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Modes of Insertion into Global Value Chains as a Source of Firms'
Heterogeneity?
Evidence from a Panel of Korean Manufacturing Firms 1990-2015

May 2018

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INCAS

Understanding institutional change in Asia: a comparative perspective with Europe

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ABOUT THE INCAS PROJECT

INCAS is a Marie Skłodowska-Curie Actions R.I.S.E funded project under the European Commission's H2020 Programme.

The project INCAS aims at creating a top-level research and advanced training network on institutional change in Asia, in comparative perspective with Europe.

The coordinator, Ecole des Hautes Etudes en Sciences Sociales (France), promotes this network together with Oxford University (UK), Freie Universität Berlin (Germany), and in collaboration with Waseda University (Japan). The aim of the proposed mobility scheme is to give birth to a European consortium and network of faculties and advanced graduate students specialized in the comparative analysis of institutional change in Asia and Europe. The partners have chosen Japan as a reference point because of its comparability with Europe as shown by previous studies, its historical influence on development and further institutional changes in Asia, and the expertise accumulated within our research team.

Analyzing current economic dynamics in Japan and later expanding this analysis to other Asian countries promises to generate insights that might be help to better understand challenges for Europe and to prepare relevant policy proposals. Our purpose is to compare the results obtained in the case of Japan and few other Asian countries (South Korea, Taiwan, China, and possibly Thailand, after having checked the data availability), not only to previous results on Europe but also to original results we will get on European countries (primarily France – which will be our reference country in Europe – and then the UK, Germany, and Italy) in mobilizing new historical data and applying our theoretical framework.

Modes of Insertion into Global Value Chains as a Source of Firms' Heterogeneity?

Evidence from a Panel of Korean Manufacturing Firms 1990-2015

Pauline Debanes
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Abstract

While the slowdown of accumulation has been at the center of the financialization literature since the 2000s, not much has been written on the investment behavior of firms beyond the US and Europe neither in the case of non-leading firms. This article addresses this gap by testing if the “low growth, low investment” track of the Korean economy since the Asian crisis can be explained by the modalities of firms' insertion into global value chains (GVCs), defined according to the activity of firms, the governance of the chain they are part of, and their possibility of upgrading. Empirical evidence derived from a cluster analysis using micro and sectoral data of manufacturing firms, confirm that modalities of insertion into GVCs are a source of heterogeneity of firms' investment behavior. The original methodology developed in this paper enriches the understanding of the complexity and heterogeneity of governance intra-value chains and intra-firms.

Keywords

Global Value Chains; Heterogeneity; Investment Behaviour; Korea; Firm-Level Evidence

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Biography

Pauline Debanes is an advanced Ph.D. candidate at EHESS, Paris. Before starting her research on the transformation of the role of the state in South Korea, she worked as an economic attaché at the French Embassy in Korea for one year. For her Doctoral research, she did an intensive fieldwork in Seoul's startup ecosystem during the first semester of 2016. Interested in comparing institutional change in Asia, she has edited a special issue entitled “*Towards a Renewal of the Developmental State in Asia?*” with Sébastien Lechevalier (*Critique Internationale*, 2014) and has co-authored, with Sébastien Lechevalier and Wonkyu Shin, an article comparing the financialisation of industrial policy in Japan and Korea (*Structural Change and Economic Dynamics*, 2017).

1. Introduction

The structural decreasing trend of investment rate in advanced economies has been one of the major stylized facts of the post-Fordist era. In the case of the United States (US), a large body of literature has pointed out the increasing financialization of non-financial corporations since the 1980s that would explain the slowdown of fixed assets accumulation. This macroscopic trend is also associated to the globalization of production, which has given incentives to large firms in core countries for cutting costs by outsourcing part of their activities (Gereffi, 1999; Milberg, 2008; Milberg & Winkler, 2013). The spatial restructurings of trade and production were concomitant with the financial liberalization and the global expansion of financial markets. Indeed, the outsourcing strategy of firms has been encouraged by shareholders lurking on the higher rate of returns yield by financial transactions rather than productive ones (Krippner, 2005; Crotty, 2005).

More attention has recently been given to the interrelation of the processes of financialization and globalization of production. The findings show a significant correlation between outsourcing behavior and financialization in the case of leading global firms, mainly from the US and Europe (Baud & Durand, 2011; Froud. et al., 2012; Milberg & Winkler, 2013; Soener, 2015). However, less has been written on the investment behavior of firms beyond the US and Europe, nor in the case of non-leading firms. Scholars looking at developing and emerging economies stress the important heterogeneity of firms behavior depending on their transnational linkages and their local institutional embeddedness (Ashman et al., 2011; Powell, 2013; Akkemik & Özen, 2013; Bonizzi, 2017).

This article addresses this gap by focusing only on the impact of global trade restructuring on firms' investment behavior in the case of Korean manufacturing firms since the 1990s¹. The Korean economy has experienced a slowdown of accumulation following the Asian crisis of the late 1990s and has been ever since in a "low growth, low investment" trajectory (see Park & Doucette, 2016). This domestic economic environment has been mitigated by the active participation of Korean firms in regional and global networks of production. Following a fast upgrading during the industrialization period, they have now become pivotal stakeholders of several production networks by governing their regional supply chains (Frederick et al., 2017). It is proposed here to investigate the modalities of insertion into GVCs, taken as a source of heterogeneity of investment behavior. The modalities of insertion into GVCs are defined according to the activity of firms, the governance of the chain they are part of, and their possibility of upgrading. This dynamic concept of modes of insertion intends to grasp the localized features of the firms within value chains as well as their mobility, given the overall hierarchical structure of value chains.

The contribution of this article is twofold. A theoretical effort is made to conceptualize the modalities of insertion into GVCs. This concept accounts for the recent development of the GVC literature and incorporates a more dynamic perspective on firms' engagement in GVCs. It is argued that the modalities of firm insertion into GVCs are a source of heterogeneity, especially regarding investment behavior. The second contribution is empirical. The original taxonomy of five modes of insertion into GVC is provided based on a cluster analysis using micro and sectoral data. The use of micro-data for GVC analysis is rare, and the methodology developed in this paper enrich the understanding of the complexity and heterogeneity of governance intra-value chains and intra-firms.

