

Global Value Chains, Governance, and Upgrading Processes: Firm-Level Evidence from Italy

Emanuele Brancati^{a,b}, Raffaele Brancati^b,
and Andrea Maresca^b

October 20, 2014

ABSTRACT

This paper contributes to recent studies on Global Value Chains (GVCs) by empirically testing the effect of GVC belonging on firms' upgrading capacity. We address this issue by focusing on the Italian experience and implementing a novel approach to identify GVCs and their forms of governance. Our findings support the existence of upgrading premia for firms in GVCs, but mainly confined to final producers and relational suppliers. Even after controlling for a rich set of firm-specific observable and unobservable factors, we find significant effects on firms' performance, as well as on the extensive and intensive margins of innovation, R&D, and export.

JEL classification: D24, F23, F26, O30.

Keywords: Global value chains, GVC governance, innovation, R&D, export, productivity, sales.

^a LUISS Guido Carli University, viale Romania 32, 00197 Rome (Italy).

^b MET, via Sabotino 2A, 00195 Rome (Italy).

1 Introduction

The fragmentation of production processes, the deep changes in distribution channels, and the diffusion of information technologies that characterized the last decades turned upside down the worldwide productive system. Globalization brought a profound metamorphosis in the international division of labor, with widespread phenomena of outsourcing and off-shoring that further reduced firms' degree of vertical integration (OECD, 2013). In this framework of sudden mutations, firms were called for a radical reorganization of their activities that frequently translated into the creation or reinforcement of cross-boarder inter-firm connections. This issue has become even more crucial in the recent crises when the involvement in global value chains (GVCs) provided firms (even the small ones) with an invaluable chance to participate in global networks, survive, and grow despite the stagnation of the domestic markets.

This paper contributes to recent studies on value chains by testing the effects of GVC belonging on the upgrading capacity of a company. We address this research question by providing a novel approach to identify GVCs and their form of governance, and analyzing heterogeneous impacts on firms' performance, innovativeness, R&D, and export activity between 2008 and 2013.

The empirical framework of the paper is the Italian economy, which represents an interesting laboratory to provide new insights on this field of research. First of all, it furnishes the chance to analyze the effect of GVCs within developed countries, while most of the existing literature mainly focused on LDCs. Moreover, the Italian system offers a suitable environment for the diffusion of value chains: an industry characterized by a large number of suppliers, with high division of labor, and frequent inter-firm connections. While traditional studies on Italy emphasize the role of industrial clusters, districts and of buyer/supplier physical proximity, recent changes in the economic system require a change in perspective. The globalization, the business opportunities provided by new technologies, and the competitive pressure from emerging countries triggered an evolutionary process that pushed firms, even the small ones, to pursue a global dimension by stretching the borders of their networks (see for instance Amighini and Rabellotti, 2006; Chiarvesio and Di Maria, 2009; Chiarvesio, Di Maria, and Micelli, 2010; among others). These arguments are even more relevant in recent times, when the Lehman and sovereign debt crises brought deep contractions in the domestic demand and the opportunity of global-scale linkages represented a crucial factor for firms' survival.

In other words, the recent Italian experience provides a privileged point of view to explore the role of value chains and GVC governance in affecting firms' upgrading processes.

There are several features of the analysis that is worth emphasizing. First, we take advantage of a newly available database —the MET survey on Italian companies— based on a large sample of firms representative of the entire industrial system. The dataset is based on the widest survey administrated in a single European country and allows to study even the behavior of micro-sized companies with less than ten employees. The latter are typically excluded from previous works despite their huge incidence (more than 90% of firms in Italy, but significant in other countries too) and the great potential benefits they can gain from GVCs. The richness of dataset furnishes the opportunity of a novel empirical definition of value chains and GVC governance based upon type and destination markets of goods sold, type and origin markets of inputs purchased, existence and length of inter-firm relationships, and firms' degree of participation in the conception of the final product. The database also provides information on firm structural characteristics, behaviors and upgrading strategies allowing to explore several dimensions of firms' upgrading propensity. Even if our conception of upgrading is more oriented toward the existence of firms' strategic behaviors (ranging from a detailed breakdown by product, process, and organizational-managerial innovations, to firm investment in R&D projects and export activity), we also provide results for the magnitude of the upgrade undertaken (intensive margins) and for firms' productivity and performance.

The main findings of the paper are easily summarized. Despite firms involved in GVCs display an upgrading propensity that is significantly higher than “stand-alone” companies or enterprises in national value chains, the mere affiliation to GVCs is not sufficient for firm success. The form of GVC governance (i.e. the system of relationships within a value chain) dramatically affects firms' probability of upgrading. *Final* producers, as well as firms involved in *relational* GVC (highly-qualitative), have a 10%-to-5% higher probability of innovating (especially for the introduction of new products) and undertaking R&D projects. *Vice versa*, *market*-based relationships, or *captive* and *hierarchical* GVCs, seem to have no significant role in fostering a firm's innovativeness. Interestingly, belonging to GVCs also boosts the exporting probability of previously non-internationalized companies, albeit the impact is found to be more homogeneous across the different forms of governance. Furthermore, this effect is not limited to firms' probability of upgrading, but

extends to the magnitude of the upgrade undertaken (intensive margins of innovation, R&D, and export). Finally, our findings also show a relevant impact on firm performance. Final producers and firms in relational GVCs display a sales growth rate that is significantly higher than other companies, while only highly-qualitative suppliers seem to have an advantage in terms of productivity. These findings are stable across a number of robustness tests controlling for possible endogeneity, simultaneity bias, self selection, persistence of the phenomena of interest, and even for firm observable and unobservable heterogeneity.

The remainder of the paper is as follows. Section 2 presents the related literature and further discusses the main contributions. Section 3 outlines the empirical strategy and our definitions of value chain and GVC governance. Section 4 provides details on the dataset employed and descriptive statistics. Section 5 shows the results, and Section 6 concludes.

2 Related literature

This paper is mainly related to previous studies on inter-firm connections, GVCs, and upgrading processes. Since the seminal papers of Gereffi and Korzeniewicz (1994) and Gereffi (1999), a growing strand of the literature reinterpreted the international productive system and the functioning of inter-firm linkages in the light of the GVC approach (Gereffi and Kaplinsky, 2001; Henderson, Dicken, Hess, Coe, and Yeung, 2002; Humphrey and Schmitz, 2002; Sturgeon, Van Biesebroeck, and Gereffi, 2008; Navas-Alemán, 2011; among many others). The emphasis of these studies is on the opportunities for local producers to take advantage from new markets and to learn from global leaders along the chains. The common rationale is that complex and organized relationships produce positive effects that go beyond the mere sum of bilateral connections because of the exchange of managerial expertise and technical knowledge. In other words, GVCs are seen as a fertile environment for firms' upgrading processes.

Even if the definition of upgrading is manifold –ranging from the introduction of product and process innovation, to functional and inter-chain upgrading: Dolan and Humphrey, 2000; Humphrey and Schmitz, 2002– most of the literature agrees that the mere participation in GVCs is not a synonymous of a company's success. Instead, firms' upgrading capacity is seen to crucially depend upon their own way to relate with other companies, or in different words, upon the specific form of governance of the value chain.

The work of Gereffi, Humphrey, and Sturgeon (2005) simplifies the heterogeneous set of buyer-supplier relationships into five main forms of GVC governance. The latter are classified by the complexity of transactions, the codifiability of information, and the capability of suppliers along the following set of relationships:

- *Markets*: based upon simple market relationships with low degree of dependence of the supplier. The transactions are easily codified and performed with little explicit coordination.
- *Modular GVC*: transactions are based on complex goods that are produced following customers' specifications. The product technological content is easy to codify so that complex information can be exchanged with little explicit coordination. Codifiability allows for the use of generic machineries (i.e. low asset specificity) implying low degree of dependence for suppliers.
- *Relational GVC*: complex interactions between buyers and sellers with strong mutual dependence. Product specifications cannot be codified, transactions are complex, and are characterised by a high level of asset specificity as well as great suppliers' capability.
- *Captive GVC*: transactions involving suppliers that are heavily dependent on final buyers because of significant switching costs. Captive GVCs imply a high degree of monitoring and control by the lead firm committing complex products to lowly-capable suppliers.
- *Hierarchy*: relationships based upon in-house production, which are characterised by a high degree of vertical integration and a managerial control going from headquarters to subsidiaries and affiliates.

This classification, then adopted as a milestone in the GVC literature, emphasizes the idea that differences in the capability of suppliers, in the codifiability of transactions, and in the complexity of the exchanged goods can strongly affect how knowledge is transferred within GVCs, thus impacting firms' upgrading capacity.

Despite the large number of papers examining GVCs on a theoretical basis, the empirical evidence at the micro level is still underwhelming, being mostly related to case studies or limited to specific industries. This strand of the literature virtually analyzed any industrial sector: from footwear and apparel (Gereffi, 1999; Schmitz, 1999; Bair and Gereffi, 2001, 2003; Evgeniev and Gereffi, 2008; Gereffi and Frederick, 2010), to agriculture (Dolan and Humphrey, 2000; Fernandez-Stark, Bamber, and Gereffi, 2011), from electronics (Sturgeon, 2002; Borrus, Ernst, Haggard, et al., 2003; Vind and Fold, 2007; Sturgeon and Kawakami,

2010; Lee, Gereffi, and Nathan, 2013), to chemicals (Kannegiesser, 2008), and motor vehicles (Humphrey, 2003; Sturgeon and Florida, 2004; Sturgeon, Memedovic, Van Biesebroeck, and Gereffi, 2009; Sturgeon and Van Biesebroeck, 2010).

Related to the role played by the *type* of value chain involvement in inducing differential upgrading opportunities, Humphrey and Schmitz (2002) focus on LDCs to show the relevance of commercial transactions, investments, and knowledge flows in fostering upgrading processes. The latter are closely related to a firm learning mechanism that crucially depends on the specific form of governance within the GVC (Morrison, Pietrobelli, and Rabellotti, 2008; Sturgeon and Memedovic, 2010; Pietrobelli and Rabellotti, 2011).¹

Also on firms' upgrading, Bazan and Navas-Alemán (2004) explore the effect of power asymmetry between committing firms and sellers, while Giuliani, Pietrobelli, and Rabellotti (2005) employ data on clusters from Latin America to show the positive role played by the complexity of the inter-firm relationships. Finally, Schmitz (2004) and Gereffi, Humphrey, and Sturgeon (2005) focus on the effect of technological change (and the evolution of specific production functions) on GVC governance, thus highlighting a dynamic nature of the latter.

At the micro level, Pietrobelli and Saliola (2008) focus on Thailand to document the positive role of buyer involvement with local suppliers in affecting productivity, technology diffusion, and output growth. They also show heterogeneous effects along the different types of GVC organization. Similarly, Saliola and Zanfei (2009) find that knowledge intensive relationships are positively associated with the presence of global buyers in the local market.

The literature on the Italian system is rich, but mainly related to outsourcing, off-shoring, and internationalization of supplier firms. Costa and Ferri (2007) address micro determinants and employment consequences of international production outsourcing, while Daveri and Jona-Lasinio (2008) study the positive effect of "narrow off-shoring" on productivity growth. Accetturo, Giunta, and Rossi (2011) investigate the relationship between functional upgrading and firm performance between 2008 and 2009. Chiarvesio, Di Maria, and Micelli (2010) analyze the relationships among internationalization, innovation strategies and performance of SMEs. Giovannetti, Marvasi, and Sanfilippo (2014) document a positive association between

¹A different form of GVC change is stressed by Sturgeon and Lester (2004) emphasizing the evolution of big domestic suppliers in developed countries into "global suppliers" integrated in a GVC.

the probability of internationalization and firms' involvement in *filière* (on the 2011-wave of the MET survey). Finally, Giunta, Nifo, and Scalera (2012) focus on sales growth and hiring decisions, while Agostino, Giunta, Nugent, Scalera, and Trivieri (2014) analyze how the productivity of suppliers is affected by several indicators of firms' own ability.

This paper contributes to the existing literature along several dimensions. First of all, we improve upon studies at the cluster/sector level by taking advantage of micro data on the entire economy. Although analyses on a few case studies allow for a detailed traceability of the relationships along a value chain, their results lack of general validity (i.e. refer to very specific relationships) and cannot be adequately tested because of the limited sample size. Our paper provides insights on the role of GVCs for the overall economy by exploiting up-to-date data on a large number of companies belonging to both manufacturing *and* service industries.² Moreover, the dataset conveys even information on the behavior of micro-sized firms with less than 10 employees. Very small companies are always neglected by previous literature despite their great diffusion and the high potential benefits they can gain from GVC belonging. Importantly, this is the first paper dealing with econometric issues by exploiting a panel dimension of the data, and quantifying the role of GVCs during the Lehman and sovereign debt crisis.

