	100.0%
	of which, PS	-	53.4%	50.0%	50.0%	51.7%
	Single	0.0%	57.5%	31.1%	11.3%	100.0%
	of which, PS	-	47.5%	45.5%	33.3%	45.3%
	Dual	0.0%	57.3%	37.3%	5.3%	100.0%
	of which, PS	-	46.5%	71.4%	75.0%	57.3%
	Triple	0.0%	50.0%	50.0%	0.0%	100.0%
	of which, PS	-	100.0%	50.0%	-	75.0%
	Total	0.0%	53.9%	35.8%	10.2%	100.0%
	of which, PS	-	50.3%	53.8%	47.1%	51.2%

Source: author's elaborations based on EFIGE dataset.

Table 2.5A Explanatory variables correlation matrix

	GVC	tfp2008	size	age	INNO	training	HK	labour_ flex	GROUP	qual_ cert	foreign_ comp	EXTERNAL_ FINANCING	PTO_ turnover	PURE_ SUPPLIER
GVC	1.0000													
tfp2008	-0.0986	1.0000												
size	0.2749	-0.1305	1.0000											
age	0.0943	0.0071	0.2334	1.0000										
INNO	0.1933	-0.0251	0.1588	0.0299	1.0000									
training	0.0149	0.0841	0.1153	0.0075	0.1169	1.0000								
HK	0.1138	0.0276	0.0199	-0.0068	0.0907	0.0614	1.0000							
labour_flex	0.0283	0.0090	0.0870	-0.0104	0.1163	0.1148	-0.0132	1.0000						
GROUP	0.1360	-0.0190	0.4159	0.0319	0.0460	0.1355	0.0271	0.0231	1.0000					
qual_cert	0.1183	0.0294	0.3370	0.0744	0.1172	0.1994	0.0680	0.0822	0.1900	1.0000				
foreign_ comp	0.3320	-0.0668	0.1582	0.0907	0.1106	0.0599	0.0859	0.0040	0.1626	0.0969	1.0000			
EXTERNAL_ FINANCING	0.0100	-0.0463	-0.0154	-0.0711	0.1139	0.0188	0.0156	0.0978	-0.1161	0.0252	-0.0479	1.0000		
PTO_ turnover	0.1312	-0.0749	-0.0964	-0.0672	-0.0682	-0.0500	-0.0050	-0.1140	-0.0304	-0.0103	0.0737	-0.0217	1.0000	
PURE_ SUPPLIER	0.0542	-0.0365	-0.0876	-0.0593	-0.0779	-0.0581	-0.0100	-0.1016	-0.0102	-0.0101	0.0677	-0.0360	-	1.0000

Source: author's calculations based on EFIGE dataset.

Table 2.6A GVC participation and positioning and firms' survival – sub-sample A

	(5)A	(6)A	(7)A	(8)A
GVC	0.008 (0.051)	-0.004 (0.050)		
SINGLE_GVC			-0.004 (0.054)	-0.013 (0.054)
DUAL_GVC			0.035 (0.064)	0.018 (0.063)
TRIPLE_GVC			-0.034 (0.131)	-0.051 (0.131)
PTO_turnover	-0.002*** (0.001)		-0.002*** (0.001)	
PURE_SUPPLIER		-0.103** (0.046)		-0.104** (0.046)
tfp2008	0.275*** (0.045)	0.276*** (0.045)	0.275*** (0.045)	0.276*** (0.045)
size	0.077*** (0.021)	0.070*** (0.021)	0.077*** (0.021)	0.079*** (0.021)
age	0.076* (0.039)	0.079** (0.039)	0.076** (0.039)	0.079** (0.039)
INNO	0.124*** (0.047)	0.124*** (0.047)	0.123*** (0.047)	0.124*** (0.047)
training	0.099** (0.046)	0.096** (0.046)	0.099** (0.046)	0.095** (0.046)
HK	0.057 (0.047)	0.059 (0.047)	0.057 (0.047)	0.059 (0.047)
labour_flex	0.002 (0.064)	0.002 (0.064)	0.001 (0.065)	0.007 (0.065)
GROUP	-0.126** (0.060)	-0.124** (0.060)	-0.127** (0.060)	-0.125** (0.060)
qual_cert	-0.012 (0.047)	-0.013 (0.047)	-0.013 (0.047)	-0.014 (0.047)
foreign_comp	0.019 (0.047)	0.023 (0.047)	0.016 (0.046)	0.021 (0.047)
EXTERNAL_FINANCING	-0.155*** (0.045)	-0.156*** (0.045)	-0.115*** (0.045)	-0.156*** (0.045)
Country dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Observations	5,837	5,837	5,837	5,837

Notes: calculations based on EFIGE dataset. Maximum likelihood estimates. White-robust standard errors in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 2.7A. GVC participation and positioning and firms' survival – sub-sample B

	(5)B	(6)B	(7)B	(8)B
GVC	0.013	0.003		
	(0.054)	(0.054)		
SINGLE_GVC			-0.004	-0.011
			(0.058)	(0.058)
DUAL_GVC			0.044	0.029
			(0.066)	(0.065)
TRIPLE_GVC			-0.040	-0.057
			(0.129)	(0.129)
PTO_turnover	-0.002***		-0.002***	
	(0.001)		(0.001)	
PURE_SUPPLIER		-0.108**		-0.110**
		(0.049)		(0.049)
tfp2008	0.275***	0.277***	0.278***	0.277***
	(0.048)	(0.048)	(0.048)	(0.048)
size	0.080***	0.081***	0.079***	0.081***
	(0.022)	(0.022)	(0.029)	(0.022)
age	0.089**	0.091**	0.089**	0.092**
	(0.041)	(0.041)	(0.041)	(0.041)
INNO	0.108**	0.108**	0.107**	0.107**
	(0.049)	(0.049)	(0.049)	(0.049)
training	0.075	0.072	0.074	0.071
	(0.048)	(0.048)	(0.048)	(0.048)
HK	0.064	0.066	0.063	0.066
	(0.050)	(0.045)	(0.051)	(0.050)
labour_flex	0.019	0.020	0.018	0.020
	(0.068)	(0.068)	(0.068)	(0.068)
GROUP	-0.179***	-0.176***	-0.180***	-0.176**
	(0.061)	(0.061)	(0.062)	(0.062)
qual_cert	-0.022	-0.023	-0.024	-0.025
	(0.050)	(0.050)	(0.050)	(0.050)
foreign_comp	-0.001	0.003	-0.004	0.001
	(0.050)	(0.050)	(0.050)	(0.050)
EXTERNAL_FINANCING	-0.146***	-0.147***	-0.147***	-0.148***
	(0.047)	(0.047)	(0.047)	(0.050)
Country dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Observations	5,611	5,611	5,611	5,611

Notes: calculations based on EFIGE dataset. Maximum likelihood estimates. White-robust standard errors in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 2.8A GVC participation and positioning and firms' survival – sub-sample C

	(5)C	(6)C	(7)C	(8)C
GVC	0.022	0.011		
	(0.055)	(0.055)		
SINGLE_GVC			0.004	-0.004
			(0.059)	(0.059)
DUAL_GVC			0.053	0.035
			(0.067)	(0.066)
TRIPLE_GVC			-0.010	-0.027
			(0.133)	(0.133)
PTO_turnover	-0.002***		-0.002***	
	(0.001)		(0.001)	
PURE_SUPPLIER		-0.115**		-0.116**
		(0.050)		(0.050)
tfp2008	0.274***	0.275***	0.275***	0.275***
	(0.048)	(0.048)	(0.048)	(0.048)
size	0.074***	0.076***	0.073***	0.075***
	(0.022)	(0.022)	(0.023)	(0.023)
age	0.098**	0.101**	0.098**	0.101**
	(0.042)	(0.042)	(0.042)	(0.042)
INNO	0.111**	0.111**	0.110**	0.110**
	(0.050)	(0.050)	(0.050)	(0.050)
training	0.092*	0.088*	0.092*	0.087*
	(0.050)	(0.049)	(0.050)	(0.049)
HK	0.047	0.050	0.046	0.050
	(0.051)	(0.051)	(0.051)	(0.051)
labour_flex	0.006	0.007	0.005	0.006
	(0.068)	(0.068)	(0.069)	(0.069)
GROUP	-0.134**	-0.131**	-0.135**	-0.131**
	(0.064)	(0.064)	(0.064)	(0.064)
qual_cert	-0.017	-0.018	-0.018	-0.019
	(0.051)	(0.050)	(0.051)	(0.050)
foreign_comp	0.000	0.005	-0.003	0.002
	(0.051)	(0.051)	(0.051)	(0.051)
EXTERNAL_FINANCING	-0.160***	-0.160***	-0.160***	-0.161***
	(0.048)	(0.048)	(0.048)	(0.048)
Country dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Observations	5,104	5,104	5,104	5,104

Notes: calculations based on EFIGE dataset. Maximum likelihood estimates. White-robust standard errors in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%.

3. Firms' participation to global value chains and employment growth

This work aims at empirically investigating whether and how firms' engagement in GVCs, in terms of both participation and positioning, is related to the variation in employment that they experienced during the Great Recession. Working on EFIGE data, we focus on French, German, Italian and Spanish firms and look at their employment variation rate calculated between 2008 and 2014 in relation to their GVC participation and positioning. We propose a measure to evaluate the former building on Veugelers *et al.* (2013), restricting the scope of the indicator used by the authors. We account for the latter by looking at the share of firms' turnover generated by sales of producing-to-order goods. Besides estimating our model relying on OLS and quantile regression, we also borrow from the impact evaluation techniques and apply a PS matching. Results show a positive relation between GVC participation and firms' employment growth, while no role appears to be played by GVC positioning.

3.
Firms' participation to global value chains and employment growth

3.1 Introduction

Globalization's "second unbundling" (R. Baldwin, 2011) has seen production processes of goods and services being split into a series of tasks, with firms confronted with new organizational choices. In fact, they can decide whether to carry the various production activities out in-house or through outsourcing contracts, at home or abroad. Therefore, value chains[1] (VCs) have become more and more fragmented and internationally spread, reaching a *global*[2] dimension (GVCs). Such process of international fragmentation of production has been pointed out as being one of the main changes the global economy has experienced during the last decades of the 20th century (Krugman, 1995) and it has emerged as a topic of great interest for researchers, especially in recent years. In fact, the fragmentation of production activities has deep economic (but also social and environmental) implications for countries, both on a macro and on a micro level. For instance, the development of GVCs has reshaped international trade – with exchanges in intermediate goods representing its largest share (e.g. UNCTAD, 2013) – and national comparative advantages – with specialization happening more and more at the "task" level. In fact, competition could be measured at a level smaller than the one concerning whole industries, since countries can rather exploit competitive advantage niches referred to individual activities within production processes (e.g. Cheng, Rehman, Seneviratne, & Zhang, 2015). This could represent an opportunity for growth especially for developing countries, which could enter the international competitive arena through GVC participation focused on one or a few productive tasks.

Nevertheless, in a highly interconnected world, disturbances propagate faster and more easily. In this regard, a number of studies points at the linkages building international production networks as being one of the determinants of the big trade collapse experienced

[1] The expression "value chain" was first introduced by Michael Porter (1985). In a more recent contribution, Kaplinsky and Morris (2001, p. 4) define it as "the full range of activities required to bring a product or service from conception through the different phases of production, delivery to final consumers, and final disposal after use".

[2] "Global value (in an earlier version, "commodity") chains", "international production networks" and other expressions have been all used to refer to the same phenomenon. See Bair (2005) and the first article of this work for further insight about the varied terminology used in the literature. In this article, the terms 'chain' and 'network' are employed interchangeably.

during the immediate aftermath of the 2008-2009 crisis (e.g. Altomonte, Di Mauro, Ottaviano, Rungi, & Vicard, 2012; Baldwin, 2009). In such circumstances, in fact, firms involved in GVCs may have acted as "agents of propagations", with internationalization strategies potentially increasing companies' vulnerability when dealing with shocks affecting international trade (Békés, Halpern, Koren, & Muraközy, 2011). Despite being the main players within global production networks, however, firms and their GVC participation has not been much studied. As underlined in the first article of this work, this is mostly due to the lack of good quality micro data, which makes it also difficult to set a unique framework of analysis to investigate international value chains at the enterprise level and to carry out studies aiming at dynamic and/or cross-country comparisons. Despite these issues, researchers have been able to find evidence of a positive relation between companies' involvement into GVCs and their performance, measured resorting to a variety of indicators, e.g. labour productivity, total factor productivity (TFP), intensive margin of trade, propensity to innovate (cf. section 2).

This work, too, focuses on firms and their engagement into global production networks. In particular, it takes into account the employment variation occurred at the firm level between 2008 and 2014 and investigates whether and how it is related to companies' involvement and role within GVCs. We use data from the EU-EFIGE/Bruegel-Unicredit Survey (EFIGE) and compare manufacturing enterprises located in France, Germany, Italy and Spain.

Hence, the main contribution of this work is twofold. First, it enriches the literature dealing with international production networks from a micro point of view; second – and most importantly –, it focuses on employment growth, a variable mostly overlooked when investigating the relation between firm performance and GVC participation.

The rest of this article is structured as follows. The next section provides a literature review of the most relevant works related to our investigation. Section 3.3 presents the data and the variables we use and shows some descriptive analysis, dealing also with the representativeness issue of our sample (section 3.3.1). Section 3.4 represents the core of our research, illustrating the three parts of our empirical investigation (3.4.1 OLS regressions; 3.4.2 quantile regressions; 3.4.3 impact evaluation analysis) and presenting our results. Section 3.5 concludes.

3.2 Literature review

The Great Recession of 2008-09 has been the most severe economic crisis the world has experienced since World War II. At the end of 2008 "world trade experienced a sudden, severe and synchronized collapse" (R. Baldwin, 2009), with exchanges of manufactured goods (measured in current dollars) decreasing by around 30 percent between the first semester of 2008 and the first semester of 2009. In volume terms, world GDP, exports and imports fell by 2.3, 12.2 and 12.9 percent respectively, while the European Union (EU) countries were even more affected by the crisis, recording a reduction of 4.2 percent in GDP, 14.8 in exports and 14.5 in imports (WTO, 2010).

Several researchers have indicated global value chains as being one of the causes of this so-called big trade collapse, responsible of having strengthened the transmission of the shocks of the 2008-09 crisis (e.g. Cheung & Guichard, 2009; Freund, 2009). One explanation resides in vertical specialization and in the increase in trade of intermediate goods generated by the development of international production networks. In fact, exchanges in components – which can take place several times between countries before they are included in final goods – are very sensitive to variations in final demand, and this affects trade, especially in those industries more vertically specialized internationally (e.g. Bems, Johnson, & Yi, 2009; Yi, 2009). Inventory adjustments carried out by final firms have been identified as another possible shock-transmitting mechanism. In short, companies producing final goods experiencing demand reductions find themselves holding too much inventory; therefore, they cut their orders to their suppliers and sell the products they have in stock. By doing so, they 'pass' the demand shock to intermediate firms, which are more affected the more they are specialized in production tasks far from the final market; it is the so-called "bullwhip effect" (Alessandria, Kaboski, & Midrigan, 2011).

What happened to firms involved in international production networks during the crisis? Altomonte *et al.* (2012) distinguish two types of relations connecting firms within GVCs: intra-group links, where transactions happen between companies belonging to the same group, and supply contracts, or arm's length transactions. Focusing on French firms, they find that intra-group exchanges in intermediate goods fell faster – and recovered faster – than arm's length trade. Such higher GVC-related trade elasticity seems to confirm the bullwhip effect. Using EFIGE data referred to the first phase of the crisis (2008-2010), Békés et al. (2011) provide a detailed picture showing how firms were affected by the recession and how they reacted. The portrait appears very heterogeneous. Looking at internationalization strategies, the authors

noted how exporters contracted more than non-exporters, while importers and outsourcers – although performing slightly worse than non-importers – showed a minimal reduction in revenues. Deepening the analysis by taking into account firms' position within international production networks, Békés et al. (2011) find that active outsourcers or companies controlling other ones have fared better during the crisis, together with those selling final goods and employing skilled workers. On the contrary, intermediate firms and those controlled by other companies have shown a higher reduction in employment. The financial position of the firms mattered, too, since companies having reported financial constraints have also contracted more. Finally, firms selling to public clients had a lower sales decline. Accetturo and Giunta (2017) also rely on EFIGE data to investigate how the crisis has affected German and Italian firms by taking into account their participation and positioning within GVCs. The authors show that companies located in Italy have been characterized by much lower growth in sales with respect to those operating in Germany and underline that, among the former, there is a larger presence of intermediate companies. Accetturo and Giunta (2017) also find that the latter – regardless of their location – tend to be smaller and they appear to have experienced a greater decrease in sales during the 2008-2009 crisis[3]. Nevertheless, such gap between intermediate and final firms is reduced in the case of suppliers whose main customer is located abroad; in fact, they engage in product innovation and their export share over total sales is similar to the one of downstream firm. Accetturo *et al.* (2011) illustrate a similar picture, albeit characterized by a high degree of heterogeneity. Overall, intermediate firms, on average, tend to be smaller (in terms of labour force), to have a lower export propensity and lower productivity levels (proxied by the share of turnover per employee). Nevertheless, firms' performance during the first phase of the crisis differs according to their upgrading trajectories. The 'immobile' companies (i.e. those having pursued no upgrading strategies) fared worse than those having implemented both relational and functional upgrading. Firms carrying out only relational upgrading, however, appear to have been more exposed to international shock, thus performing worse than those implementing functional upgrading only. Brancati et al. (2017), too, investigate how Italian firms participating to GVCs fared during the great recession relying on the MET database. They detect great heterogeneity among companies' performance. Specifically, they show that high-skilled suppliers involved in relational GVC appear to be more innovative, while other GVC participation modes give firms no premium compared to exclusively domestic ones.

[3] As underlined in the first article of this work, this is consistent with the so-called "subcontracting discount" (Razzolini & Vannoni, 2011).

Other research not focused specifically on the great recession period and investigating firms' performance in relation to their participation to international and/or domestic production networks usually takes into account productivity indicators (both in terms of TFP and labour productivity) or other variables, such as export propensity or innovativeness. Concerning the latter, for example, Giovannetti *et al.* (Giovannetti, Marvasi, & Sanfilippo, 2015) and Giovannetti and Marvasi (2016) find that there is a positive and significant association between companies' participation to VCs and both their probability of export and their intensive margin of trade, especially for downstream firms. In general, the literature agrees on GVC participants being more productive (e.g. Agostino, Giunta, Scalera, & Trivieri, 2016; J. Baldwin & Yan, 2014; Veugelers, Barbiero, & Blanga-Gubbay, 2013), with final companies usually performing better than intermediate ones (e.g. Agostino, Giunta, Nugent, Scalera, & Trivieri, 2015; Giovannetti & Marvasi, 2017; Wynarczyk & Watson, 2005).

What about employment growth?

Theoretically, according to Taglioni and Winkler (2016), global value chains offer countries the opportunity to boost employment in agricultural, manufacturing and services activities. In particular, engagement in international production networks would benefit the labour market through three channels:

1. Demand effect: companies involved in international production networks are usually characterized by a higher demand of skilled labour, especially multinational enterprises (MNEs). Moreover, the latter may try to acquire human capital by offering higher employment benefits.
2. Training effect: workers employed in local firms participating to GVCs are more likely to get trained, for example by the firms' international clients;
3. Labour turnover effect: movements of workers from GVC participating companies to exclusively domestic ones can facilitate knowledge flows among firms.