The article proceeds as follows. The first section discusses at greater length the various features that characterize the modes of insertion into global value chains (the activity of firms, governance of supply chains and upgrading opportunities). The second section implements a cluster analysis to determine the mode of insertion at the firm-level based on firms' financial data completed by sectoral data from input-output tables.

2. Mode of insertion into GVC and heterogeneity of firms' investment behavior.

Facing a heightened competition from developing and emerged economies and under pressure for profitability from the capital market, non-financial corporations have resorted to different strategies to maintain their activity and sustain their profitability. It is argued here that their mode of insertion into GVCs is a key determinant of their investment behavior. This subsection defines a mode of insertion as a dynamic apprehension of firms' activity in the value chain combined with their coordination capabilities of intra- and inter-value chains. As such, the concept of mode of insertion echoes two concepts at the core of the GVC framework; those of governance of the value chains (power relations and the coordination between firms), and upgrading opportunities. Existing taxonomies of governance, individual empirical cases, and firm-level studies are surveyed in this section to delineate the contours of modes of insertion

1. The assessment of the modalities of insertion into global value chains compared to the financialization channel is examined elsewhere.

2.1 Mode of insertion: intra and inter-chains coordination at the firm-level

The existing taxonomies of global value chains are related to the concept of governance, which embodies the organizational consequences of the power of leading firms over the supply chain. The analysis of coordination of the chains by leading firms, or their governance, refines transaction cost theories by conceptualizing a spectrum of relationships between leading firms and suppliers (see Humphrey & Schmitz, 2002; Gereffi et al., 2005).

A basic dichotomy has initially been proposed by Gereffi (1996, 1999) between two types of chains: producer-driven and buyer-driven supply chains, which are two types of control of leading firms over their backward linkages (see contribution in Gereffi and Korzeniewicz [eds], 1994; Gereffi, 1999; Gereffi & Memedovic, 2003). The producer-driven supply chains are to be found in the more technical manufacturing sectors (electronics, automobile, aircraft, and semiconductors) where the manufacturer leads the production process, while buyer-driven chains reflect the weight of global buyers, focused on branding, marketing or retailing, in charge of the coordination of the production process. Types of chains are associated with organizational features, mainly the degree of vertical integration. Producer-driven chains tend to be dominated by few vertically integrated firms, in close coordination with their subcontractors, exercising strong market power over the distribution channels. On the contrary, buyer-driven chains are more competitive and deconcentrated; only the higher-end of the chain is concentrated into a few global buyers, shaping their sourcing strategies to optimize their revenues.

Building upon this buyer/producer-driven distinction, the concept of governance has emerged to take into consideration organizational features of the value chain. Essentially, the type of governance determines how the value added is shared across firms, the more the governance is hierarchical, the more the value added is concentrated at the higher-end of the chain. In-between completely decentralized relationships ('Markets') and vertical integration ('Hierarchy'), Gereffi et al. (2005) proposed three intermediate categories that reflect the distribution of power and the dependence between lead firms and suppliers which can be 'Modular', 'Relational' or 'Captive'. It is largely consistent with Humphrey and Schmitz (2002) who define two intermediate categories of 'Networks' and 'Quasi-hierarchy'.

The governance of the value chain is closely linked to the array of relationship possible between firms at the micro-level. Thus, in each type of governance, the position of firms involves coordination intra and inter-chain, with downstream and upstream industries. Indeed, GVC scholars have documented on the contingency of the activity of suppliers, themselves embedded in supply chains they do not govern, on not only the linkages they have with leading firms but also on their local network. For instance, the emergence of core (or top-tier) suppliers mentioned in the previous section is a good example of how some suppliers have gained power over the rest of the value chain by becoming the only interlocutor of leading firms (see Palpacuer et al., 2004). Then, while first-tier suppliers need to sustain their capabilities to keep their preferred position which necessitates investment spending, component suppliers are more focused on price competition in markets of highly demanded standardized goods (Blažek, 2015). The coordination of non-leading firms, from the lower-end of the chains, can also create nodes of productivity, as described by Newman (2009) who shows that farmer's cooperatives proved to be related to higher capital accumulation than individual farmers.

Beyond the established typologies of governance or the success stories of localized strategies of industrial upgrading, scholars have recently argued for a more dynamic and granular approach of modes of governance (Sturgeon & Ponte, 2013). As convincingly defended by Blažek (2015) based on a thorough account of the literature, typologies of modes of governance should preferably be used to understand the localized part of GVCs in order to account for the evolution of modes of governance over time, but also for their coexistence within the same value chain and even within the same firm (see also Haakonsson, 2009).

The analytical concept of mode of insertion intends to contribute to this line of research by putting the firm at the center of the analysis. The insertion of firms at the micro-level hinges not only on their business activity but also on their dynamic capabilities to engage with upstream and downstream industries, as well as across value chains. GVCs are then apprehended as dynamically interconnected, which involves that they overlap and have an evolutive design. Such a dynamic approach fits the aim of this paper to grasp the heterogeneity of the investment behavior of firms across value chains by considering the combination of different levels of embeddedness and change. In particular, the governance of value chains will impact the investment behavior of firms, whether it is for non-leading firms to maintain an established type of coordination or to challenge it, or for leading firms to sustain their extraction of value added.

2.2 Mode of insertion: industrial upgrading and the possibility of change

Industrial upgrading is one of the core concerns of the GVC framework which has been providing the analytical tools to analyze the successful –or not- experience of firms in climbing the value-added ladder of the supply chains. In a more modular and dynamic approach, industrial upgrading can be defined as a significant improvement of firms' capabilities that impact the intra or inter-chains involvement of the firm². This definition allows moving beyond an approach of industrial performance to consider the gain of capabilities, in terms of innovation but also welfare or sustainability. Except for the intrinsic features of firms that determine their capabilities to grow and develop, external factors can foster upgrading such as the institutional environment (Yeung, 2014) but also the spatial localization of firms.

Studies of upgrading opportunities have highlighted the importance of the spatial proximity of firms and their geographical localization. Concerned with the linkages of firms within their regional and global networks, GVC scholars have analyzed the knowledge and capabilities in cases of spatial agglomeration such as industrial clusters (Humphrey & Schmitz, 2000; Giuliani et al., 2005; Sturgeon et al., 2008). Bair and Gereffi (2001) observe the advantage of large firms in the Torreon blue jean cluster in Mexico, able to take advantage of the entry of foreign buyers to upgrade their process while small firms remained trap in the *maquiladoras* model. To the size factor, Giuliani et al. (2005) add that the benefits from spatial agglomeration are strongly dependent upon the industrial sector. Gereffi (2009) stresses the local specificities, such as the 'supply-chain cities', reflecting the spatial concentration and specialization of some segment of the production process at the core of China's model of upgrading.