A further contribution of this work is our novel empirical identification of value chains and GVC forms of governance. The few empirical papers exploiting firm-level data either took for granted the involvement of all manufacturing companies in complex inter-firm connections (thus assuming that GVCs are economy-wide phenomena), or employed firms' exporting status and international sub-contracting as simple proxies for GVCs. Although firms' degree of interconnection experienced strong increases in the last decades, we regard the first assumption as very debatable, especially within developed countries with sizable domestic markets. The adoption of proxies for GVCs is the only feasible option, but we argue that the complexity of the phenomenon requires more sophisticated indicators for a precise identification of the value chains. In addressing this last issue, our approach relies on a rich availability of data allowing to match information on the type of goods sold (intermediate or final), their destination markets (domestic or foreign), origin markets of the inputs purchased, and "length" of the inter-firm relationships (domestic or international). Furthermore,

²Given the strong inter-sectoral connection highlighted by the literature on value chains, a sample that is representative of the overall economy (see Section 4 for more details) is a necessary condition for a broad approach to GVCs.

we propose a classification of GVC governance that allows for empirical tests on firms' upgrading propensity. In the spirit of Gereffi, Humphrey, and Sturgeon (2005), we exploit information on the share production devoted to final goods, the stability of inter-firm relationships, the affiliation to groups of firms, and the degree of participation in the conception of the final product to classify companies into final producers, market/modular, captive, relational, and hierarchical suppliers.³ We then exploit this information to study several dimensions of upgrading based on both the extensive and intensive margins of innovation (further classified into product, process and organizational-managerial ones), R&D and export activity, as well as productivity and sales growth.

3 Empirical methodology

This section presents the empirical strategy of the paper. First, we describe our approach in identifying GVCs and their different forms of governance. We then illustrate the econometric methodology and the set of variables employed in the analysis.

3.1 Identifying global and national value chains

Exactly identifying firms in GVCs is an impossible task to accomplish on a large scale. The empirical papers dealing with micro data typically resorted to firms' international activity as an indicator for the involvement in value chains. This approach relies on strong assumptions and oversimplifies the very nature of GVCs; a complex phenomenon that can hardly be proxied by simple measures and requires a large amount of information to be properly identified. Our paper takes a step forward in this direction by providing a structured empirical definition of GVCs that possibly improves upon the traditionally used proxies.

Our identification strategy stems directly from the GVC literature and combines information on the type of good sold (intermediate or final), its destination market (domestic or foreign), the origin market of inputs purchased, and the existence/extension of stable inter-firm relationships (domestic or international networks). Firms are then classified into "stand alone", belonging to national value chains (NVC), or global value chains (GVC), according to the following matrix:

³In the same spirit, Saliola and Zanfei (2009) propose an alternative classification based upon three different forms of GVC governance.

		Type of good sold			
		Intermediate		Final	
		Domestic	Export	Domestic	Export
Input purchased	Domestic	NVC or GVC (if inter. netw.) (1)	GVC (2)	Stand alone or NVC (if dom. netw.) or GVC (if inter. netw.) (3)	Stand alone or NVC (if dom. netw.) or GVC (if inter. netw.) (4)
	Import	NVC or GVC (if inter. netw.) (5)	GVC (6)	Stand alone or NVC (if dom. netw.) or GVC (if inter. netw.) (7)	GVC (8)

This scheme permits to identify the cells with the highest *a priori* likelihood of containing companies in a GVC.

The need of several types of information is motivated by the great heterogeneity in the possible forms of participation in a value chain. In the same economic scenario coexist companies that are completely integrated in a global dimension, firms whose international activity is only oriented toward the research of new markets (or input purchase) but that are not involved in GVCs, and companies that belong to a GVC even without any direct relationship with foreign enterprises (i.e. “long GVC”).⁴ Our approach based on multiple criteria helps disentangling this heterogeneity.

We first exploit information on the type of good sold, its destination market, and the origin market of the inputs purchased. Since intermediate goods are typically employed in broader productive processes, firms exporting semi-finished products can be reasonably considered as participating in one (or more) GVC(s) (cells 2 and 6). Similarly, a company importing its inputs *and* exporting final goods is totally integrated in a global dimension and is likely to be involved in a production on a global scale (cell 8). A certain degree of ambiguity arises when dealing with firms that are internationalized to some extent (either import input factors *or* export final goods, cells 4, 5, and 7). In other words, a partial internationalization is compatible with firms that are links of a chain as well as stand alone companies whose international activity is only the result of strategic behaviors (searching for new markets or purchasing inputs at a lower cost).

⁴A firm is said to be in a long value chain if participates to the production process of a GVC, but has no direct relationship with foreign companies. In other words, firms that are integrated in long GVCs contributes to the production process on a global scale, but have exclusively close interactions with domestic companies (that in turn will have connections at the supranational level).

In order to disentangle this ambiguity and account for the aforementioned possibility of long value chains, we further enrich our classification with information on global networks. The MET survey (see Section 4 for further details) provides punctual information on the existence of stable and relevant direct or indirect relationships with foreign companies. We regard this as a necessary condition for the belonging to GVCs. By exploiting this additional dimension, we are able to identify partially-internationalized companies that participate in a GVC (about 25% of the ambiguous cases in cells 4, 5, and 7) as well as domestic firms involved in long GVCs (10% of the domestic companies in cells 1 and 3).⁵

Similarly, firms are considered to belong to a national value chain (NVC) if they sell intermediate goods on a local scale or declare to be part of domestic networks. The excluded group is deemed to be composed by stand alone companies.

3.2 Identifying GVC forms of governance

Theoretical literature suggests that the mere participation in GVCs is not sufficient to ensure firm success. We test this proposition by grouping companies along different forms of GVC governance and exploring heterogeneities in their upgrading propensities.

The criterion proposed by Gereffi, Humphrey, and Sturgeon (2005) requires knowledge on suppliers' capability as well as on the complexity and codifiability of the transactions. Since this information is typically difficult to quantify, sector specific, and unavailable, we propose a similar classification based upon some indirect proxies. Our approach exploits data on the share of final goods sold, the existence of stable and relevant inter-firm relationships, the affiliation to corporate groups, and the degree of participation in the conception of the final product. Firms in GVCs are then classified into final producers, market/modular, hierarchical, captive, and relational suppliers according to the following characteristics:

1. *Final producers*: firms declaring their sales to entirely come from final —industrial or consumption— goods.⁶

⁵Notice that this classification is only feasible for manufacturing firms. Companies in the service sectors are defined to be in a GVC if they belong to international networks (without any further information on the destination/origin markets).

⁶The threshold used throughout the paper is 100% of sales from final goods. As a robustness check we also employ 90% or 80% without any relevant change in the results.

2. *Market/modular suppliers*: companies without any stable and relevant relationship with client firms.⁷

In this regard, the absence of strong ties with other companies in a GVC (even for commercial purposes) implies a low degree of dependence, and implicitly requires a high degree of codifiability of the transactions. This is positively correlated with the low switching costs characterizing both market and modular suppliers.⁸

3. *Hierarchical suppliers*: firms in a GVC that are subsidiaries of a corporate group (typically managerially controlled by a parent company representing the final producer of the chain).⁹

4. *Captive suppliers*: subcontractors with relevant and stable relationships with client firms, and no participation in the conception of the final product.¹⁰ The existence of relevant commercial networks proxies for their strong dependence, while the absence of participation in the definition of the final product captures the low capability of the supplier, as well as the potential high control/monitoring by the lead firm.

5. *Relational suppliers*: companies characterized by relevant stable relationships with client firms, and high degree of participation in the definition of the final product. Also in this case, relevant commercial networks proxy for mutual dependence, while firms' participation in the conception of the final product captures the high capability of the supplier.¹¹

Notice that the absence of information on asset specificity and degree of technological standardization of the product (i.e. modularity) makes for us impossible to uniquely identify modular suppliers. Instead, they are grouped together with market GVCs because of the high degree of independence shared by both forms of governance.¹²

⁷This information comes directly from the following question in the MET survey: "are there any stable and significant relationships with other companies for commercial purposes?".

⁸While the absence of strong ties with other firms is a crucial condition for market relationships, it may also capture a component of modularity. This is the case if, as we think, there is a positive correlation with firms' use of generic machinery allowing to spread investments across a wide customer base.

⁹To derive this piece of data we match information on the affiliation to corporate groups with a dummy variable for parent companies (imposed equal to zero).

¹⁰The existence of commercial network is defined as in Footnote 7, while firms' degree of participation in the conception of the final product comes from the following question in the MET survey: "to what extent does your firm participate in the conception and definition of the final product for the market?". The survey allows answers on a scale from zero to four. Throughout the core of the paper, captive suppliers are required to have no participation (0), but we also try alternative thresholds (1 or 2) with no significant changes in the results.

¹¹Throughout the paper we impose a positive threshold for firms' participation in the conception of the final product. We also test the robustness of our results to the adoption of alternative thresholds (greater than 1 or 2).

¹²On the one hand, market relationships typically deals with lowly-complex transactions that do not require a strong

Finally, it is worth emphasizing that the availability of repeated interviews implies an identification of GVC belonging that is time varying. In other words, our measures permit to capture changes in the GVC status as well as upgrading along the value chains. This variation has crucial importance in the identification of the effects of interest, allowing for the inclusion of firm-specific fixed effects aimed at purging the estimates from firms’ unobservable heterogeneity.

3.3 Econometric specification

The econometric analysis exploits the classification outlined in the previous sections to explore firms’ upgrading processes within GVCs. We take into account several definitions of upgrading, based upon the extensive and intensive margins of innovation, R&D, and export activity (only relevant for firms in long value chains), as well as firms’ productivity and sales growth. The baseline specifications test the existence of “upgrading premia” for firms in global and national value chains (Equation 1), or analyze heterogeneities across the different forms of GVC governance (Equation 2):

$$Pr(Y_{i,t} = 1) = \phi(\alpha_1 GVC_{i,t-1} + \alpha_2 NVC_{i,t-1} + \beta_1^\top X_{i,t-1} + \lambda_{i,t}^\top), \quad (1)$$

$$Pr(Y_{i,t} = 1) = \phi(\alpha^\top GVCgovernance_{i,t-1} + \beta_2^\top X_{i,t-1} + \lambda_{i,t}^\top); \quad (2)$$

where $Y_{i,t}$ is the dichotomous dependent variable —either innovation, R&D, or export—, $GVC_{i,t-1}$ and $NVC_{i,t-1}$ are indicators for global and national value chains, while $GVCgovernance_{i,t-1}$ is a vector of dummy variables identifying the beginning-of-period GVC forms of governance.¹³ The standard reduced form equations 1 and 2 include a rich set of covariates ($X_{i,t-1}$) capturing firms’ structural (size, age, sales, cash flow, market share, vertical integration, productivity) and strategic characteristics (affiliation to networks or groups of firms, human capital, as well as R&D and export activity),¹⁴ as well as time effects and controls for firms’ industry (12), region (20), or province (110) ($\lambda_{i,t}$). The latter aims at capturing common shocks

connection with customer firms. On the other, the relevant complexity of intermediate goods in modular chains is offset by technical standards (components and modules) preventing the birth of strong connections with the buyers. Indeed, Sturgeon and Gereffi (2008) state that “modular GVCs are the most market-like form of GVC governance and share the use of generic machinery as well as a wide customer base”.

¹³Notice that a positive association between GVCs and export status is intrinsic in the very definition of GVCs. What is not trivial is whether firms that belong to long GVCs (i.e. not internationalized) in $t - 1$, have a higher likelihood to upgrade and expand their activities abroad in time t . The rest of this section presents several approaches aimed at isolating this effect.

¹⁴A detailed definition of the variables employed is provided in Appendix.

that are time varying as well as permanent effects associated to the belonging sector or the geographical location of a company.¹⁵

Because of the high persistence in the phenomena of interest, most of the analysis is performed through pooled probit models with heteroskedasticity-consistent standard errors. However, we also implement some panel data estimators allowing for the inclusion of firm-specific and time fixed effects.¹⁶

There are two main issues we have to take into account in assessing the effects of GVCs on firms' upgrading propensity. The first one has to do with reverse causality, whereby GVCs do not foster upgrading processes but instead are themselves the consequence of successful upgradings. The second interrelated point is linked to the possible self selection of more dynamic companies into GVCs.