Nevertheless, we found little research investigating the link between GVC participation and positioning and employment growth at the firm level.

Some studies focus on the quality of labour generated by firms' engagement in international production networks, mostly in intermediate companies. Arnold (2010), for example, investigates the cases of two export-oriented centres, one in Turkey (Denizli) and one in India (Tiruppur), mainly engaged in the apparel and textile industries. The author illustrates how the development of GVC participation, mostly by large firms located in the two areas, has changed the organization of production, affecting also employment practices. In fact, firms

directly connected to the international buyers have adapted to the volatility of the global demand by resorting to a number of smaller subcontractors, to which they rely when production increases are required. This strategy shields bigger firms during periods of lower demand, while transferring all the insecurity to smaller firms and their employees, who can find themselves working for huge amount of hours during peaks in production and being unemployed for several months afterwards. Subcontractors, in fact, implement more insecure employment arrangements and resort more to recruiting rural and female workers, considered more tolerant of long shifts. Dolan (2004) reaches a similar conclusion, albeit concerning a different industry and country. In fact, she finds that Kenyan firms operating in the fresh vegetables commodity chain (which is dominated by UK retailers) adopt a strategy based on organizational flexibility in order to cope with competitive pressure. Therefore, although said companies offer considerable employment opportunities, they rely mainly on "insecure" forms of work arrangements. A different point of view is provided by Beerepoot and Kumar (2015), who investigate employment in the security services in Mumbai, India. Demand in such industry has increased with firms located in the city having become more and more internationalized and involved in GVCs, therefore attracting an increasing amount of foreign clients. The latter demand mostly trained and educated workers, leading to an average increase in the salary and in the skills possessed by employees in the security service sector. The International Labour Organization (ILO) recognizes both pros and cons about GVCs development and employment creation (ILO, 2016). In fact, it underlines the positive impact of global value chains on job creation, whose importance is even more relevant when considering the demographic changes affecting the world's population (e.g. aging or the increase in women's participation to the labour market). Nevertheless, it signals that GVC mechanisms have contributed to a worsening of working conditions under several aspects, from wages to workers' safety and health. That is why, together with firms' upgrading (Gereffi, 1999; Humphrey & Schmitz, 2002), researchers are starting to focus also on the so-called "social upgrading". It indicates the improvement of workers' position promoted by companies' economic upgrading, which not always implies the former (Barrientos, Gereffi, & Rossi, 2011).

Another strand of literature looks at the employment variation related to firms' internationalization strategies that can be associated to engagement in global production networks, namely offshoring. In particular, there has been much investigation on the effect of companies' outward foreign direct investments (FDIs) on employment in their home country, to understand whether such strategy substitutes or complements the latter. Concerning the

manufacturing industry – the one our analysis takes into account – results vary. Focusing on the United States, for instance, some contributions seem to exclude a negative impact of offshoring on domestic employment (Desai, Foley, & Hines, 2009; Mankiw & Swagel, 2006). Hijzen and Swaim (2007), taking into account 17 high-income OECD countries, also find that labour intensity is not affected by offshoring, which appears to have a positive effect in the industry employment. However, an OECD study on 12 countries analysing material and services offshoring shows how the latter has a negative impact on employment at home (OECD, 2007). Looking specifically at the type of tasks offshored and distinguishing among professional categories affected, Bramucci *et al.* (Bramucci, Cirillo, Evangelista, & Guarascio, 2017) find that – in five European countries – the cost reduction motive seems to be the major driver of offshoring strategies especially in the manufacturing industry, where employers carrying out less skilled or more routinized tasks are negatively affected.

Moving away from the GVC focus, a rich literature has investigated the relation between employment growth and specific firms' characteristics – especially size and age – , also looking at the recent years of the economic crisis. The link between firms' growth and size is often investigated to assess whether the Law of Proportional Effect is valid. Such rule, also known as the Gibrat's Law, states that the proportional rate of growth of a firm is independent of its absolute size. The majority of the research seems to reject this thesis. Amorim Varum and Barros Rocha (2013), for example, look at the relation between firms' size and employment variation in periods of economic downturn. Relying on a panel of micro data encompassing Portuguese firms, they illustrate how crises affect employment growth negatively, especially in larger firms, which are, however, faster to recover. Bianchi and Biffignandi (Bianchi & Biffignandi, 2018) investigate the effect of the recent recession on employment growth at the firm level, focusing on the Italian case. They find that firm size has a negative effect on employment change only for the micro enterprises (with less than 10 employees), while it is positive for the other ones, with negative changes in these classes mainly attributable to unfavourable industrial composition and business cycle. Grazzi and Moschella (2017) look at the relation of both size and age, together with companies' export status (which they use to proxy productivity), with firms' growth. Working on Italian firms, they show how the positive association between the latter and companies' internationalization declines with age, and size keeps on being negatively associated with growth even when accounting for age, contrary to other evidence on the matter (e.g. Haltiwanger, Jarmin, & Miranda, 2013, on US firms). Barba Navaretti *et al.* (Barba Navaretti, Castellani, & Pieri, 2014) resort to quantile regressions and

illustrate how, among French, Italian and Spanish firms between 2001-2008, younger companies grew more than older ones, especially in the highest growth quantiles. Heyman *et al.* (Heyman, Norbäck, & Persson, 2017), too, find that small young firms give the larger contribution in terms of net job creation; however, they underline that it is old large companies that are mainly responsible for the creation of productivity gains.

While size and age are the main variables investigated when studying companies' growth, other characteristics may play a role. Schreyer (2000), for instance, analyses fast growing companies and points out that they are more R&D intensive and more common among firms partly of fully owned by others. Rahaman (2011) looks at the relation between companies' access to financing and their growth. While the latter is significantly influenced by the availability of internal financing, such effect decreases when bank credits (i.e. external financing) become more accessible. This suggests that, given a choice, companies prefer to fund their growth by recurring to external financing.

3.3 Data, variables and descriptive analysis

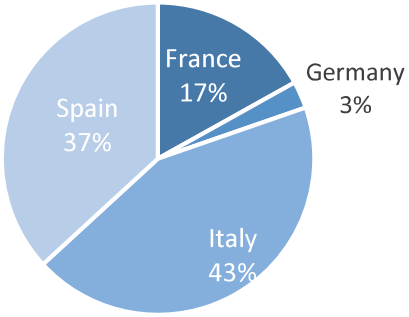
Our research has been carried out relying on data provided by the EU-EFIGE/Bruegel-UniCredit dataset (in short, the EFIGE dataset), a database recently collected within the EFIGE project (*European Firms in a Global Economy: internal policies for external competitiveness*) supported by the Directorate General Research of the European Commission through its 7th Framework Program and coordinated by Bruegel. It provides information on almost 15,000 manufacturing companies having at least 10 employees and located in Austria, France, Germany, Hungary, Italy, Spain and United Kingdom. Such sampling is stratified by sector and firm size, with an over-sampling for large companies. Data were collected in 2010, refer to years 2007-2009 and provide both qualitative and quantitative information on around 150 items related to: structure of the firms, workforce, investment, technological innovation and R&D, export and internationalization processes, market structure and competition, financial structure and bank-firm relationship[4]. Moreover, balance sheet information was recently updated up to 2014.

For the purposes of our analysis, we focus on firms located in France, Germany, Italy and Spain, excluding the other three as they are economically smaller or different in terms of

[4] See Altomonte and Aquilante (2012) for further information on the EFIGE database.

productive structure. The EFIGE database provides observations covering around 11,700 firms located in the four selected countries but, unfortunately, due to several missing data, our sample is restricted to 3,778 units, roughly one third of the original one. Figure 3.1 and table 3.1 provide a first look at our data, showing firms' distribution based on country and size[5]. Lamentably, data gaps lead to an under-representation of German firms in the sample (3% of the total). Within countries and with the exception of Germany, small firms represent the largest share of companies, especially in Italy (around 82%) and Spain (almost 84%). Table 3.1A in the Appendix illustrates how firms are distributed over industries based on country and size.

Figure 3.1 Sample composition based on firms' location
Percentages over total.



Source: author' s elaborations on EFIGE data.

Table 3.1 Firms' distribution based on country and size
Percentages over total in the same country.

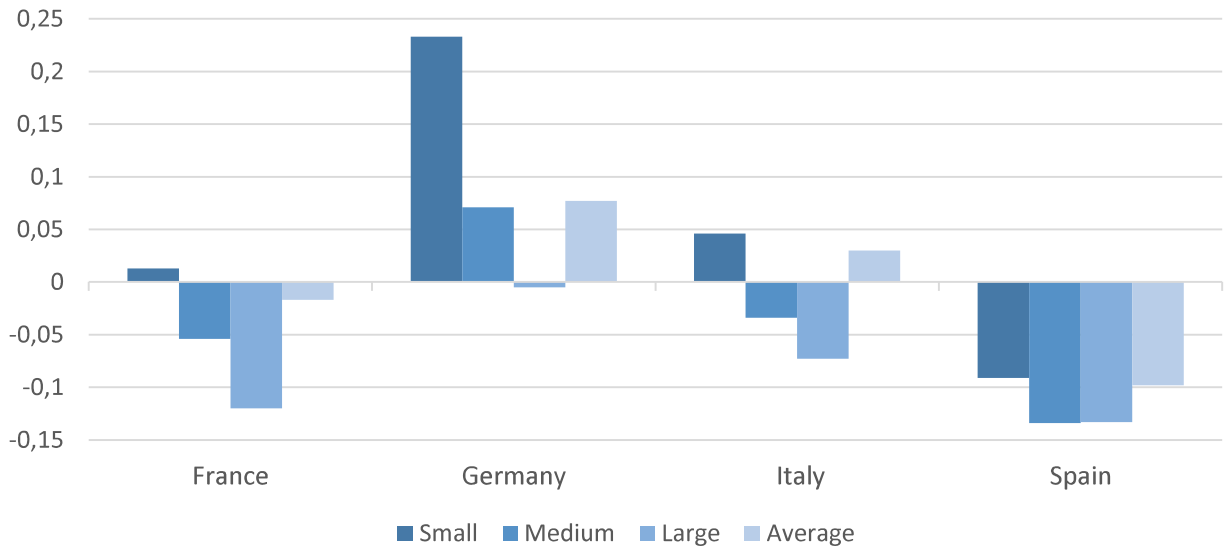
	France		Germany		Italy		Spain	
	N.	**%**	**N.**	**%**	**N.**	**%**	**N.**	**%**
Small	399	62.44	16	15.24	1,346	81.92	1,167	83.9
Medium	193	30.2	63	60	226	13.76	169	12.15
Large	47	7.36	26	24.76	71	4.32	55	3.95
Total	639	100	105	100	1,643	100	1,391	100

Source: author's elaborations on EFIGE data.

[5] Small firms: 10-49 employees; medium firms: 50-249 employees; large firms: 250 or more employees.

The two key variables of our analysis are the variation rates of employment at the firm level between 2008 and 2014 and companies' participation to global value chains. A first look at the former (figure 3.2) shows a considerable level of heterogeneity among countries and firm size, with Germany being characterized by a general employment growth (except for a slight decline in large firms), while Spanish companies have recorded a widespread decrease in the number of workers (almost -10% on average). Italy and France both show a decline in employment only within larger firms (medium and large sized).

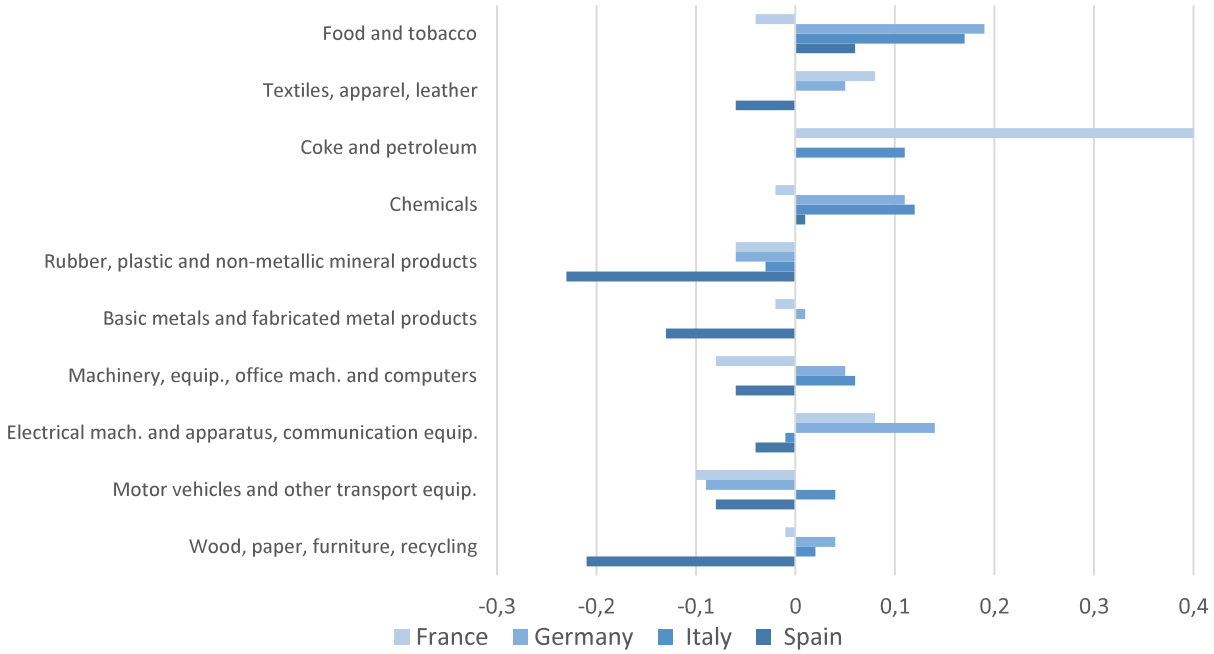
Figure 3.2 2008-2014 employment variation
Variation rates over same class size and average.



Source: author's elaborations on EFIGE data.

In figure 3.3, we deepen our analysis looking at employment variation rates in each industry and country. Again, a heterogeneous picture emerges, with Spain suffering the most severe employment decrease in the majority of sectors. Among these, chemicals and food and tobacco are those showing higher employment growth at the firm level (with the exception of French companies), while in the industry of rubber, plastic and non-metallic mineral products firms have recorded a general fall in employment in every country.

Figure 3.3 2008-2014 employment variation over industries
Average variation rates in each country-industry category



Source: author's elaborations on EFIGE data.

A crucial aspect of our research concerns measuring companies' GVC participation and positioning. Since we are aware that firms can participate to international production networks through several channels, we account for such diversity by distinguishing among three alternative GVC participation modes. In doing so, as done also in the previous chapter of this work, we build on Veugelers *et al.* (2013), but we apply a stricter definition of GVC participation. Specifically, we take into account the three internationalization strategies available to firms.

(1) Importing: we consider as GVC participants those firms importing intermediate goods or services.

(2) Exporting: we recognize as GVC participants companies exporting intermediate goods (therefore, selling to other firms) or final goods produced for foreign firms through outsourcing contracts. In fact, firms exporting final goods produced at home to sell them to foreign final customers cannot be considered as part of an international production network.

(3) Producing abroad: we view as GVC participants firms producing abroad (through either FDIs or outsourcing contracts) intermediate goods or final goods not destined to the local market. We do so in order to exclude from our taxonomy companies making their

products entirely abroad and selling them to local customers, as this does not signal the existence of a global value chain.

How to get this information from the EFIGE dataset? It provides data about the type of products firms import, therefore distinguishing companies belonging to the first category is quite straightforward. In order to single out exporting firms participating to GVCs, we look at their customers. Thus, we consider as GVC participants only those exporting companies:

1. which are passive outsourcers, so they produce (intermediate or final) goods for foreign firms;
2. whose turnover is generated (entirely or partly) by selling produced-to-order goods to other firms, since, according to a proportionality assumption, we can assume that at least part of their exports consists of such products.

Finally, to understand whether companies producing abroad are part of an international production network, we take into account the destination of the goods produced abroad. National firms are considered as GVC participants when the goods produced abroad by their foreign affiliates or outsourcers are:

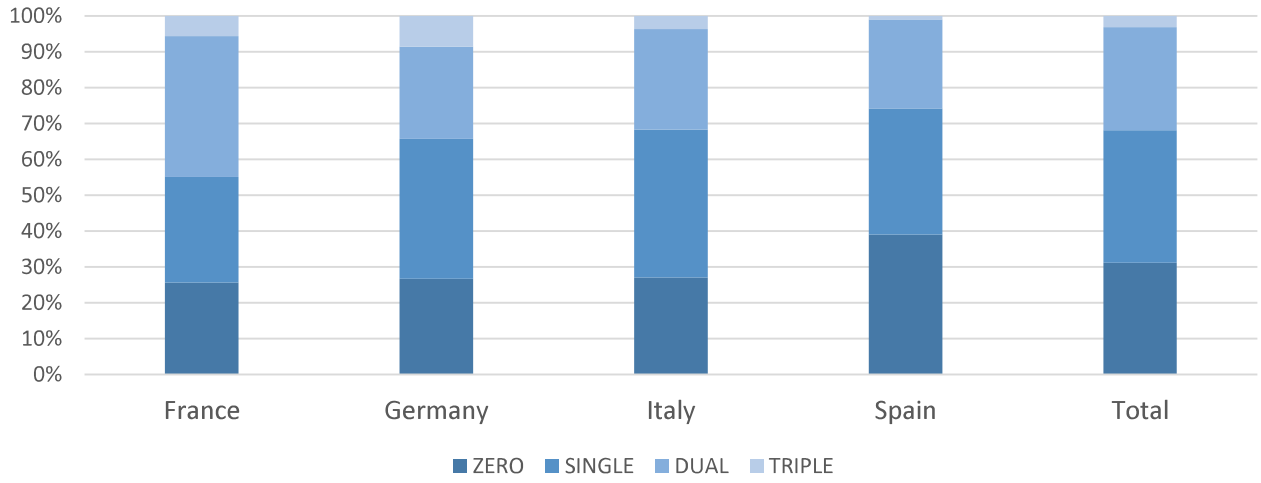
1. intermediate goods imported in their home country to be used in their production processes;
2. final goods imported in their home country to be sold in the domestic market;
3. goods imported in their home country to be then exported to third countries.

According to the number of GVC-related international activities a firm is engaged in, we distinguish among three mutually exclusive global value chain participation modes: single, dual or triple (with the 'zero' mode identifying non participants). As long as a firm is part of an international production network through one of these strategies, we consider it as a GVC participant. Almost one third of the firms in the sample is not active within international production networks. Those companies which do are active in GVCs privilege being engaged in only one international strategy (single mode participation), except for French firms which mainly implement a dual GVC participation mode. Not surprisingly, the third mode GVC engagement – the most complex one – concerns the lowest share of firms (figure 3.4).

