

BACKGROUND PAPER

# THE RELATIONSHIP BETWEEN GVCS AND PRODUCTIVITY

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## THE RELATIONSHIP BETWEEN GVCs AND PRODUCTIVITY

Chiara Criscuolo, Jonathan Timmis and Nicholas Johnstone

1. GVCs present a challenge to our view of the world economy. Production is increasingly fragmented across country borders, with various parts of the production process, from design to distribution, segmented across different countries. Firms are part of complex production networks that embody diverse goods and services inputs from other domestic and foreign firms. Whilst there is extensive research on the links between globalisation and productivity, for example on the effects of gross trade, this literature is largely underpinned by models of final goods. We know far less about productivity effects viewed through the lens of internationally fragmented production.

2. Whilst some of the lessons drawn from research on final goods trade are clearly also relevant for GVCs, this may not be universally true. On the one hand, the changing organisation of production across firms and countries emphasises the importance of some well-established policy levers in the context of GVCs (such as trade policy). On the other hand, some previously under-explored policy levers (such as domestic service market competition and debates about co-location of activities) may be brought to the forefront. The rise of complex supply chains therefore brings a new perspective to the policy debate.

3. The aim of this paper is to provide a brief overview of what we currently know about the links between GVCs and productivity. The arrival of new trade in value-added metrics has uncovered that GVCs are becoming an increasingly important feature of the world economy, with production increasingly clustered in regional supply chains, and services and MNEs play a key role in these networks. These GVCs trends have important implications for productivity and policy, with potential gains through firms specialising in their most productive tasks and utilising new varieties and higher quality foreign goods, services and intangible inputs. Engagement with MNEs provides an opportunity for knowledge spillovers to local firms, but the embeddedness with global production networks can lead to greater exposure to shocks. GVCs amplify the effects of trade barriers relative to final goods trade, and these barriers including non-tariff barriers such as border bottlenecks and diversity of standards. Policies that promote domestic market competitiveness, particularly in services, are key to benefiting from GVCs as are those that facilitate the upscaling and development of absorptive capacity of SMEs.

4. The changing geography of production, has led to winners and losers from GVCs. Some countries and industries having become key hubs in regional production (such as China's within Factory Asia); others have grown in importance because of their links with these hubs (such as Vietnam), while others have lost their centrality and have become more peripheral. Forthcoming research at the OECD will consider how embeddedness within a GVC (as a key hub or satellite or peripheral industry) affects the productivity of firms. The analysis will capture the productivity effects of changes to GVC centrality, and also reflect the resilience of productivity to supply chain risks from downstream / upstream shocks in third-countries. Conditional on resource availability, further research could also construct indicators the capture the cumulative effect along the value chain of product market regulations, trade restrictiveness and non-tariff barriers to trade.

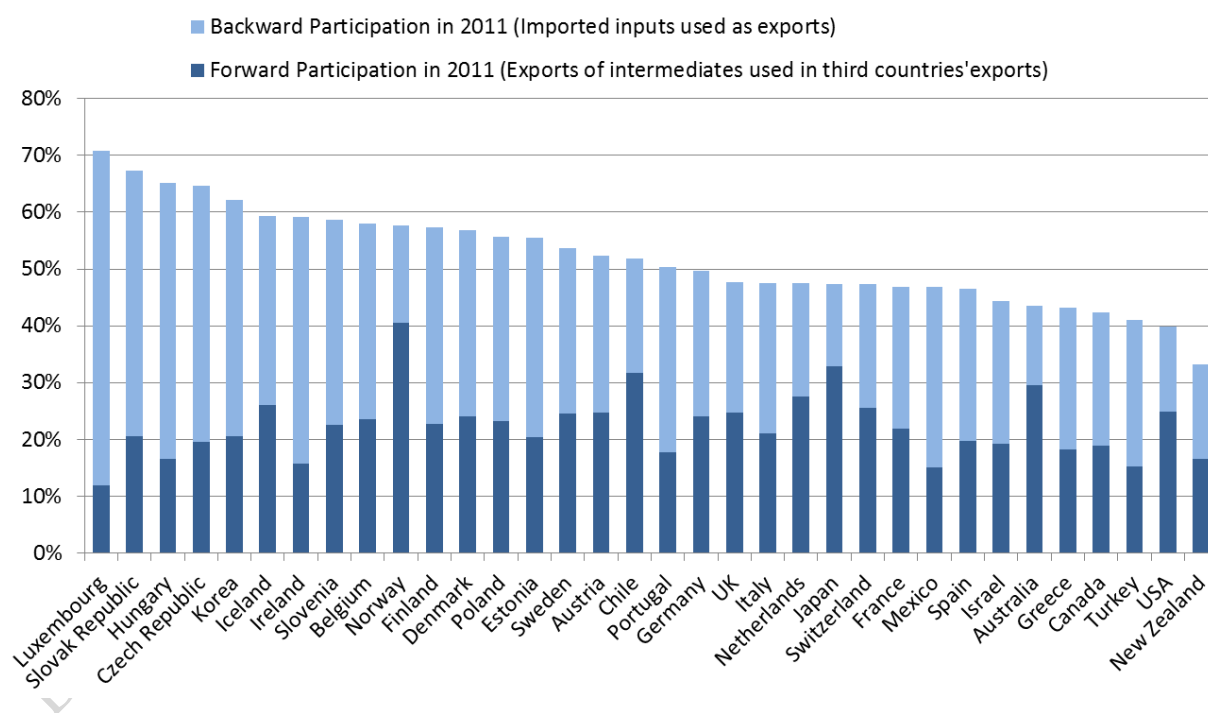
5. Accordingly, this paper is organised as follows. In the first section we highlight some key facts uncovered in recent analyses of GVCs, in particular, drawing on trade in value-added metrics. Secondly, we outline some of the salient issues for performance that have been uncovered so far. Finally, we illustrate some policy implications emphasised by GVCs, and briefly highlight some forthcoming work at the OECD.