Moreover, the geographical localization of production increasingly matters when considering the opportunities for firms to improve their mode of insertion into GVCs (see Gibbon & Ponte, 2005 on the different upgrading trajectories in Africa; Hernández et al., 2014 for Latin America). The North-East Asia experience of industrialization is often taken as a successful case of upgrading. Indeed, it has involved the upgrading of Japan followed by the NIEs (Hong-Kong, Taiwan, Singapore, South Korea) which have sustained their power in the value chains by extending their reach into South-East Asia (Gereffi, 1999; Kishimoto, 2004; Escaith & Inomata, 2013). In particular, East Asian firms have managed to upgrade from supplier to leading positions in low productivity sectors, such as the apparel industry, and then upgrade to medium and high-tech industries (Table 1). The external linkages of the NIEs with US firms have also played a role as highlighted by Feenstra and Hamilton (2006: p212) who reenacted the supply-side story of the developmental state in the industrial upgrading of Korea. Given the time and space specificities of the Japan and NIEs' experiences, the possibilities of industrial upgrading of China is highly debated nowadays; Chinese manufacturers seem to have fewer opportunities to climb the ladders of the supply chain as exemplified by the business strategy of Foxconn International Holdings (Froud et al., 2012; Lüthje & Butollo, 2016). The localized understanding of value chains dynamics is, in this case, crucial to understanding the potential lock-in effects that prevent firms down the value chains to build their capabilities. Moreover, the limited upgrading opportunities of suppliers shed light on the dialectic of the spatial restructuring of trade. Indeed, the GVC framework has focused on the inclusiveness, often neglecting the corresponding 'disarticulation' forces (Bair & Werner, 2011).

It is expected that the relationship between the upgrading dimension and the mode of insertion will depend on the activities undertaken by the firm. Indeed, investment in fixed assets, in the case of manufacturing, is only needed to expand the production process (tangible activities), while intangible investment corresponds to the higher-end of value chains activities such as ante-production (R&D) or post-production (Marketing and branding) (see the distribution of value in manufacturing GVC in Frederick et al. [2017: 5-12]). Hence, upgrading opportunities for third-tier suppliers will be positively correlated with investment in fixed assets while upgrading opportunities for top-tier suppliers might involve a trade-off between investment in fixed assets and intangible investment.

The three outlined dimensions of the mode of insertion into GVCs resonate with existing qualitative studies on Korean firms. If Korea has attracted so much attention in the 1990s, it is due to its label of NIE gained at this period given the rapid and successful industrial upgrading of Korean firms from the textile industry to the electronics and automotive industries (Lee & Lim, 2001). The outsourcing drive kicked-off in the late 1980s and accelerated after the Asian crisis (Figure 1). When looking into the mode of insertion of firms into GVCs, the contemporary Korean case is fascinating because Korean firms are involved in global leadership positions as well as global suppliers, in both producer-driven

2. The upgrading possibilities, and their spatial component, are a key feature of the dynamism of the mode of insertion into GVCs. In reference to the evolutionist theory of the firms (Teece & Pisano, 1994; Dosi et al., 2000; Winter, 2003), firms are always adapting to new constraints and new prospects, through which they dynamically use and build their capabilities. Hence, if firms are constantly evolving, so is the design of GVCs, despite some structural features of stability. At the theoretical level, this paper argues that the concept of mode of insertion, articulating the dimensions of activity, governance and upgrading at the firm-level, allows a dynamic analysis of how firms are engaging into GVCs, without presupposing a unimodal and linear path of evolution possible from supplier to leading firms.

chains (Samsung, LG, Hyundai, Kia, Asiana, Korean air) and buyer-driven chains with large retailing firms (Gmarket, Lotte). Moreover, in a context of growing importance of the Asian region in global trade patterns and global production network (Azmeah & Nadvi, 2014), Korean firms are at the forefront of GVC restructuring. In particular, their mode of insertion is likely to be impacted by the deep embeddedness of Korean firms with Chinese firms, which is at the same time a major feature of the highly vertically integrated type of governance of Korean global manufacturers, and a likely source of limitation of upgrading opportunities of firms across several value chains considering the rise of the Chinese manufacturers (Mu & Lee, 2005).

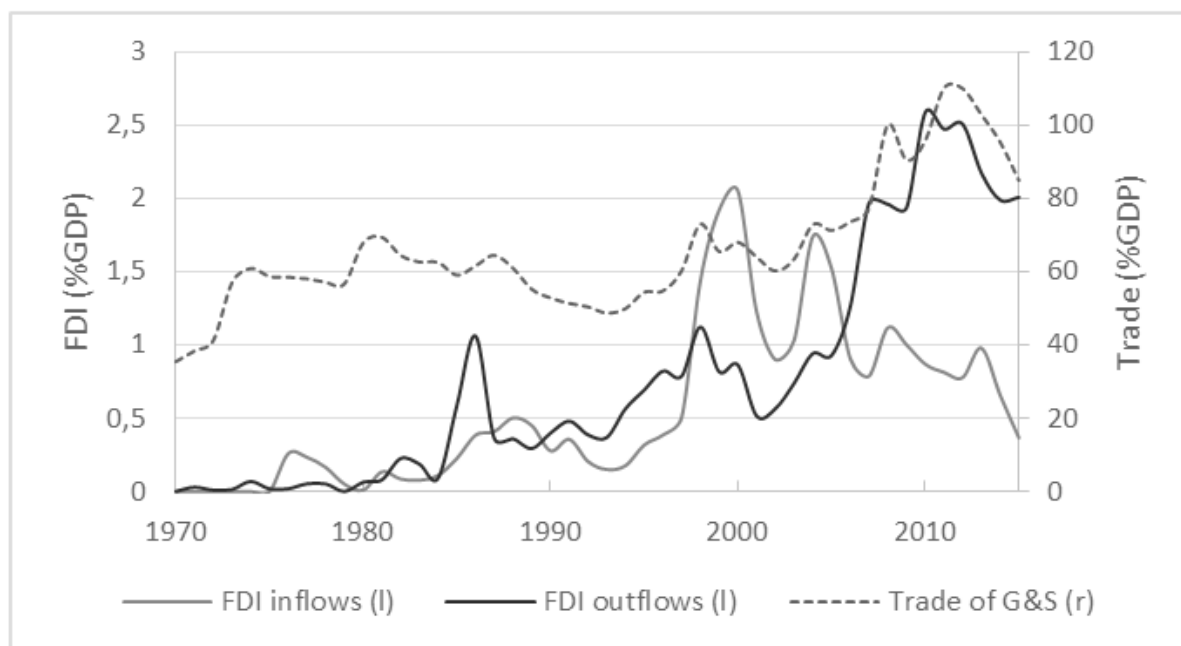
This section has described the three dimensions of the mode of insertion into GVCs: activity, governance, and upgrading, which aim at capturing the engagement of firms into GVCs dynamically. The next section determines the data at the firm-level that will be used to implement a cluster analysis of the mode of insertion into GVCs.