As widely recognized in the literature, participation to international production networks is not the only aspect of the GVC phenomenon that can be related to firms' performance. Positioning within production chains matters, too (cf. section 3.2). In order to account for it, as seen in Accetturo and Giunta (2017), we resort to the variable indicating the share of turnover generated by produced-

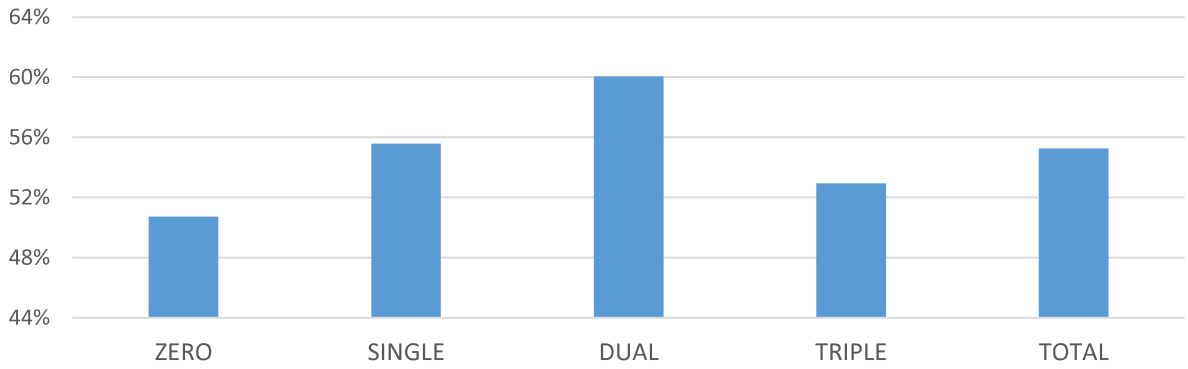
to-order goods[6]; firms whose entire turnover derives from the sale of such products are defined as 'pure suppliers' (PS). The latter represent more than half of the firms in our sample, regardless of their involvement in an international production network; among dual GVC participant, however, the share of pure suppliers reaches the 60.1% over total companies (figure 3.5).

Figure 3.4 GVC participation modes at the country level and sample average
Percentages over total in each country and on average in the whole sample.



Source: author's elaborations on EFIGE data.

Figure 3.5 Pure suppliers and GVC participation modes
Sample's average percentages over each GVC participation category and over total.



Source: author's elaborations on EFIGE data.

Table 3.2 shows the distribution of firms across countries according to their GVC participation and positioning. Irrespective of location, small firms record the highest shares in the zero-mode GVC participation category (i.e. absence of GVC involvement), suggesting, in line with the literature, that companies' size matters when investigating the implementation of internationalization strategies. This, in turn, is confirmed by looking at data on triple-mode firms, which are mostly large. France

[6] The EFIGE survey, in question E1, asks firms to indicate the average percentage of their turnover made by sales of produced-to-order goods.

and Italy are the countries with the largest share of pure suppliers over total companies, with only large Italian firms showing a lower proportion of them. Fewer German and Spanish companies sell exclusively to other firms; among the former, the highest share of pure suppliers is recorded for single and dual GVC participants, while, among the latter, intermediate companies are especially those involved in international production networks in dual and triple modes.

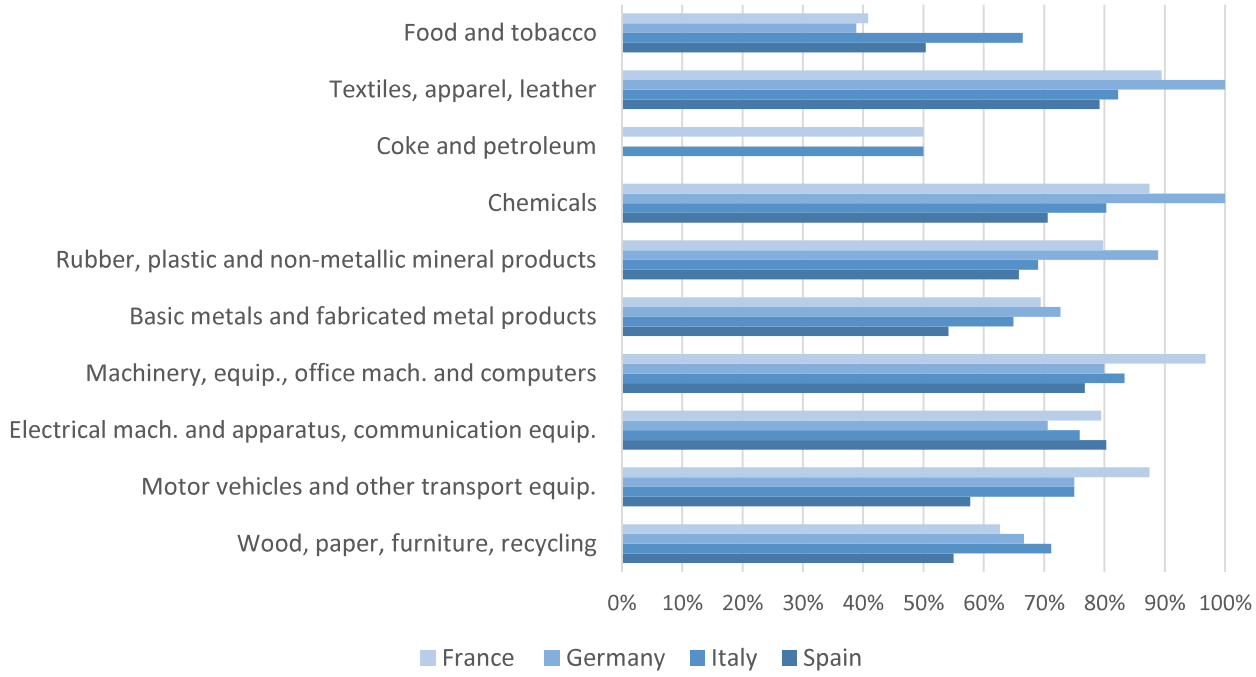
Table 3.2 Firms' distribution over countries, GVC participation modes and GVC positioning
Percentages over same country-size category.

		ZERO	SINGLE	DUAL	TRIPLE	TOTAL
France	Small	33.1	32.6	31.1	3.3	100
	of which, PS	62.1	70	75	76.9	69.2
	Medium	15	25.9	51.8	7.3	100
	of which, PS	72.4	72	75	64.3	73.1
	Large	6.4	17	57.4	19.1	100
	of which, PS	66.7	75	85.2	66.7	78.7
Germany	Small	50	43.8	6.3	0.0	100
	of which, PS	25	57.1	100	-	43.8
	Medium	22.2	34.9	33.3	9.5	100
	of which, PS	21.4	36.4	57.1	33.3	39.7
	Large	23.1	46.2	19.2	11.5	100
	of which, PS	33.3	50	40	33.3	42.3
Italy	Small	30.5	42.3	24.6	2.5	100
	of which, PS	64.2	67.4	63.1	44.1	64.8
	Medium	11.9	36.7	42	9.3	100
	of which, PS	59.3	71.1	63.2	47.6	64.2
	Large	8.5	35.2	49.3	7	100
	of which, PS	50	32	60	40	47.9
Spain	Small	43.2	34.4	21.9	0.5	100
	of which, PS	38.1	38.1	44.3	66.7	39.6
	Medium	21.9	35.5	40.8	1.8	100
	of which, PS	29.7	23.3	43.5	33.3	33.1
	Large	3.6	49.1	38.2	9.1	100
	of which, PS	0	25.9	57.1	60	40

Source: author's elaborations on EFIGE data.

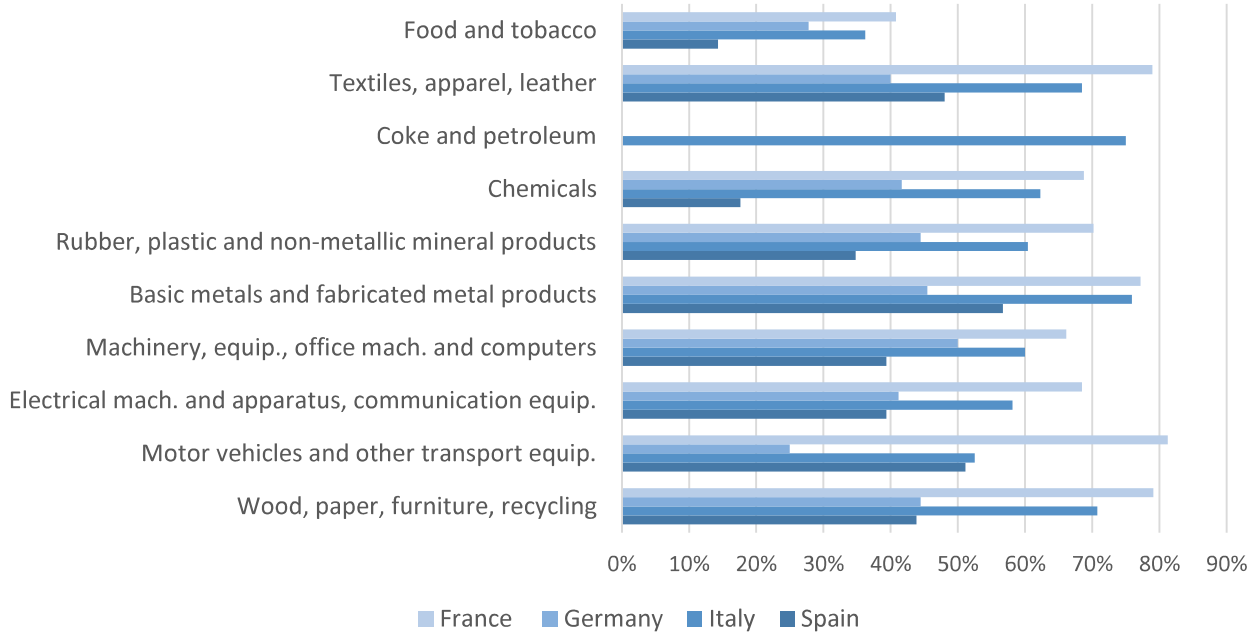
Table 3.2A in the Appendix shows the distribution of firms over countries and industries, distinguishing among the 4 GVC participation modes (including non-participants) and illustrating also the share of pure suppliers in each industry. The picture is quite heterogeneous; therefore, we can resort to figures 3.5 and 3.6 to interpret it more easily. Chemicals, machinery and equipment, and textiles, apparel and leather are the industries with the higher GVC participation rates in the whole sample. Spanish firms appear to be less active within international production networks with respect to the others, with the exception of the electrical machinery and apparatus industry, where they show GVC participation rates similar to their French counterparts. Italian firms appear to be the most involved in global production chains within the sectors of food and tobacco and wood, paper, furniture and recycling, which are usually considered to be part of the 'made in Italy' industries.

Figure 3.6 GVC participation rates in industries
Percentages over same industry-country category.



Source: author's elaborations on EFIGE data.

Figure 3.7 Pure suppliers
Percentages over same country-industry category.

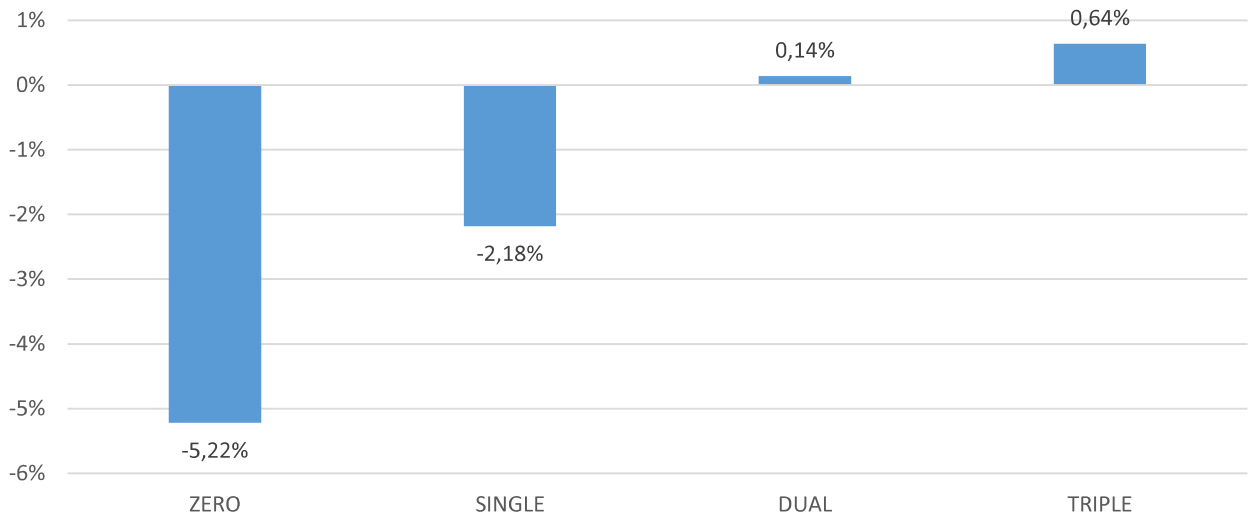


Source: author's elaborations on EFIGE data.

Concerning companies' positioning within production chains, France and Italy show the highest share of fully intermediate firms in every sector. Such result is in line with what Accetturo

and Giunta (2017) observe investigating GVC participation and positioning of German and Italian companies, finding among the latter a larger amount of suppliers. German firms are positioned at the end of the production chain (i.e., they are mostly final firms) especially in the motor vehicles industry, very relevant in the German economy.

Figure 3.8 Average percentage 2008-2014 employment variation and GVC participation modes
Average percentages over GVC participation categories over the whole sample.



Source: author's elaborations on EFIGE data.

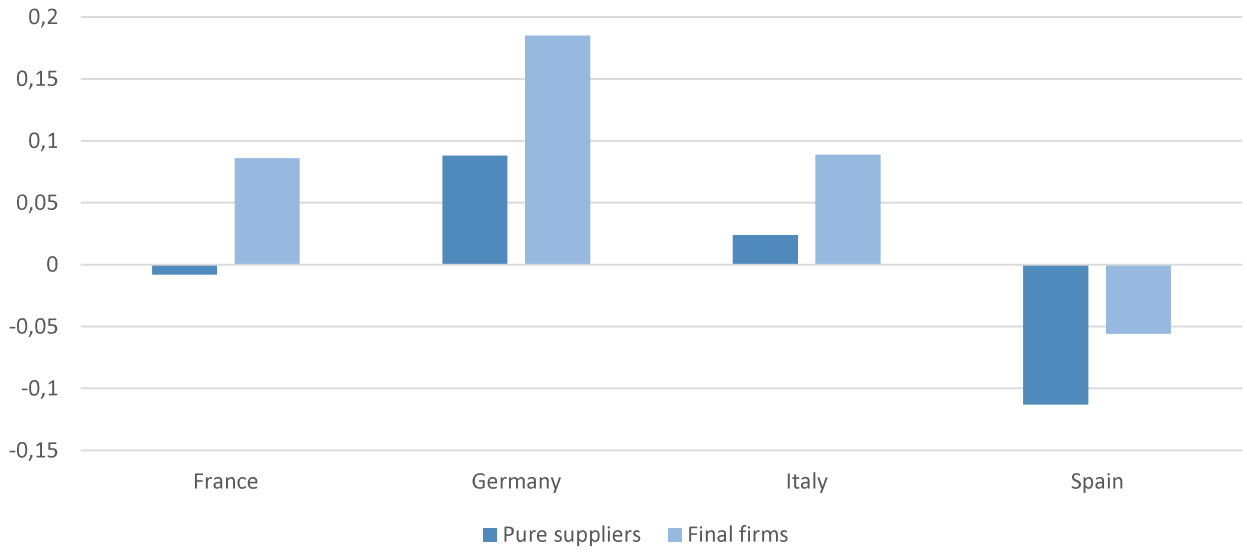
In figure 3.8, we start studying how our two variables of interest – employment variation and GVC participation – are related. A first look at the histogram would suggest that at higher levels of engagement within international production networks correspond higher employment growth (or lower employment decrease). Such descriptive analysis is repeated in table 3.3, considering the various industries individually. Apart from some exceptions (e.g. motor vehicles and textiles and apparel), firms involved in international production networks always show higher (lower) positive (negative) employment variation.

Table 3.3 Employment variation and GVC participation modes at the industry level
Four countries' average variation rates in industry-GVC participation modes categories

	Zero	Single	Dual	Triple	GVC
Food and tobacco	0.05	0.11	0.14	0.15	0.12
Textiles, apparel, leather	0.07	0.04	-0.02	-0.26	-0.02
Coke and petroleum	0.47	-0.07	0	-	-0.05
Chemicals	-0.01	0.04	0.07	0.3	0.07
Rubber, plastic and non-metallic mineral products	-0.19	-0.14	0.01	-0.09	-0.07
Basic metals and fabricated metal products	-0.08	-0.03	-0.03	0.1	-0.03
Machinery, equip., office mach. and computers	0	-0.03	0	0.34	0
Electrical mach. and apparatus, communication equip.	-0.06	0.04	0.03	0	0.03
Motor vehicles and other transport equip.	0.03	-0.11	-0.02	-0.14	-0.07
Wood, paper, furniture, recycling	-0.1	-0.08	-0.07	-0.06	-0.08

Source: author's elaborations on EFIGE data.

Figure 3.9 2008-2014 employment variation and GVC positioning
Average variation rates in GVC positioning-country category



Source: author's elaborations on EFIGE data.

Finally, we look at the employment variation rate experienced by firms according to their position within international production networks. In order to do so, as anticipated, we take into account the share of firms' turnover generated by sales of produced-to-order goods Specifically, in figure 3.9, we look at the change in the number of employees recorded among pure suppliers and exclusively final firms[7]. It appears that, in all the countries considered, final firms are characterized

[7] Given such choice, figure 3.9 does not account for "hybrid" companies, i.e. those selling to other firms only part of their products.

by higher (lower) positive (negative) employment variation rate. This is in line with the literature observing a worse performance of intermediate firms as compared to the final ones (e.g. Razzolini and Vannoni's "subcontracting discount" (2009)).

3.3.1 Sample's representativeness

As anticipated, the EFIGE database provides around 11,700 observations covering French, German, Italian and Spanish companies. Some of those miss basic firm-level information (e.g. age, industry), therefore the available data actually encompasses 11,547 firms. Due to additional missing data on companies' employment and productivity, we are able to exploit only 3,778 observation (sample 1). We are aware that the original EFIGE dataset is representative of European firms located in the countries considered, therefore, before carrying out our empirical analysis, we have investigated whether our sub-sample can be considered representative of the original one.

Table 3.4 Sample 1 - Composition

	Whole population		Sample 1		
	Abs.	% over total	Abs.	% over total	% over same nationality
France	2,759	24%	639	17%	23%
Germany	2,935	25%	105	3%	4%
Italy	3,021	26%	1,643	43%	54%
Spain	2,832	25%	1,391	37%	49%
Total	11,547	100%	3,778	100%	33%

Source: author's elaborations on EFIGE data.

As perceivable by looking at table 3.4, our sub-sample is unbalanced with respect to the original population in terms of countries' representativeness. Specifically, German firms are largely under-represented. Taking this into account and considering the specificities of German companies' performance during the crisis (i.e. higher average employment variation rates with respect to other countries), as a robustness check we are going to test our model by running it on another sub-sample (sample 2), obtained by excluding German firms from our initial one.