## 1. Background: Some key facts and trends

6. Participation in GVCs has been increasing over time, presenting new opportunities for growth. Economies can participate in GVCs by using imported inputs in their exports (the so-called backward linkages in GVC) or by supplying intermediates to third country exports (forward linkages). Figure 1 shows that the overall participation in GVCs (measured as the sum of backward and forward linkages) differs substantially across countries, with larger economies relying less on international trade and small open economies being more integrated into GVCs (OECD, 2013a). The overall participation in GVCs (measured as the sum of backward and forward linkages) has increased for every OECD member country since 1995, despite the recent slowdown following the economic crisis<sup>1</sup> (see Figure 2). This presents a markedly different picture from gross trade; for instance, Estonia's GVC participation grew the slowest within the OECD, however their gross trade grew the 3<sup>rd</sup> fastest (also see Figure 2). This may reflect Estonia upgrading into activities of higher (domestic) value-added, with the foreign content of ICT and electronics falling substantially as domestic value-added exports have risen (OECD and WTO, 2015a). Conversely, Korea's GVC participation grew the second fastest within the OECD over 1995-2011, however, its increase in gross trade was only the 11<sup>th</sup> fastest (see Figure 2). This reflects Korea's role in the growth of Factory Asia, with China being the most important destination for Korea's intermediates (OECD and WTO, 2015b). GVC participation can stimulate productivity growth through many possible channels, including access to a larger variety of cheaper or higher quality imported inputs, increased knowledge spillovers, leveraging economies of scale and specialisation in firms' core activities and higher value added (most productive) tasks. These channels are discussed further in the following section.

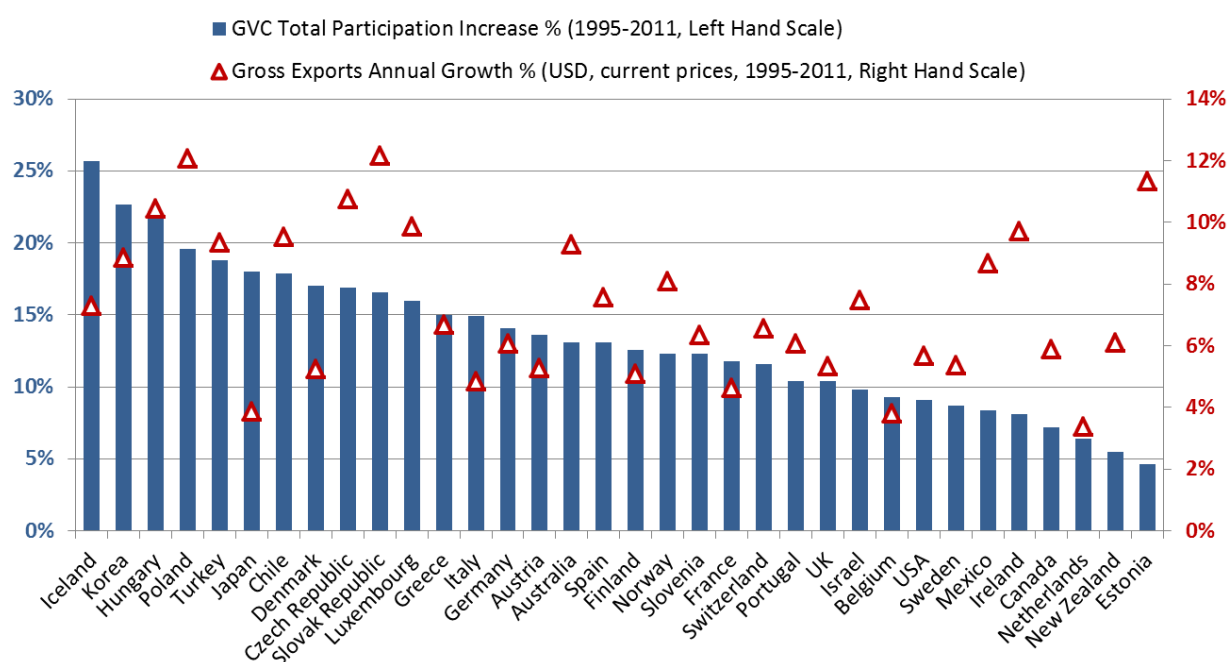
**Figure 1: GVC Backward and Forward Participation in 2011**



Source: Authors' calculations based on OECD TiVA Database, 2015 Edition

<sup>1</sup> Note that in most OECD countries the increase in GVC participation in the post-crisis period has been much slower than pre-crisis. According to the authors' calculations based on the OECD TiVA Database (2015 Edition), only Eastern Europe did not experience a slowdown after the crisis: their increase in GVC participation was faster in 2008-2011 than in 2005-2008.

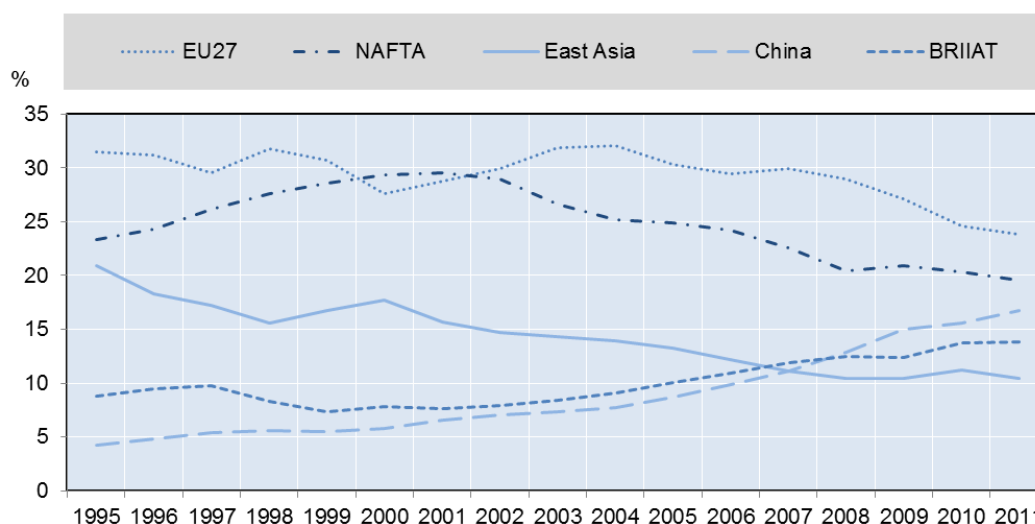
**Figure 2: GVC Participation Increase & Gross Exports Growth between 1995 and 2011**



Source: Authors' calculations based on OECD TiVA Database, 2015 Edition

7. GVCs are characterised by regional hubs, with the bulk of production activity clustered within regional supply chains (Baldwin, 2012). However, there are asymmetric growth opportunities within production networks. This is because the geography of GVCs is transforming; with a declining global share of manufacturing value-added from traditional production centres in Europe and North America and the growth of emerging economies such as China (see Figure 3, and Wiebe and Yamano, forthcoming). The rising importance of China and its central role in “Factory Asia” is a well-documented feature of modern manufacturing. However, the emergence of China as a key hub has accompanied a reorganisation of activities elsewhere, with some countries’ industries experiencing declining importance, “peripheralisation”, in global value chains. GVCs highlight the interdependencies across the production network, with the performance of input suppliers affecting productivity in output markets, which we elaborate in the next section. Peripheralisation may therefore affect domestic productivity growth, both through these indirect network effects as well as through more direct channels, such as reduced productivity spillovers from GVC participants to other firms or constrained growth opportunities of the most productive domestic firms – those firms most likely to be directly engaged with GVCs. Finally, the concentration of activity in key hubs plays an important role in the transmission of shocks along GVCs and therefore affects countries’ resilience, which is explored in the subsequent section.