We address these econometric issues in several ways. First of all, we alleviate problems of reverse causality by ruling-out simultaneity bias. Matching current upgrading with lagged values of the GVC status partially solves reverse causation but may leave residual endogeneity if Y and GVC are highly persistent.¹⁷ To overcome this issue we estimate Equations 1 and 2 also on the subset of non-upgrading firms in $t - 1$ (i.e. $Y_{i,t-1} = 0$),¹⁸ or, alternatively, allowing an AR(1) process for the dependent variable.¹⁹ Moreover, we also employ conditional logistic models accounting for the inclusion of individual fixed effects that clean the estimation from all firms' (observable and unobservable) characteristics that are stable over time.²⁰ Notice that this approach permits to purge the possible self selection of permanently more dynamic firms into GVCs. Finally, we further take care of self selection by estimating our baseline specifications for a subsample of "balanced firms" recovered through Coarsened Exact Matching techniques (CEM, Iacus, King, and Porro,

¹⁵Notice that if we did not control for $\lambda_{i,t}$, and if GVCs (or some specific forms of GVC governance) were predominantly diffused within industries or geographical areas characterized by higher upgrading propensities, our estimates would be upward biased because of the neglected industrial and geographical components. Instead, $\lambda_{i,t}$ purges common effects and allows for a cross-industry/cross-region comparison. Similarly, the time effects aim at controlling for the possible correlation between GVC diffusion and unobserved shocks affecting the entire economy.

¹⁶Our choice of the econometric model is entirely driven by the research question we are dealing with. Although models that fully exploit the panel structure of the data have the great advantage to control for firm-specific idiosyncratic components, they require variation over time of the binary dependent variables. Given the high persistence and state-dependence of innovation, R&D, and export, these models produce an excessive reduction in the sample size, implying a selection bias due to the chosen empirical approach. However, we also present results from conditional logistic models in Section 5.5.

¹⁷Indeed, innovation activity and R&D typically display strong persistence because of the cumulative nature of learning processes (Rosenberg, 1976), "success-breeds-success" (Stoneman and David, 1986), or strategies of innovation/R&D smoothing.

¹⁸Notice that, when dealing with firms' exporting status, this approach rules out all the endogeneity that is intrinsic in the definition of GVC. Focusing on non-exporters in $t - 1$ is equivalent to explore the effect of long value chains (the only type of GVCs that is not excluded from the estimation sample) on firms' probability of exporting.

¹⁹This robustness check (not reported) is still performed through pooled probit models. It is worth stressing that the introduction of lagged dependent variables in our analysis (on a pooled cross-section and without any control for firm fixed effects) does not produce any bias in the estimators requiring the use of dynamic panel data techniques.

²⁰As anticipated in Footnote 16, the price to pay for the inclusion of firm fixed effects is a relevant reduction in the sample size (-56% to -92%, depending on the specification).

2011).²¹

The last econometric issue that is worth discussing is the possibility of correlated shocks. In other words, if there is a polarization of GVCs (or certain forms of GVC governance) within specific industries or geographical areas, firms' upgrading strategies may result from the reaction to unobserved correlated shocks rather than from the propulsive role of GVCs.²² To address this concern we enrich our baseline specifications with an extensive set of time fixed effects that are specific for firms' belonging industry (12 industries \times 3 periods), region (20 \times 3), and geographical province (110 \times 3).

Other estimations throughout the paper are variations upon the baseline specifications 1 and 2 and are discussed in Section 5.

4 Data

The main source of data is the MET database on Italian firms (Brancati, 2012), the widest survey administered in a single European country. The timing of the waves —2008, 2009, 2011, and 2013— allows to capture firms' behavior, performances, and strategies from the beginning of the Lehman turmoil to the conclusion of the sovereign debt crisis.²³ The sample is selected and stratified in order to guarantee representativeness at size, geographical region and industry levels (see Table 1 for some details). The dataset contains roughly 25,000 firms per wave, referring to both manufacturing (60%) and service industries (40%). The MET surveys contain a rich set of information including: type of goods sold and destination market, type of input purchased and origin market, existence and extension of inter-firm networks, affiliation to corporate groups, participation in the conception of the final product, as well as information on innovation, R&D, human capital, export, and several other firm-level characteristics.

Survey data are then matched with balance sheet information from CRIBIS D&B. From the original dataset the application of selection-filters produces a relevant contraction in the sample size. The major reduction comes from the focus (for econometric purposes) on multiply-interviewed companies and firms with

²¹In other words, we first employ a coarsened exact matching to identify a subsample of firms with the same *ex ante* probability of GVC belonging (matched for age, size, region, industry, human capital, and productivity), and then exploit the new balanced sample to re-estimate Equations 1 and 2.

²²This is the case if the two financial crises induced differential effects across industries and regions. Notice that, while we control for industrial and regional heterogeneities that are constant over time (embedded in $\lambda_{i,t}$), the baseline specification does not account for time-varying correlated shocks.

²³Each questionnaire asks for firms' situation at the end of the previous year.

complete balance-sheet information.²⁴ In addition, some observations are dropped because of unreasonable values (negative or nil assets, negative or nil sales) or to reduce the influence of outliers (balance sheet variables are censored at 1%). Depending on the specification, the final estimation sample ranges from 19,000 to 14,000 observations.

4.1 Descriptive statistics

Table 2 presents summary statistics for the main variables employed. Overall, 25% of the firms in the sample belongs to our definition of GVC (employing roughly 40% of the total labor force): 37% are final producers, while market/modular, captive, relational, and hierarchical suppliers are 21%, 13%, 21%, and 8%, respectively.

Table 3 reports conditional statistics for innovation, R&D, and export. Firms belonging to GVCs display higher propensities of upgrading, with shares of dynamic companies that are two-to-four times larger than non-GVC firms. This phenomenon is strongly heterogeneous across forms of governance and is mainly driven by the higher dynamism of final producers and relational suppliers.

The aim of the next section is to assess whether this evidence only represents a positive association, or instead there is a causal nexus linking GVCs and firms' upgrading propensity.

5 Results

This section presents the results of the paper. We first analyze the effect of GVC belonging on firms' probability of innovation and R&D. We then explore heterogeneities by GVC forms of governance and discuss the results for the intensive margins, as well as the real impact on productivity and sales growth.

5.1 GVC belonging and firms' upgrading

Table 4 presents results for the baseline specification (Equation 1) on the extensive margin of innovation. Firms belonging to GVCs display an innovative propensity that is 8%-to-5% higher than national value chains (not significant) and stand alone companies (our benchmark). This effect is robust to the inclusion of

²⁴This induces a sample reduction of about 60%.

a rich set of covariates; from simple controls for firms’ structural characteristics (column 1), to an extensive series of strategic behaviors (R&D, network and corporate group belonging, human capital, and export) and industrial/geographical fixed effects (columns 2 and 3).

In order to account for possible reverse causality driven by the persistence of firms’ innovativeness, columns 4–6 present the estimates for the subsample of non-innovative companies in $t - 1$ ($Y_{i,t-1} = 0$). Also in this case, GVC belonging is found to significantly foster firms’ innovative propensity (4% increase for the richest specification in column 6).

The other controls present sensible coefficients too. In line with *a priori* expectations structural characteristics play a critical role in affecting firm innovativeness, with large and young companies characterized by a higher likelihood of introducing innovations. As expected, firm innovative propensity heavily reacts to the availability of internal funds (cash flow), to the presence of R&D projects and skilled workers (human capital), and to the positive externalities from international trade. Moreover, the affiliation to corporate groups have a positive impact on firms’ probability of innovating, but belonging to “informal networks” plays an even more important role. The other estimates have ambiguous signs and are not robust along different specifications adopted.

Table 5 presents coherent results for the extensive margins of R&D. Firms involved in GVCs show greater dynamic propensities, translating into a probability of undertaking R&D projects that is 8%-to-5% higher than stand alone companies. Interestingly, national value chains seem to display relevant dynamic attitudes too (albeit lower than GVCs), but this effect tends to vanish once controlling for the persistence of the dependent variable (not significant in the richest specification of column 6).

5.2 Heterogeneities by GVC forms of governance

Once shown the higher upgrading propensity of firms in GVCs, we explore heterogeneities across the different forms of GVC of governance. Theoretical literature suggests that the mere participation in GVCs is not sufficient for a company’s upgrading, that instead is related to firm own way to operate within the chain. We empirically test this statement by enriching the baseline specification with the definitions of governance outlined in Section 3.2.

Table 6 presents the estimates for Equation 2 on firms’ innovativeness. Results clearly show that the effect of GVC belonging on the probability of introducing innovations is far from being homogeneous and strictly depends upon the form of inter-firm relationships within the value chain. Coherently with theoretical predictions, final producers and suppliers involved in relational GVCs display a degree of innovativeness that is 3%-to-10% higher than non-GVC companies.²⁵ These effects statistically dominate other forms of GVC governance (not significant in the richest specification of column 3), and are robust to the inclusion of controls for firms’ dynamic attitudes (R&D, human capital, and export activity) as well as for the persistence of the dependent variable (columns 4–6).

As an additional point, Table 7 also investigates differential effects for the breakdown of product, process, and organizational-managerial innovations.²⁶ As expected, final producers are more inclined to the introduction of new products (6% higher than non-GVC companies), but show no propensity for process and organizational-managerial improvements. *Vice versa*, relational suppliers display the broadest range of innovativeness, albeit with a strictly decreasing intensity from product (6%), to process (2.3%), and organizational innovations (2.1%). Finally, market/modular and hierarchical suppliers are characterised by a higher likelihood of introducing new production processes, while captive suppliers are more prone to adopt softer forms of improvements (i.e. organizational-managerial ones).²⁷

Table 8 presents the results for firms’ investment in R&D. Once again, the higher average degree of dynamism highlighted in the previous section (Table 5) hides relevant heterogeneities across forms of GVC governance. Coherently with our previous findings, final producers and highly-qualitative (relational) suppliers have a probability of undertaking R&D projects that is 8%-to-10% higher than non-GVC companies, while the effects of other forms of governance are never statistically significant.

The last form of strategic upgrading we analyze is related to firms’ degree of internationalization. While the positive association between GVCs and exporting status is induced by construction, our sample also includes companies involved in long GVCs (roughly 5%). This provides the opportunity to study whether

²⁵We also tried to classify NVCs by different forms of governance. Since their estimates are again never statistically different from zero, our choice throughout the rest of the paper is to focus only on the upgrading propensity of firms in GVCs, interpreting the estimated coefficients as deviations from stand alone companies and NVCs (our new benchmark).

²⁶Organizational-managerial innovations are defined as “the implementation of new organizational or managerial methods in the firms’ business practices, workplace organization or external relationships”. Even though they are clearly softer forms of innovation, this kind of improvements can be extremely relevant in economic context dominated by SMEs.

²⁷However, the effect on captive and hierarchical suppliers disappears once focusing on the subset of non-innovative firms in $t - 1$ (columns 4–6).

the insertion in a production process at the international level leads domestic companies to search for an international dimension. In other words, we ask whether the participation in long GVCs fosters a different form of upgrading achieved through the penetration into new markets.

Table 9 answers this question by presenting results for the subsample of non-exporters in $t - 1$. Firms participating in long GVCs (the only type of GVCs that is left in the estimation) have a probability of exporting that is roughly 60% higher than non-GVC companies, with an effect that is almost homogeneous across the different forms of governance. This provides evidence that, even if the form of governance dramatically affect firms' upgrading strategy, the mere affiliation to GVCs still produces significant effects in terms of market upgrading.

5.3 Intensive margins of innovation, R&D, and export

Previous findings clearly document a higher upgrading propensity for firms in GVCs, especially for final producers and relational suppliers. This section addresses a closely related question by analyzing their impact on the intensive margins of innovation, R&D, and export. In other words, we explore whether GVC belonging affects both probability *and* magnitude of firms' upgrading, or instead has effects that are limited to the extensive margins.

To this purpose, we re-estimate Equation 2 on a new set of dependent variables capturing the intensive margins of upgrading. We proxy the intensity of innovation with two alternative variables: the share of sales from products that are innovative for the market (capturing the weight of radical product innovations), and the share of sales from products that are innovative only for the firm (and not for the market, capturing softer forms of improvements such as mimicking products). Similarly, we proxy R&D intensity with firms' expenditure in R&D projects as a share of total sales, and export intensity as the share of sales from exported products.

Table 10 reports synthetic results from pooled tobit models. The estimates are mostly coherent with our previous findings. Not only GVC belonging fosters firms' probability of introducing innovations, but has also effects on the magnitude of the innovation introduced. Once again, the heterogeneity across forms of governance highlights a dominant role for final producers and relational suppliers, and no significant impact

for the other forms of GVCs (at least in the richest specifications of column 6). Importantly, their effect is stronger for the introduction of truly innovative products (second panels) than for the implementation of pre-existent innovations (first panels). Their higher dynamic attitude is confirmed by the third panels presenting results for R&D intensity.

Finally, GVC belonging also boosts the degree of international opening through strong and positive impact on firms' export activity. This effect is more homogeneous across forms of GVC governance and persist even for previously non-internationalized companies (belonging to long GVCs, column 6).