Table 3.5 Sample 2 - Composition

	Whole population		Sample		
	Abs.	% over total	Abs.	% over total	% over same nationality
France	2,759	32%	639	17%	23%
Italy	3,021	35%	1,643	45%	54%
Spain	2,832	33%	1,391	38%	49%
Total	8,612	100	3,673	100	43%

Source: author's elaborations on EFIGE data.

The 3,673 observations encompassed by sample 2 still show a larger presence of Italian and Spanish firms compared to the original population (table 3.5).

In order to check for our samples' representativeness, however, we have focused on the main variables of our interest: GVC participation, GVC participation modes (single GVC, dual GVC and triple GVC) and VC positioning indicators, i.e. the share of turnover generated by produced-to-order goods and being a pure supplier. We test whether our subsamples are significantly different from the original population as far as these variables are concerned, by using a z-test. Contrary to t-tests, most useful when comparing two independent samples with a limited number of observations (n<30), z-tests can be used to confront samples belonging to a defined population when standard deviations are known. Thus, we test whether the means of our variables of interest in our two samples are significantly different from the correspondent ones measured over the whole population. If it so, we conclude that our sub-samples are not representative of the original population. The results of our analysis are shown in table 3.6.

Table 3.6 Representativeness of sample 1 and 2

	Sample 1			Sample 2		
	Population mean	*Sample mean*	*Representative*	*Population mean*	*Sample mean*	*Representative*
GVC	0.646	0.688	No	0.68	0.687	Yes
Single GVC	0.355	0.37	No	0.363	0.369	Yes
Dual GVC	0.258	0.287	No	0.282	0.288	Yes
Triple GVC	0.033	0.031	Yes	0.034	0.03	Yes
Pure supplier	0.543	0.552	Yes	0.593	0.557	No
Produced-to-order goods share of turnover	72	72.45	Yes	75.9	72.79	No

Source: author's elaborations on EFIGE data.

As expected, sample 1 is less representative of the whole population in terms of GVC participation with respect to sample 2. The latter, in fact, appears to be representative of the original population for all the GVC engagement modes. Nevertheless, only sample 1 is representative

regarding GVC positioning, measured as either being a pure supplier or referring to the share of turnover generated by sales of produced-to-order goods.

3.4 Empirical analysis and main results

3.4.1 OLS regression analysis

We now deepen our analysis concerning the relation between employment growth and GVC participation and positioning at the firm level relying on econometrics. First, we estimate the following equation (1), using – as done also for the rest of the estimations of this sub-section – ordinary least squares (OLS) with robust standard errors.

$$\Delta e_i = \alpha + \beta_1 GVC_i + \beta_2 tfp2008_i + \beta_3 lnage_i + \beta_4 lnemployees_i + \beta_5 INNO_i + \phi_1 \eta_c + \phi_2 \gamma_s + \varepsilon_i \quad (1)$$

The variables appearing in the equation are the following:

- Δe_i is the variation (in log scale) in number of employees between 2008 and 2014 for firm *i*;
- GVC_i is a dummy = 1 if firm *i* is part of a GVC, as previously defined (cf. section 3);
- $tfp2008_i$ is the total factor productivity (tfp) of firm *i* in 2008;
- $lnage_i$ measures the age (in logs) of firm *i* in 2008;
- $lnemployees_i$ indicates the number of employees (in logs) of firm *i* in 2008[8];
- $INNO_i$ is a dummy = 1 if firm *i* has adopted product, process or market innovation in 2008;
- η_c and γ_s are, respectively, country and sector dummies.

Equation (1) represents the baseline of our model, encompassing all the basic variables to control for in order to account for heterogeneity at the firm level, such as size and age. However, as done also in the second chapter of this work, we enrich our estimations (equation 2) by adding two other sets of controls.

$$\Delta e_i = \alpha + \beta_1 GVC_i + \beta_2 tfp2008_i + \beta_3 lnage_i + \beta_4 lnemployees_i + \beta_5 INNO_i + \beta_6 training_i + \beta_7 hk_i + \beta_8 labour\_flex_i + \beta_9 GROUP_i + \beta_{10} qual\_cert_i + \beta_{11} foreign\_comp_i + \beta_{12} EXTERNAL\_FINANCING_i + \phi_1 \eta_c + \phi_2 \gamma_s + \varepsilon_i \quad (2)$$

[8] Contrary to the second chapter of this work, in this case we do have data about the number of employees each firm had in 2008, since we have already excluded from our sample those companies for which such information is unavailable in Efige. Therefore, we rely on the number of employees to control for size, since doing so by looking at the total assets would force us to give up additional observations because of missing data.

The first one comprises measures aiming at accounting for the quality of the labour force and its relation with the firm, specifically:

- $training_i$ is a dummy = 1 if the workers in firm *i* got trained in 2008;
- hk_i is a dummy = 1 if the share of the workers with a graduate degree was higher in firm *i* than the national average in its industry in 2008;
- $labour\_flex_i$ is a dummy = 1 if firm *i* has used part-time or fixed term employment contracts in 2008.

The second one aims at accounting for additional characteristics of the firms. In particular:

- $GROUP_i$ is a dummy = 1 if firm *i* belonged to a group (either domestic or foreign) in 2008;
- $qual\_cert_i$ is a dummy = 1 if firm *i* has gone through any quality certification in 2008;
- $foreign\_comp_i$ is a dummy = 1 if (in 2008-2009) the firm *i* has declared to have competitors abroad;
- $EXTERNAL\_FINANCING_i$ is a dummy = 1 if the firm *i* has recurred to external financing in the period 2008-2009.

Finally, we run our model again by adding the GVC positioning measures alternatively: produced-to-order goods share on turnover ($PTO\_turnover_i$, equation 3) and being a pure supplier (equation 4). Table 3.3A in the Appendix presents the correlation matrix among the independent variables of our model, while in table 3.7 we show our results.

$$\Delta e_i = \alpha + \beta_1 GVC_i + \beta_2 tfp2008_i + \beta_3 lnage_i + \beta_4 lnemployees_i + \beta_5 INNO_i + \beta_6 training_i + \beta_7 hk_i + \beta_8 labour\_flex_i + \beta_9 GROUP_i + \beta_{10} qual\_cert_i + \beta_{11} foreign\_comp_i + \beta_{12} EXTERNAL\_FINANCING_i + \beta_{13} PTO\_turnover_i \, \phi_1 \eta_c + \phi_2 \gamma_s + \varepsilon_i \quad (3)$$

$$\Delta e_i = \alpha + \beta_1 GVC_i + \beta_2 tfp2008_i + \beta_3 lnage_i + \beta_4 lnemployees_i + \beta_5 INNO_i + \beta_6 training_i + \beta_7 hk_i + \beta_8 labour\_flex_i + \beta_9 GROUP_i + \beta_{10} qual\_cert_i + \beta_{11} foreign\_comp_i + \beta_{12} EXTERNAL\_FINANCING_i + \beta_{13} PURE\_SUPPLIER_i \, \phi_1 \eta_c + \phi_2 \gamma_s + \varepsilon_i \quad (4)$$

Table 3.7 GVC participation and positioning and employment variation (2008-2014)

	(1)	(2)	(3)	(4)
GVC	0.070*** (0.015)	0.065*** (0.016)	0.065*** (0.016)	0.065*** (0.016)
PTO_turnover	-	-	0.000 (0.000)	-
PURE_SUPPLIER	-	-	-	0.021 (0.015)
tfp2008	0.140*** (0.019)	0.145*** (0.019)	0.145*** (0.019)	0.145*** (0.019)
lnage	-0.026** (0.013)	-0.022* (0.013)	-0.022* (0.013)	-0.021 (0.013)
lnemployees2008	-0.060*** (0.009)	-0.077*** (0.011)	-0.077*** (0.011)	-0.077*** (0.011)
INNO	0.062*** (0.015)	0.051*** (0.015)	0.051*** (0.015)	0.052*** (0.015)
training	-	0.012 (0.015)	0.012 (0.015)	0.012 (0.015)
hk	-	0.005 (0.015)	0.005 (0.015)	0.006 (0.015)
labour_flex	-	0.005 (0.015)	0.005 (0.017)	0.005 (0.017)
GROUP	-	0.053*** (0.021)	0.053*** (0.021)	0.054*** (0.021)
qual_cert	-	0.048*** (0.015)	0.048*** (0.015)	0.047*** (0.015)
foreign_comp	-	-0.005 (0.014)	-0.005 (0.014)	-0.005 (0.014)
EXTERNAL_FINANCING	-	0.040*** (0.014)	0.040*** (0.014)	0.041*** (0.014)
Constant	0.503*** (0.103)	0.469*** (0.102)	0.464*** (0.103)	0.458*** (0.103)
Country dummies	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Observations	3,778	3,778	3,778	3,778
R-squared	0.107	0.114	0.114	0.114

Source: author's calculations based on EFIGE data. OLS estimates. White-robust standard errors in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%.

To account for the various levels of engagement firms can choose within international production networks, in equations (5) and (6) we repeat the analysis carried out in the (1) and (2) ones respectively, but we substitute the dummy GVC with three GVC participation modes dummies: $SINGLE\_GVC_i$, $DUAL_GVC_i$and $TRIPLE\_GVC_i$.

$$\Delta e_i = \alpha + \beta_1 SINGLE\_GVC_i + \beta_2 DUAL\_GVC_i + \beta_3 TRIPLE\_GVC_i + \beta_4 tfp2008_i + \beta_5 lnage_i + \beta_6 lnemployees_i + \beta_7 INNO_i + \phi_1 \eta_c + \phi_2 \gamma_s + \varepsilon_i \quad (5)$$

$$\Delta e_i = \alpha + \beta_1 SINGLE\_GVC_i + \beta_2 DUAL\_GVC_i + \beta_3 TRIPLE\_GVC_i + \beta_4 tfp2008_i + \beta_5 lnage_i + \beta_6 lnemployees_i + \beta_7 INNO_i + \beta_8 training_i + \beta_9 hk_i + \beta_{10} labour\_flex_i + \beta_{11} GROUP_i + + \beta_{12} qual\_cert_i + \beta_{13} foreign\_comp_i + \beta_{14} EXTERNAL\_FINANCING_i + \phi_1 \eta_c + \phi_2 \gamma_s + \varepsilon_i \quad (6)$$

In (7) and (8) we also account for GVC positioning, resorting to the variables PTO_turnover and PURE_SUPPLIER alternatively. The results of our estimations are shown in table 3.8.

$$\Delta e_i = \alpha + \beta_1 SINGLE_{GVC_i} + \beta_2 DUAL_{GVC\,i} + \beta_3 TRIPLE_{GVC\,i} + \beta_4 tfp2008_i + \beta_5 lnage_i + \beta_6 lnemployees_i + \beta_7 INNO_i + \beta_8 training_i + \beta_9 hk_i + \beta_{10} labour\_flex_i + \beta_{11} GROUP_i + + \beta_{12} qual\_cert_i + \beta_{13} foreign\_comp_i + \beta_{14} EXTERNAL\_FINANCING_i + \beta_{15} PTO\_turnover_i + \phi_1 \eta_c + \phi_2 \gamma_s + \varepsilon_i \quad (7)$$

$$\Delta e_i = \alpha + \beta_1 SINGLE_{GVC_i} + \beta_2 DUAL_{GVC\,i} + \beta_3 TRIPLE_{GVC\,i} + \beta_4 tfp2008_i + \beta_5 lnage_i + \beta_6 lnemployees_i + \beta_7 INNO_i + \beta_8 training_i + \beta_9 hk_i + \beta_{10} labour\_flex_i + \beta_{11} GROUP_i + + \beta_{12} qual\_cert_i + \beta_{13} foreign\_comp_i + \beta_{14} EXTERNAL\_FINANCING_i + \beta_{15} PURE\_SUPPLIER_i + \phi_1 \eta_c + \phi_2 \gamma_s + \varepsilon_i \quad (8)$$

GVC participation seems to have had a positive and significant relation with employment variation at the firm level during the crisis. The employment variation rate of companies involved in international production networks is 6.5% higher than the one of exclusively domestic firms (table 3.7, first row). In particular, firms participating to GVC in a dual mode appear to be the most favoured by GVC participation in terms of employment growth (table 3.8), recording a rate around 10% higher than non-participants. Being part of a global production network through only one internationalization activities also appears to be significantly and positively related to employment growth, which is around 5% higher for single-mode participant with respect to the zero-mode ones. Full involvement in GVC, however, does not seem to be significantly associated to an increase in employment for firms. That is also the case of GVC positioning, with pure suppliers apparently not favoured nor unfavoured with respect to final firms in terms of employment growth. Productivity and innovative capacity are also significantly and positively related to increase in employment, as well as a number of firms' characteristics such as being part of a group, having received a quality certification or having

recurred to external financial resources right before the crisis. In line with the literature, firms' age and size appear to be significantly and negatively related to employment growth[9]. Nevertheless, the quality of the labour force employed or the type of contract binding it to the firm do not seem to have had any influence on the employment variation experienced by the companies during the crisis.

Table 3.8 GVC participation modes and positioning and employment variation (2008-2014)

	(5)	(6)	(7)	(8)
SINGLE_GVC	0.049***	0.048***	0.048***	0.048***
	(0.017)	(0.017)	(0.017)	(0.017)
DUAL_GVC	0.104***	0.099***	0.098***	0.098***
	(0.018)	(0.019)	(0.020)	(0.019)
TRIPLE_GVC	0.062	0.047	0.047	0.048
	(0.049)	(0.049)	(0.049)	(0.049)
PTO_turnover	-	-	0.000	-
			(0.000)	
PURE_SUPPLIER	-	-	-	0.020
				(0.015)
tfp2008	0.141***	0.146***	0.146***	0.146***
	(0.019)	(0.019)	(0.019)	(0.019)
lnage	-0.027**	-0.023*	-0.023*	-0.022*
	(0.013)	(0.013)	(0.013)	(0.013)
lnemployees2008	-0.063***	-0.079***	-0.079***	-0.078***
	(0.010)	(0.011)	(0.011)	(0.011)
INNO	0.060***	0.049***	0.049***	0.050***
	(0.015)	(0.015)	(0.015)	(0.015)
training	-	0.012	0.012	0.012
		(0.015)	(0.015)	(0.015)
hk	-	0.003	0.003	0.004
		(0.015)	(0.015)	(0.015)
labour_flex	-	0.003	0.003	0.004
		(0.017)	(0.017)	(0.017)
GROUP	-	0.052**	0.052**	0.052**
		(0.021)	(0.021)	(0.021)
qual_cert	-	0.047***	0.047***	0.053**
		(0.015)	(0.015)	(0.021)
foreign_comp	-	-0.009	-0.009	-0.009
		(0.014)	(0.014)	(0.015)
EXTERNAL_FINANCING	-	0.039***	0.039***	0.040***
		(0.014)	(0.014)	(0.014)
Constant	0.528***	0.493***	0.490***	0.482***
	(0.104)	(0.102)	(0.103)	(0.103)
Country dummies	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Observations	3,778	3,778	3,778	3,778
R-squared	0.109	0.116	0.116	0.116

Source: author's calculations based on EFIGE data. OLS estimates. White-robust standard errors in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%.

[9] A better understanding of the relation between size and employment growth can be obtained by looking at the scatterplot showing the relation between the number of employees (in logs) and the variation in the number of employees (measured as difference in logs). That is illustrated in figure 1A in the Appendix.

3.4.1.1 Robustness checks

In order to assess the robustness of our results, we have performed a number of tests. First, we have restricted our sample excluding German firms (sub-sample a, corresponding to sample 2 in section 3.3.1) and we have run again our model. Results are shown in table 3.9.

Table 3.9 GVC participation modes and positioning and employment growth (2008-2014) – sub-sample a

	(2a)	(4a)	(6a)	(8a)
GVC	0.065*** (0.016)	0.065*** (0.016)	-	-
SINGLE_GVC	-	-	0.048*** (0.017)	0.047*** (0.017)
DUAL_GVC	-	-	0.098*** (0.020)	0.097*** (0.020)
TRIPLE_GVC	-	-	0.065 (0.051)	0.065 (0.051)
PURE_SUPPLIER	-	0.020 (0.015)	-	0.019 (0.015)
tfp2008	0.146*** (0.019)	0.145*** (0.019)	0.147*** (0.019)	0.147*** (0.019)
lnage	-0.025** (0.013)	-0.024* (0.013)	-0.026** (0.013)	-0.025** (0.012)
lnemployees2008	-0.079*** (0.011)	-0.079*** (0.011)	-0.081*** (0.012)	-0.081*** (0.012)
INNO	0.049*** (0.015)	0.050*** (0.015)	0.047*** (0.015)	0.048*** (0.015)
training	0.009 (0.015)	0.009 (0.015)	0.009 (0.015)	0.009 (0.015)
hk	0.003 (0.015)	0.004 (0.015)	0.001 (0.015)	0.002 (0.015)
labour_flex	0.007 (0.017)	0.007 (0.017)	0.004 (0.017)	0.005 (0.017)
GROUP	0.070*** (0.021)	0.071*** (0.021)	0.069*** (0.021)	0.069*** (0.021)
qual_cert	0.045*** (0.015)	0.045*** (0.015)	0.044*** (0.015)	0.044*** (0.015)
foreign_comp	-0.001 (0.014)	-0.002 (0.014)	-0.005 (0.015)	-0.006 (0.015)
EXTERNAL_FINANCING	0.040*** (0.014)	0.040*** (0.014)	0.039*** (0.014)	0.039*** (0.014)
Constant	0.362*** (0.080)	0.347*** (0.081)	0.378*** (0.080)	0.364*** (0.082)
Country dummies	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Observations	3,673	3,673	3,673	3,673
R-squared	0.114	0.115	0.116	0.117

Source: author's calculations based on EFIGE data. OLS estimates. White-robust

standard errors in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%.

The outcome of this first test confirms what we have observed over the whole sample both in terms of sign and in those of size of the coefficients. GVC participation – especially two-way, but also one-way – is positively and significantly associated to firms' employment variation rate between 2008 and 2014. Triple mode GVC participation and GVC positioning, however, do not appear to have any significant relation with our variable of interest.

As a second robustness check, we have run our model on another sub-sample of firms, identified by focusing - among the GVC participants - on those being 'substantially internationalized'. We have selected them building on Veugelers *et al.* (2013), who recognize as internationally active those companies (i) whose trade turnover (i.e. turnover generated from imports, exports or international production activities) is above the 25th percentile in their sector, and (ii) whose share of trade turnover over total is above the 25th percentile in their sector. Due to data availability, we can apply only the second criterion. Since we aim at singling out substantially internationalized companies in each sector, we measure the 25th threshold by considering the whole set of information available in EFIGE (11,457 observations for France, Germany, Italy and Spain). Our sub-sample of international firms (sub-sample b) is made by 3,307 companies. Table 3.10 shows the results of our analysis referred only to them.

Again, our results are confirmed. There is a positive and significant relation between employment growth and firms' participation to GVC, even when companies involved in global value chains are selected only among the "substantially internationalized" ones. Positioning within international production networks, however, still appears to be not relevant on employment variation. Interestingly, when restricting our sample to encompass only the most internationalized companies, their age does not seem to matter anymore as far as employment growth is concerned. The other outcomes are in line with what previously observed.