**Figure 3: Regional shares in world GVC income for all manufactures (%)**

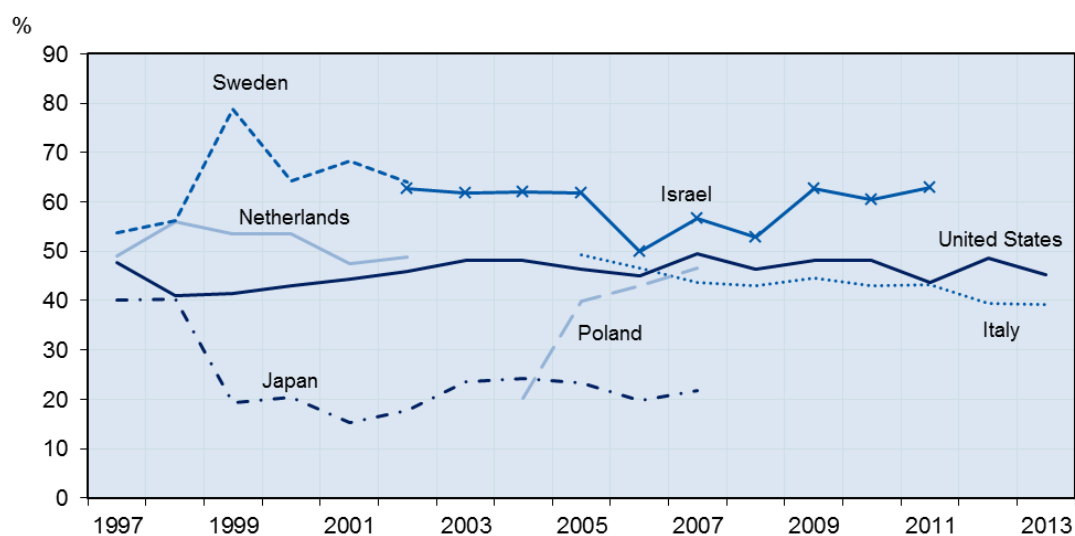


Source: Timmer et al. (2013)

Note: GVC income is defined as value-added in the production of final manufacturing goods. East Asia includes Japan, South Korea and Taiwan. BRIIAT includes Brazil, Russia, India, Indonesia, Australia, and Turkey. EU27 includes all European countries that have joined the European Union. NAFTA includes Canada, Mexico and the US.

**8.** Multinationals are one of the main drivers of GVCs, which creates asymmetric growth opportunities for local firms depending upon how well they are integrated with MNEs. MNEs coordinate complex international production networks, where relationships with suppliers range from arm's-length contractual relationships to direct ownership of affiliates. MNEs cross-border trade with their affiliates alone accounts for a substantial portion of world trade in goods, comprising nearly half of US exports (Figure 4). Participating in GVCs provides an opportunity for knowledge spillovers from these multinationals to local firms, firstly because MNE firms are typically at the global productivity frontier (OECD, 2015a). Secondly, MNEs generate knowledge spillovers along the value chain; through sharing knowledge with domestic suppliers and encouraging the adoption of new practices (see Alfaro, 2014 for a review of the academic literature). The mobility of workers from MNEs to other domestic firms can also be an important channel for knowledge transfers, which can lead to productivity gains for their new employers (Balsvik, 2011). However, such spillovers are unlikely to be realised universally, only firms with sufficient absorptive capacity are likely to achieve the potentially available productivity gains; we discuss this further in the next section.

**Figure 4: Share of intra-firm exports in total exports of affiliates under foreign control**



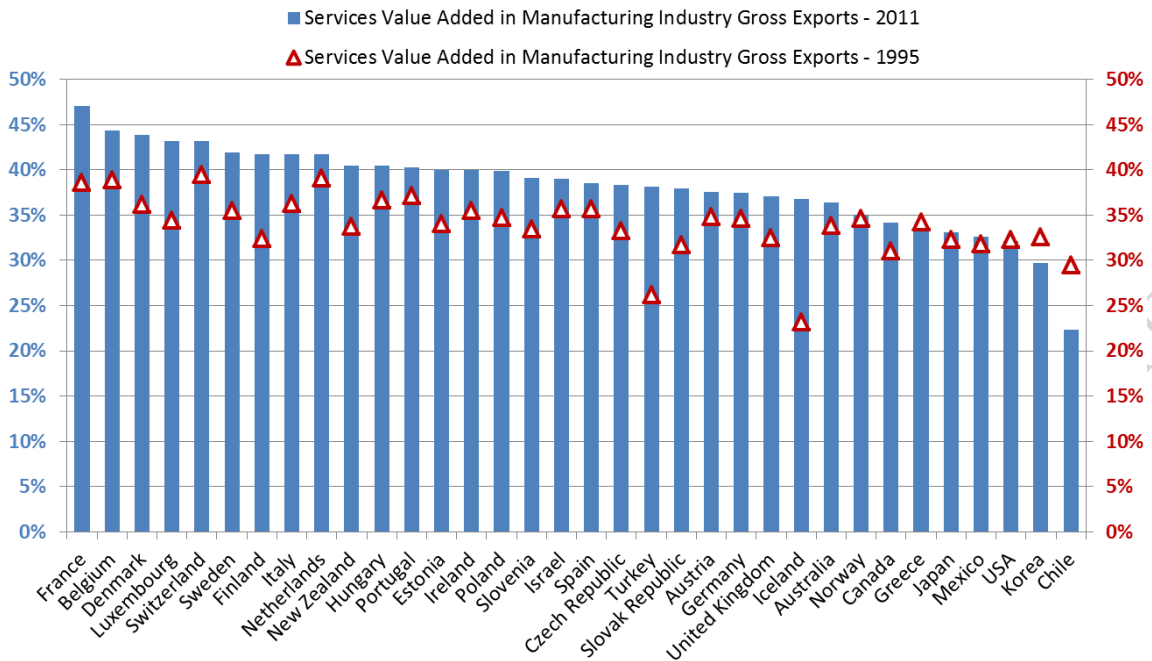
Source: Authors' calculations based on OECD Activities of Multinational Enterprises Database, May 2016