Table 1 Share of Medium and High-Tech exports in total manufacturing exports by country (%Total exports)

	1970	1980	1990	2000	2010	2015
Japan	31%	47%	50%	49%	51%	54%
NICs	1%	4%	7%	11%	17%	21%
Singapore	9%	13%	13%	15%	19%	22%
South Korea	3%	11%	18%	27%	36%	41%
Hong Kong	6%	8%	11%	9%	15%	11%
Taiwan	10%	15%	23%	24%	30%	28%
China	8%	9%	11%	18%	23%	25%
Developing South East Asia	1%	2%	6%	12%	17%	19%
Indonesia	1%	0%	3%	11%	12%	16%
Malaysia	2%	6%	8%	10%	13%	16%
Philippines	1%	3%	8%	9%	16%	18%
Thailand	1%	3%	8%	20%	30%	34%
Viet Nam	2%	2%	0%	5%	9%	9%
Cambodia, Laos	0%	6%	1%	4%	2%	5%

Source: CHELEM database (Total export is the sum of non-manufacturing and manufacturing exports)

Figure 1 Evolution of trade integration in Korea



Source: World Development Indicators

3. Estimation of modes of insertion into GVC at the firm-level, a cluster analysis approach

This section aims at delineating the kind of variables at the firm-level needed to infer the mode of insertion into GVCs, in order to implement a cluster analysis of firms according to their mode of insertion. The definition of the mode of insertion in the previous section emphasized three components: the vertical integration of firms, the composition of outputs, and the linkages across firms. Two components of sectoral linkages and growth are added after reviewing the literature making use of sectoral and firm-level data. From these components, concrete variables are constructed from a dataset of financial statements of Korean manufacturing firms (1990-2015) extracted from the Korea Information Service database. Then, the number of dimensions is reduced with a principal component analysis that is used to implement a cluster analysis.

3.1 Data

The data used in this paper come from the Korea Information Service (KIS-value) database that provides financial statements and non-financial data of firms with assets above 7bn³. This dataset contains exhaustive information across all the sectors of the economy on surviving firms. The study focuses here on non-financial corporations in the manufacturing sector (the C section according to the Korean industrial sector classification with December as a fiscal month) from 1990 to 2015. Two samples are drawn from the raw dataset.

A first sample is constituted to investigate the decomposition of the balance sheet of Korean manufacturing firms. Because the median of each variable is looked individually, the top and bottom 1% for each regression variables (except the dependent variable) are trimmed. The sample is then reduced to 163 804 observations with 9898 firms in 2015. The cluster analysis is performed on a stratified random sample on size and age of 500 firms drawn from the trimmed dataset of Korean manufacturing firms. Only firms with more at least three consecutive years of observations after cleaning the missing values for regression variables are included in the sample.

These firm-level data are complemented by input-output tables published by the Bank of Korea since 1990. A table of correspondence is established by the author between sectors of the tables and the Korean classification of industry into twenty-four manufacturing sectors.

3. Data are compiled by the National Information & Credit Evaluation Inc. This database is widely used in empirical studies.

3.2 Variables

The components of modes of insertion are grouped into four categories of vertical integration, the composition of outputs, spatial and sectoral linkages and growth. These four components are largely consistent with the few studies determining the type of GVC governance or supply chain strategies at the firm level (Palpacuer & Tozanli, 2008; Brancati et al., 2017).

Firm-level studies mainly make use of data obtained from qualitative surveys. Brancati et al. (2017) exploit a qualitative survey to determine the mode of participation to GVCs at the firm-level, defined in a similar way as by Humphrey and Schmitz [2002] and Gereffi et al. [2005], that vary according to three dimensions: the formal vertical integration, the linkages with other firms and the company's value added. Palpacuer & Tozanli (2008) propose a typology, based on quantitative and qualitative data, of the main governance patterns across the largest agrifood producers in Europe. They add variables of ownership control and the type of industrial strategy. Saliola & Zanfei (2009) use the criterion of knowledge transfer to distinguish three different types of value chain governance. With a panel data of Thai firms (PICS survey), they test the variables determining the type of governance, including the presence of multinational firms, their local embeddedness and the capabilities of local suppliers measured by qualitative data and the number of patents filed. Usual control variables of age, size, and industry are added in studies at the firm level.

Inspired by existing literature but given the limitation of our study to quantitative data from financial statements, proxies of components are chosen as follows. The *vertical integration of firms* is proxied by three variables: the capital-intensity ratio, the affiliation to a group and the size of the firm. One of the main reasons for a vertical integration strategy is lowering costs of transactions and maximizing the firm's share in the value chain. Hence, highly vertically integrated firms are more likely to have a dominant position in the value chain, either governing the value chains or being a top-supplier of leading firms. The capital intensity ratio is expected to be positively correlated with vertical integration because less prone to outsourcing. Belonging to a group and the size are associated with higher integration. Indeed, firms belonging to a group are *de facto* integrated, and large firms are more likely to be vertically integrated. The size and the affiliation to a group are two dummy variables, with the former representing large firms (fourth quartile of asset distribution in the total dataset).