5.4 Real effects on productivity and sales growth

Once assessed the impact of GVC belonging on firms' upgrading strategies, we take a step forward and analyze the real effects on productivity and sales growth. The different nature of the dependent variables allows us to fully exploit the panel structure of the dataset and adopt a dynamic specification controlling for firm-specific and time fixed effects.

Table 11 reports the estimates from two-step system GMM models (Arellano and Bover, 1995; Blundell and Bond, 1998) with Windmeijer finite-sample correction of the standard errors. The estimator combines the original equation (in level) with its transformed version in first differences, allowing for a dynamic estimation of a small-T, large-N unbalanced panel, and taking into account heteroskedasticity and autocorrelation within firms. Endogenous variables are instrumented with appropriately-lagged levels in the differenced equation and with their first differences in the level equation.

Even controlling for previous realizations of the dependent variables, for structural and strategic characteristics that are time varying, common shocks, and stable firm-specific factors, GVC belonging is found to affect both productivity and sales growth.²⁸ This effect is extremely heterogeneous across forms of GVC governance and is stronger for firms' revenues than for productivity (as defined by the log-value added per worker).²⁹ Being a final producers increases firms' sales by about 7%, while has no significant effect on productivity. Differently, relational suppliers increase their value added by 10% more, and have a sales

²⁸Notice that the Arellano-Bond test of second-order serial correlation of the error term indicates that values lagged twice of more are legitimate instruments for our endogenous variables. Moreover, the Hansen J-test does not detect any misspecification of the estimated model.

²⁹We also tried to perform the analysis on firms' TFP as an alternative measure for productivity. Results are mostly coherent, albeit not always significant.

growth that is roughly 5% greater than other companies.³⁰ The other forms of GVC governance are again not statistically significant.³¹

5.5 Robustness

We run a number of robustness tests to check the validity of our results, mainly aimed at further exploring reverse causality, self selection, and the possibility of unobserved shocks.

- We allow the dependent variable to display an AR(1) process in Equations 1 and 2. This approach provides consistent results and rules out any endogeneity issue driven persistence of innovation and R&D.³²
- We include regressors' mean to account for firms' unobserved heterogeneity in the pooled probit framework. This allows to purge the specification from the possible spurious correlation between GVC belonging and some unobservable firm-specific factors that are stable over time. The inclusion of regressors' mean permits to control for most of the self selection and avoid the use of panel data techniques inducing relevant reductions in the sample size. Results are almost unaffected.
- We also exploit the panel structure of our dataset implementing conditional logistic regressions (on Equations 1 and 2) accounting for the inclusion of firm specific and time fixed effects. Even with a very reduced sample size, Table 12 presents results that are largely coherent with our previous findings, suggesting they are not driven by unobserved heterogeneity.
- We employ a mixed strategy relying on matching techniques to further explore the issue of self selection. First we exploit Coarsened Exact Matching models (CEM: Iacus, King, and Porro, 2011) to select a subsample of firms with the same *ex ante* probability of belonging to GVCs (the treatment variable).³³

We then repeat the analyses of Section 5 on the new balanced sample. Our results still indicate higher

³⁰Notice that, even if the dependent variable is in log-level, controlling for previous realizations of $Y_{i,t}$ allows to interpret the other estimates as partial effects on the growth rate.

³¹Table 11 also shows the validity of our instrumenting set by presenting p-values for the Arellano-Bond test of serial correlation and for the Hansen J-test of overidentifying restrictions.

³²Because we are still dealing with a pooled cross section, and we do not control for any firm fixed effects inducing the so called Nickell bias, the inclusion of lagged dependent variables does not require the adoption of the same dynamic panel data techniques employed in Table 11.

³³Firms are matched along some structural characteristic, as well as human capital and productivity (see Footnote 21 for further details).

upgrading propensities for GVC firms, especially for final producers and relational suppliers.

- We include time effects that are specific for firms' belonging industry (12×3), region (20×3), and province (110×3) to control for unobservable correlated shocks. Results are qualitatively unaffected.
- We implement multivariate probit models to account for third party factors affecting at the same time firms' innovativeness, R&D propensity, and export status. This approach accounts for the simultaneity of these phenomena allowing for a correlation across the error terms of the three equations. Results are largely unchanged.
- We put to test alternative definitions of relational and captive suppliers by employing different thresholds for firms' participation in the conception of the final product. Once again, only relational suppliers have a significant effect on firms' upgrading strategies.
- Additional robustness checks are related to the enrichment of the matrix $X_{i,t-1}$ with: further lags for balance sheet measures (lagged twice or three times), alternative definitions of firms' size (log of total assets), alternative measures for R&D and export in Tables 6 and 7 (R&D share, share of employees devoted to R&D projects, and export share), controls for the legal form of the company (partnerships, cooperatives and enterprises), for firms' productivity (defined as log-value added per worker, or TFP as computed by Levinsohn and Petrin, 2003), and financial status (leverage and composition of funding).
- We adopt alternative clustering of the standard errors (industry, region —with bootstrapping—, or province, as well as two-way clustering at the industry-region level). Statistical significance of the estimates is roughly unchanged.³⁴

6 Concluding remarks

Despite the large number of studies examining GVCs on a theoretical basis, the evidence at the micro level is still underwhelming. This paper contributes to the existent literature by empirically testing the effect of

³⁴Notice that, because of the weighting matrix used in the second step, alternative clustering also produces changes in the estimates of the two-step system-GMM models. Results are however consistent with the ones presented in the previous section.

GVC belonging on firms' upgrading capacity. Importantly, we address this research question by moving the attention away from LDCs, and examining the effects on Italian firms in times of crisis.

Our analysis exploits up-to-date survey data containing information on a large sample of SMEs, including micro-sized companies with less than ten employees. The empirical strategy of the paper exploits the richness of the MET database and provides a novel approach to identify GVCs and their form of governance. Our identification classifies five main GVC classes by matching information on type and destination markets of the goods sold, type and origin markets of the inputs purchased, the existence and length of inter-firm relationships, the affiliation to corporate groups, and firms' degree of participation in the conception of the final product. We then analyze the impact of GVC belonging and GVC forms of governance on firms' innovativeness, investment in R&D, export, performance, and productivity.

Our findings provide empirical support to the existence of upgrading premia for firms involved in GVCs, translating into a degree of innovativeness that is 8%-to-5% higher than stand-alone companies and enterprises in national value chains. These effects are very heterogeneous across forms of GVC governance, being stronger for final producers and highly-qualitative (relational) suppliers. This result is robust along several definitions of upgrading capacity, ranging from the extensive and intensive margins of innovation, R&D, and export, to measures of performance such as productivity and sales growth.

Finally, our results are stable across a rich set of robustness tests controlling for possible reverse causality, self selection, persistence of the phenomena of interest, and even for firm observable and unobservable heterogeneity.

References

- Accetturo, Antonio, Anna Giunta, and Salvatore Rossi, 2011, *Le imprese italiane tra crisi e nuova globalizzazione* (Banca d'Italia).
- Agostino, Mariarosaria, Anna Giunta, Jeffrey Nugent, Domenico Scalera, and Francesco Trivieri, 2014, The importance of being a capable supplier: Italian industrial firms in global value chains, *International Small Business Journal* (forthcoming).
- Amighini, Alessia, and Roberta Rabellotti, 2006, How do Italian footwear industrial districts face globalization?, *European Planning Studies* 14, 485–502.
- Arellano, Manuel, and Steve Bond, 1991, Some tests of specification for panel data: Montecarlo evidence and application to employment equations, *Review of Economic Studies* 58, 277–297.
- Arellano, Manuel, and Olympia Bover, 1995, Another look at the instrumental variable estimation of error-components models, *Journal of Econometrics* 68, 29–51.
- Bair, Jennifer, and Gary Gereffi, 2001, Local clusters in global chains: the causes and consequences of export dynamism in torreon's blue jeans industry, *World development* 29, 1885–1903.
- , 2003, Upgrading, uneven development, and jobs in the North American apparel industry, *Global Networks* 3, 143–169.
- Bazan, Luiza, and Lizbeth Navas-Alemán, 2004, The underground revolution in the Sinos Valley: A comparison of upgrading in global and national value chains, *Local enterprises in the global economy: Issues of governance and upgrading* 3, 110–139.
- Blundell, Richard, and Stephen Bond, 1998, Initial conditions and moment restrictions in dynamic panel data model, *Journal of Econometrics* 87, 115–143.
- Borras, Michael, Dieter Ernst, Stephan Haggard, et al., 2003, *International production networks in Asia: rivalry or riches* (Routledge).

- Brancati, Raffaele, 2012, Crisi industriale e crisi fiscale. Rapporto MET 2012. Le relazioni delle imprese, le criticità, il fisco e le politiche pubbliche, *Meridiana Libri*.
- Chiarvesio, Maria, and Eleonora Di Maria, 2009, Internationalization of supply networks inside and outside clusters, *International Journal of Operations & Production Management* 29, 1186–1207.
- , and Stefano Micelli, 2010, Global value chains and open networks: The case of Italian industrial districts, *European Planning Studies* 18, 333–350.
- Costa, Stefano, and Giovanni Ferri, 2007, The determinants and employment effects of international outsourcing: The case of Italy, *Dipartimento di Scienze Economiche, Università di Bari, Working Paper* 16.
- Daveri, Francesco, and Cecilia Jona-Lasinio, 2008, Off-shoring and productivity growth in the Italian manufacturing industries, *CESifo Economic Studies* 54, 414–450.
- Dolan, Catherine, and John Humphrey, 2000, Governance and trade in fresh vegetables: The impact of UK supermarkets on the African horticulture industry, *Journal of development studies* 37, 147–176.
- Evgeniev, Evgeni, and Gary Gereffi, 2008, Textile and apparel firms in turkey and bulgaria: Exports, local upgrading and dependency, *Economic Studies* 17, 148–179.
- Fernandez-Stark, Karina, Penny Bamber, and Gary Gereffi, 2011, The offshore services value chain: upgrading trajectories in developing countries, *International Journal of Technological Learning, Innovation and Development* 4, 206–234.
- Gereffi, Gary, 1999, International trade and industrial upgrading in the apparel commodity chain, *Journal of international economics* 48, 37–70.
- , and Stacey Frederick, 2010, The global apparel value chain, trade and the crisis: challenges and opportunities for developing countries, *World Bank Policy Research Working Paper Series, Vol.*
- Gereffi, Gary, John Humphrey, and Timothy Sturgeon, 2005, The governance of global value chains, *Review of international political economy* 12, 78–104.

- Gereffi, Gary, and Raphael Kaplinsky, 2001, The value of value chains: Spreading the gains from globalisation, *Institute of Development Studies Bulletin* 32, 1–8.
- Gereffi, Gary, and Miguel Korzeniewicz, 1994, Commodity chains and global capitalism, *ABC-CLIO* 149.
- Giovannetti, Giorgia, Enrico Marvasi, and Marco Sanfilippo, 2014, Supply chains and the internalization of SMEs: Evidence from Italy, *Robert Schuman Centre for Advanced Studies Research Paper* 62.
- Giuliani, Elisa, Carlo Pietrobelli, and Roberta Rabellotti, 2005, Upgrading in global value chains: Lessons from Latin American clusters, *World development* 33, 549–573.
- Giunta, Anna, Annamaria Nifo, and Domenico Scalera, 2012, Subcontracting in Italian industry: Labour division, firm growth and the North–South divide, *Regional Studies* 46, 1067–1083.
- Henderson, Jeffrey, Peter Dicken, Martin Hess, Neil Coe, and Henry Wai-Chung Yeung, 2002, Global production networks and the analysis of economic development, *Review of international political economy* 9, 436–464.
- Humphrey, John, 2003, Globalization and supply chain networks: the auto industry in brazil and india, *Global Networks* 3, 121–141.
- , and Hubert Schmitz, 2002, How does insertion in global value chains affect upgrading in industrial clusters?, *Regional studies* 36, 1017–1027.
- Iacus, Stefano, Gary King, and Giuseppe Porro, 2011, Causal inference without balance checking: Coarsened exact matching, *Political analysis* 20, 1–24.
- Kannegiesser, Matthias, 2008, Value chain management in the chemical industry, *Global value chain planning of commodities. Heidelberg: Physica-Verlag.*
- Lee, Joonkoo, Gary Gereffi, and Dev Nathan, 2013, Mobile phones: Who benefits in shifting global value chains?, *Capturing the Gains, Revised Summit Briefing.*
- Levinsohn, James, and Amil Petrin, 2003, Estimating production functions using inputs to control for unobservables, *The Review of Economic Studies* 70, 317–341.