Table 3.10 GVC participation modes and positioning and employment growth (2008-2014) – sub-sample b

	(2b)	(4b)	(6b)	(8b)
GVC	0.072***	0.072***		
	(0.017)	(0.017)		
SINGLE_GVC			0.057***	0.057***
			(0.018)	(0.018)
DUAL_GVC			0.095***	0.094***
			(0.020)	(0.020)
TRIPLE_GVC			0.046	0.047
			(0.050)	(0.050)
PURE_SUPPLIER		0.018		0.016
		(0.016)		(0.016)
tfp2008	0.146***	0.145***	0.146***	0.146***
	(0.020)	(0.020)	(0.020)	(0.020)
lnage	-0.022	-0.022	-0.023	-0.022
	(0.014)	(0.014)	(0.014)	(0.014)
lnemployees2008	-0.073***	-0.073***	-0.074***	-0.074***
	(0.012)	(0.012)	(0.012)	(0.012)
INNO	0.050***	0.051***	0.049***	0.050***
	(0.016)	(0.016)	(0.016)	(0.016)
training	0.004	0.004	0.004	0.004
	(0.016)	(0.016)	(0.016)	(0.016)
hk	0.019	0.019	0.017	0.018
	(0.016)	(0.016)	(0.016)	(0.016)
labour_flex	0.006	0.006	0.004	0.005
	(0.019)	(0.018)	(0.019)	(0.019)
GROUP	0.051**	0.051**	0.050**	0.051**
	(0.022)	(0.022)	(0.022)	(0.022)
qual_cert	0.046***	0.046***	0.046***	0.045***
	(0.017)	(0.017)	(0.017)	(0.017)
foreign_comp	-0.006	-0.006	-0.008	-0.008
	(0.016)	(0.016)	(0.016)	(0.016)
EXTERNAL_FINANCING	0.042***	0.043***	0.042***	0.043***
	(0.015)	(0.015)	(0.015)	(0.015)
Constant	0.487***	0.479***	0.505***	0.498***
	(0.111)	(0.111)	(0.109)	(0.109)
Country dummies	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Observations	3,307	3,307	3,307	3,307
R-squared	0.107	0.108	0.109	0.109

Source: author's calculations based on EFIGE data. OLS estimates. White-robust standard errors in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%.

Finally, as a third check, we focus on another subsample (c) obtained by combining the two criteria previously applied: taking into account only French, Italian and Spanish firms and excluding from GVC participants those which are not "substantially internationalized". The results obtained by running our model on sub-sample c are presented in table 3.11.

Table 3.11 GVC participation modes and positioning and employment growth (2008-2014) – sub-sample c

	(2c)	(4c)	(6c)	(8c)
GVC	0.072***	0.071***		
	(0.017)	(0.017)		
SINGLE_GVC			0.057***	0.057***
			(0.019)	(0.019)
DUAL_GVC			0.094***	0.093***
			(0.021)	(0.021)
TRIPLE_GVC			0.062	0.063
			(0.051)	(0.051)
PURE_SUPPLIER		0.015		0.014
		(0.016)		(0.021)
tfp2008	0.146***	0.146***	0.147***	0.147***
	(0.021)	(0.021)	(0.021)	(0.021)
lnage	-0.025*	-0.025*	-0.025*	-0.025*
	(0.013)	(0.013)	(0.013)	(0.013)
lnemployees2008	-0.075***	-0.075***	-0.076***	-0.076***
	(0.012)	(0.012)	(0.012)	(0.012)
INNO	0.048***	0.049***	0.046***	0.047***
	(0.016)	(0.016)	(0.016)	(0.016)
training	0.000	0.000	0.000	0.000
	(0.016)	(0.016)	(0.016)	(0.016)
hk	0.017	0.018	0.015	0.016
	(0.016)	(0.016)	(0.016)	(0.016)
labour_flex	0.008	0.008	0.006	0.006
	(0.019)	(0.019)	(0.019)	(0.019)
GROUP	0.069***	0.070***	0.068***	0.069***
	(0.023)	(0.023)	(0.023)	(0.023)
qual_cert	0.043***	0.042***	0.042***	0.042**
	(0.016)	(0.016)	(0.016)	(0.016)
foreign_comp	-0.001	-0.002	-0.003	-0.004
	(0.016)	(0.016)	(0.016)	(0.016)
EXTERNAL_FINANCING	0.042***	0.042***	0.041***	0.042***
	(0.015)	(0.015)	(0.045)	(0.045)
Constant	0.378***	0.368***	0.392***	0.383***
	(0.087)	(0.087)	(0.085)	(0.085)
Country dummies	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Observations	3,212	3,212	3,212	3,212
R-squared	0.107	0.108	0.108	0.109

Source: author's calculations based on EFIGE data. OLS estimates. White-robust standard errors in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%.

Even by focusing on the strictest version of our sample, our results are confirmed. GVC participation – specifically single and double mode GVC participation – is positively and significantly associated to an increase in the number of workers (or to a lower decrease of the labour force) when compared to non-involvement in international production networks. Nevertheless, being an intermediate or a final firm is not relevant in terms of employment growth.

Our results are confirmed even if we use alternative variables to consider firms' characteristics, such as total assets to control for firm size or an increase in external financing (instead of the simple recourse to external financing) to account for firms' financial position.

3.4.2 Quantile regressions

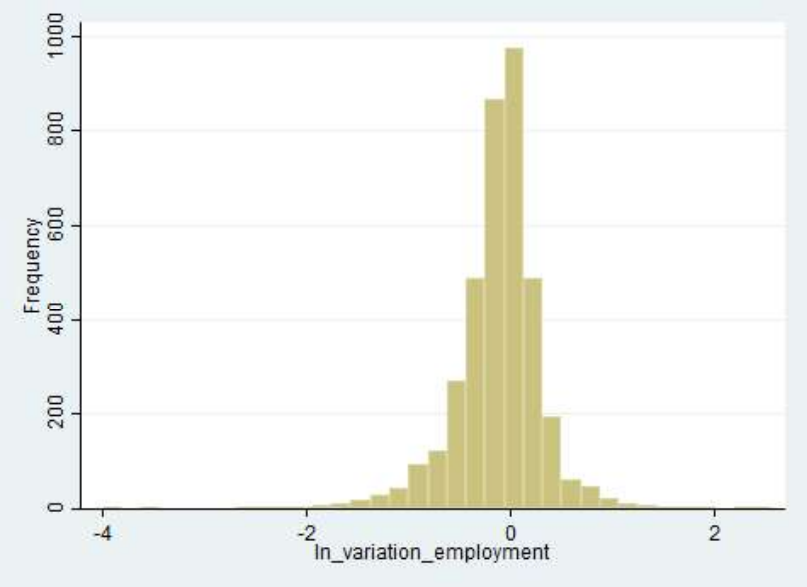
As observed while performing our descriptive analysis, there is large heterogeneity among firms in terms of the employment variation experienced during the crisis. Using OLS regressions to investigate whether and how GVC participation – and especially GVC participation modes – is related to employment growth does not account for such diversity. In fact, estimates obtained by applying OLS refer to the average effect of the explanatory variables on the average unit (in our case, firm). As explained better by Mosteller and Tuckey in their widely cited paragraph: "What the regression curve does is give a grand summary for the averages of the distributions corresponding to the set of x's. We could go further and compute several regression curves corresponding to the various percentage points of the distributions and thus get a more complete picture of the set. Ordinarily this is not done, and so regression often gives a rather incomplete picture. Just as the mean gives an incomplete picture of a single distribution, so the regression curve gives a correspondingly incomplete picture for a set of distributions." (Mosteller & Tuckey, 1977, p. 266). Thus, we resort to quantile regression to get a better picture of the nature of the relation we are investigating. In fact, one the advantages of quantile regressions consists in the ability to describe the whole conditional distribution of the dependent variable (showed in figure 3.10) instead of focusing on its mean. Therefore, we can estimate coefficients at various quantiles of the conditional distributions, investigating more accurately whether the relation between GVC participation and positioning and employment growth differs if we focus on companies that have experienced severe fall in the number of workers (located at the left end of the distribution of our dependent variable) or on those having recorded highest increases in employment (positioned at the right end of the distribution). Moreover, in quantile regressions the distribution of the error terms is not assumed to be identical at all points of the conditional distribution, so it is possible to contemplate that the estimated slope parameters differ at different quantiles of the conditional distribution of our dependent variable, thus accounting for firms' heterogeneity (Coad & Rao, 2008).

First proposed by Koenker and Basset (1978), the quantile regression model can be written as:

$$y_{it} = x'_{it}\beta_\theta + u_{\theta it} \qquad with \qquad Quant_\theta(y_{it}|x_{it}) = x'_{it}\beta_\theta \tag{9}$$

where y_{it} is a dependent variable, x is a vector of regressors, β is the vector of parameter to estimate and u is a vector of residuals. $Quant_{\theta}(y_{it}|x_{it})$ indicates the θ^{th} conditional quantile of y_{it} given x_{it}[10].

Figure 3.10 Employment variation rate (2008-2014)



Source: author's elaborations on EFIGE data.

We have estimated the linear regression model presented in equation (1) and its following modifications (equation 2, 3 and 4) resorting to quantile regressions. Results are illustrated in table 3.12a and 3.12b.

[10] For more on the quantile regression models, see Bunchinsky (1998) or Koenker and Hallock (2001).

Table 3.12a GVC participation and positioning and employment growth (2008-2014) – Quantile regressions

	Equation (1)					Equation (2)				
	10%	25%	50%	75%	90%	10%	25%	50%	75%	90%
GVC	0.097***	0.075***	0.059***	0.050***	0.072***	0.100***	0.074***	0.059***	0.047***	0.047
	(0.032)	(0.018)	(0.012)	(0.014)	(0.014)	(0.034)	(0.017)	(0.016)	(0.016)	(0.033)
PTO_turnover										
PURE_SUPPLIER										
tfp2008	0.190***	0.150***	0.093***	0.082***	0.077**	0.204***	0.156***	0.098***	0.087***	0.076***
	(0.026)	(0.018)	(0.018)	(0.019)	(0.031)	(0.023)	(0.016)	(0.016)	(0.015)	(0.027)
lnage	-0.006	-0.019	-0.032**	-0.073***	-0.101***	-0.005	-0.016	-0.031***	-0.072***	-0.096***
	(0.019)	(0.012)	(0.012)	(0.011)	(0.019)	(0.019)	(0.011)	(0.008)	(0.008)	(0.014)
lnemployees2008	-0.035*	-0.033***	-0.033***	-0.028***	-0.051***	-0.037*	-0.041***	-0.043***	-0.036***	-0.072***
	(0.018)	(0.008)	(0.007)	(0.009)	(0.014)	(0.020)	(0.004)	(0.009)	(0.008)	(0.014)
INNO	0.042	0.043**	0.045***	0.046***	0.041*	0.023	0.035**	0.043***	0.039***	0.044*
	(0.031)	(0.020)	(0.017)	(0.014)	(0.022)	(0.019)	(0.016)	(0.010)	(0.010)	(0.023)
training						0.013	0.027*	0.010	0.004	0.013
						(0.026)	(0.015)	(0.009)	(0.014)	(0.022)
hk						0.033	0.009	0.005	0.017	0.015
						(0.021)	(0.018)	(0.014)	(0.015)	(0.030)
labour_flex						-0.001	-0.009	-0.001	0.027	-0.009
						(0.038)	(0.020)	(0.014)	(0.020)	(0.021)
GROUP						0.015	0.023	0.030*	0.020	0.083***
						(0.043)	(0.020)	(0.016)	(0.019)	(0.026)
qual_cert						0.035	0.040**	0.038***	0.024**	0.069***
						(0.030)	(0.016)	(0.014)	(0.011)	(0.019)
foreign_comp						0.000	-0.004	0.000	-0.004	0.008
						(0.020)	(0.013)	(0.010)	(0.014)	(0.022)
EXTERNAL_FINANCING						0.030	0.027	0.028**	0.038***	0.048**
						(0.025)	(0.017)	(0.013)	(0.011)	(0.019)
Constant	0.046	0.186	0.452***	0.686***	1.080***	0.026	0.180	0.268**	0.658***	1.067***
	(0.109)	(0.125)	(0.151)	(0.206)	(0.174)	(0.145)	(0.116)	(0.127)	(0.175)	(0.177)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,778	3,778	3,778	3,778	3,778	3,778	3,778	3,778	3,778	3,778
R-squared	0.115	0.085	0.053	0.044	0.049	0.117	0.088	0.057	0.048	0.061

Source: author's calculations based on EFIGE data. Simultaneous quantile regressions performed using the Stata command sqreg and reported for the 10%, 25%, 50%, 75% and 90% quantiles. Standard errors in parenthesis; the variance-covariance matrix is obtained via bootstrapping, including between-quantile blocks. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 3.12b GVC participation and positioning and employment growth (2008-2014) – Quantile regressions

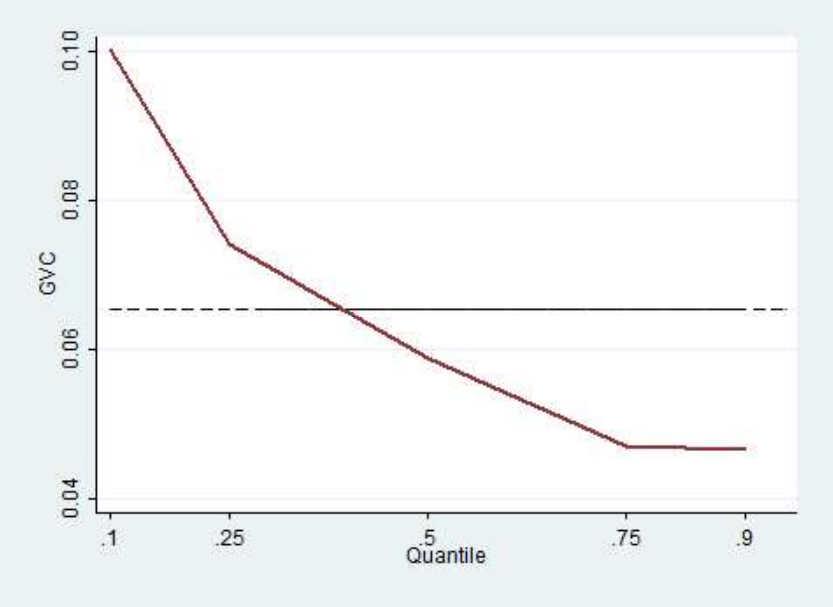
	Equation (3)					Equation (4)				
	10%	25%	50%	75%	90%	10%	25%	50%	75%	90%
GVC	0.106***	0.074***	0.054***	0.042***	0.045	0.102***	0.075***	0.057***	0.043***	0.047
	(0.032)	(0.021)	(0.015)	(0.013)	(0.028)	(0.030)	(0.016)	(0.014)	(0.015)	(0.029)
PTO_turnover	0.000	0.000	0.000	0.000	0.000					
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
PURE_SUPPLIER						0.009	0.004	0.016	0.011	0.005
						(0.031)	(0.021)	(0.016)	(0.018)	(0.025)
tfp2008	0.199***	0.156***	0.099***	0.085***	0.077***	0.204***	0.156***	0.098***	0.086***	0.077***
	(0.028)	(0.018)	(0.017)	(0.014)	(0.030)	(0.038)	(0.016)	(0.014)	(0.013)	(0.028)
lnage	-0.006	-0.016	-0.030***	-0.068***	-0.097***	-0.003	-0.017	-0.028**	-0.072***	-0.094***
	(0.021)	(0.014)	(0.009)	(0.009)	(0.014)	(0.021)	(0.014)	(0.011)	(0.009)	(0.020)
lnemployees2008	-0.036*	-0.042***	-0.043***	-0.040***	-0.072***	-0.037**	-0.042***	-0.045***	-0.038***	-0.071***
	(0.021)	(0.011)	(0.009)	(0.009)	(0.010)	(0.018)	(0.008)	(0.008)	(0.009)	(0.011)
INNO	0.021	0.035**	0.044***	0.042***	0.043*	0.022	0.034**	0.042***	0.039***	0.043**
	(0.016)	(0.015)	(0.013)	(0.014)	(0.024)	(0.027)	(0.017)	(0.009)	(0.013)	(0.022)
training	0.008	0.029**	0.010	-0.001	0.012	0.015	0.028*	0.010	0.002	0.012
	(0.033)	(0.014)	(0.011)	(0.014)	(0.023)	(0.039)	(0.016)	(0.013)	(0.013)	(0.017)
hk	0.031*	0.009	0.006	0.012	0.016	0.033	0.011	0.006	0.014	0.017
	(0.018)	(0.011)	(0.010)	(0.010)	(0.022)	(0.026)	(0.017)	(0.007)	(0.014)	(0.022)
labour_flex	-0.004	-0.009	-0.001	0.023	-0.009	0.002	-0.004	0.000	0.025	-0.004
	(0.022)	(0.016)	(0.015)	(0.016)	(0.039)	(0.032)	(0.024)	(0.015)	(0.021)	(0.044)
GROUP	0.012	0.022	0.031*	0.023	0.084**	0.008	0.025	0.037**	0.022	0.081**
	(0.036)	(0.023)	(0.016)	(0.018)	(0.043)	(0.042)	(0.027)	(0.017)	(0.017)	(0.031)
qual_cert	0.033	0.039**	0.038***	0.029**	0.069***	0.027	0.037*	0.038***	0.025*	0.068***
	(0.036)	(0.017)	(0.009)	(0.013)	(0.017)	(0.026)	(0.020)	(0.009)	(0.014)	(0.025)
foreign_comp	0.010	-0.004	-0.001	-0.003	0.007	0.004	-0.005	-0.002	-0.002	0.010
	(0.033)	(0.013)	(0.011)	(0.017)	(0.019)	(0.018)	(0.017)	(0.011)	(0.012)	(0.018)
EXTERNAL_FINANCING	0.021	0.030	0.030**	0.044***	0.047*	0.030	0.028**	0.030**	0.041***	0.047**
	(0.031)	(0.022)	(0.014)	(0.012)	(0.025)	(0.030)	(0.013)	(0.013)	(0.015)	(0.023)
Constant	0.022	0.201*	0.274**	0.626***	1.069***	0.003	0.179*	0.273*	0.644***	1.057***
	(0.178)	(0.108)	(0.128)	(0.187)	(0.188)	(0.170)	(0.104)	(0.151)	(0.190)	(0.248)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,778	3,778	3,778	3,778	3,778	3,778	3,778	3,778	3,778	3,778
R-squared	0.117	0.088	0.057	0.048	0.061	0.117	0.088	0.057	0.048	0.061

Source: author's calculations based on EFIGE data. Simultaneous quantile regressions performed using the Stata command sqreg and reported for the 10%, 25%, 50%, 75% and 90% quantiles. Standard errors in parenthesis; the variance-covariance matrix is obtained via bootstrapping, including between-quantile blocks. * significant at 10%, ** significant at 5%, *** significant at 1%.