The *composition of outputs* exposes the organization of firms' production. The variables used are value-added to sales and the intangible assets intensity (taken as a proxy of technological intensity). The ratio of value-added to sales discloses the number of production stages undertaken by the firms, as well as their respective contribution to the value chains. It is therefore expected that high-value-added to sales be correlated with a leading position in the value chain, but because the financialization of firms has a negative impact on value added (Tomaskovic-Devey et al., 2015), leading global firms might have a lower ratio than other firms. The intangible intensity, which increases the probability of a leading position, is an important variable to identify the upgrading potential of firms. The technological intensity is also related to vertical integration, positively for downstream industries and negatively for upstream industries (Acemoglu et al., 2010).

The third component are the *linkages across firms*, divided into sectoral and spatial linkages. Following Hirshman (1958), backward and forward linkages derived from input-output matrixes have widely been used to inform of the relative importance of sectors and their linkages (Gereffi & Memedovic, 2003; Giuliani et al., 2005; De Backer & Miroudot, 2014; Alfaro et al., 2015). While backward linkages measure the number of production stages from other sectors incorporated into a given output, and therefore the length of suppliers, forward linkages estimate the linkages of firms with downstream industries (Jones, 1976). Backward and forward linkages of each industry are computed yearly from the national input-output tables. The sectoral linkages are combined with a spatial linkage at the firm-level. Following Scholl & Brenner (2016) a spatial clustering index is computed with the address of firms' headquarters:

$$D_i = \sum_{j=1, j \neq i}^J \left(\left(\frac{1}{J-1} \right) e^{-0.05(d_{i,j})} \right)^{-1}$$

A high value of D_i indicates a strong spatial proximity of firm i with other firms. In the literature on cluster industries and regional innovation systems, it has been shown that the agglomeration of firms has a positive impact on growth and productivity (Sturgeon et al., 2008). Hence, a higher clustering index should be associated with a higher position in global value chains.

Finally, the *growth* component reflects the yearly dynamic as well as the sectoral dynamic at the firm level. It is proxied by two variables: the growth of sales and the return on assets, which are two indicators of performance and efficiency. Growth is expected to be correlated positively with the linkages of firms and the vertical integration. The correlation between growth variables and the variables serving as proxies of the composition of output is expected to be rather low because it highly depends on the sector and the activity undertaken by the firms.

3.3 Cluster analysis

Before implementing a cluster analysis, a principal component analysis is run on a set of variables reflecting the four components of the mode of insertion described in the precedent sub-sections (Table 2). This first step aims at reducing the number of variables into a limited number of factors, linear combinations of the chosen variables of interest. The analysis is based on the distribution of variables in deciles, which have the advantage of dealing with outliers as well as take into account categorical variables such as affiliation and size. In the first step, the polychoric matrix is computed and then serves as an input for a principal component analysis (see the mathematics of polychoric matrix in Mütten [1983]). Four factors which represent 60% of total inertia (criterion of eigenvalue above one) are retained. Based on the factor loadings of each variable, the four axes can be interpreted as follows: vertical integration, profitability, the capture of value-added, modularity of the supply chain.

Table 2 Summary statistics of the variables used in the PCA (before discretization)

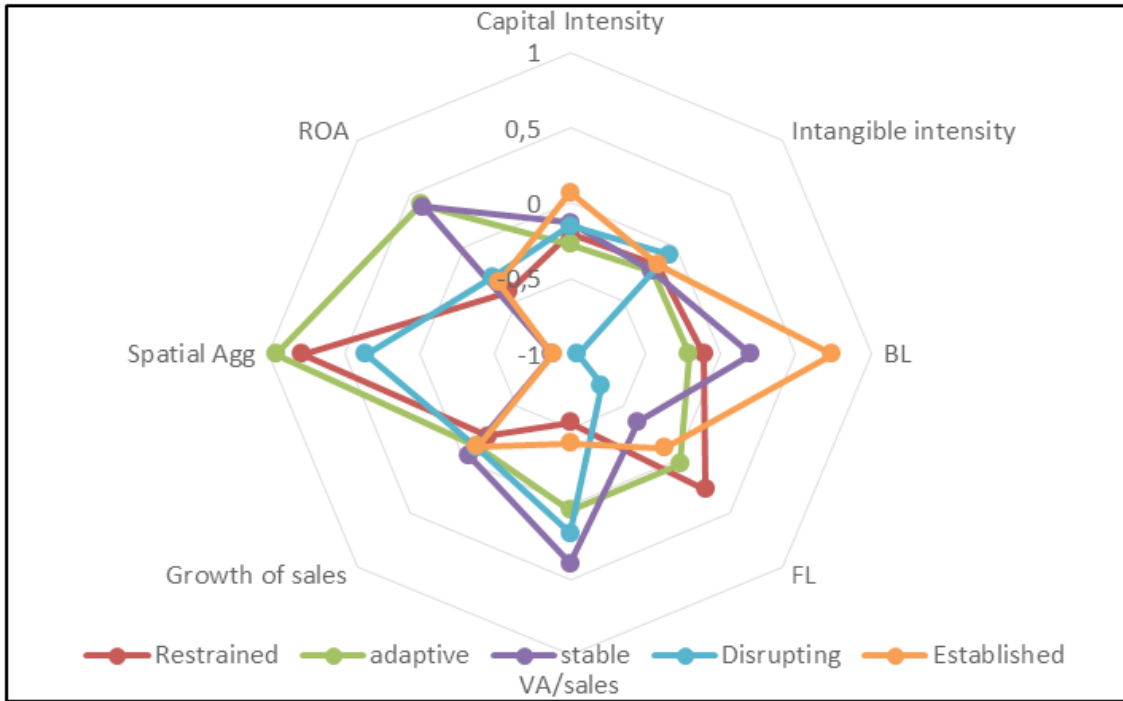
Variable	N	Missing		Std Dev	Min	Max
		values	Mean			
K/L	6821	10	10.58	28.94	0.01	1196.0
Intangible assets/sales	6742	89	0.04	0.15	-0.15	2.84
VA/sales	6799	32	26.79	12.39	-33.68	166.49
Backward Linkages (BL)	6831	0	2.08	0.22	1.12	2.43
Forward Linkages (FL)	6831	0	2.09	0.85	1.02	5.98
Spatial Agglomeration index	6831	0	0.09	0.05	0.00	0.29
Sales growth	6831	0	0.18	0.71	-0.92	38.30
ROA	6831	0	0.08	0.09	-0.76	0.75

Source: KIS-data, stratified random sample of 500 hundred manufacturing firms, Author's calculation

The participation modes of Korean manufacturing firms to GVCs is determined by cluster analysis with no initial hypothesis on the clusters. This method has the advantage to take into account the multidimensional aspect of participation in GVCs and its dynamics. Indeed, the principal component analysis is constructed with yearly firms' data, and cluster assignment can vary from year to year for a given firm. Therefore, this methodology can grasp the industrial upgrading (or downgrading) of firms. With the PCA, each observation can be characterized by its factor coordinates. The number of clusters and the initial centers of clusters is determined by the Ward method, a hierarchical clustering method minimizing the within-cluster variance. Five clusters are chosen, and modes of insertion are identified based on the score of individuals across factors.