- Morrison, Andrea, Carlo Pietrobelli, and Roberta Rabellotti, 2008, Global value chains and technological capabilities: a framework to study learning and innovation in developing countries, *Oxford Development Studies* 36, 39–58.
- Navas-Alemán, Lizbeth, 2011, The impact of operating in multiple value chains for upgrading: The case of the Brazilian furniture and footwear industries, *World Development* 39, 1386–1397.
- Nickell, Stephen, 1981, Biases in dynamic models with fixed effects, *Econometrica* 49, 1417–1426.
- OECD, 2013, *Interconnected Economies: Benefiting from Global Value Chains* (OECD Publishing).
- Pietrobelli, Carlo, and Roberta Rabellotti, 2011, Global value chains meet innovation systems: Are there learning opportunities for developing countries?, *World Development* 39, 1261–1269.
- Pietrobelli, Carlo, and Federica Saliola, 2008, Power relationships along the value chain: Multinational firms, global buyers and performance of local suppliers, *Cambridge Journal of Economics* 32, 947–962.
- Rosenberg, Nathan, 1976, On technological expectations, *Economic Journal* 86, 523–535.
- Saliola, Federica, and Antonello Zanfei, 2009, Multinational firms, global value chains and the organization of knowledge transfer, *Research Policy* 38, 369–381.
- Schmitz, Hubert, 1999, Global competition and local cooperation: success and failure in the sinos valley, brazil, *World development* 27, 1627–1650.
- , 2004, *Local enterprises in the global economy: Issues of governance and upgrading* (Edward Elgar Publishing).
- Stoneman, Paul, and Paul David, 1986, Adoption subsidies vs information provision as instruments of technology policy, *Economic Journal* pp. 142–150.
- Sturgeon, Timothy, and Richard Florida, 2004, Globalization, deverticalization, and employment in the motor vehicle industry, *Locating global advantage: Industry dynamics in the international economy* pp. 52–81.

- Sturgeon, Tim, and Gary Gereffi, 2008, The challenge of global value chains: Why integrative trade requires new thinking and new data, *Report for Industry Canada. Duke University: Durham*.
- Sturgeon, Timothy, and Richard K Lester, 2004, The new global supply-base: new challenges for local suppliers in east asia, *Global production networking and technological change in East Asia* pp. 35–87.
- Sturgeon, Timothy, and Olga Memedovic, 2010, Mapping global value chains: Intermediate goods trade and structural change in the world economy, *Development Policy and Strategic Research Branch Working Paper* 05.
- Sturgeon, Timothy, and Johannes Van Biesebroeck, 2010, Effects of the crisis on the automotive industry in developing countries : a global value chain perspective, *The World Bank: Policy Research Papers* 5330.
- , and Gary Gereffi, 2008, Value chains, networks and clusters: Reframing the global automotive industry, *Journal of economic geography* 8, 297–321.
- Sturgeon, Timothy J, 2002, Modular production networks: a new american model of industrial organization, *Industrial and corporate change* 11, 451–496.
- , and Momoko Kawakami, 2010, *Global value chains in the electronics industry: was the crisis a window of opportunity for developing countries?* (World Bank).
- Sturgeon, Timothy J, Olga Memedovic, Johannes Van Biesebroeck, and Gary Gereffi, 2009, Globalisation of the automotive industry: main features and trends, *International Journal of Technological Learning, Innovation and Development* 2, 7–24.
- Vind, Ingeborg, and Niels Fold, 2007, Multi-level modularity vs. hierarchy: global production networks in singapore’s electronics industry, *Geografisk Tidsskrift-Danish Journal of Geography* 107, 69–83.
- Windmeijer, Frank, 2005, A finite sample correction for the variance of linear efficient two-step GMM estimators, *Journal of Econometrics* 126, 25–51.

Tables

Table 1: Sample composition of the MET surveys

	2008	2009	2011	2013
Micro (1-9)	38.4%	60.0%	61.6%	48.1%
Small (10-49)	38.4%	26.0%	24.7%	33.6%
Medium (50-249)	19.5%	10.4%	10.6%	13.5%
Large (>250)	3.60%	3.50%	3.10%	4.80%
North	46.6%	39.8%	42.1%	40.2%
Center	32.0%	33.7%	31.8%	30.5%
South	21.4%	26.5%	26.1%	29.3%
High-tech	33.5%	29.1%	31.1%	31.9%
Non High-tech	66.5%	70.9%	68.9%	68.1%
# of firms	24896	22340	25090	25000

Notes: composition of the sample by firm size class (# of employees), geographical macro-region and industrial macro-sector (high-tech sectors are considered: chemicals, plastic, means of transportation, engineering, electric and electronic equipment). The original sample is mainly stratified along 12 industries, 20 regions and four size classes. The large amount of interviews is compatible with an oversampling of more innovative firms in the manufacturing sector, and of companies in certain geographical regions. The oversampling scheme is performed with Bayesian models exploiting the observed frequencies of previous waves. The survey is administrated *via* phone calls or *via* web with the assistance of a phone operator. The actual administration follows a preselection of the most suitable answerer. In the case of incoherent answers along the survey, firms are interviewed a second time as an additional control of validity. For further details about the sampling scheme, the administration methods, and the control procedures see Brancati (2012).

Table 2: Descriptive statistics.

Variable	Type	Mean	Std.	Min	Max
GVC	Dummy	0.251	0.406	0.000	1.000
NVC	Dummy	0.254	0.435	0.000	1.000
Final	Dummy	0.094	0.292	0.000	1.000
Mark/Mod	Dummy	0.052	0.222	0.000	1.000
Captive	Dummy	0.032	0.177	0.000	1.000
Relational	Dummy	0.055	0.228	0.000	1.000
Hierarchy	Dummy	0.018	0.134	0.000	1.000
Innovation	Dummy	0.302	0.459	0.000	1.000
Export	Dummy	0.240	0.427	0.000	1.000
R&D	Dummy	0.150	0.357	0.000	1.000
Prod	Dummy	0.189	0.391	0.000	1.000
Proc	Dummy	0.149	0.356	0.000	1.000
Org	Dummy	0.169	0.374	0.000	1.000
Share innovation (firm)	Bounded	3.183	13.49	0.000	100.0
Share innovation (market)	Bounded	4.482	17.22	0.000	100.0
Export share	Bounded	10.12	21.39	0.000	100.0
R&D share	Bounded	0.915	5.090	0.000	100.0
Log-productivity	Continuous	10.51	1.105	-0.654	17.32
Log-sales	Continuous	14.74	1.636	10.35	18.87
Size	Continuous	2.441	1.399	0.693	10.72
Age	Continuous	2.704	0.933	0.000	7.607
Sales	Continuous	1.145	0.787	0.000	4.365
Cash flow	Continuous	0.024	0.106	-0.389	0.410
Market share	Bounded	0.029	0.070	0.000	0.496
Vertical integration	Continuous	0.268	0.280	0.000	0.951
Network	Dummy	0.367	0.482	0.000	1.000
Group	Dummy	0.134	0.340	0.000	1.000
Human capital	Bounded	7.610	17.32	0.000	100.0

Notes: descriptive statistics for the main variables employed. All measures are defined in Appendix.

Table 3: Conditional upgrading propensity by GVC form of governance.

	Innovation	R&D	Export
Non GVC	18.9%	9.67%	10.2%
GVC	41.1%	36.8%	67.8%
Final	44.1%	42.5%	68.9%
Mark/Mod	39.1%	14.9%	62.5%
Captive	31.4%	21.5%	64.5%
Relational	43.1%	39.8%	69.8%
Hierarchy	30.6%	26.6%	64.9%

Notes: percentage of innovative firms (column 1), R&D companies (column 2), and exporters (column 3) conditionally on their participation in GVCs and GVC forms of governance. All measures are defined in Appendix.

Table 4: GVC belonging and firms' innovativeness.

Sample:	Y: Innovation					
	(1)	Entire (2)	(3)	Innovation _{t-1} = 0		
				(4)	(5)	(6)
GVC	0.080*** [0.009]	0.048*** [0.009]	0.048*** [0.009]	0.069*** [0.008]	0.044*** [0.008]	0.043*** [0.008]
NVC	0.013 [0.009]	0.008 [0.009]	0.008 [0.009]	0.010 [0.008]	0.005 [0.008]	0.005 [0.008]
Size	0.053*** [0.002]	0.032*** [0.002]	0.031*** [0.002]	0.022*** [0.002]	0.009*** [0.002]	0.009*** [0.002]
Age	-0.012** [0.005]	-0.007 [0.005]	-0.006 [0.005]	-0.007 [0.005]	-0.002 [0.004]	-0.002 [0.004]
Sales	-0.016*** [0.004]	-0.006 [0.004]	-0.006 [0.004]	-0.001 [0.004]	0.006 [0.004]	0.006 [0.004]
Cash flow	0.176*** [0.036]	0.142*** [0.034]	0.142*** [0.034]	0.113*** [0.033]	0.087*** [0.031]	0.083*** [0.031]
Market share	0.039 [0.046]	-0.081* [0.045]	-0.098** [0.046]	-0.163*** [0.048]	-0.221*** [0.047]	-0.244*** [0.047]
Vertical integration	-0.015 [0.012]	-0.001 [0.012]	-0.002 [0.011]	-0.019* [0.011]	-0.011 [0.010]	-0.008 [0.010]
R&D		0.262*** [0.006]	0.263*** [0.007]		0.181*** [0.006]	0.172*** [0.006]
Network		0.063*** [0.008]	0.062*** [0.008]		0.086*** [0.007]	0.088*** [0.007]
Group		0.051*** [0.008]	0.046*** [0.008]		0.014* [0.007]	0.012 [0.007]
Human capital			0.023 [0.017]			0.097*** [0.014]
Export			0.001*** [0.0001]			0.001** [0.0001]
Controls						
Time	yes	yes	yes	yes	yes	yes
Industry(12)	yes	yes	yes	yes	yes	yes
Region(20)	yes	yes	no	yes	yes	no
Province (110)	no	no	yes	no	no	yes
# obs.	18887	18887	18797	14112	14112	14057
Pseudo-R ²	0.109	0.162	0.163	0.098	0.157	0.176
Loglik	-10372	-9756	-9692	-5362	-5010	-4886
LR $\chi^2()$	2543***	3775***	3764***	1168***	1872***	2094***

Notes: marginal effects from probit models. The dependent variable is *Innovation*. The left panel reports the estimates on the entire sample, while the right panel refers to subset of non-innovative firms in $t - 1$. All measures are defined in Appendix. *, **, *** denote, respectively, significance at 10%, 5%, and 1% level. Robust standard errors in brackets.

Table 5: GVC belonging and firms' investment in R&D.

Sample:	Y: R&D					
	(1)	Entire (2)	(3)	(4)	R&D _{t-1} = 0 (5)	(6)
GVC	0.076*** [0.007]	0.076*** [0.008]	0.074*** [0.008]	0.044*** [0.006]	0.044*** [0.006]	0.052*** [0.009]
NVC	0.025*** [0.008]	0.025*** [0.008]	0.023*** [0.008]	0.013** [0.006]	0.013** [0.006]	0.014 [0.009]
Size	0.054*** [0.002]	0.053*** [0.002]	0.052*** [0.002]	0.022*** [0.002]	0.021*** [0.002]	0.019*** [0.002]
Age	-0.011*** [0.004]	-0.012*** [0.004]	-0.010** [0.004]	-0.009*** [0.003]	-0.010*** [0.003]	-0.009** [0.003]
Sales	-0.027*** [0.004]	-0.026*** [0.004]	-0.023*** [0.004]	-0.013*** [0.003]	-0.012*** [0.003]	-0.011*** [0.003]
Cash flow	0.111*** [0.030]	0.118*** [0.030]	0.102*** [0.030]	0.067*** [0.025]	0.064** [0.025]	0.047* [0.025]
Market share	0.101*** [0.036]	0.101*** [0.037]	0.067* [0.037]	-0.044 [0.036]	-0.054 [0.036]	-0.079** [0.037]
Vertical integration	-0.030*** [0.010]	-0.040*** [0.010]	-0.026*** [0.010]	-0.020** [0.008]	-0.019** [0.008]	-0.011 [0.008]
Network		0.073*** [0.007]	0.069*** [0.007]		0.057*** [0.006]	0.058*** [0.006]
Group		0.012*** [0.007]	0.009 [0.006]		0.011* [0.006]	0.006 [0.006]
Human capital			0.210*** [0.013]			0.147*** [0.010]
Export			0.002*** [0.0001]			0.001*** [0.0001]
Controls						
Time	yes	yes	yes	yes	yes	yes
Industry(12)	yes	yes	yes	yes	yes	yes
Region(20)	yes	yes	no	yes	yes	no
Province (110)	no	no	yes	no	no	yes
# obs.	18888	18888	18797	15966	15966	15663
Pseudo-R ²	0.216	0.235	0.265	0.144	0.145	0.182
Loglik	-7670	-7669	-4325	-4314	-4214	-4121
LR $\chi^2()$	4235***	4238***	4242***	1455***	1458***	1522***

Notes: marginal effects from probit models. The dependent variable is $R\&D$. The left panel reports the estimates on the entire sample, while the right panel refers to subset of firms with no R&D projects in $t - 1$. All measures are defined in Appendix. *, **, *** denote, respectively, significance at 10%, 5%, and 1% level. Robust standard errors in brackets.