Even when applying the quantile regression technique, GVC participation still appears to be positively and significantly related to employment growth at the firm level. Nevertheless, when controlling for additional variables (eq. 2, 3 and 4), interesting results emerge. The coefficient related to GVC participation lowers while we move from focusing on the left end of the distribution of our dependent variable to concentrating on the right end, where the most performing firms (in terms of increase in employment) lay. Moreover, when the analysis is carried-out looking closely at the 90% quantile of the distribution, GVC participation loses its significance. This would lead us to conclude that, for those companies having recorded higher negative variation rates in employment, GVC participation actually shows a stronger, significant and positive association with it. In other words, among those firms whose employment has suffered a stronger negative variation, GVC participants have shown lower negative variation rates. Nevertheless, for the very best performers (belonging to the 90% quantile), GVC participation is not significantly related to employment growth. Moreover, it is worth noticing that very few variables are significant in relation to the employment variation rate when the latter records its highest negative values (10% quantile). In such condition, in fact, besides GVC participation, only firms' productivity and size appear significantly related to employment variation, positively and negatively respectively. For instance, firms' age, whose association with firm growth is often investigated, gets more significant and related (higher negative coefficients) to changes in employment while we move to the right end of the distribution.

A better grasp of the contribution of quantile regressions in analyzing a phenomenon already investigated by resorting to simple OLS regression can be gained by looking at figure 3.11, which confronts the results obtained by the former and the latter for equation (2). The black horizontal line indicates the coefficient linked to GVC participation as estimated by the OLS regression, therefore having the same level for all the firms, notwithstanding of their position within the distribution of the dependent variable. The red line, however, is the quantile regression curve, which illustrates how the value of the estimated coefficient for GVC participation differs over the employment variation rate distribution. As anticipated, the biggest contribution of GVC participation is detected for those firms having recorded highest decreases in their labour force. Being involved in international production networks, in fact, is most significantly and positively linked to employment variation rate for the companies that have performed worse in terms of the latter.

Figure 3.11 Variation in the coefficient of GVC participation over the conditional quantiles



Source: author's calculations based on EFIGE data. Simultaneous quantile regressions performed on equation (2) using the Stata command sqreg. Graph made by using the 'grqreg' Stata module (Azevedo, 2004). The horizontal line represents the OLS estimate.

We have repeated our analysis resorting to simultaneous quantile regressions to estimate also equations (5), (6), (7) and (8), in order to detect whether and how participation to global production chains is related to employment growth accounting for different degrees of involvement. Results are presented in table 3.13a and 3.13b and showed graphically in figure 3.12.

Table 3.13a GVC participation modes and positioning and employment growth (2008-2014) – Quantile regressions

	Equation (5)					Equation (6)				
	10%	25%	50%	75%	90%	10%	25%	50%	75%	90%
SINGLE_GVC	0.082***	0.062***	0.044***	0.031*	0.048**	0.100***	0.066***	0.045***	0.036	0.027
	(0.030)	(0.013)	(0.016)	(0.016)	(0.019)	(0.024)	(0.025)	(0.016)	(0.022)	(0.026)
DUAL_GVC	0.132***	0.103***	0.081***	0.062***	0.087***	0.147***	0.099***	0.081***	0.062**	0.058*
	(0.038)	(0.019)	(0.019)	(0.018)	(0.030)	(0.048)	(0.033)	(0.017)	(0.028)	(0.030)
TRIPLE_GVC	0.050	0.038	0.019	0.084	0.195**	0.024	0.029	0.028	0.109	0.225**
	(0.161)	(0.048)	(0.046)	(0.070)	(0.079)	(0.119)	(0.048)	(0.038)	(0.073)	(0.102)
PTO_turnover										
PURE_SUPPLIER										
tfp2008	0.192***	0.143***	0.093***	0.080***	0.078***	0.201***	0.155***	0.095***	0.085***	0.075***
	(0.021)	(0.017)	(0.015)	(0.013)	(0.030)	(0.025)	(0.018)	(0.018)	(0.016)	(0.020)
lnage	-0.012	-0.016	-0.028***	-0.073***	-0.099***	-0.019	-0.017	-0.024**	-0.071***	-0.099***
	(0.020)	(0.013)	(0.007)	(0.012)	(0.018)	(0.021)	(0.012)	(0.010)	(0.011)	(0.014)
lnemployees2008	-0.035**	-0.032***	-0.037***	-0.030***	-0.059***	-0.035**	-0.038***	-0.047***	-0.040***	-0.077***
	(0.016)	(0.006)	(0.005)	(0.006)	(0.009)	(0.018)	(0.009)	(0.009)	(0.008)	(0.014)
INNO	0.031	0.037**	0.046***	0.054***	0.050**	0.021	0.031*	0.042***	0.043***	0.044**
	(0.028)	(0.017)	(0.014)	(0.012)	(0.021)	(0.025)	(0.017)	(0.012)	(0.012)	(0.022)
training						0.020	0.028*	0.014	0.003	0.017
						(0.020)	(0.017)	(0.011)	(0.011)	(0.024)
hk						0.021	0.013	0.005	0.013	0.016
						(0.024)	(0.017)	(0.012)	(0.011)	(0.026)
labour_flex						-0.002	-0.011	0.001	0.021	0.008
						(0.035)	(0.023)	(0.012)	(0.014)	(0.032)
GROUP						0.013	0.013	0.038***	0.027	0.082**
						(0.027)	(0.020)	(0.012)	(0.017)	(0.035)
qual_cert						0.031	0.037**	0.035***	0.027**	0.068***
						(0.028)	(0.018)	(0.012)	(0.013)	(0.025)
foreign_comp						-0.014	-0.008	-0.007	-0.007	0.002
						(0.029)	(0.022)	(0.015)	(0.013)	(0.024)
EXTERNAL_FINANCING						0.032	0.027	0.033**	0.040**	0.053
						(0.025)	(0.017)	(0.015)	(0.016)	(0.034)

Constant	0.126 (0.174)	0.214 (0.174)	0.449*** (0.142)	0.677*** (0.186)	1.128*** (0.201)	0.111 (0.263)	0.179 (0.182)	0.264** (0.134)	0.654*** (0.170)	1.079*** (0.201)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,778	3,778	3,778	3,778	3,778	3,778	3,778	3,778	3,778	3,778
R-squared	0.116	0.086	0.054	0.045	0.052	0.117	0.089	0.058	0.048	0.062

Source: authors' calculations based on EFIGE dataset. Simultaneous quantile regressions performed using the Stata command sqreg and reported for the 10%, 25%, 50%, 75% and 90% quantiles. Standard errors in parenthesis; the variance-covariance matrix is obtained via bootstrapping, including between-quantile blocks. * significant at 10%, ** significant at 5%, *** significant at 1%.

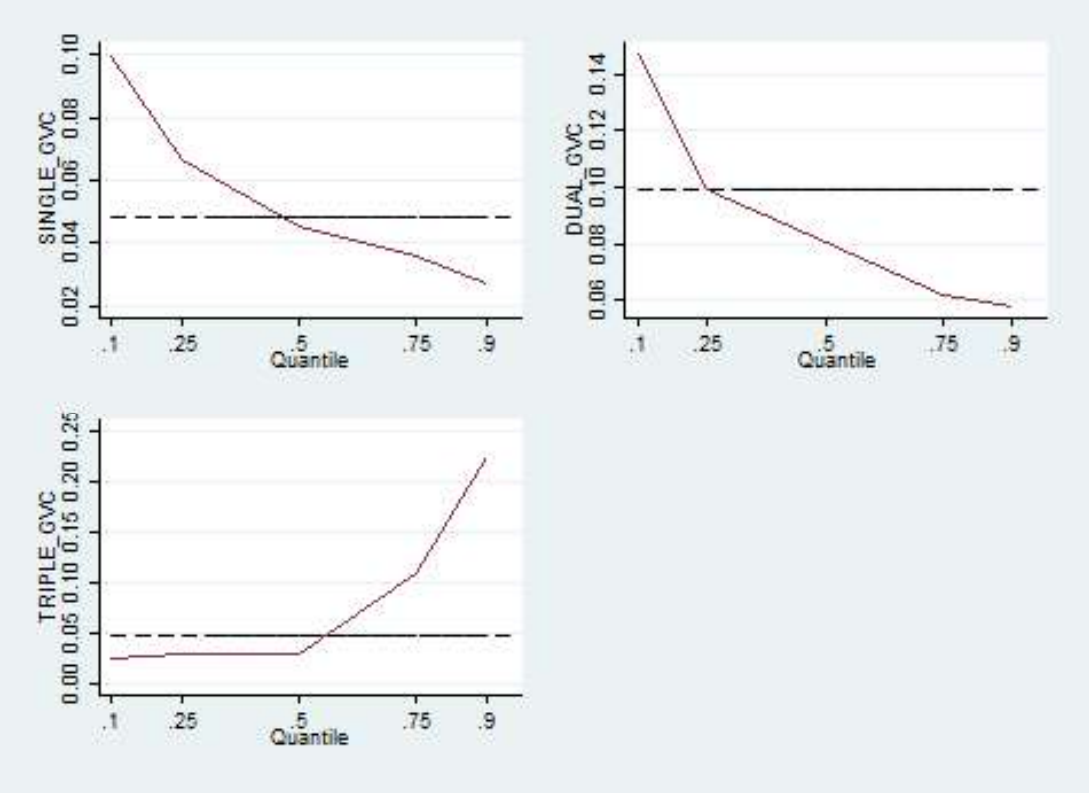
Table 3.13b GVC participation modes and positioning and employment growth (2008-2014) – Quantile regressions

	Equation (3)					Equation (4)				
	10%	25%	50%	75%	90%	10%	25%	50%	75%	90%
SINGLE_GVC	0.100*** (0.031)	0.072*** (0.017)	0.044*** (0.009)	0.032* (0.018)	0.027 (0.026)	0.098** (0.041)	0.066*** (0.025)	0.044*** (0.016)	0.032 (0.023)	0.028 (0.029)
DUAL_GVC	0.137*** (0.043)	0.106*** (0.021)	0.079*** (0.014)	0.055*** (0.020)	0.057* (0.031)	0.146*** (0.036)	0.100*** (0.024)	0.080*** (0.016)	0.054*** (0.020)	0.057** (0.028)
TRIPLE_GVC	0.002 (0.128)	0.032 (0.029)	0.024 (0.033)	0.102 (0.067)	0.225* (0.133)	0.037 (0.117)	0.025 (0.045)	0.023 (0.041)	0.100 (0.061)	0.220** (0.096)
PTO_turnover	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)					
PURE_SUPPLIER						0.016 (0.030)	0.003 (0.018)	0.016 (0.015)	0.010 (0.015)	0.003 (0.019)
tfp2008	0.198*** (0.040)	0.155*** (0.019)	0.095*** (0.020)	0.084*** (0.016)	0.075*** (0.021)	0.204*** (0.032)	0.152*** (0.017)	0.096*** (0.014)	0.085*** (0.013)	0.072** (0.035)
lnage	-0.016 (0.020)	-0.018 (0.015)	-0.025** (0.011)	-0.072*** (0.015)	-0.099*** (0.021)	-0.016 (0.024)	-0.019 (0.013)	-0.026** (0.013)	-0.071*** (0.012)	-0.097*** (0.015)
lnemployees2008	-0.039* (0.022)	-0.039*** (0.009)	-0.047*** (0.007)	-0.040*** (0.008)	-0.077*** (0.013)	-0.041* (0.024)	-0.039*** (0.010)	-0.047*** (0.007)	-0.039*** (0.008)	-0.077*** (0.013)
INNO	0.021 (0.030)	0.029 (0.020)	0.043*** (0.014)	0.047*** (0.013)	0.044** (0.022)	0.025 (0.036)	0.033* (0.019)	0.043*** (0.013)	0.043*** (0.013)	0.042* (0.022)
training	0.019 (0.031)	0.027 (0.018)	0.013 (0.011)	0.000 (0.015)	0.015 (0.023)	0.027 (0.028)	0.027 (0.017)	0.013 (0.010)	0.001 (0.013)	0.018 (0.025)

	0.019	0.012	0.006	0.010	0.016	0.020	0.011	0.008	0.011	0.019
hk	(0.025)	(0.016)	(0.014)	(0.013)	(0.021)	(0.029)	(0.022)	(0.010)	(0.015)	(0.021)
	-0.012	-0.013	0.003	0.021	0.009	-0.005	-0.010	0.004	0.021	0.008
labour_flex	(0.031)	(0.019)	(0.011)	(0.022)	(0.038)	(0.037)	(0.025)	(0.015)	(0.027)	(0.036)
	0.025	0.015	0.038***	0.027	0.081**	0.017	0.018	0.035**	0.024*	0.078**
GROUP	(0.035)	(0.019)	(0.014)	(0.023)	(0.037)	(0.038)	(0.023)	(0.016)	(0.014)	(0.040)
	0.032	0.038*	0.035***	0.026**	0.067***	0.025	0.037**	0.034***	0.025**	0.067***
qual_cert	(0.029)	(0.020)	(0.013)	(0.013)	(0.023)	(0.030)	(0.016)	(0.010)	(0.013)	(0.023)
	-0.017	-0.009	-0.005	-0.005	0.002	-0.016	-0.006	-0.006	-0.004	0.003
foreign_comp	(0.029)	(0.019)	(0.009)	(0.014)	(0.020)	(0.027)	(0.022)	(0.013)	(0.016)	(0.024)
	0.030	0.032*	0.034***	0.040**	0.053*	0.032	0.030*	0.034***	0.039**	0.052**
EXTERNAL_FINANCING	(0.026)	(0.018)	(0.011)	(0.016)	(0.029)	(0.026)	(0.017)	(0.011)	(0.016)	(0.024)
	0.109	0.199*	0.268**	0.640***	1.078***	0.117	0.183	0.280**	0.647***	1.077***
Constant	(0.143)	(0.116)	(0.106)	(0.153)	(0.190)	(0.145)	(0.113)	(0.147)	(0.199)	(0.215)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,778	3,778	3,778	3,778	3,778	3,778	3,778	3,778	3,778	3,778
R-squared	0.118	0.089	0.058	0.049	0.062	0.118	0.089	0.058	0.048	0.062

Source: authors' calculations based on EFIGE dataset. Simultaneous quantile regressions performed using the Stata command sqreg and reported for the 10%, 25%, 50%, 75% and 90% quantiles. Standard errors in parenthesis; the variance-covariance matrix is obtained via bootstrapping, including between-quantile blocks. * significant at 10%, ** significant at 5%, *** significant at 1%.

Figure 3.12 Variation in the coefficient of GVC participation modes over the conditional quantiles



Source: authors' calculations based on EFIGE dataset. Simultaneous quantile regressions performed on equation (6) using the Stata command sqreg. Graph made by using the 'grqreg' Stata module (Azevedo, 2004). Horizontal lines represent the OLS estimates.

Quantile regressions, while confirming the irrelevance of VC positioning for the purposes of our analysis, provide an interesting outcome concerning the relation between GVC participation modes and employment variation. It confirms the strong and positive significance of single and (in particular) dual mode participation modes, but results vary a lot, depending on which firms we focus on. Both one-way and two-ways involvement in international production networks record a decrease in the intensity of their relation with employment variation rates while we move our analysis from companies located at the left end of the distribution of our dependent variable towards those at the right end. Single-mode GVC participation, however, also loses its significance. The third-mode GVC participation shows quite an opposite dynamic. While being irrelevantly related to employment variation for those firms that experience the worst decrease of it, for the best performers the coefficient referred to the tree-way engagement in international production networks is significant and quite high. Among the enterprises that grew the most in terms of employment, those participating to GVC through imports, exports and international production recorded around 22% higher employment growth rate. Therefore, we can say that for the most growing firms, a full involvement in international production networks gives an additional contribution to their superior performance, together with other characteristics. Looking at the other variables of our analysis, we find that one of

those is firms' innovative capacity. We also observe that owing a quality certification is significantly and positively related to employment growth, with the highest coefficient referred to firms located at the right end of the distribution. This can imply that such credential is actually valid in signalling best performing firms.

3.4.3 Policy evaluation techniques – Propensity Score (PS) matching

The empirical analysis carried out so far, based on linear regressions estimated by the ordinary least square technique, presents two kinds of issues. First, due to the estimation method used, it can only provide information about the association between our two variables of interest – employment growth rate at the firm level and GVC participation – without allowing for interpretation concerning the causal direction of such relation. Second, some of the explanatory variables we use (firms' characteristics such as productivity, size or innovative capacity) might determine also whether a company is involved in an international production network.

In order to overcome such limitations, we borrow from the field of policy (or "impact", or "program") evaluation analysis[11] and resort to the technique of the propensity score (PS) matching. In principles, impact evaluation analysis would aim at estimating the impact that a treatment (e.g. a policy or a medicine) has on some outcome variable of a subject by comparing it to the same variable measured in absence of treatment for the same individual. Such evaluation should be carried out by taking into account also all those factors (called "confounders") that could potentially interfere with the treatment and its effect on the outcome variable. The treatment effect (TE) on subject i should be measured as:

$$TE = y_{1i} - y_{0i} \qquad (10$$

where y is the outcome variable and the subscripts 1 and 0 indicate respectively the "treated" and the "untreated" statuses. Of course, measuring the TE properly is impossible, because of the missing observation problem (Holland, 1986). In other words, an individual can be either treated or untreated; therefore, it is possible to observe y_{1i} or y_{0i} alternatively, but not both of them at the same time.

In our case, we consider GVC participation as a sort of treatment received only by some companies. Thus, we can distinguish between two groups of firms in our sample: those that have been "treated", i.e. have received the treatment (GVC participants; GVC dummy = 1), and those that,

[11] The econometric literature on policy evaluation finds its roots in health statistics and in the literature investigating the "treatment effect" (e.g. Angrist, 1991; Husted, Cook, Farewell, & Gladman, 2000; Rothman, Greenland, & Lash, 2008).

having not been treated, form the so-called "control group" (non-GVC participants; GVC dummy = 0). We are interested in assessing what (if any) impact the treatment (GVC participation) has had on a specific outcome: firms' employment growth (previously indicated as Δe_i, from now on referred to as y_i). We aim at measuring the average treatment effect (ATE), calculated as:

$$ATE(x) = E(y_1 - y_0|x) \tag{11}$$

where x is the set of confounders taken into account[12].

How to deal with the missing observation problem, consisting in the impossibility of witnessing a counterfactual? If the selection into treatment was random, it would be possible to measure the ATE by simply calculating the difference in mean between the treated and the control groups. In our case, firms' decision to participate in a global value chain cannot be considered as being randomly distributed. Based on the literature about international production networks, we know that some companies are more likely to participate to GVCs than others are; in other words, companies self-select into treatment. For instance, firms participating to GVCs are usually more productive and innovative then the merely domestic ones. However, if the set of firms' characteristics influencing their GVC participation strategy is known (i.e. selection to treatment based on observables), the random treatment assignment condition can be assumed to be valid again. Such hypothesis is the so-called conditional independence assumption (CIA, or "unconfoundedness"), first introduced by Rosenbaum and Rubin (1983); it states that, given that x are known, y_1 and y_0 are independent from the treatment (indicated with w). Formally, (y0; y1) _|_ w|x. In this case, it is possible to overcome the missing observation issue by resorting to a non-parametric approach which creates confrontable groups of companies: the propensity score matching (PSM)[13]. This method generates the best combinations of treated and untreated subjects, so that by comparing the means of their outcome variables it is possible to compute the ATE. In order to do so, the PSM relies indeed on the propensity score, i.e. the probability for each subject to be treated conditional on a group of characteristics that influence the selection into treatment and the outcome. Therefore, such variable has the advantage of summarizing the multiple confounders in one single value.