The modes of insertion are determined based on the score of factors for each cluster but also by the mean and median value of the nominal variables of vertical integration, the composition of output, linkages, and growth (Figure 2). Five modes of insertion are described based on the factors according to the three dimensions of activity, governance and upgrading opportunities (Table 3). To describe these modes of insertion further, we estimate a probit model for each modality where the panel structure of the data is taken into consideration (Generalized Estimating Equations). The continuous variables used in the cluster analysis are used supplemented with sectoral dummies and size dummy. The profile of each mode of insertion reveals that firms' engagement to GVCs cannot be reduced to sectoral specificities. For instance, firms from the automotive sector are likely to have a stable or an established mode of insertion. The petroleum, chemical and metal industries are more represented in the restrained, adaptive or established modes of insertion. The disruptive mode of insertion has a more distinctive sectoral pattern in coherence with its definition.

Figure 2 Profile of mode of insertion (standardized median values by cluster)



Source: KIS-data, stratified random sample of 500 hundred manufacturing firms, Author's calculation.

Table 3 Description of modes of insertion inferred from the cluster analysis

Mode of insertion into GVCs	Description according to activity, governance, upgrading opportunities
Restrained	Firms that are undertaking low-value-added capital-intensive activities such as component manufacturers. They tend to be vertically integrated and have many opportunities to upgrade.
Adaptive	These firms are not vertically integrated but manage to capture a good share of the value-added. They correspond to supplier firms embedded in modular supply chains with good upgrading opportunities considering their growth and the modularity of their linkages with other firms.
Stable	The stable mode of insertion is characterized by top-tiers suppliers with a fair capture of value added and a local power on the upstream industries of the value chains. Their upgrading opportunities are low because, as the lead supplier, they face a rigid supply chain.
Disruptive	Related to innovative leading firms that invest a large amount on intangible investment and implement strategies for capturing the value added.
Established	This mode of insertion corresponds to leading global producers, which are large subsidiaries of highly vertically integrated groups. These firms are at the forefront of the value chain; their upgrading opportunities are rather low as the firms are getting close to the technological frontier.

Source: Author

Table 4 Determinants of mode of insertion - GEE Probit

	Restrained	Adaptive	Stable	Disruptive	Established
Intercept	23.59 **	8.42	-34.09 **	-80.24 **	55.85 **
Capital intensity	-0.04 **	-0.14 **	0.00 *	0.00	0.01 **
Intangible intensity	-0.11	-16.50 **	-2.77 **	0.93 **	0.57 **
<i>Sectoral dummies</i>					
Petrol, chem, metal	0.32 **	0.22 **	-0.15 **	-0.46 **	0.13 *
Pharmaceutical	-0.31 **	0.95 **	-0.26 **	0.16	-0.32 **
Food industry	-0.08	-0.20 *	0.05	-0.45 **	0.26 **
Automotive	-0.47 **	-0.76 **	0.24 **	-0.50 **	0.62 **
Electronics	-1.66 **	-0.68 **	-0.55 **	0.83 **	-0.31 **
Growth of sales	-0.19 **	-0.16 **	0.11 **	-0.01	0.05 *
ROA	-7.40 **	2.72 **	5.45 **	-2.78 **	-2.41 **
Large firms	0.04	0.28 **	-0.16 **	-0.05	0.12 **
Small firms	-0.29 **	-0.08	0.26 **	0.09	0.00
BL	-0.28 *	-0.12	0.09	-2.06 **	0.98 **
FL	0.09 **	-0.26 **	-0.13 **	-1.83 **	0.21 **
Year	-0.01 **	0.00	0.02 **	0.04 **	-0.03 **
N observations	1297	1286	1396	1179	1526
N firms	224	210	282	182	226

** : pvalue<0.01; * pvalue<0.05. Note: The models test the probability of being in one cluster across years. Hence, a given firm can belong to different cluster depending on its upgrading trajectory. The reference of the sectoral dummies is the value 0 (do not operate in the given sector). The reference for the size dummy is the medium size, defined as the second and third quartile of the distribution). Source: KIS-data, stratified random sample of 500 hundred manufacturing firms, Author's calculation.

3.4 Heterogeneity of investment behavior by mode of insertion

Given the five modalities of insertion into GVCs identified at the firm-level, this sub-section now turns to the investment behavior of firms over time. The median level of investment is plotted by mode of insertion, for the period 1991-2015 with a smooth filter (Figure 3) and unfiltered data are plotted for the 2009-2015 period (Figure 4).