**9.** Services are key to GVCs, however in recent years, services overall productivity growth has been sluggish (see Figure 6). Goods and services are increasingly being both joint inputs to and jointly produced by manufacturing firms. Services provide the link that help coordinate cross-border production (such as transport, distribution, finance, communication and business services). The strong complementarity of services with global production networks, and the trend towards increasingly service activities in OECD economies, “servicification”, are highlighted in new measures of trade in value-added. Services represent a substantial portion of the value-added in GVCs, even for manufacturing industry exports. Services comprise 37% of the value-added in manufacturing exports for the OECD as a whole in 2011, and above 40% for several countries including the France and Italy and the EU as a whole (see Figure 5)<sup>2</sup>. Emerging evidence from OECD work shows that the aggregate productivity growth slowdown (as shown in Figure 6) is accompanied by a marked divergence in productivity performance between global frontier firms and others. The slowdown in service sector growth has not been a result of a slowdown of frontier firms, as service sector firms at the global frontier have achieved strong productivity growth of 5% per annum over the period 2001-2009. But rather it is driven by the sluggish performance of non-frontier services firms, which have shown flat growth of -0.1% per annum over the same period (Andrews et al., 2015).

<sup>2</sup> The importance of services is not reflected in gross trade flows, where goods remain more likely to be traded directly across borders than services, which serves to highlight the importance of new trade in value-added measures.

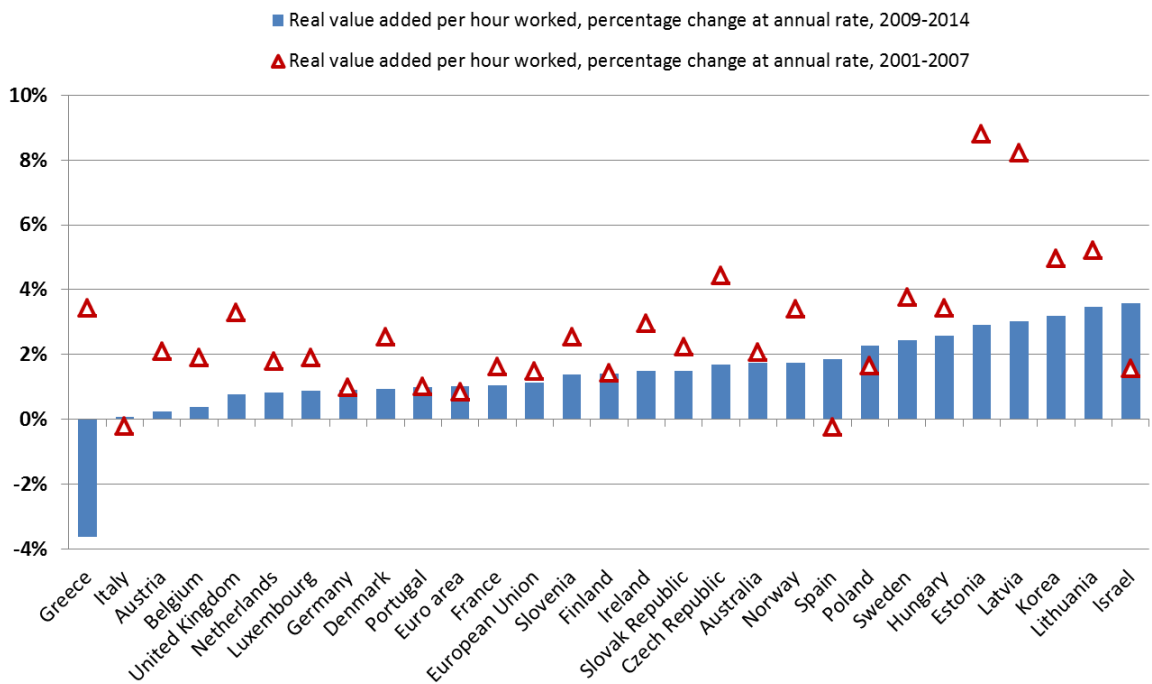


**Figure 5: Services Value Added in Manufacturing Exports**



Source: Authors' calculations based on OECD TiVA Database, 2015 Edition

**Figure 6: Labour Productivity Growth – Business Services (Excl. Real Estate)**



Source: OECD Compendium of Productivity Indicators 2016

## **2. Key implications for productivity**

**10.** Understanding the productivity effects of GVCs is the focus of an emerging literature. Far less is known about the link between productivity and GVCs, than between productivity and trade in final goods. However, new findings are emerging utilising novel data on domestic supplier networks of trading firms and input linkages across industries and countries. In this section we draw on this emerging literature where possible, to highlight the pertinent performance implications of GVCs that have been uncovered so far.

### **2.1 Specialisation, offshoring and productivity**

**11.** Specialisation in tasks is an important source of GVC productivity gains. The growth of GVCs has led to increasing specialisation in specific activities within value chains, with firms often no longer part of complete domestic supply chains. Reductions in trade costs and innovations in ICT have increased the scope of tasks that can be offshored in recent years (OECD and World Bank, 2015). By specialising in those core tasks most efficiently provided by the firm, and offshoring less efficient parts of the production process abroad, firms can reap productivity gains (Grossman and Rossi-Hansberg, 2008). Firms can also gain from the ability to import cheap, additional and/or higher quality varieties of offshored inputs (as discussed in the following section), which could be an improvement on previous in-house inputs, or from efficiency gains from the restructuring of internal processes. Empirically these productivity gains have been shown to extend to both the offshoring of manufacturing production processes and service functions (see for example, Amiti and Wei, 2009; Schwörer, 2013; Winkler, 2010).

**12.** ...but GVCs are much broader than offshoring. Offshoring only provides a partial insight into global value chains. The domestic or foreign sourcing of firm inputs is clearly relevant for the backward participation of GVCs, however, GVCs also encompass the whole supply chain network (including suppliers of suppliers etc.) which is not captured by offshoring. Offshoring concerns only the sourcing of inputs, but GVCs also reflect the destination of firm production, i.e. whether the production of the firm is used in third country exports (see earlier GVC forward participation metric). Therefore, analysis of GVCs requires a far broader scope of production networks than offshoring alone.

### **2.2 Foreign inputs**

**13.** Trade in goods, services and intangible inputs is at the heart of global value chains. The bulk of trade is comprised not of final goods or services, but of trade in intermediate parts and components and intermediate services. Among OECD economies, trade in intermediate inputs accounts for 56% of total goods trade and 73% of services trade over the period 1995-2005 (Miroudot et al., 2009). Firms can integrate into GVCs by supplying intermediate inputs for the exports of firms abroad or as users of foreign inputs in their own exports. GVCs present a new means to access international markets: economies need no longer build complete supply chains at home; instead, they can leverage foreign inputs in their production.