When performing our analysis, we have chosen to use the following variables as confounders:

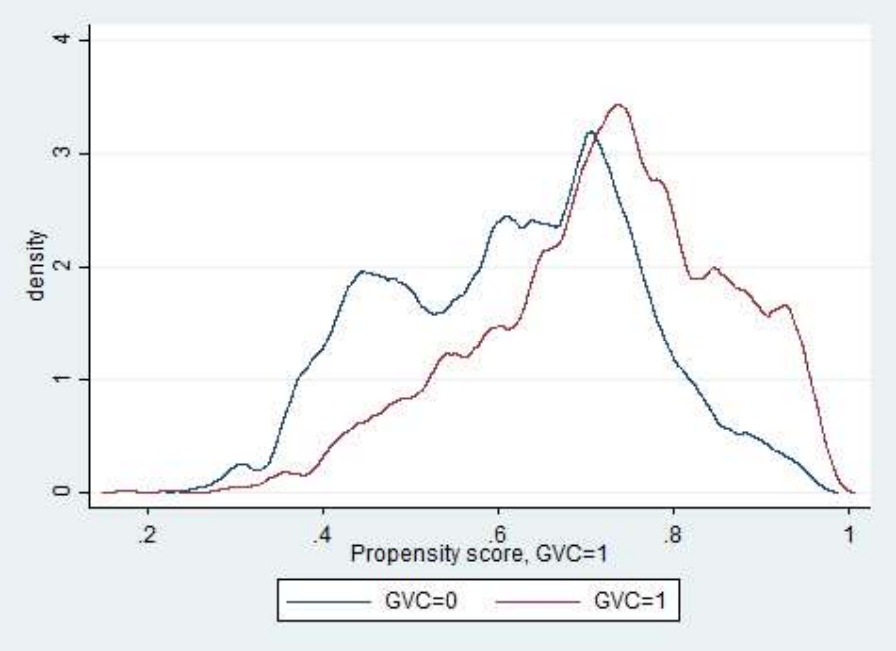
[12] However, we provide also estimates referring to the Average Treatment Effect on Treated (ATET), presented in table 3.14.

[13] Besides the CIA, two other conditions must hold in order for the PSM to be used, namely the common support condition and the stable unit treatment value assumption (SUTVA). The former requires that the set of selected covariates does not perfectly predict the outcome nor it prognosticate exactly whether a subject is selected into treatment or not. The latter supposes that the treatment of a unit does not influence the outcome of another subject. More in Cerulli (2015).

- $tfp2008_i$, to account for firms' productivity levels in 2008, the starting point of our analysis;
- $size\_class_i$, to take into account firms' size[14];
- age_class_i; to account for firms' age[15];
- $INNO_i$, a dummy = 1 if firm *i* has adopted product, process or market innovation in 2008;
- $GROUP_i$, a dummy = 1 if firm *i* belonged to a group (either domestic or foreign) in 2008;
- $country\_code_i$, a variable to control for firms' location;
- $sector\_code_i$, a variable to control for firms' industry.

Before performing our analysis, we test that our sample – split between treated and untreated unit – is balanced over each confounder; the test confirms that the balancing properties are satisfied[16]. We also check that the overlap assumption is valid, testing whether each unit has a positive probability of being either treated or untreated (figure 3.13).

Figure 3.13 Testing the overlap assumption



[14] This is a categorical variable that takes the values: 1 for small firms (from 10 to 49 employees), 2 for medium firms (from 50 to 249 employees), 3 for large firms (more than 250 employees).
[15] This is also a categorical variable, taking the value of 1 for young firms (6 years old or younger in 2008), 2 for intermediate firms (from 7 to 19 years old in 2008), 3 for old firms (20 years old or older in 2008).
[16] In order to do so, we use the Stata command pscore (Becker & Ichino, 2002) This command divides the sample in k equally spaced intervals. Within each one of them, it tests that the average value for each confounder is not statistically different between treated and untreated subjects.

We can confidently state that there is no evidence of the overlap assumption being violated, as most of the mass of the two estimated densities lies in areas where they overlap. Figure 3.14 illustrates the PS distribution for the treated and control groups before and after the matching. The reduction of the differences between the two distributions signals, again, the good quality of the matching experiment. A similar information is given by figure 3.15, where the PS distribution for the treated and control groups is represented through box plots.

Figure 3.14 Propensity score distribution for treated and control groups before and after matching

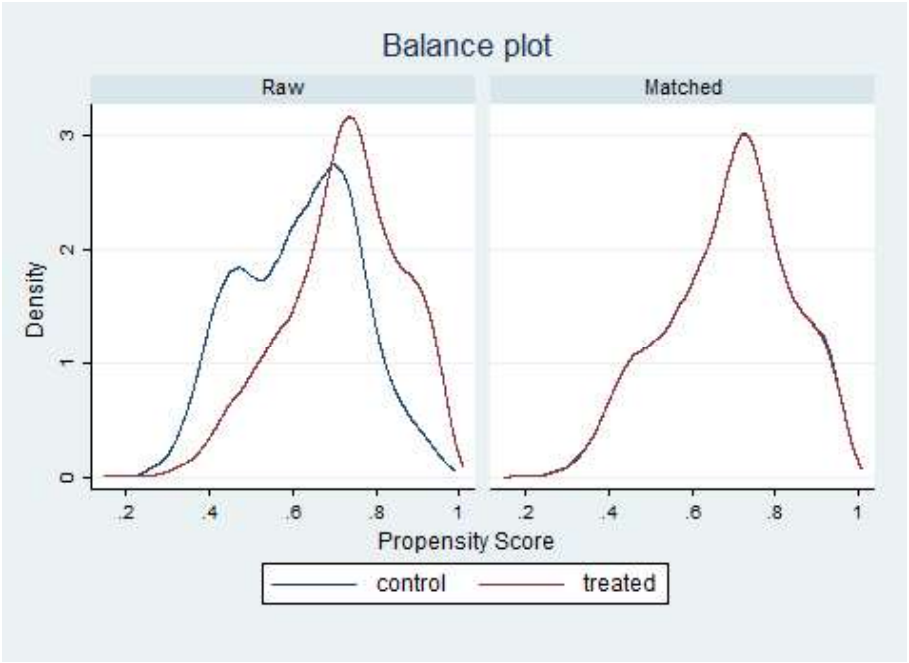
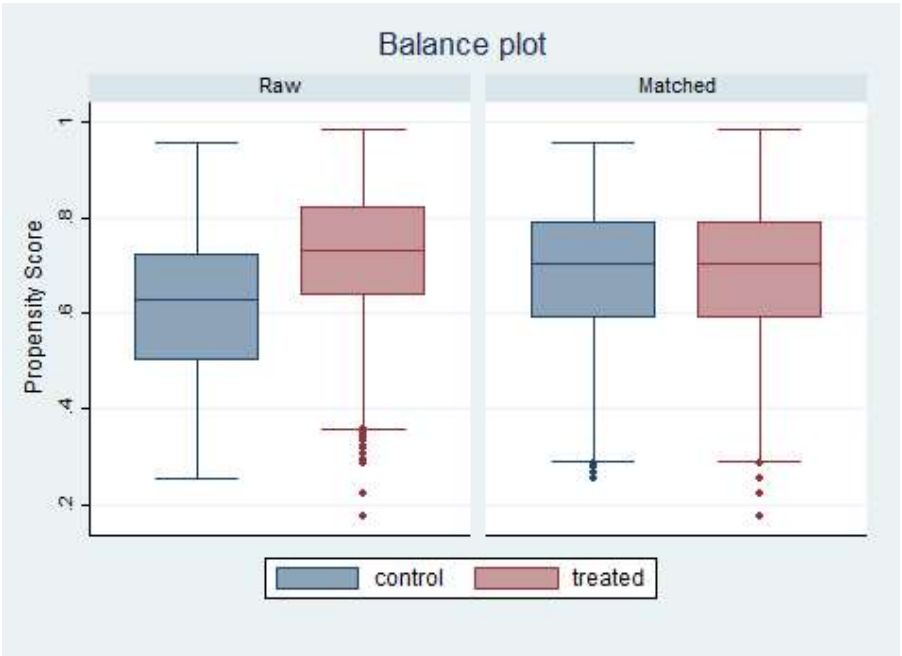


Figure 3.15 Propensity score box plots for the treated and control groups before and after the matching



We perform our matching estimate using the Stata command "teffects psmatch", which calculates standard errors conform to Abadie and Imbens (2012), and choose the "nearest neighbor 2" matching technique. Results are shown in table 3.14, while table 3.15 reports the results of our post-estimation check to test the good quality of the matching.

Table 3.14 Average treatment effect of GVC participation on employment growth

N. Observations	Treated observations	Control observations	ATE (GVC 1 vs 0)	ATET (GVC 1 vs 0)
3,778	2,599	1,179	0.076*** (0.017)	0.070*** (0.019)

Source: authors' calculations based on EFIGE dataset. PS matching (nearest neighbour 2) performed using the Stata command "teffects psmatch". Standard errors in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 3.15 Standardized differences and variance ratio of confounders before and after the matching

	Standardized differeces		Variance ratio	
	Raw	Matched	Raw	Matched
tfp2008	-0.245	-0.012	1.324	1.136
size class	0.459	0.005	2.738	1.036
age class	0.177	-0.035	0.856	1.050
INNO	0.450	0.016	0.759	0.988
GROUP	0.296	0.003	1.589	1.003
country_code	-0.222	0.038	1.065	0.842
sector_code	0.143	0.025	0.878	0.940

Thanks to impact evaluation analysis, not only we can confirm that GVC participation is significantly associated with employment growth at the firm level, but we can state that the former has a positive impact on the latter, identified by the average treatment effect. We are confident that our estimation is correct since the standard differences of the confounders between the treatment and control group are much closer to zero after the matching, as well as their variance ratio are closer to one[17].

[17] This appear to be true for all the control variables selected except for country_code. Nevertheless, we have checked for the good quality of our estimation also by performing the PS matching using the "psmatch2" command in Stata and the ex-post check carried out confirms that, after the estimate, the confounders are no longer statistically significant, as it should be in a matched sample.

3.5 Concluding remarks

While several research acknowledges the propagation role played by global value chain during the recent trade collapse, fewer investigations have aimed at analysing what happened to firms involved in international production networks during the crisis. Those that have dealt with such research question have focused mainly on a few performance indicators at the firm level, namely on those assessing firms' productivity levels, such as tfp or labour productivity. These appear positively related to GVC participation, although intermediate firms seem to perform worse than final ones.

In this work, relying on the EFIGE dataset, we take into account a different aspect of firms' performance by looking at the variation in employment they have experienced comparing the pre- and post-crisis data (2008-2014). During this period, the average number of employees per firm has decreased, but the average employment variation rate differs considerably if we compute it distinguishing among companies according to their level of engagement into international production networks, with exclusively domestic firms having suffered the most.

In the first part of our empirical analysis, we have investigated the relation between GVC participation and positioning and employment variation at the firm level using simple OLS regressions. The results exclude any relation between VC positioning and employment growth, while the latter appears to be significantly and positively related to engagement into global production networks. Nevertheless, only some GVC participation modes seem to matter in terms of employment variation, namely single and dual modes, while a three-way involvement in international production networks resulted not significant.

In order to deepen our analysis and account more for firms' heterogeneity, in the second part of our empirical investigation we resort to simultaneous quantile regression in order to assess whether the relation between GVC participation and employment variation differs according to the degree of the latter. We find that GVC participation is always positively and significantly related to employment growth, notwithstanding of the quantile we focus on, while the absence of any significance for VC positioning is confirmed. Nevertheless, interesting results emerge when taking into account the different GVC participation modes. While the two-way engagement in global production networks appears to be always significantly and positively associated to employment variation, the single GVC participation mode loses its significance for those firms showing the highest employment growth rates, which result strongly related to the triple-mode GVC engagement. Therefore, we can conclude that, among companies growing more in terms of employment, those fully participating to international production networks (i.e. by importing, exporting and producing abroad) show higher employment increase than those which do not.

Finally, in the last part of our empirical analysis, we have resorted to impact evaluation techniques. This has allowed us to overcome two issues concerning the first part of our work. First, using OLS regressions does not allow any interpretation concerning the causal direction of the relation linking our two variables of interest – employment growth rate at the firm level and GVC participation. Second, some of the explanatory variables we have used (firms' characteristics such as productivity, size or innovative capacity) might determine also whether a company is involved in an international production network. By relying on the propensity score matching method we are able to compare units (in our case, firms) similar under all the aspects considered as confounders (e.g. productivity, innovativeness), except for GVC participation. By doing so, we can isolate the impact of companies' engagement in global production networks on their employment growth, by considering the former as a "treatment". We have found a positive and significant average treatment effect of GVC participation on companies' increase of the labour force.

The main contribution of our work consists in shedding some light on the relation between participation to global production chains and employment growth at the firm level, which is a subject that has been quite overlooked in the literature. However, there is large scope for further research, for instance by looking at the quality of jobs whose creation has been favoured by GVC participation (e.g. directed to skilled vs. unskilled workers; part-time or more stable work contracts), which we cannot take into account due to data limitations.

References

Abadie, A., & Imbens, G. W. (2012). *Matching on the estimated propensity score*.

Accetturo, A., & Giunta, A. (2017). Value chains and the great recession: Evidence from Italian and German firms. *International Economics*.

Accetturo, A., Giunta, A., & Rossi, S. (2011). *The Italian firms between crisis and the new globalization*. *Occasional Papers, Bank of Italy* (Vol. 86).

Agostino, M., Giunta, A., Nugent, J. B., Scalera, D., & Trivieri, F. (2015). The importance of being a capable supplier: Italian industrial firms in global value chains. *International Small Business Journal*, *33*(7), 708–730.

Agostino, M., Giunta, A., Scalera, D., & Trivieri, F. (2016). Italian Firms in Global Value Chains : Updating our Knowledge. *Rivista Di Politica Economica*, *VII–IX*.

Alessandria, G., Kaboski, J. P., & Midrigan, V. (2011). US Trade and Inventory Dynamics. *The American Economic Review*, *101*(3), 303–307.

Altomonte, C., & Aquilante, T. (2012). *The EU-EFIGE/Bruegel-UniCredit dataset* (No. 13).

Altomonte, C., Di Mauro, F., Ottaviano, G., Rungi, A., & Vicard, V. (2012). *Global Value Chains During the Great Trade Collapse: A Bullwhip Effect? European Central Bank Working Paper Series*.

Amorim Varum, C., & Barros Rocha, V. C. (2013). Employment and SMEs during crises. *Small Business Economics*, *40*(1), 9–25.

Angrist, J. D. (1991). Grouped Data Estimation and Testing in Simple Labor Supply Models. *Journal of Econometrics*, *47*, 243–266.

Arnold, C. E. (2010). Where the low road and the high road meet: flexible employment in global value chains. *Journal of Contemporary Asia*, *40*(4), 612–637.

Azevedo, J. P. W. (2004). grqreg: Stata module to graph the coefficients of a quantile regression. Boston College Department of Economics.

Bair, J. (2005). Global Capitalism and Commodity Chains: Looking Back, Going Forward. *Competition & Change*, *9*(2), 153–180.

Baldwin, J., & Yan, B. (2014). *Global Value Chains and the Productivity of Canadian Manufacturing Firms*. *Economic Analysis Research Paper Series*.

Baldwin, R. (Ed.). (2009). *The great trade collapse: Causes, consequences and prospects*. Cepr.

Baldwin, R. (2011). *Trade And Industrialisation After Globalisation's 2nd Unbundling: How Building And Joining A Supply Chain Are Different And Why It Matters* (NBER Working Paper Series No. 17716). Cambridge, MA.

Barba Navaretti, G., Castellani, D., & Pieri, F. (2014). Age and firm growth: evidence from three

European countries. *Small Business Economics*, *43*, 823–837.

Barrientos, S., Gereffi, G., & Rossi, A. (2011). Economic and Social Upgrading in Global Production Networks: A New Paradigm for a Changing World. *International Labour Review*, *150*(3/4), 319–340.

Becker, S. O., & Ichino, A. (2002). Estimation of average treatment effects based on propensity scores. *The Stata Journal*, *2*(4), 358–377.

Beerepoot, N., & Kumar, R. (2015). Upgrading service delivery and employment conditions through indirect insertion in global value chains. *Competition & Change*, *19*(5), 374–389.

Békés, G., Halpern, L., Koren, M., & Muraközy, B. (2011). *Still standing: how European firms weathered the crisis: The third EFIGE policy report* (Bruegel Blueprint Series No. 15).

Bems, R., Johnson, R. C., & Yi, K.-M. (2009). The collpase of global trade: update on the role of vertical linkages. In R. Baldwin (Ed.), *The Great Trade Collapse: Causes, Consequences and Prospects*. CEPR.

Bianchi, A., & Biffignandi, S. (2018). Employment Growth by Firm Size During the Recent Crisis in Italy: A Multifactor Partitioning Analysis. *Growth and Change*, *49*(2), 314–338.

Bramucci, A., Cirillo, V., Evangelista, R., & Guarascio, D. (2017). *Offshoring, industry heterogeneity and employment* (No. 88). Berlin.

Brancati, E., Brancati, R., & Maresca, A. (2017). Global value chains, innovation and performance: Firm-level evidence from the Great Recession. *Journal of Economic Geography*, *17*(5), 1039–1073.

Buchinsky, M. (1998). Recent Advances in Quantile Regression Models: A Practical Guideline for Empirical Research. *The Journal of Human Resources*, *33*(1), 88–126.

Cerulli, G. (2015). *Econometric Evaluation of Socio-Economic Programs: Theory and Applications*. Berlin: Springer-Verlag.

Cheng, K., Rehman, S., Seneviratne, D., & Zhang, S. (2015). *Reaping the Benefits from Global Value Chains*. *IMF Working Paper*.

Cheung, C., & Guichard, S. (2009). *Understanding the world trade collapse* (No. 70). *OECD Economic Department Working Papers n. 729*.

Coad, A., & Rao, R. (2008). Innovation and firm growth in high-tech sectors: A quantile regression approach. *Research Policy*, *37*(4), 633–648.

Desai, M. A., Foley, C. F., & Hines, J. R. (2009). Domestic Effects of the Foreign Activities of U. S. Multinationals. *American Economic Journal: Economic Policy*, *1*(1), 181–203. https://doi.org/10.1257/pol.1.1.181

Dolan, C. S. (2004). On farm and packhouse: Employment at the bottom of a global value chain.

Rural Sociology, *69*(1), 99–126.

Freund, C. (2009). *The Trade Response To Global Downturns: Historical Evidence* (Policy Research Working Paper No. 5015).

Gereffi, G. (1999). International trade and industrial upgrading in the apparel commodity chain. *Journal of International Economics*, *48*(1), 37–70.

Giovannetti, G., & Marvasi, E. (2016). Food exporters in global value chains: Evidence from Italy. *Food Policy*, *59*, 110–125.

Giovannetti, G., & Marvasi, E. (2017). Governance, value chain positioning and firms' heterogeneous performance: The case of Tuscany. *International Economics*, (November), 1–22.

Giovannetti, G., Marvasi, E., & Sanfilippo, M. (2015). Supply chains and the internationalization of small firms. *Small Business Economics*, *44*(4), 845–865.