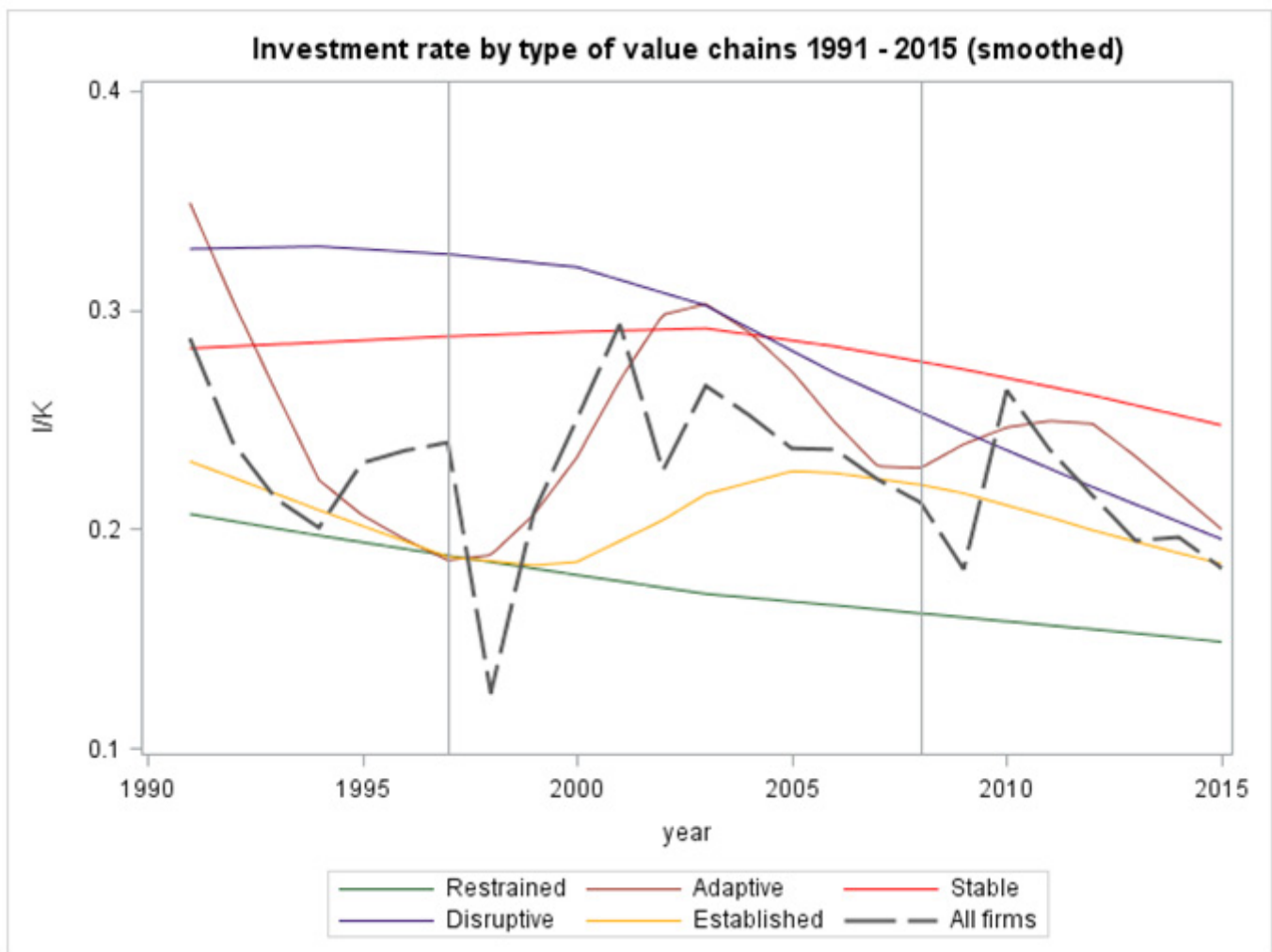
The plot of the median level of investment by mode of insertion yields interesting results. In the long run (Figure 4), there are distinct levels of investment by mode of insertion. Firms inserted into GVCs according to the restrained modalities, essentially component suppliers, have a lower and steadily declining level of investment. The global manufacturers, inserted according to the established modality, have the lowest level of investment after the restrained firms, though with a rebound after the Asian crisis. The trajectory of firms belonging to the adaptive modality is closer to the overall median, which reveals a larger sensitivity to the national context and better faculty to adjust their investment level. The stable and disrupting modalities of insertion are associated with a higher level of investment over the period studied. While the stable modality, corresponding to top-tier suppliers, has a rising trend of investment level from 1991 to the mid-2000s followed by a declining trend, the level of investment of the disrupting cluster was significantly higher before the mid-2000s but dropped sharply afterward. After the post 2008-crisis rebound (Figure 5), the investment level of firms with a stable, disruptive and adaptive mode of insertion has stabilized around 0.2. During this period, firms in the established modality experienced the sharpest drop of investment rate and the restrained modality bottomed out at 0.12.

These findings confirm our initial hypothesis that the investment behavior of firms is correlated to their mode of insertion into GVCs. Moreover, the heterogeneity of investment rate between the modes of insertion is coherent to the

literature. Indeed, the trajectory in the established modality fits the empirical evidence that large global manufacturers tend to decrease their investment in fixed assets to focus on other types of investment. The low and declining trend of investment rate of low-rank suppliers inserted into GVCs in a restrained way corroborates the global trend of rationalization of the supply chain with some suppliers limited to low-value-added activity and no prospect to upgrade. Although some suppliers, especially those in a dominant position enjoying a stable insertion into GVCs, have kept a higher level of investment in fixed assets, given that they are ensuring the larger bunk of the production process.