**14.** The available variety and quality of foreign inputs (capital, labour and intermediates) can positively impact firm productivity. The availability of previously unobtainable varieties of imported inputs provides additional possibilities for production, allowing firms to save on costs or upgrade the quality of their inputs. Foreign competition for domestic suppliers of inputs may also lead to price reductions or quality improvements, benefiting users of domestic inputs too.

**15.** Increases in the available variety and quality of imported intermediate goods and capital can positively impact firm productivity. A large literature shows that productivity gains extend both to firms that directly import these inputs (Amiti and Konings, 2007; Goldberg et al., 2010; Topalova and Khandelwal, 2011; Bas and Strauss-Kahn, 2015; Halpern et al., 2015), but also to firms that source locally, suggesting effects of increased competition in domestic input markets (Amiti and Konings, 2007). Emerging evidence is revealing how the liberalisation of service markets, particularly the

entry of new foreign service providers, can lead to substantial productivity gains in downstream manufacturing firms (Arnold et al., 2011; Arnold et al., 2016).

**16.** ...but imported inputs also reflect the embodiment of the skills, factors of production and technologies used to produce them. These skills, factors and technologies are embodied in all prior stages of the value chain, which highlights the importance of measurement using value-added (rather than gross) trade metrics. Recent work at the OECD highlights that the jobs embodied in value-added exports are increasingly shifting towards higher levels of skill (OECD, forthcoming), therefore imported inputs may allow access to a greater variety of human capital than is available domestically<sup>3</sup>. Industries that source intermediates that embody a higher R&D knowledge content tend to have higher productivity (Nishioka and Ripoll, 2012), suggesting embodied R&D can be a form of technology transfer to local firms.

**17.** MNEs are an important vehicle for provision of foreign knowledge and services inputs to affiliates within the firm group. In Figure 4 earlier, we saw that MNEs cross-border trade with their affiliates accounts for a substantial portion of world trade in goods, however, MNEs are also an important source of knowledge and services for their affiliates (OECD, World Bank and WTO, 2014). Moreover, the possession of strategic assets (such as investments in knowledge, R&D and skills) can be an important motivation for FDI, in order to protect the use of these assets<sup>4</sup> (see Antras and Yeaple, 2014). Firms may transfer knowledge and services embodied in intermediate goods, as highlighted above, or choose to provide direct disembodied transfers to their affiliates (Keller and Yeaple, 2013).

### **2.3 MNEs, knowledge spillovers and upgrading**

**18.** GVCs are a well-established vehicle for productivity spillovers to local firms. A substantial part of GVC integration is mediated through FDI, and such multinational enterprises are typically at the global frontier of productivity, innovation and technology. Exposure to the global frontier can provide an opportunity for local firms to increase productivity through learning about advanced technologies or good organisational and managerial practices (Saia et al., 2015; Guadalupe et al, 2012). A large literature has investigated FDI spillovers and arrives at a broad consensus in favour of positive productivity spillovers to industries that supply multinationals through backward linkages, with little evidence through other linkages<sup>5</sup> (Havránek and Iršova, 2011; Alfaro, 2014). Lead firms tend to demand more or better quality inputs from suppliers and may directly share knowledge, technology and encourage the adoption of new practices to achieve this. The literature currently uses aggregated industry-level measures of linkages; however little is currently known about how spillovers are transmitted from firm-to-firm. This may be a fruitful application of new data on firm linkages in domestic production networks.

**19.** Knowledge acquisition is an important motive for FDI, which can potentially to increase knowledge diffusion. Firms may relocate some activities, including innovation activities, to obtain access to so-called strategic assets – skilled workers, technological expertise, or the presence of competitors and suppliers – and learn from their experience (OECD, 2008). Firms locate in leading edge countries close to the technology frontier, in order to benefit from the diffusion of advanced technologies (Griffith et al., 2006). In addition, MNE acquisition of foreign firms can lead to a relocation of innovative activities to where they are most efficiently undertaken and increase knowledge diffusion to affiliates within the group (Stiebale, 2016).

**20.** Knowledge spillovers from the frontier accrue asymmetrically, benefitting firms with sufficient absorptive capacity. A pre-requisite for local firms to gain from spillovers, is sufficient capacity to absorb frontier technologies. By investing in their own tacit knowledge, such as through engaging in R&D, firms can increase their ability to absorb new technologies (Griffith et al, 2004).

<sup>3</sup> Note however, that local skills remain pertinent for GVC participation, particularly for knowledge-intensive activities, with ongoing OECD work directed in this area (OECD, World Bank and WTO, 2014; Jamet and Squicciarini, 2016).

<sup>4</sup> Since writing and enforcing contracts over the use of strategic assets with an arm's length supplier may not be possible.

<sup>5</sup> Less consistent evidence is found in favour of horizontal spillovers, to firms within the same industry, or through forward linkages to firms downstream (Iršova and Havránek, 2013).

This can pose a particular challenge for firms far from the frontier, with low absorptive capacity, as they are unlikely to benefit from exposure to frontier technologies (Saia et al., 2015). In addition, positive spillovers may be offset by MNEs crowding out some local firms, at least in the short-term following entry of MNEs (Aitken and Harrison, 1999; Kosová, 2010). The additional competition in output markets and increased demand for inputs may lead to lower growth rates and exit of local firms far from the frontier.

**21.** Investments in Knowledge Based Capital is an important driver of GVC upgrading and growth. Empirical evidence confirms the links between innovation, value creation and economic growth (OECD, 2010). The value created by a GVC is unevenly distributed and depends on the ability of participants to supply sophisticated and hard-to-imitate products and services (OECD, 2013a). To upgrade the efficiency of production processes or increase the value-added of their products requires investment in organisational capital, skills and ICT to complement the necessary product / process innovations (OECD, 2013b). The bulk of the value-added in GVCs accrues to upstream and downstream processes (such as R&D, design, marketing). Increasingly, such products or services stem from forms of knowledge-based capital such as brands, basic R&D, design and the complex integration of software with organisational (OECD, 2013b). However, there are many aspects of upgrading that are currently unknown. In particular, we know little about the extent of interdependencies between activities, for instance, whether complex manufacturing capabilities are a pre-requisite to engage in high-value added activities like R&D, design and marketing.