Table 6: GVC forms of governance and firms' innovativeness.

Sample:	Y: Innovation					
	(1)	Entire (2)	(3)	Innovation _{t-1} = 0		
				(4)	(5)	(6)
Final	0.101*** [0.010]	0.051*** [0.011]	0.032*** [0.011]	0.096*** [0.008]	0.061*** [0.009]	0.054*** [0.010]
Mark/Mod	0.041*** [0.014]	0.024* [0.014]	0.017 [0.014]	0.037*** [0.013]	0.028** [0.013]	0.023* [0.013]
Captive	0.049*** [0.017]	0.042** [0.017]	0.026 [0.017]	0.013 [0.015]	0.010 [0.016]	0.003 [0.016]
Relational	0.100*** [0.012]	0.056*** [0.013]	0.038*** [0.013]	0.074*** [0.011]	0.041*** [0.012]	0.033*** [0.012]
Hierarchy	0.054*** [0.018]	0.007 [0.019]	0.003 [0.019]	0.040** [0.017]	0.027 [0.017]	0.026 [0.018]
Size	0.058*** [0.002]	0.033*** [0.002]	0.031*** [0.002]	0.022*** [0.002]	0.010*** [0.002]	0.009*** [0.002]
Age	-0.012** [0.005]	-0.006 [0.005]	-0.006 [0.005]	-0.007 [0.005]	-0.002 [0.004]	-0.002 [0.004]
Sales	-0.016*** [0.004]	-0.006 [0.004]	-0.006 [0.004]	-0.001 [0.004]	0.006 [0.004]	0.006 [0.004]
Cash flow	0.195*** [0.036]	0.153*** [0.034]	0.143*** [0.034]	0.119*** [0.033]	0.089*** [0.031]	0.083*** [0.031]
Market share	0.085* [0.046]	-0.052 [0.045]	-0.095** [0.046]	-0.151*** [0.048]	-0.218*** [0.047]	-0.244*** [0.047]
Vertical integration	-0.027** [0.012]	-0.008 [0.012]	-0.002 [0.011]	-0.023** [0.011]	-0.013 [0.010]	-0.008 [0.010]
R&D		0.270*** [0.006]	0.263*** [0.007]		0.181*** [0.006]	0.172*** [0.006]
Network		0.066*** [0.008]	0.068*** [0.008]		0.088*** [0.007]	0.088*** [0.007]
Group		0.052*** [0.008]	0.046*** [0.008]		0.014* [0.007]	0.011 [0.007]
Human capital			0.023 [0.017]			0.097*** [0.014]
Export			0.001*** [0.0001]			0.001** [0.0001]
Controls						
Time	yes	yes	yes	yes	yes	yes
Industry(12)	yes	yes	yes	yes	yes	yes
Region(20)	yes	yes	no	yes	yes	no
Province (110)	no	no	yes	no	no	yes
# obs.	18888	18888	18797	14112	14112	14057
Pseudo-R ²	0.095	0.151	0.162	0.097	0.157	0.177
Loglik	-10537	-9877	-9696	-5364	-5009	-4882
LR χ^2 ()	2214***	3533***	3756***	1163***	1874***	2103***

Notes: marginal effects from probit models. The dependent variable is *Innovation*. The left panel reports the estimates on the entire sample, while the right panel refers to subset of non-innovative firms in $t - 1$. All measures are defined in Appendix. *, **, *** denote, respectively, significance at 10%, 5%, and 1% level. Robust standard errors in brackets.

Table 7: GVC forms of governance and firms' innovativeness: heterogeneities by innovation type.

Sample: Form of innovation:	Y: Form of innovation					
	Entire			Innovation _{t-1} = 0		
	Prod (1)	Proc (2)	Org (3)	Prod (4)	Proc (5)	Org (6)
Final	0.061*** [0.008]	-0.009 [0.008]	-0.013 [0.009]	0.061*** [0.007]	0.010 [0.006]	0.006 [0.007]
Mark/Mod	0.009 [0.011]	0.023** [0.011]	0.007 [0.012]	0.010 [0.010]	0.017* [0.009]	0.004 [0.010]
Captive	0.017 [0.014]	0.021* [0.013]	0.032** [0.015]	0.007 [0.012]	0.012 [0.011]	0.018 [0.012]
Relational	0.057*** [0.011]	0.023** [0.010]	0.021* [0.011]	0.051*** [0.009]	0.015* [0.008]	0.024** [0.009]
Hierarchy	0.019 [0.015]	0.028** [0.012]	-0.019 [0.015]	0.015 [0.012]	0.012 [0.010]	0.009 [0.013]
Size	0.012*** [0.002]	0.022*** [0.002]	0.030*** [0.002]	0.003* [0.002]	0.007*** [0.001]	0.011*** [0.002]
Age	-0.006 [0.004]	-0.002 [0.004]	-0.015*** [0.004]	-0.002 [0.003]	0.001 [0.003]	-0.006* [0.003]
Sales	-0.008** [0.004]	-0.004 [0.003]	0.002 [0.003]	0.001 [0.003]	0.002 [0.003]	0.006** [0.003]
Cash flow	0.091*** [0.029]	0.097*** [0.028]	0.089*** [0.029]	0.049** [0.025]	0.069*** [0.023]	0.055** [0.024]
Market share	-0.041 [0.036]	0.044 [0.033]	0.005 [0.037]	-0.132*** [0.033]	-0.045 [0.029]	-0.114*** [0.033]
Vertical integration	-0.012 [0.010]	0.008 [0.010]	0.007 [0.010]	-0.012 [0.008]	-0.002 [0.008]	-0.002 [0.008]
R&D	0.230*** [0.005]	0.150*** [0.005]	0.114*** [0.006]	0.141*** [0.004]	0.091*** [0.004]	0.072*** [0.005]
Network	0.028*** [0.007]	0.044*** [0.007]	0.051*** [0.007]	0.036*** [0.005]	0.055*** [0.005]	0.056*** [0.006]
Group	0.004 [0.007]	0.021*** [0.006]	0.039*** [0.007]	-0.015 [0.016]	0.011* [0.007]	0.015** [0.006]
Human capital	0.017 [0.014]	0.005 [0.013]	0.030** [0.014]	0.069*** [0.011]	0.045*** [0.010]	0.049*** [0.011]
Export	0.001*** [0.0001]	0.001*** [0.0001]	0.0001 [0.0001]	0.001*** [0.0001]	0.001*** [0.0001]	0.0001 [0.0001]
Controls						
Time	yes	yes	yes	yes	yes	yes
Industry(12)	yes	yes	yes	yes	yes	yes
Region(20)	yes	yes	no	yes	yes	no
Province (110)	yes	yes	yes	yes	yes	yes
# obs.	18797	18798	18798	15891	15962	16028
Pseudo-R ²	0.208	0.144	0.091	0.222	0.167	0.109
Loglik	-7260	-6924	-7883	-3908	-3612	-4224
LR $\chi^2()$	3817***	2347***	1590***	2235***	1452***	1036***

Notes: marginal effects from probit models. The dependent variables are product innovations (*Prod*) in columns 1 and 4, process innovations (*Proc*) in columns 2 and 5, or organizational-managerial innovations (*Org*) in columns 3 and 6. The left panel reports the estimates on the entire sample, while the right panel refers to subset of non-innovative firms in $t - 1$. All measures are defined in Appendix. *, **, *** denote, respectively, significance at 10%, 5%, and 1% level. Robust standard errors in brackets.

Table 8: GVC forms of governance and firms' investment in R&D.

Y: R&D						
Sample:	Entire			R&D _{t-1} = 0		
	(1)	(2)	(3)	(4)	(5)	(6)
Final	0.129*** [0.007]	0.150*** [0.008]	0.103*** [0.008]	0.087*** [0.006]	0.103*** [0.007]	0.088*** [0.007]
Mark/Mod	0.045*** [0.011]	0.033*** [0.011]	0.018 [0.011]	0.021** [0.010]	0.010 [0.011]	0.006 [0.010]
Captive	0.027** [0.013]	0.052*** [0.014]	0.023* [0.014]	0.003 [0.012]	0.022* [0.013]	0.015 [0.013]
Relational	0.112*** [0.009]	0.139*** [0.010]	0.097*** [0.011]	0.073*** [0.008]	0.094*** [0.009]	0.078*** [0.009]
Hierarchy	0.013 [0.014]	0.005 [0.015]	0.001 [0.014]	-0.011 [0.013]	-0.018 [0.014]	-0.018 [0.014]
Size	0.062*** [0.002]	0.060*** [0.002]	0.051*** [0.002]	0.022*** [0.002]	0.021*** [0.002]	0.019*** [0.002]
Age	-0.012*** [0.004]	-0.012*** [0.004]	-0.011** [0.004]	-0.009*** [0.003]	-0.010*** [0.003]	-0.009** [0.003]
Sales	-0.028*** [0.004]	-0.026*** [0.004]	-0.023*** [0.004]	-0.013*** [0.003]	-0.012*** [0.003]	-0.011*** [0.003]
Cash flow	0.130*** [0.030]	0.128*** [0.030]	0.103*** [0.030]	0.067*** [0.025]	0.064** [0.025]	0.047* [0.025]
Market share	0.136*** [0.036]	0.121*** [0.037]	0.073** [0.037]	-0.044 [0.036]	-0.054 [0.036]	-0.079** [0.037]
Vertical integration	-0.042*** [0.010]	-0.040*** [0.010]	-0.026*** [0.010]	-0.020** [0.008]	-0.019** [0.008]	-0.011 [0.008]
Network		0.059*** [0.007]	0.063*** [0.007]		0.057*** [0.006]	0.058*** [0.006]
Group		0.019*** [0.007]	0.009 [0.006]		0.011* [0.006]	0.006 [0.006]
Human capital			0.210*** [0.013]			0.147*** [0.010]
Export			0.002*** [0.0001]			0.001*** [0.0001]
Controls						
Time	yes	yes	yes	yes	yes	yes
Industry(12)	yes	yes	yes	yes	yes	yes
Region(20)	yes	yes	no	yes	yes	no
Province (110)	no	no	yes	no	no	yes
# obs.	18888	18888	18797	15966	15966	15663
Pseudo-R ²	0.202	0.204	0.242	0.135	0.138	0.173
Loglik	-7809	-7792	-7400	-4366	-4356	-4145
LR χ^2 ()	3958***	3992***	4726***	1373***	1394***	1745***

Notes: marginal effects from probit models. The dependent variable is $R\&D$. The left panel reports the estimates on the entire sample, while the right panel refers to subset of firms with no R&D projects in $t - 1$. All measures are defined in Appendix. *, **, *** denote, respectively, significance at 10%, 5%, and 1% level. Robust standard errors in brackets.

Table 9: Forms of governance in long GVCs and firms' exporting status.

Y: Export						
Sample:	Export $_{t-1} = 0$					
	(1)	(2)	(3)	(4)	(5)	(6)
GVC	0.637*** [0.007]	0.615*** [0.007]	0.609*** [0.007]			
Final				0.530*** [0.013]	0.630*** [0.013]	0.585*** [0.016]
Mark/Mod				0.338*** [0.018]	0.285*** [0.016]	0.233*** [0.016]
Captive				0.402*** [0.020]	0.544*** [0.019]	0.646*** [0.028]
Relational				0.450*** [0.015]	0.597*** [0.015]	0.600*** [0.018]
Hierarchy				0.107*** [0.032]	0.118*** [0.030]	0.109*** [0.032]
Size	0.023*** [0.002]	0.016*** [0.002]	0.015*** [0.002]	0.023*** [0.002]	0.013*** [0.002]	0.012*** [0.002]
Age	0.003 [0.004]	0.005 [0.004]	0.003 [0.004]	-0.001 [0.004]	0.001 [0.004]	0.001 [0.004]
Sales	-0.010*** [0.003]	-0.006 [0.003]	-0.006 [0.004]	-0.011*** [0.003]	-0.005 [0.003]	-0.005 [0.003]
Cash flow	0.118*** [0.028]	0.102*** [0.027]	0.092*** [0.027]	0.098*** [0.029]	0.083*** [0.027]	0.076*** [0.027]
Market share	0.111*** [0.043]	0.077** [0.041]	0.096** [0.044]	0.148*** [0.043]	0.105** [0.041]	0.111*** [0.042]
Vertical integration	-0.071*** [0.009]	-0.055*** [0.009]	-0.052*** [0.009]	-0.071*** [0.009]	-0.059*** [0.009]	-0.059*** [0.009]
R&D		0.113*** [0.006]	0.106*** [0.006]		0.096*** [0.006]	0.093*** [0.006]
Network		-0.211*** [0.007]	-0.160*** [0.007]		-0.159*** [0.007]	-0.160*** [0.007]
Group		0.015** [0.007]	0.014** [0.007]		0.015** [0.007]	0.014** [0.007]
Human capital			0.048*** [0.014]			0.048*** [0.014]
Controls						
Time	yes	yes	yes	yes	yes	yes
Industry(12)	yes	yes	yes	yes	yes	yes
Region(20)	yes	yes	no	yes	yes	no
Province (110)	no	no	yes	no	no	yes
# obs.	16439	16439	16356	16439	16439	16356
Pseudo-R ²	0.514	0.528	0.535	0.503	0.555	0.562
Loglik	-5309	-5160	-5058	-5192	-4644	-4543
LR χ^2 ()	11267***	11565***	11651***	10511***	11607***	11686***

Notes: marginal effects from probit models. The dependent variable is Export. Both the left and right panels report the estimates on the subset of non-exporter firms in $t - 1$. All measures are defined in Appendix. *, **, *** denote, respectively, significance at 10%, 5%, and 1% level. Robust standard errors in brackets.