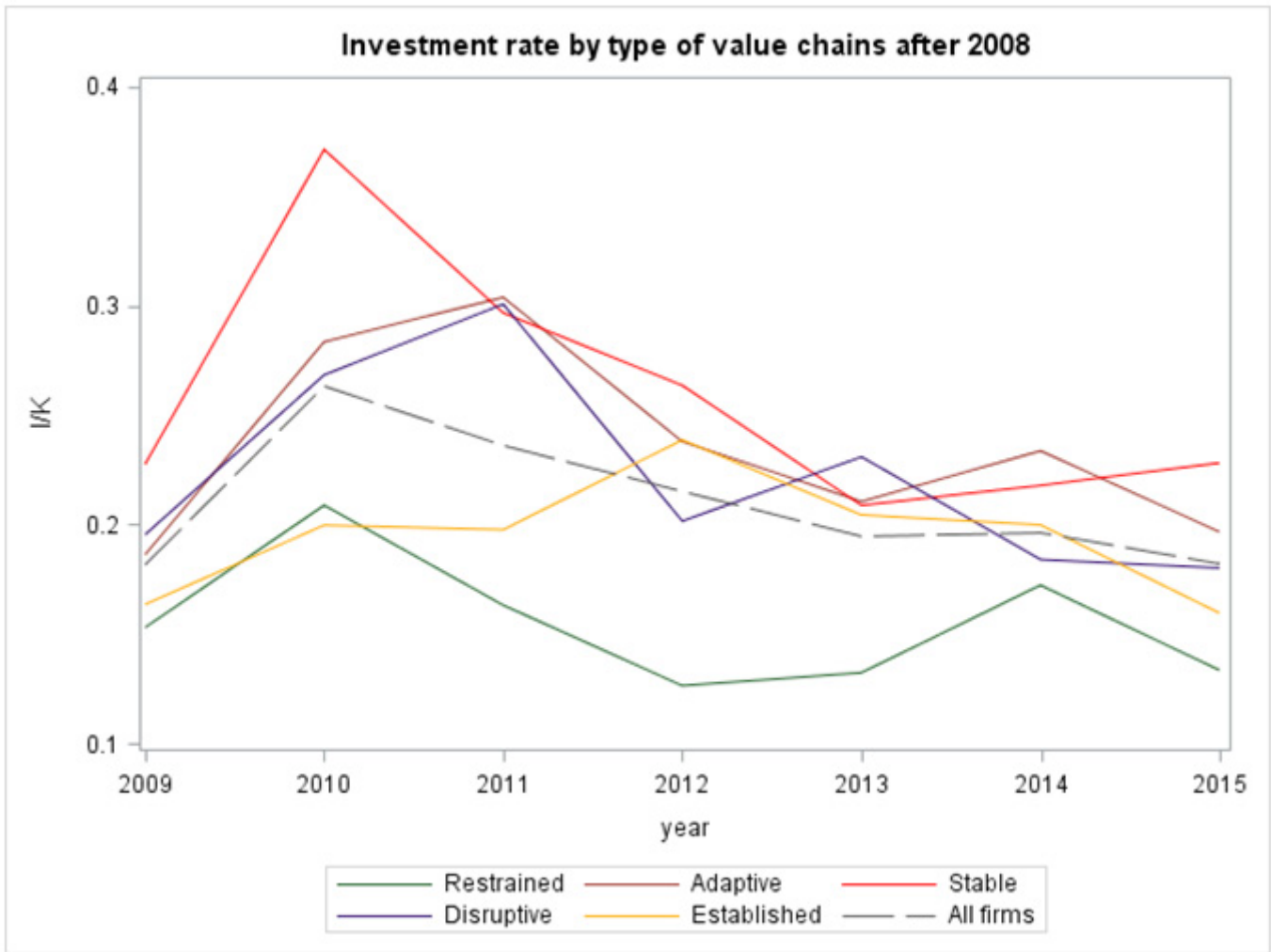
The contribution of this second section is threefold. First, based on a thorough review of the literature, the modes of insertion are conceptualized. This analytical concept is then operationalized with firm-level data of Korean manufacturing firms using non-hierarchical cluster analysis. Finally, this research method provides conclusive results on the importance of the GVC channel to explain the heterogeneity of investment behavior of firms.

Figure 3 Investment rate by type of value chains 1991-2015 (smoothed median level)



Source: KIS-data, stratified random sample of 500 hundred manufacturing firms, Author's calculation

Figure 4 Investment rate by type of value chains after 2008 (median level)



Source: KIS-data, stratified random sample of 500 hundred manufacturing firms, Author's calculation

4. Conclusion

This paper has investigated the heterogeneity of firms' investment behavior by focusing on the participation to GVCs. This research engages, on the one hand, with the literature on the heterogeneity of firms that is mainly concerned with the size of firms, the export capabilities and, in the case of Korea, the affiliation to *chaebols*. On the other hand, it participates to the renewed research program apprehending financialization and globalization as interrelated processes (Milberg, 2008) that account for the engagement of firms into GVCs only by considering their outsourcing strategies.

The empirical results have shed light on a fruitful typology of modalities of insertion into GVCs that grasp an original source of heterogeneity across firms and an econometric estimation of the determinant of investment taking into account both the financialization and the GVC channels. The restructuring of production process along global value chains has led firms to coordinate their activities intra and inter value chains. Hence, modes of insertion are characterized by three dimensions of activity, governance, and upgrading opportunities. A cluster analysis based on key variables of vertical integration, the composition of output, linkages across firms and growth has yielded five distinct modes of insertion—Restrained, Adaptive, Stable, Disruptive, and Established that correspond to distinct investment behavior. While firms belonging to the Restrained modality have the lowest investment rate during this period, a high rate is sustained by the firms in the Stable modality, a high but more volatile rate is a feature of the Adaptive and Disruptive modalities, and the Established firms have steadily decreased their rate of investment after a post-2008 rebound.

The contributions of the chapter are as follows. First, an original methodology is developed to infer the insertion into GVCs at the firm-level from microeconometrics data. There is a technical difficulty of quantitative work mobilizing the GVC framework when no survey data on this topic are available. In this chapter, only financial statements and industry-

level are used, and an extra effort of featured engineering has provided essential indicators of firms' linkages with global production network at the domestic level. Second, the empirical analysis provides evidence on other sources of heterogeneity of firms' behavior besides for the size or the affiliation to a group, the two usual sources found in the literature on Korean firms. Finally, the definition of modalities of insertion at the firm-level constitutes a theoretical step in considering the GVC channel within financialization framework.

This paper takes part in a broader research program on financialization in Korea. Building upon these results, the typology of modes of insertion are then introduced to a post-Keynesian specification of an investment function to test the different hypotheses on the impact of the GVC channel on investment behavior and its relationship with the financialization channels of *crowding-out* and *financial burden* for a panel of Korean manufacturing firms.

The main limit of this paper is technical. The database used has too many missing values for the information on export, and no qualitative information about their activity beyond the national space, nor about their relationship with upstream and downstream firms⁴. One avenue for future research is, therefore, to consolidate different database, qualitative and quantitative, in order to derive more informed results on the modalities of insertion into GVCs. To the author's knowledge, few isolated attempts by independent research groups and international organizations exist to build such a database incorporating. There is a gap between the increasing use of the GVC framework by scholars and practitioners and the lack of comprehensive datasets; more research is needed in this direction.

Moreover, future research should further explain the determinants of the modalities of insertion into GVCs and explore the trajectories of firms over time. In the sample studied, some firms remain in the same modality for the whole period while others change from one modality to another. Put aside the technical considerations on the limits of cluster analysis, firms engage in GVCs in a dynamic fashion, and several case studies document the upgrading trajectory of firms from low-rank manufacturers to global leaders. The determinants of trajectories can be tackled by several aspects, either by management approaches of firms' agility navigating production networks, quantitatively by exploring larger dataset or by sociologically grounded analysis.

4. There exist databases based on survey of firms in relation to exports and sourcing behavior such as the survey of business activities by Korea National Statistics Office but with a restricted access.

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