Grazzi, M., & Moschella, D. (2017). Small, young, and exporters: New evidence on the determinants of firm growth. *Journal of Evolutionary Economics*, *28*(1), 125–152.

Haltiwanger, J., Jarmin, R. S., & Miranda, J. (2013). Who creates jobs? Small versus large versus young. *The Review of Economics and Statistics*, *95*(2), 347–361.

Heyman, F., Norbäck, P.-J., & Persson, L. (2017). Who creates jobs and who creates productivity? Small versus large versus young versus old. *Economics Letters*, *164*, 50–57.

Hijzen, A., & Swaim, P. (2007). Does offshoring reduce industry employment? *National Institute Economic Review*, *201*, 86–96.

Holland, P. W. (1986). Statistics and Causal Inference. *Journal of the American Statistical Association*, *81*(396), 945–960.

Humphrey, J., & Schmitz, H. (2002). How does insertion in global value chains affect upgrading in industrial clusters ? *Regional Studies*, *36*(9), 1017–1027.

Husted, J. A., Cook, R. J., Farewell, V. T., & Gladman, D. D. (2000). Methods for assessing responsiveness: a critical review and recommendations. *Journal of Clinical Epidemiology*, *53*(June 2018), 459–468.

ILO. (2016). Reports of the Committee on Decent Work in Global Supply Chains: Resolution and conclusions submitted for adoption by the Conference. In *International Labour Conference, 105th Session*.

Kaplinsky, R., & Morris, M. (2001). *A Handbook for Value Chain Research*. *Institute for Development Studies: Brighton, UK*.

Koenker, R., & Basset, G. J. (1978). Regression Quantiles. *Econometrica*, *46*(1), 33–50.

Koenker, R., & Hallock, K. F. (2001). Quantile Regression. *Journal of Economic Perspectives*,

15(4), 143–156.

Krugman, P. (1995). Growing World Trade: Causes and Consequences. *Brookings Papers on Economic Activity*, *26*(1, 25th Anniversary Issue), 327–377.

Mankiw, G. N., & Swagel, P. (2006). *The Politics and Economics of Offshore Outsourcing* (NBER Working Paper Series No. 12398).

Mosteller, F., & Tuckey, J. W. (1977). *Data Analysis and Regression*. MA: Addison-Wesley, Reading.

OECD. (2007). Offshoring and employment: trends and impact. Paris: OECD Publishing.

Porter, M. E. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. The Free Press.

Rahaman, M. M. (2011). Access to financing and firm growth. *Journal of Banking and Finance*, *35*(3), 709–723. https://doi.org/10.1016/j.jbankfin.2010.09.005

Razzolini, T., & Vannoni, D. (2011). Export premia and subcontracting discount: Passive strategies and performance in domestic and foreign markets. *World Economy*, *34*(6), 984–1013.

Rosenbaum, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, *70*(1), 41–55.

Rothman, K. ennet. J., Greenland, S., & Lash, T. L. (2008). *Modern epidemiology* (3rd editio). Philadelphia: Lippincott Williams & Wilkins.

Schreyer, P. (2000). *High-growth firms and employment*. *OECD Science, Technology and Industry Working Papers 2000/03*.

Taglioni, D., & Winkler, D. (2016). *Making Global Value Chains Work for Development*. *Trade and Development series*. Washington, DC: World Bank Group.

UNCTAD. (2013). Global Value Chains and Development: Investment and value added trade in the global economy. *Unctad*, 32.

Veugelers, R., Barbiero, F., & Blanga-Gubbay, M. (2013). Meeting the manufacturing firms involved in GVCs. In R. Veugelers (Ed.), *Manufacturing Europe's future* (Bruegel Bl, pp. 107–138). Bruegel.

WTO. (2010). *World Trade Report 2010: Trade in natural resources*.

Wynarczyk, P., & Watson, R. (2005). Firm growth and supply chain partnerships: An empirical analysis of UKSME subcontractors. *Small Business Economics*, *24*(1), 39–51.

Yi, K.-M. (2009). The collapse of global trade: the role of vertical specialization. In R. Baldwin & S. Evenett (Eds.), *The collapse of global trade, murky protectionism, and the crisis. Recommendations for the G20* (pp. 45–48). Cepr.

Appendix 3 – Additional tables and figures

Table 3.1A Firms' distribution according to country, size and industry

Percentages over same size class and over total firms.

	France				Germany				Italy				Spain			
	Small	*Medium*	*Large*	*% over tot*	*Small*	*Medium*	*Large*	*% over tot*	*Small*	*Medium*	*Large*	*% over tot*	*Small*	*Medium*	*Large*	*% over tot*
Food and tobacco	7.27	7.77	10.64	7.67	50	7.94	19.23	17.14	9.44	7.96	5.63	9.07	18.25	16.57	20	18.12
Textiles, apparel, leath.	6.02	6.74	2.13	5.95	0	7.94	0	4.76	12.56	12.83	7.04	12.36	5.91	4.14	1.82	5.54
Coke and petroleum	0.5	0	0	0.31	0	0	0	0	0.22	0	1.41	0.24	0	0	0	0
Chemicals	4.26	6.22	6.38	5.01	12.50	3.17	30.77	11.43	2.67	8.85	7.04	3.71	4.03	8.28	12.73	4.89
Rubber, plastic and non-metallic mineral prod.	15.29	15.03	8.51	14.71	0	11.11	7.69	8.57	11.22	11.06	15.49	11.38	10.71	18.34	9.09	11.57
Basic metals and fabricated metal prod.	35.59	27.98	21.28	32.24	0	15.87	3.85	10.48	23.77	24.34	9.86	23.25	23.14	20.12	14.55	22.43
Machinery, equip., office mach. and computers	8.27	12.44	10.64	9.7	6.25	26.98	7.69	19.05	14.19	13.72	25.35	14.61	11.74	9.47	3.64	11.14
Electrical mach. and apparatus, communication equip.	10.03	13.99	12.77	11.42	25	14.29	15.38	16.19	8.92	5.31	12.68	8.58	3.86	4.73	14.55	4.39
Motor vehicles and other transp. equip.	0.75	2.07	19.15	2.5	0	3.17	7.69	3.81	2.3	2.65	4.23	2.43	2.91	4.14	7.27	3.24
Wood, paper, furniture, recycling	12.03	7.77	8.51	10.49	6.25	9.52	7.69	8.57	14.71	13.27	11.27	14.36	19.45	14.20	16.36	18.69

Source: author's elaborations on EFIGE data.

Table 3.2A Firms' distribution over countries, industries, GVC participation and positioning modes
Percentages over same country-industry category

	France						Germany						Italy						Spain					
	Zero	Single	Dual	Triple	% GVC over tot	% PS over tot	Zero	Single	Dual	Triple	% GVC over tot	% PS over tot	Zero	Single	Dual	Triple	% GVC over tot	% PS over tot	Zero	Single	Dual	Triple	% GVC over tot	% PS over tot
Food and tobacco	59.2	22.4	16.3	2	40.8	40.8	61.1	27.8	11.1	0	38.9	27.8	33.6	40.9	24.8	0.7	66.4	36.2	49.6	36.1	13.9	0.4	50.4	14.3
Textiles, appar. leath.	10.5	36.8	42.1	10.5	89.5	78.9	0	60	20	20	100	40	17.7	35.5	36.9	9.9	82.3	68.5	20.8	42.9	33.8	2.6	79.2	48.1
Coke and petroleum	50	50	0	0	50	0	-	-	-	-	-	-	50	25	25	0	50	75	-	-	-	-	-	-
Chemicals	12.5	34.4	50	3.1	87.5	68.8	0	66.7	33.3	0	100	41.7	19.7	23	52.5	4.9	80.3	62.3	29.4	29.4	36.8	4.4	70.6	17.6
Rubber, plastic and non-metallic mineral prod.	20.2	34	40.4	5.3	79.8	70.2	11.1	55.6	22.2	11.1	88.9	44.4	31	35.3	32.6	1.1	69	60.4	34.2	37.9	26.7	1.2	65.8	34.8
Basic metals and fabricated metal prod.	30.6	29.6	36.4	3.4	69.4	77.2	27.3	36.4	27.3	9.1	72.7	45.5	35.1	41.1	22	1.8	64.9	75.9	45.8	30.1	24	0	54.2	56.7
Machinery equip., office mach. and comp.	3.2	27.4	59.7	9.7	96.8	66.1	20	30	35	15	80	50	16.7	54.2	25	4.2	83.3	60	23.2	43.9	32.9	0	76.8	39.4
Electrical mach. and apparatus, communication equip.	20.5	17.8	50.7	11	79.5	68.5	29.4	47.1	17.6	5.9	70.6	41.2	24.1	44	27	5	75.9	58.2	19.7	32.8	42.6	4.9	80.3	39.3
Motor vehicles and other transport equip.	12.5	18.8	56.3	12.5	87.5	81.3	25	0	25	50	75	25	25	37.5	30	7.5	75	52.5	42.2	26.7	31.1	0	57.8	51.1
Wood, paper, furniture, recycling	37.3	37.3	22.4	3	62.7	79.1	33.3	22.2	44.4	0	66.7	44.4	28.8	42.4	25.8	3	71.2	70.8	45	34.6	19.2	1.2	55	43.8

Source: author's elaborations on EFIGE data.

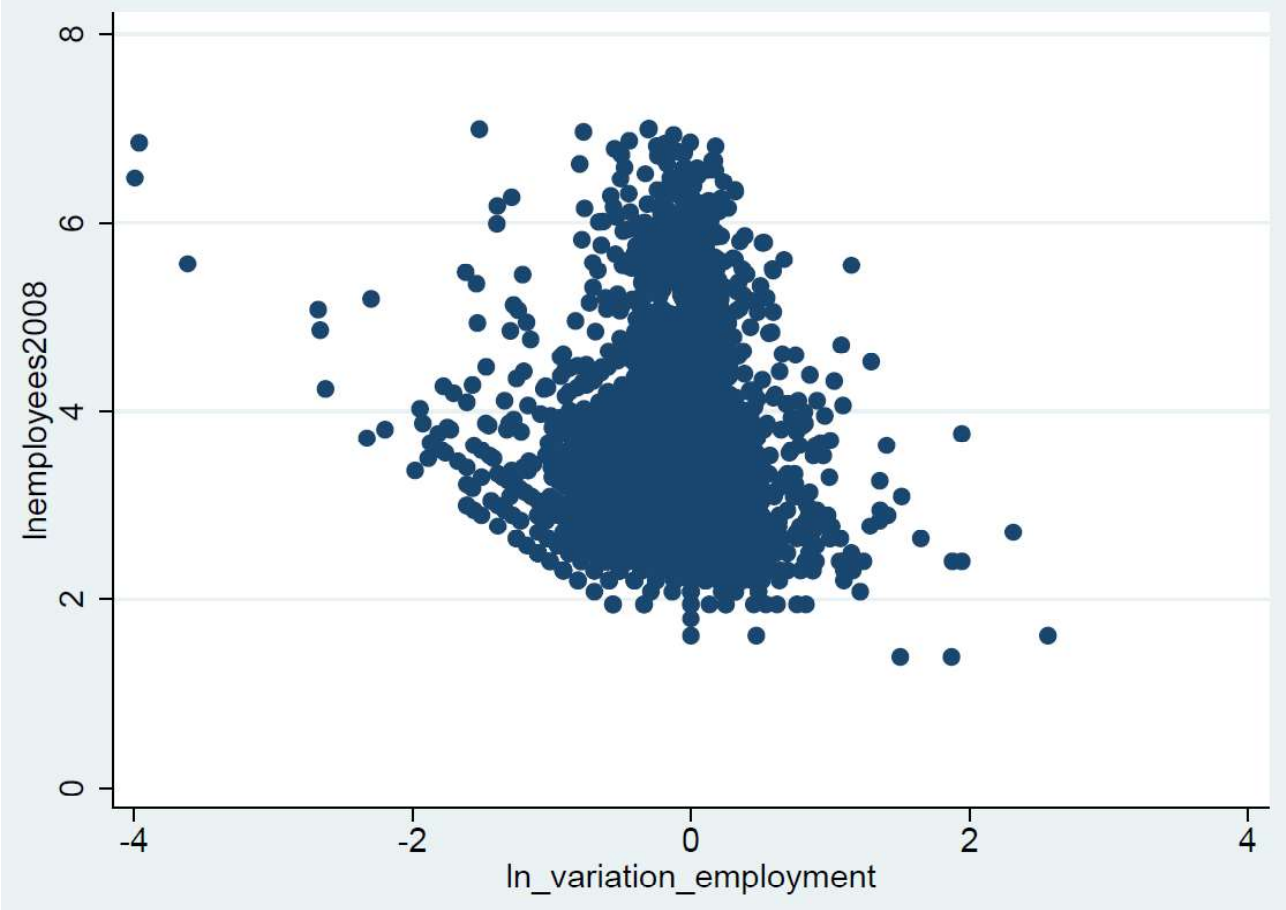
Table 3.3A Covariates' correlation matrix

	GVC	tfp2008	lnage	lnemployees2008	INNO	training	hk	labour_flex	GROUP	qual_cert	foreign_comp	EXTERNAL_FINANCING	PTO_turnover	PURE_SUPPLIER
GVC	1													
tfp2008	-0.1102	1												
lnage	0.0856	-0.0147	1											
lnemployees 2008	0.2252	-0.0854	0.1969	1										
INNO	0.2096	0.0082	0.0246	0.1244	1									
training	-0.006	0.0949	-0.018	0.1406	0.1271	1								
hk	0.1143	0.0343	-0.006	-0.068	0.095	0.074	1							
labour_flex	0.0289	0.0229	-0.012	0.1517	0.1088	0.1119	-0.0131	1						
GROUP	0.1307	-0.0074	0.0159	0.4344	0.0587	0.1326	0.0489	0.027	1					
qual_cert	0.1225	0.0261	0.0591	0.2849	0.118	0.1926	0.0992	0.0594	0.1847	1				
foreign_comp	0.3307	-0.0704	0.0854	0.1956	0.1275	0.0588	0.1054	0.0082	0.1546	0.107	1			
EXTERNAL_FINANCING	0.011	-0.0435	-0.034	-0.0135	0.1329	0.0188	0.0076	0.0926	-0.1224	0.0413	-0.0493	1		
PTO_turnover	0.1446	-0.1069	-0.044	-0.0343	-0.054	-0.0677	-0.0254	-0.1249	-0.0241	-0.0002	0.0762	-0.0444	1	
PURE_SUPPLIER	0.0616	-0.0658	-0.033	-0.0203	-0.079	-0.0759	-0.0264	-0.1164	0.0088	0.0012	0.0774	-0.0631	0.7745	1

Source: author's calculations based on EFIGE data.

Figure 3.1A Firms' size and employment variation

Scatterplot showing the relation between the number of employees firms recorded in 2008 (in logs) and the variation in employment they experienced between 2008 and 2014.



Conclusions

The international fragmentation of production processes has truly impacted the global economy pervasively. It has changed the way we look at trade and countries' competitiveness and it has certainly opened a new paradigm in the light of which firms and their performance can be studied. Undoubtedly, it has been largely acknowledged that internationally active enterprises perform better than exclusively domestic ones, but looking at them through the lenses of global value chains allow to account for additional elements that can help to better understand how companies operate and what impacts on their outcomes, such as the relations with other firms, the importance of occupying a leading position along the chain or the incentives to innovate deriving from being part of a production networks.

The main contribution of the first chapter of this work is to provide a systematic review of the literature investigating the link between firms' performance and their engagement in GVCs. It has been underlined how several measures have been used to account for the latter, with researchers being limited by the lack of good quality micro data, which especially makes it hard to perform longitudinal and/or cross-country analysis. Despite such restraints, the research produced so far agrees on some key points, namely on companies' engagement in international production networks being positively related to their performance. Moreover, several studies remark the presence of a performance disparity between final an intermediate firms, where the latter are disadvantaged. However, such gap appears to be bridgeable leveraging on companies' innovation and internationalization capabilities.

The first empirical work of this dissertation (chapter 2) we investigate the relation between companies' engagement in international production networks and their chances to survive the Great Recession. We focus on companies located in France, Germany, Italy and Spain, whose data are available in the EFIGE database, and we perform two kinds of empirical tests. First, we rely on a probit model, whose results show how merely being part of an international production network has no significant effect on companies' chances to survive. VC positioning, on the other hand, matters a lot, with intermediate firms having a higher risk of exiting the market. We have also run a Cox duration model, which confirm our findings relatively to intermediate firms having a harder time surviving the crisis.

In the third chapter of this dissertation, we investigate the relation between GVC participation and positioning and companies' performance by taking into account an aspect quite overlooked in the literature: employment growth at the firm level. We maintain the focus on French, German, Italian and Spanish firms and the variation rate in the number of employees is measured comparing the size of companies before and after the recent economic crisis. The average number of employees per company has decreased between 2008 and 2014, but enterprises involved in international production networks show significant higher positive (or lower negative) variation rates. In particular, one-way and two-way modes of involvement in global production networks appear significantly and positively related to employment growth, while the three-way engagement results relevant only among those companies that have recorded the highest positive employment variation rates. Such findings have been confirmed even when the impact of GVC participation and positioning on companies' growth has been tested resorting to the impact evaluation analysis techniques, specifically the propensity score matching. The latter allows for comparison among firms that are equal under many aspects, except fort their engagement in international production networks, which – in building the model – is considered as being a "treatment". Again, being involved in a global production network impacts positively on the employment growth at the firm level, while GVC positioning appears not to matter as we find no relevant difference between intermediate and final firms.

The results of our two empirical works might appear inconsistent with each other. However, it is worth reminding that they take into account two different groups of firms. In our last investigation (chapter 3) our sample of firms is – by definition – made only by those that have survived the crisis. Thus, it captures a relation which is subsequent to the one analysed in chapter 2.

For the purposes of firms' survival during the Great Recession, we can hypothesize that if on one hand GVC participation is associated with better firms' performance (as acknowledged in the literature), on the other hand it might have represented a feature increasing firms' exposure to international shocks, given the role that international production networks have played in the 2008-2009 big trade collapse. Such contrasting aspects of the relation between GVC participation and firms' performance might explain why the former is not significant for the purposes of companies' survival. Unfavourable positioning within value chains, on the contrary, is related to a worse firm performance. Not only intermediate firms suffer from a performance gap with respect to the final ones, but they also were the most penalized by the organizational changes (such as the inventory adjustments) implemented by

the latter to face the crisis. These considerations might explain why suppliers had a higher chance to exit the market during the years following the Great Recession.

In chapter 3, however, such selection has already happened. Less productive firms and those located in an intermediate position have already exited the market in a higher share with respect to the rest, since we evaluate the relation between GVC participation and positioning and employment growth taking into account companies that are still active. Among them, being involved in an international production network is a feature positively related to growth, with no significant difference between the intermediate and the final ones.

We are aware that our work presents some limitations; for example, we do not have information about the characteristics of the workers that have lost their job during the Great Recession (chapter 3), as we do not know the timing of firms' exit from the market (right after the crisis hit or after a few years?), nor we have data about companies that entered the market in the same period. Such limits, while leaving scope for further research, are due to the lack of information available. We are also willing to deepen the analysis carried out so far by distinguishing even more among the various internationalization activities through which firms can participate to international production networks, which might represent an interesting way to carry on our work.

List of figures

List of tables