#### **2.4**      *Upscaling*

**22.** To participate directly in GVCs requires scale. Small firms are often not able to build the necessary internal capabilities to meet the strict product and quality standards demanded, or overcome external barriers such as regulations and customs procedures. Building such capabilities can require substantial investment in process and product innovations, managerial and workforce skills development and adoption of modern technologies. Only firms with sufficient scale are able to incur the substantial sunk costs to develop these capabilities necessary for GVC integration. However, unlike trade in final goods, GVCs present opportunities for SMEs to become specialised in a subset of productive tasks, which may alleviate some of the barriers to SME participation. Scale requirements are likely to be a particular problem for firms operating in small, geographically isolated economies. Firm size tends to grow with market size, meaning that smaller markets are likely to have fewer firms with sufficient scale to participate directly in GVCs<sup>6</sup>.

**23.** ..and upscaling may yield productivity gains. The cost of many productivity-enhancing investments, including those concerning GVC participation listed above, is largely fixed. Such investments are only viable for sufficiently large firms that can spread the fixed costs over high sales volumes. Firm upscaling may therefore contribute to productive investments. Firm-level research shows correlations consistent with this narrative; larger manufacturing firms are on average more productive, across many dimensions, than smaller firms and are more likely to invest in skills, ICT and R&D (OECD, 2010b, 2013a; González et al., 2012).

**24.** However, new trade in value-added metrics highlight the importance of indirect contributions to the value chain, not apparent in trade in final goods metrics. Indirect participation can provide a way to overcome many of the barriers to scale. Through intermediaries and international buyers, domestic producers can avoid design and marketing costs, search costs, reduce foreign market information barriers and benefit from the transfer of knowledge from foreign firms (Artopoulos et al., 2013). Many firms are indirectly connected to GVCs, for instance, as domestic suppliers of exporters, and therefore gross trade flows will understate the importance of SMEs to global supply chains. Unfortunately data on the SME contribution to GVCs is often not available and,

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<sup>6</sup> For European countries, the size of the domestic market is correlated almost one-for-one with the number of exporting firms (Mayer and Ottaviano, 2008).

therefore, relatively strong assumptions<sup>7</sup> can be required to decompose industry-level TiVA data into the contribution of SMEs and larger firms. Exploratory and on-going work at the OECD, using such an approach, highlights a sizeable contribution of SMEs to value-added trade flows which far exceeds their contribution to gross trade (OECD and World Bank, 2015).

**25.** Scale issues remain pertinent for indirect contributions to the value chain. Exporting firms are likely to pass down relevant product and quality standards, demanded by their foreign customers, to domestic suppliers. Accordingly, domestic suppliers have to overcome additional sunk costs to supply exporting firms, which only sufficiently large suppliers can do. Emerging evidence on domestic micro-linkages between firms is consistent with this narrative; Belgian suppliers of exporters are indeed larger and more productive than suppliers of non-exporters (Dhyne and Rubinova, 2016).

## **2.5 *Shocks, resilience and growth***

**26.** Embeddedness within a GVC affects the resilience of economies to macroeconomic shocks, (see an extensive resilience discussion within chapter 8 of OECD, 2013a). International trade is a key mechanism for the cross-country transmission of shocks and GVCs can intensify this propagation relative to trade in final goods alone. The international fragmentation of production means industries in different countries are connected through a complex web of intermediate input linkages. Accordingly, a shock to one part of the supply chain can propagate throughout the production network, as highlighted by the 2016 Kunamoto earthquake where Japanese supplier disruption led to the temporary shutdown of US auto plants and the 2011 Tohoku earthquakes (Boehm, Flaaen, and Pandalai-Nayar, 2015) and Thailand's great floods in the same year (Fujita, 2013). Through these interconnections, firms are potentially exposed to a myriad of risks, including geopolitical risks (such as political violence), infrastructure risks (such as the 2010 Icelandic volcano eruption and air travel), and financial risks (such as the recent economic crisis) (OECD, 2013a). In the aggregate, growing evidence supports the role of GVCs as a conduit for shocks, with strong correlations between countries' GVC links and business cycle co-movement (Burstein et al., 2008; Bergin et al., 2009; Ng, 2010).

**27.** Mitigating supply chain risks implies a productivity trade-off. The small margin of error that firms typically build into value chains in order to reduce costs considerably increases risks (OECD, 2013a). Firms can mitigate their vulnerability to (supply) shocks through holding additional input inventories (Kahn, 1987; Alessandria, Kaboski and Midrigan, 2011) or diversifying their range of input suppliers (OECD, 2013a). However, holding additional inventories is costly to the firm as it ties up working capital. Supplier diversification may increase input costs through purchasing in smaller quantities (per supplier), sourcing from more expensive suppliers and the costs of transacting with more firms / countries. Therefore in an effort to mitigate supply shocks, firms may incur higher production costs and reduce their productivity even during normal times.

**28.** Resilience is also determined by position within a GVC. Evidence for the US suggests that industry growth is more strongly determined by industries that are directly linked (as customers / suppliers) and less correlated with those indirect links (e.g. with the suppliers of their suppliers) (Carvalho, 2014 and OECD, 2013a). In addition, position within a GVC determines resilience to different types of shocks. Downstream industries are relatively more vulnerable to supply shocks higher up the value chain.

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<sup>7</sup> Piacentini and Fortanier (2015) outline a preliminary disaggregation of industry-level OECD TiVA data using firm-level data from the OECD Structural and Demographic Business Statistics Database and OECD/Eurostat Trade by Enterprise Characteristics Database. The purchases of domestic inputs by SMEs and large firms are estimated from the residual between output, value-added and imports. Purchases of foreign inputs are segmented based on the share of goods imports purchased by SMEs and large firms. SME and large firm supply of inputs is assumed to be in proportion to their respective share of industry gross output. The authors highlight that their results depend heavily on these assumptions chosen to estimate the unobserved transactions between firms of different sizes.



**29.** GVC position (and hence resilience) is determined by productive investments. Firms can reduce their vulnerability to supply shocks by moving up the value chain and specialising in upstream activities such as design, R&D and innovation. Firms can also move up the value chain by improving efficiency or increasing the value-added of their products; either by upgrading their existing product mix, adding new products or moving into new value chains (OECD, 2013a). These often require substantial productive investments. However, moving up the value chain does not immunise firms to GVC shocks, rather, position determines the type of shocks a firm is more exposed to. Upstream industries further from the final consumers are more exposed to demand shocks (Acemoglu et al., 2015).