Table 10: GVC forms of governance and firms' upgrading: intensive margins.

	Whole sample			$Y_{t-1} = 0$		
Y: Share innovation (firm)						
Final	18.73*** [2.484]	14.21*** [2.773]	10.65*** [2.828]	30.55*** [4.391]	27.88*** [5.017]	20.79*** [5.295]
Mark/Mod	6.396* [3.657]	0.338 [3.646]	0.186 [3.677]	15.36** [6.923]	8.279 [6.952]	6.644 [6.911]
Captive	9.726** [4.394]	14.11*** [4.574]	9.404** [4.533]	-4.072 [8.671]	8.155 [8.985]	2.410 [9.074]
Relational	20.71*** [3.058]	18.74*** [3.463]	13.01*** [3.609]	31.36*** [5.387]	30.56*** [6.267]	23.99*** [6.396]
Hierarchy	-0.464 [4.382]	-5.740 [4.534]	-5.899 [4.788]	-6.631 [8.344]	-1.304 [8.775]	-3.349 [8.808]
Y: Share innovation (market)						
Final	33.94*** [3.756]	22.69*** [4.194]	13.92*** [4.422]	48.28*** [5.678]	41.08*** [6.654]	27.64*** [6.890]
Mark/Mod	5.590 [5.690]	-1.066 [5.654]	-3.876 [5.646]	14.72 [9.125]	7.196 [9.222]	4.750 [9.027]
Captive	8.332 [6.983]	11.52 [7.218]	6.142 [7.250]	2.042 [11.07]	10.00 [11.70]	1.870 [11.57]
Relational	32.70*** [4.675]	23.74*** [5.287]	16.03*** [5.398]	47.89*** [6.914]	42.19*** [8.177]	28.75*** [8.220]
Hierarchy	6.135 [6.716]	7.049 [6.958]	3.952 [7.002]	11.82 [10.22]	20.80* [10.92]	18.63* [10.79]
Y: R&D share						
Final	8.046*** [0.717]	9.811*** [0.826]	9.391*** [0.815]	12.51*** [1.270]	15.59*** [1.484]	10.72*** [1.543]
Mark/Mod	3.051*** [1.040]	2.133** [1.064]	1.854* [1.050]	4.322** [2.018]	2.326 [2.104]	0.848 [2.052]
Captive	2.057* [1.246]	4.068*** [1.338]	4.174*** [1.318]	-0.327 [2.376]	3.410 [2.564]	0.578 [2.533]
Relational	7.599*** [0.871]	9.742*** [1.019]	9.205*** [1.005]	8.030*** [1.529]	12.08*** [1.839]	7.639*** [1.855]
Hierarchy	1.221 [1.055]	-0.003 [1.133]	0.355 [1.118]	-3.571 [2.564]	-4.920* [2.735]	-5.223* [2.706]
Y: Export share						
Final	43.80*** [0.865]	49.85*** [0.961]	49.77*** [0.962]	66.55*** [1.804]	77.63*** [1.932]	77.32*** [1.930]
Mark/Mod	21.34*** [1.166]	16.58*** [1.153]	16.46*** [1.155]	36.28*** [2.313]	25.69*** [2.274]	25.15*** [2.278]
Captive	31.74*** [1.378]	41.13*** [1.440]	41.10*** [1.441]	47.23*** [2.727]	63.33*** [2.819]	62.93*** [2.816]
Relational	35.40*** [1.042]	44.18*** [1.170]	43.93*** [1.171]	51.63*** [2.067]	68.76*** [2.285]	67.92*** [2.284]
Hierarchy	5.437*** [1.485]	5.357*** [1.570]	5.662*** [1.579]	15.81*** [3.445]	17.96*** [3.532]	17.40*** [3.542]
Time	yes	yes	yes	yes	yes	yes
Industry(12)	yes	yes	yes	yes	yes	yes
Region(20)	yes	yes	no	yes	yes	no
Province (110)	no	no	yes	no	no	yes

Notes: estimates from tobit regression models. The dependent variables are *Share innovation (firm)* in the top panels, *Share innovation (market)* in the second panels, *R&D share* in the third panels, and *Export share* in the last panels. Left panels report the estimates on the entire sample, while right panels refer to subset of firms for which $Y_{t-1} = 0$. All measures are defined in Appendix. Additional covariates in the estimations (not shown) varies across columns and follow the specifications in Table 6 for the two top panels, Table 8 for the third panels, and Table 9 for the last panels. *, **, *** denote, respectively, significance at 10%, 5%, and 1% level. Robust standard errors in brackets.

Table 11: GVC belonging, forms of governance, productivity, and sales.

Y:	Log-productivity		Log-sales	
	(1)	(2)	(3)	(4)
GVC	0.0950*		0.0883***	
	[0.0526]		[0.0276]	
Final		-0.0353		0.0772***
		[0.0558]		[0.0214]
Mark/Mod		-0.00606		-0.0182
		[0.0590]		[0.0237]
Captive		0.0520		0.0423
		[0.0513]		[0.0300]
Relational		0.0957**		0.0495**
		[0.0484]		[0.0241]
Hierarchy		-0.0683		-0.0398
		[0.0903]		[0.0377]
$Y_{i,t-1}$	0.277***	0.276***	0.981***	0.981***
	[0.0432]	[0.0429]	[0.0289]	[0.0286]
Age	0.167	0.0171	0.00103	-0.000406
	[0.125]	[0.0307]	[0.00623]	[0.00627]
Size	-0.436	0.0410	0.0493*	0.0505*
	[0.373]	[0.0784]	[0.0277]	[0.0273]
Export	0.371	0.0643	-0.000741	-0.000539
	[0.262]	[0.0600]	[0.001340]	[0.00303]
Fixed effects				
Time	yes	yes	yes	yes
Firm	yes	yes	yes	yes
# obs.	7578	7578	17682	17682
Hansen p-value	0.217	0.344	0.292	0.411
AR(1) p-value	0.000	0.000	0.000	0.000
AR(2) p-value	0.271	0.311	0.675	0.698

Notes: estimates from two-step system GMM models with time and firm fixed effects. The dependent variables are *Log-productivity* in columns 1 and 2, and *Log-sales* in columns 3 and 4. All measures are defined in Appendix. All variables are instrumented with their lagged (2 and 3) levels in the differenced equation, and with their first difference in the level equation. *Hansen p-value* reports the p-value of the Hansen J test of over identifying restrictions. *AR(q) p-value* denotes the Arellano and Bond (1991) test of qth order serial correlation. *, **, *** denote, respectively, significance at 10%, 5%, and 1% level. Standard errors with Windmeijer finite-sample correction in brackets.

Table 12: GVC forms of governance and firms' upgrading: controlling for unobserved heterogeneity.

Y:	Innovation		R&D		Export	
	(1)	(2)	(3)	(4)	(5)	(6)
Final	0.471*** [0.162]	0.352** [0.173]	0.585*** [0.219]	0.583*** [0.220]	3.015*** [0.589]	2.998*** [0.586]
Mark/Mod	0.271 [0.256]	0.253 [0.272]	0.824** [0.334]	0.763** [0.337]	0.805 [0.535]	0.680 [0.556]
Captive	0.382 [0.295]	0.301 [0.308]	-0.640* [0.378]	-0.583 [0.379]	2.508*** [0.671]	2.680*** [0.690]
Relational	0.646*** [0.224]	0.439* [0.241]	0.648** [0.277]	0.675** [0.279]	3.230*** [0.645]	3.322*** [0.675]
Hierarchy	0.332 [0.415]	0.372 [0.467]	-0.197 [0.476]	-0.468 [0.512]	1.565** [0.665]	1.689** [0.831]
Size	0.181 [0.121]	0.0529 [0.129]	0.623*** [0.181]	0.591*** [0.183]	0.474* [0.281]	0.456 [0.296]
Age	0.780 [1.080]	0.813 [1.175]	-0.859 [1.384]	-0.972 [1.383]	-5.520** [2.592]	-5.302** [2.660]
Sales	0.260 [0.189]	0.413** [0.201]	-0.092 [0.257]	-0.068 [0.260]	-1.012* [0.527]	-1.010* [0.554]
Cash flow	-1.050 [0.970]	-1.266 [1.013]	-1.853 [1.521]	-1.847 [1.523]	-2.090 [2.948]	-1.913 [3.066]
Market share	-3.837 [4.129]	-4.346 [4.435]	3.225 [6.008]	3.073 [5.973]	8.664 [13.02]	7.224 [13.12]
Vertical integration	0.277 [0.486]	0.169 [0.495]	1.827** [0.788]	1.813** [0.777]	-0.977 [1.592]	-0.919 [1.641]
Network		0.563*** [0.127]		0.501*** [0.167]		0.0778 [0.589]
Group		0.191 [0.219]		0.279 [0.248]		0.400 [0.604]
Human capital		0.109 [0.399]		0.446 [0.430]		-2.135 [1.457]
R&D		1.488*** [0.173]				1.296* [0.668]
Fixed effects						
Time	yes	yes	yes	yes	yes	yes
Firm	yes	yes	yes	yes	yes	yes
# obs.	2507	2504	1595	1592	7949	7889
Loglik	-512	-464	-292	-290	-93	-89
LR $\chi^2()$	808***	901***	581***	582***	5618***	5582***

Notes: estimates from conditional logistic (panel) regression models with time and firm fixed effects. The dependent variables are *Innovation* in columns 1 and 2, *R&D* in columns 3 and 4, and *Export* in columns 5 and 6. All measures are defined in Appendix. *, **, *** denote, respectively, significance at 10%, 5%, and 1% level. Robust standard errors in brackets.

Appendix: variable definition

Variable name	Definition
GVC	dummy identifying global value chains in $t - 1$.
NVC	dummy identifying national value chains in $t - 1$. ^a
Final	dummy identifying final producers in $t - 1$.
Mark/Mod	dummy identifying market/modular suppliers in $t - 1$.
Captive	dummy identifying captive suppliers in $t - 1$.
Relational	dummy identifying relational GVCs in $t - 1$.
Hierarchy	dummy identifying hierarchical suppliers in $t - 1$. ^b
Innovation	dummy identifying firms introducing at least one innovation in t (independently by the type).
Prod	dummy identifying firms introducing at least one product innovation in t .
Proc	dummy identifying firms introducing at least one process innovation in t .
Org	dummy identifying firms introducing at least one organizational-managerial innovation in t .
Export	dummy identifying exporter firms in t ($t - 1$ if used as a regressor).
R&D	dummy identifying firms that performed R&D activity in t ($t - 1$ if used as a regressor).
Share innovation (firm)	share of sales (in t) from products that are innovative for the firm but not for the market (imitative innovations).
Share innovation (market)	share of sales (in t) from products that are innovative both for the firm and for the market (radical innovations).
Export share	sales from exported products $_{i,t}$ /total sales $_{i,t}$.
R&D share	R&D expenditure $_{i,t}$ /total sales $_{i,t}$.
Size	$\ln(1 + \text{employees}_{i,t-1})$.
Age	$\ln(1 + \text{age}_{i,t-1})$.
Sales	total sales $_{i,t-1}$ /total assets $_{i,t-1}$.
Cash flow	$(\text{EBIT}_{i,t-1} - \text{interest payments}_{i,t-1} - \text{non-operating income}_{i,t-1} - \text{extraordinary items}_{i,t-1})/\text{total assets}_{i,t-1}$.
Market share	share of firm's sales over the aggregated sales of the belonging industry (in $t - 1$).
Vertical integration	value added $_{i,t-1}$ /total sales $_{i,t-1}$.
International network	dummy identifying companies with stable and relevant, direct or indirect connections with foreign firms.
Domestic network	dummy identifying companies with stable and relevant, direct or indirect connections with (only) domestic firms.
Network	dummy identifying companies with stable and relevant, direct or indirect inter-firm connections (independently by the extension).
Group	dummy identifying companies belonging to corporate groups (in $t - 1$).
Human capital	share of graduated employees in $t - 1$.
Log-productivity	$\ln(\text{value added}_{i,t}/\text{employees}_{i,t})$.
Log-sales	$\ln(\text{sales}_{i,t})$.