**30.** Increasing task specialisation may also impact the resilience to shocks. The unbundling of the supply chains has permitted specialisation in activities for which there is a comparative advantage. Firms can join a production network, specialising in a small part of the value chain, and at an aggregate level, developed economies are increasingly specialising in specific upstream or downstream activities (such as R&D, marketing, design). Indeed, the specialisation in productive tasks is one of the oft-cited mechanisms through which productivity gains of GVCs are realised (e.g. OECD, World Bank and WTO, 2014). However, specialisation can reduce resilience to shocks, particularly in the production of complex goods, where many countries and suppliers perform highly specialised tasks. Risks increase with the customisation of the task and the greater number of countries linked through production networks (Taglioni and Winkler, 2016).

**31.** Conversely, the micro-structure of GVC supply chain networks can also generate macroeconomic shocks. Linkages between firms and industries are not evenly distributed; instead, a minority of multinational firms are the drivers of GVCs and production networks are disproportionately dependent on a minority of input suppliers. This is true within domestic production networks, such as the US (Carvalho, 2014), and emerging evidence finds similar results for global supply chains (Cerina et al., 2015). These key hubs can propagate disruptions to many other sectors, amplifying microeconomic fluctuations in one part of the economy into a macroeconomic shock. Evidence for the US suggests that fluctuations in these key sectors are highly correlated with aggregate manufacturing growth since the 1960s (Acemoglu et al., 2012; Carvalho, 2014). MNEs may also play an important role in propagation of shocks, with emerging evidence suggesting intra-firm trade exhibited greater volatility than arm's length trade during the recent economic crisis (Altomonte et al., 2012).

### **3. What does this mean for policy?**

**32.** GVCs can provide new avenues for growth, as highlighted in previous sections. However, there are many potential barriers to deeper GVC integration and to firm's ability to seize the opportunities for growth. Many of these obstacles will be familiar to those versed in the comprehensive literature on trade in final goods and FDI. However, some of these barriers are particularly relevant for GVCs, such as trade policy, when goods cross borders multiple times. In this section, we focus on these most prominent obstacles and their policy implications.

#### **3.1 Trade policy**

**33.** Global value chains amplify the productivity effects of removing trade barriers relative to trade in final goods. The complex web of international production networks means intermediate goods often cross borders multiple times, each time accumulating additional tariffs and other trade costs. In addition, tariffs are levied on the gross value of the good (including imported inputs and previously incurred trade costs), rather than on the value added domestically at the last production stage. Since exports often embody a substantial proportion of foreign value-added this means a low nominal tariff can translate into a high tariff on value-added trade (Miroudot et al., 2013a).

**34.** Global value chains increase the interdependence of trade policy, highlighting the importance of regional and multilateral trade agreements. Industries and countries are tied together through the network of forward and backward linkages. Downstream industries are affected by the

whole system of trade costs incurred by their suppliers and conversely the whole network of suppliers is impacted by final goods trade costs. Accordingly, trade in value-added is affected not only by bilateral trade costs, but is also tied to third country barriers, through which intermediate inputs travel before reaching their destination (Noguera, 2012).

### **3.2 *Border bottlenecks***

**35.** Trade facilitation is important to achieve the gains from deeper GVC integration. The efficiency of customs and port procedures shape the global value chain, more so than trade in final goods. Customs administrative procedures and clearing processes raise the cost of accessing export markets and importing intermediates, with the costs accumulating when inputs are traded many times as in GVCs. This raises costs both in monetary terms and time delays, the latter requiring firms to hold larger inventories and working capital. For particularly time-sensitive products or those with uncertain demand, the effect of delays can be substantial, with each day in transit costing up to 2% of the value of the good (Hummels and Schaur, 2013). Recent OECD analysis finds that a small improvement<sup>8</sup> in trade facilitation performance can increase the value-added imports by between 1.5 and 3.5% (Moisé and Sorescu, 2015).

### **3.3 *Coordination of standards***

**36.** The diversity of standards has become one of the major barriers to integrating into GVCs. Technical barriers to trade cover 30% of international trade and more than 60% of agricultural products are affected by sanitary and phytosanitary measures in particular (Nicita and Gourdon, 2013). Whilst product quality and safety standards are needed to protect final consumers and the environment, these are far from harmonised across countries and there is little mutual recognition of alternative standards (OECD, 2013a). In addition, these standards are not always applied with the same consistency, with import refusals varying over the business cycle (Grundke and Moser, 2016). This in turn might hinder the development and the introduction of innovative products which would ultimately lead to productivity growth.

**37.** The cost of diverse standards can be amplified within GVCs, much more so than final goods trade, as the compliance needs to be coordinated at each stage of production and for each market ultimately supplied. Compliance can require firms to make costly investment in duplicate production processes, specific packaging and labelling or undertake multiple certification processes for the same product<sup>9</sup>. These compliance costs are particularly acute for SMEs and are a major obstacle to their GVC participation (OECD and World Bank, 2015; OECD, 2013c).

### **3.4 *Policies that promote competitive domestic markets***

**38.** Fully leveraging GVCs requires efficient domestic markets and removal of internal barriers to competition. New trade in value-added data has highlighted that service inputs are much more important to GVCs, than was recognised under prior analyses of trade in final goods (see Figure 5 earlier). Services are a key element in manufacturing competitiveness and required for the coordination of complex international supply chains. Production at each stage requires a suite of complementary services, including transport and logistics, finance, communication, and other business and professional services. In addition, R&D and design services are involved in upstream stages and distribution networks, advertising and marketing services downstream. Global production networks are therefore shaped by the quality and cost of these complementary services.

**39.** Addressing the barriers to competition in local service market and trade in services is particularly salient, given the significance of services to GVCs in particular. OECD members have few explicit barriers to services trade but there are several differences in regulation. OECD work on

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<sup>8</sup> Specifically, a small increase of 0.1, compared to trade facilitation indicators ranging between 0 and 2.

<sup>9</sup> Undertaking multiple certification processes as well as repeat testing of goods already tested in other countries may also increase the administration costs to public authorities.

Service Trade Restrictiveness Indicators reveals restrictions on foreign ownership, restrictions on the movement of people (e.g. quotas, stay duration limits), barriers to competition and regulatory transparency even amongst advanced economies. Indeed, evidence suggests services trade costs have remained remain persistently high over recent decades, despite substantial liberalisation in goods trade (Miroudot et al., 2013b). Pro-competitive domestic regulations and the liberalisation of trade in services are important to ensure the efficient functioning of the supply chain, which may be particularly important for geographically isolated countries (Hallaert et al., 2011) and would also improve the productivity of the domestic downstream markets which also use these services (Bourlès et al., 2013).