^aGVC and NVC are defined in Section 3.1.

^bFinal, Mark/Mod, Captive, Relational, and Hierarchy are defined in Section 3.2.

Separate appendix: selected robustness checks

Table 13: GVC forms of governance and firms' upgrading: specifying Y as an AR(1) process.

Y:	Innovation (1)	R&D (2)	Export (3)
Y_{t-1}	1.243*** [0.0275]	1.534*** [0.0338]	1.374*** [0.0333]
Final	0.190*** [0.0421]	0.486*** [0.0520]	2.395*** [0.0833]
Mark/Mod	0.0846 [0.0581]	0.110* [0.0667]	1.275*** [0.0926]
Captive	0.0873 [0.0694]	0.0875 [0.0832]	1.697*** [0.111]
Relational	0.177*** [0.0517]	0.418*** [0.0646]	1.961*** [0.0891]
Hierarchy	0.00134 [0.0775]	-0.00461 [0.0854]	0.505*** [0.167]
Controls			
Time	yes	yes	yes
Industry(12)	yes	yes	yes
Province (110)	yes	yes	yes
# obs.	12973	12946	13033
Pseudo-R ²	0.232	0.362	0.532
Loglik	-6309.9	-4489.7	-4217.4
LR χ^2 ()	3831.6***	5090.0***	9574.2***

Notes: estimates from probit models. The dependent variables are *Innovation* in column 1, *R&D* in column 2, and *Export* in column 3. All measures are defined in Appendix. Additional covariates in the estimations (not shown) follow the specifications in Table 6 (column 3) for the first column, Table 8 (column 3) for the second column, and Table 9 (column 3) for the the last column. *, **, *** denote, respectively, significance at 10%, 5%, and 1% level. Robust standard errors in brackets.

Table 14: GVC forms of governance and firms' upgrading: controlling for unobserved heterogeneity through regressors' mean.

Y:	Innovation (1)	R&D (2)	Export (3)
Final	0.165** [0.0646]	0.252*** [0.0928]	2.152*** [0.109]
Mark/Mod	0.158 [0.0999]	0.266* [0.141]	0.802*** [0.115]
Captive	-0.0242 [0.116]	-0.0389 [0.159]	1.073*** [0.139]
Relational	0.162* [0.0853]	0.330*** [0.120]	1.532*** [0.119]
Hierarchy	0.128 [0.134]	0.118 [0.160]	0.815*** [0.245]
Controls			
Time	yes	yes	yes
Industry(12)	yes	yes	yes
Province (110)	yes	yes	yes
# obs.	18797	18797	18888
Pseudo-R ²	0.806	0.858	0.869
Loglik	-2237.3	-1382.4	-1698.2
LR $\chi^2()$	18675.0***	16763.2***	22521.7***

Notes: estimates from probit models. The dependent variables are *Innovation* in column 1, *R&D* in column 2, and *Export* in column 3. All measures are defined in Appendix. Additional covariates in the estimations (not shown) follow the specifications in Table 6 (column 3) for the first column, Table 8 (column 3) for the second column, and Table 9 (column 3) for the the last column. Regressors means (and the average of $Y_{i,t}$) are included as additional controls. *, **, *** denote, respectively, significance at 10%, 5%, and 1% level. Robust standard errors in brackets.

Table 15: GVC forms of governance and firms' upgrading: controlling for unobservable correlated shocks.

Y:	Innovation		R&D		Export	
	(1)	(2)	(3)	(4)	(5)	(6)
Final	0.118*** [0.0397]	0.117*** [0.0402]	0.466*** [0.0412]	0.475*** [0.0419]	3.418*** [0.0807]	3.489*** [0.0833]
Mark/Mod	0.0634 [0.0492]	0.0615 [0.0500]	0.0853 [0.0528]	0.0914* [0.0537]	1.729*** [0.0867]	1.746*** [0.0884]
Captive	0.101* [0.0609]	0.0897 [0.0618]	0.109* [0.0659]	0.107 [0.0669]	3.087*** [0.105]	3.127*** [0.108]
Relational	0.144*** [0.0486]	0.131*** [0.0493]	0.432*** [0.0509]	0.446*** [0.0519]	3.260*** [0.0856]	3.293*** [0.0871]
Hierarchy	-0.00840 [0.0658]	0.0153 [0.0667]	0.00344 [0.0679]	-0.00587 [0.0690]	0.485*** [0.153]	0.497*** [0.156]
Controls						
Time×Industry (36)	yes	yes	yes	yes	yes	yes
Time×Region (60)	yes	no	yes	no	yes	no
Time×Province (330)	no	yes	no	yes	no	yes
# obs.	18798	18773	18798	18698	18798	18793
Pseudo-R ²	0.155	0.168	0.234	0.246	0.491	0.500
Loglik	-9772.9	-9627.0	-7473.9	-7346.4	-6554.1	-6444.4
LR $\chi^2()$	3604.7***	3878.2***	4580.7***	4787.4***	12682.3***	12895.9***

Notes: estimates from probit models. The dependent variables are *Innovation* in columns 1 and 2, *R&D* in column 3 and 4, and *Export* in column 5 and 6. All measures are defined in Appendix. Additional covariates in the estimations (not shown) follow the specifications in Table 6 (column 3) for columns 1 and 2, Table 8 (column 3) for columns 3 and 4, and Table 9 (column 3) for columns 5 and 6. *, **, *** denote, respectively, significance at 10%, 5%, and 1% level. Robust standard errors in brackets.

Table 16: GVC forms of governance and firms' upgrading: controlling for self selection through matching techniques.

Y:	Innovation		R&D		Export	
	(1)	(2)	(3)	(4)	(5)	(6)
GVC	0.303*** [0.0806]		0.177* [0.101]		3.385*** [0.154]	
Final		0.214** [0.0836]		0.248** [0.118]		2.683*** [0.201]
Mark/Mod		0.0338 [0.124]		-0.110 [0.146]		0.943*** [0.191]
Captive		-0.115 [0.140]		-0.00227 [0.171]		1.741*** [0.235]
Relational		0.219** [0.102]		0.434*** [0.138]		2.331*** [0.219]
Hierarchy		0.455** [0.207]		0.361 [0.225]		1.231*** [0.222]
Controls						
Time	yes	yes	yes	yes	yes	yes
Industry(12)	yes	yes	yes	yes	yes	yes
Province (110)	yes	yes	yes	yes	yes	yes
# obs.	2075	2075	1989	1989	2030	1982
Pseudo-R ²	0.096	0.099	0.219	0.225	0.481	0.482
Loglik	-1238.5	-1235.9	-976.6	-969.1	-582.1	-684.8
LR $\chi^2()$	265.8***	271.1***	547.6***	562.6***	1529.3***	1278.5***

Notes: estimates from probit models. The dependent variables are *Innovation* in columns 1 and 2, *R&D* in column 3 and 4, and *Export* in column 5 and 6. Estimation is performed on a subsample of firms with balanced *ex ante* probabilities of belonging to GVCs (treatment variable). This selection results from the application of Coarsened Exact Matching techniques (CEM, Iacus, King, and Porro, 2011) on the following list of firm-level characteristics: age, size, region, industry, human capital, and productivity. Matching weights are then employed in the probit regression showed. All measures are defined in Appendix. Additional covariates in the estimations (not shown) follow the specifications in Table 6 (column 3) for columns 1 and 2, Table 8 (column 3) for columns 3 and 4, and Table 9 (column 3) for columns 5 and 6. *, **, *** denote, respectively, significance at 10%, 5%, and 1% level. Robust standard errors in brackets.

Table 17: GVC forms of governance and firms' upgrading: controlling for simultaneously third-party factors affecting innovation, R&D, and export.

Sample:	(1)	Entire (2)	(3)	Innovation _{t-1} = 0 & R&D _{t-1} = 0		
				(4)	(5)	(6)
Innovation equation, Y: Innovation						
Final	0.324*** [0.032]	0.209*** [0.040]	0.139*** [0.038]	0.568*** [0.045]	0.383*** [0.056]	0.386*** [0.059]
Mark/Mod	0.115** [0.046]	0.074 [0.048]	0.057 [0.048]	0.185*** [0.070]	0.172** [0.075]	0.162** [0.076]
Captive	0.130** [0.055]	0.113* [0.059]	0.088 [0.059]	0.053 [0.080]	0.080 [0.088]	0.067 [0.089]
Relational	0.291*** [0.041]	0.199*** [0.048]	0.149*** [0.048]	0.338*** [0.058]	0.184*** [0.070]	0.185*** [0.072]
Hierarchy	0.169*** [0.058]	0.045 [0.065]	0.011 [0.065]	0.220** [0.092]	0.156 [0.104]	0.143 [0.104]
R&D equation, Y: R&D						
Final	0.572*** [0.033]	0.798*** [0.036]	0.458*** [0.040]	0.718*** [0.047]	0.816*** [0.055]	0.704*** [0.061]
Mark/Mod	0.199*** [0.049]	0.141*** [0.051]	0.019 [0.051]	.162** [0.079]	0.080 [0.083]	0.047 [0.084]
Captive	0.118** [0.060]	0.250*** [0.063]	0.037*** [0.064]	0.005 [0.093]	0.166* [0.101]	0.089 [0.102]
Relational	0.478*** [0.042]	0.674*** [0.047]	0.405*** [0.051]	0.566*** [0.061]	0.735*** [0.071]	0.608*** [0.075]
Hierarchy	0.068 [0.061]	0.049 [0.064]	-0.013 [0.066]	0.063 [0.099]	-0.050 [0.107]	-0.108 [0.109]
Export equation, Y: Export						
Final	2.501*** [0.064]	3.444*** [0.077]	3.171*** [0.077]	2.728*** [0.076]	3.557*** [0.093]	3.518*** [0.093]
Mark/Mod	1.729*** [0.085]	1.736*** [0.085]	1.628*** [0.082]	1.976*** [0.107]	1.945*** [0.105]	1.929*** [0.105]
Captive	1.974*** [0.096]	3.041*** [0.102]	2.878*** [0.100]	2.031*** [0.116]	3.135*** [0.122]	3.133*** [0.122]
Relational	2.152*** [0.073]	3.199*** [0.083]	2.941*** [0.083]	2.270*** [0.091]	3.390*** [0.103]	3.343*** [0.104]
Hierarchy	0.421*** [0.144]	0.509*** [0.149]	0.438*** [0.143]	0.276 [0.176]	0.369** [0.180]	0.364** [0.180]
$\hat{\rho}_{21}$	0.453*** [0.012]	-0.029 [0.040]	-0.133*** [0.033]	0.534*** [0.015]	-0.011 [0.050]	0.066 [0.058]
$\hat{\rho}_{31}$	0.250*** [0.014]	0.177*** [0.015]	0.190*** [0.016]	0.234*** [0.018]	0.181*** [0.020]	0.171*** [0.021]
$\hat{\rho}_{32}$	0.308*** [0.015]	-0.017 [0.033]	-0.398*** [0.024]	0.238*** [0.019]	0.003 [0.036]	-0.108*** [0.039]
Controls						
Time	yes	yes	yes	yes	yes	yes
Industry(12)	yes	yes	yes	yes	yes	yes
Region(20)	yes	yes	no	yes	yes	no
Province (110)	no	no	yes	no	no	yes
# obs.	18888	18888	18798	12978	12978	12933
Loglik	-24908	-24997	-24526	-13272	-12721	-12574
LR $\chi^2()$	8933***	10079***	12377***	4309***	5357***	5518***

Notes: estimates from multivariate probit models. The dependent variables are *Innovation* in the top panel, *R&D* in the second panel, and *Export* in the last panel. $\hat{\rho}_{ij}$ is the estimated correlation coefficient between the error terms of equations i and j . All measures are defined in Appendix. Additional covariates in the estimations (not shown) follow the specifications in Table 6 for the top panel, Table 8 for the second panel, and Table 9 for the last panel. *, **, *** denote, respectively, significance at 10%, 5%, and 1% level. Robust standard errors in brackets.