**40.** Lifting barriers to competition in goods markets can also promote integration within GVCs, and increase innovation and productivity. Lifting product market regulations can spur productivity growth through increased competition, increasing GVC participation. Productivity growth can be achieved through several channels. Firstly, increased competition and entry of new firms strengthens the efficiency incentives of incumbents and provides incumbents incentives to innovate to maintain their market position. In addition, by providing easier and cheaper access to inputs, reductions in red tape can also lead to gains in downstream industries utilising these intermediates (Abe, 2013).

### **3.5 *Policies to bolster SME participation***

**41.** Addressing the barriers to SME upscaling is key to encouraging GVC participation. The possibility of indirect participation in GVCs (through domestic supply of exporters) and task specialisation, give many SMEs new opportunities, particularly relative to those in final goods trade alone (as mentioned earlier). However, GVC participation still requires additional capital, for example, through required investment in product and process innovation and working capital to finance exports, and access to finance is a particular challenge for the upscaling of SMEs . GVCs therefore highlight policies that address credit market imperfections and support development of complementary sources of debt, such as venture capital markets (OECD and World Bank, 2015).

**42.** The issue of SME upscaling is also intimately connected with the reallocation of resources. Policies that impede labour market flexibility and limit immigration might restrict the ability of SMEs to hire additional, skilled workers to scale-up production. Bankruptcy legislation and judicial efficiency can encourage experimentation with innovation and new technologies, if failures are not penalised too severely, and speed the reallocation of resources from exiting firms to more productive uses (Andrews and Criscuolo, 2013).

### **3.6 *Policies that facilitate innovation and spillovers***

**43.** Policies that develop absorptive capacity are key to ensuring productivity spillovers. Knowledge-based capital is a central part of GVCs, with upstream activities including R&D, design and innovation often comprising the highest share of value-added in the production chain (Baldwin, 2013). However, sufficient absorptive capacity on the part of local firms and workers is a prerequisite to benefiting from the trickle-down of spillovers. Building absorptive capacity includes developing local innovation and enhancing human capital. Given the well-known market failures affecting investment in innovation, several countries promote innovation through incentives to collaborate between firms and universities, R&D fiscal incentives and state funding of basic research. Recent OECD work (Andrews et al., 2015) for example suggests that university-industry collaboration might play an important role in helping laggards firms benefit from knowledge spillovers from frontier firms, especially if they are SMEs.

**44.** Investment in innovation is an important driver of GVCs and is central to moving into higher value-added activities. Success in GVCs requires investment in knowledge based assets (KBC) that extend far beyond R&D, for example, in capabilities for efficiently reorganising production, in producing and commercialising more sophisticated and complex products and for successfully moving into higher-value downstream or upstream activities. Thus, innovation policies for succeeding in GVCs need to take a much broader view than just R&D. Policies that encourage

stronger links between firms and research, educational and training institutions can facilitate the knowledge transfers required for upgrading in GVCs. However, GVC participation often implies a relocation of innovation to where it is most efficiently undertaken, as noted earlier, and this restructuring can lead to overall increases in innovation and greater diffusion within firms (Stiebale, 2016). This complements within-country research finding that location-specific incentives for innovation (such as state-level R&D tax credits) may simply reallocate innovation from one location to another, rather than increasing aggregate innovation (Wilson, 2009). Location-specific incentives for innovation may therefore mute one of the potential channels for gains from GVCs.

### **3.7 Policies that realise new technology potential**

**45.** Reaping the benefits of new technologies requires policies that support complementary investments in KBC. The rise of GVCs has been made possible by falling transport costs and advances in communication technology over the recent decades (OECD, 2013a). Many new disruptive technologies are on the horizon with the potential to transform production, for instance, through nanotechnology, 3D printing, advances in robotics or enhanced data analytics using machine-to-machine communication (OECD, 2015b). However, adoption of technology, which is the focus of subsidies or tax credit policies, cannot by itself lead to substantial productivity gains, unless it is complemented by changes in the organisation of work (see for example Brynjolfsson and Hitt, 2000). What matters more than adoption, is how the technology is used within organisations. Accordingly, a large body of evidence on recent technological advances, such as ICT, highlights that the performance effects of new technologies depend on complementary firm-level investments, such as in organisation structures, management capability and skills development (Draca et al., 2006; Biagi, 2013).

## **4. Next steps**

**46.** The growth of GVCs generates both winners and losers. As mentioned above, GVCs are not primarily global in nature, but focused around regional clusters of production. The geography of GVCs has changed significantly in the last decades with some countries and industries having become key hubs in regional production (such as China's within Factory Asia); others have grown in importance because of their links with these hubs (such as Vietnam), while others have lost their centrality and have become more peripheral. The changing pattern in the geography of production generates both winners and losers. The emergence of key hubs has corresponded to a period of high productivity growth for the hubs themselves. Satellite industries and countries, that are suppliers or customers of the hubs, have the opportunity to benefit from productivity spillovers, conditional on their absorptive capacity. For other industries, at the periphery of the global value chain, firms at the bottom of the productivity distribution face the challenge of reallocation of resources and exit, and other firms require productive investments and upgrading to higher value-added activities via investment in innovative activities, such as ICT and R&D (Bloom et al., 2015). However, little is known about how changes in the geography of GVCs affect productivity at the centre and at the periphery of the GVC networks and the mechanisms of adjustment.

**47.** Forthcoming research at the OECD will consider how GVC participation affects the productivity of firms<sup>10</sup>. This work will extend the typical backward/forward linkage metrics of participation, to identify key hubs in GVCs using network measures of centrality, building on their use in the shock propagation literature (Acemoglu et al., 2012, 2015; Carvalho, 2014). The analysis will capture the productivity effects of changes to GVC centrality, and also reflect the resilience of GVCs to supply chain risks from downstream / upstream shocks in third-countries. We will examine heterogeneous effects for different types of firms and sectors, investigating potential channels for productivity effects. For example, whether GVC peripheralisation constrains the growth opportunities

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<sup>10</sup> In addition, forthcoming research at the OECD will examine the link between the structure of GVCs and product quality risks. Earlier in this paper, we highlighted that the increased interconnectedness of production networks can result in larger risks to economic shocks. Several food scandals in recent years have suggested that the growing length and complexity of GVCs may be linked with product quality risks. This work will draw on the OECD Products Recall and GVC metrics from the OECD TiVA database.

of the most productive domestic firms – those firms most likely to be directly engaged with GVCs. Or whether, GVC peripheralisation reduces the scope for productivity spillovers from GVC participants to other firms and sectors. In addition, we will examine role of the policy environment in influencing productivity outcomes. Conditional on resource availability, further research could also construct indicators the capture the cumulative effect along the value chain of product market regulations, trade restrictiveness and non-tariff barriers to trade.

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